EXHIBIT A

TECHNICAL SPECIFICATIONS

Patrick Gibney

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Date: 2019.12.03 17:20:04 -05'00'

PATRICK J. GIBNEY, STATE OF FLORIDA, PROFESSIONAL ENGINEER, LICENSE NO. 49428

THIS ITEM HAS BEEN ELECTRONICALLY SIGNED AND SEALED BY **PATRICK J. GIBNEY, P.E.** ON THE DATE INDICATED USING A **SHA AUTHENTICATION CODE**.

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SECTION 01010

SUMMARY OF WORK

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The work to be performed under this Contract shall consist of furnishing all tools, equipment, materials, supplies, and manufactured articles and for furnishing all transportation and services, including fuel, power, water, and essential communications, and for the performance of all labor, work, or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents. The work shall be complete, and all work, materials, and services not expressly shown or called for in the Contract documents which may be necessary for the complete and proper construction of the work in good faith shall be performed, furnished, and installed by the CONTRACTOR as though originally so specified or shown, at no increase in cost to the CITY.

B. Prior to construction, the CONTRACTOR shall verify existing utilities identified on the Drawings and locate other potential utilities in their working area that may not be shown on the Drawings. The utility verifications consist of excavation to verify tie-in points and to locate potential conflicts that may affect the work as shown on the Drawings. The CONTRACTOR shall be responsible for the coordination of this work with the associated utility owners and permitting agencies having jurisdiction over the specific locations to be verified. The contractor shall coordinate with the utility owners to relocate any utilities identified for relocation or need relocation for the construction of the project.

1.02 SCOPE

A. The work to be performed includes site, civil, mechanical, structural and electrical work associated with the construction of the PS 8 Replacement Project in the City of Hallandale Beach.

This project consists of the removal of two existing sanitary sewer pumps, associated piping, supports, electrical items from the existing lift station, conversion of the existing wet well to a manhole, installation of a new wet well and new submersible wastewater pumps along with the associated piping, supports, electrical items including a variable frequency drive, reconnecting the new piping to the force main, installing a new gravity sewer connection from the new development to the west, and connecting the converted manhole to the new wet well as shown on the plans. The construction activities include but are not limited to survey, locating and protection existing utilities, relocation of existing utilities, providing new 480V electric service, rehabilitation and restoration of existing pavement, maintenance of traffic, dewatering, by-pass pumping, maintaining continuous sanitary service and property access, coordination with different agencies such as the City, AT&T, and FPL, preparation and submittal of shop drawings and record drawings, testing, and other restorations.

Work shall be performed to ensure continuous operation and appropriate performance of all existing water, sewer, stormwater and franchise utilities systems, to minimize impacts to roadway traffic, parking, residents and /or businesses shall be coordinated with the City in advance.

B. It is the intent of the CITY to obtain a complete and working installation under this contract and any items of labor, materials or equipment, which may reasonably be assumed as necessary to accomplish this end, should be supplied whether or not specifically shown on the plans or described herein. Maintenance of the existing utility systems is mandated throughout the construction period.

1.03 WORK BY OTHERS

A. The CONTRACTOR shall cooperate fully with all utility forces of the CITY, or other public or private agencies engaged in the relocation, altering, or otherwise rearranging any facilities which interfere with the progress of the work, and shall schedule the work so as to minimize interference with said relocation, altering, or rearranging of facilities.

B. The CONTRACTOR'S attention is directed to the fact that work will/may be conducted at the site by other contractors during the performance of the work under this Contract. The CONTRACTOR shall conduct its operations so as to cause a minimum of interference with the Work of such other contractors, and shall cooperate fully with such contractors to provide continued safe access to their respective portions of the site, as required to perform their respective contracts.

C. When two or more contracts are being executed at one time on the same or adjacent land in such manner that Work on one contract may interfere with that on another, the CITY shall determine the sequence and order of the Work. When the territory of one contract is the necessary or convenient means of access for the execution of another contractor, such privilege of access or any other reasonable privilege may be granted by the CITY to CONTRACTOR.

1.04 LOCATION OF THE PROJECT

A. The project is located at the east side of the intersection of SE 4th Avenue and SE 5th Street, in Hallandale Beach, Florida.

1.05 CONTRACT DRAWINGS

A. The work to be performed is shown on the set of Contract Drawings entitled "City of Hallandale Beach, Department of Public Works, Pump Station No. 8 Replacement". City Project No. P1714.

1.06 CONTRACTOR FURNISHED MATERIAL AND EQUIPMENT

A. All equipment, materials, or devices incorporated in this project shall be new and unused, unless indicated otherwise in the Contract Documents and shall be the products of reliable manufacturers who, unless otherwise specified, have been regularly engaged in the manufacture of such material and equipment for at least

five (5) years. Procedures and additional requirements regarding manufacturer's experience and substitutions are included in Section 01630 - Substitutions and Product Options.

1.07 DRAWINGS OF EXISTING FACILITIES

Drawings of the existing facilities may be inspected at the City's Engineering and Construction Services Office, if available. These drawings are for information only and are not a part of the Contract Documents. In making these drawings available for inspection, the CITY makes no guarantee, either expressed or implied, as to their accuracy or completeness.

B. The CONTRACTOR shall contact representatives for other utilities, facilities in proximity of the work and Sunshine State One Call Inc., to obtain the as-built information from them directly. The utilities shown on Drawings are based upon available records supplied from various sources. The CITY makes no guarantee, either expressed or implied, as to their accuracy or completeness.

1.08 ITEMS SPECIFIED ON DRAWINGS

A. Certain items of material and/or equipment, and their installation may be specified on the Drawings and not mentioned in the Specifications. Such items are to be considered as both shown on the Drawings and noted in the Specifications and be provided by the CONTRACTOR in accordance with the Specification on the Drawings.

1.09 FIELD LAYOUT OF WORK

A. All work under this Contract shall be constructed in accordance with the Contract Drawings or as directed by the ENGINEER. Elevations of existing ground, structures and appurtenances are believed to be reasonably correct but are not guaranteed to be absolute and therefore are presented only as an approximation. Any error or apparent discrepancy in the data shown or omissions of data required for accurately accomplishing the stake-out survey shall be referred immediately to the ENGINEER for interpretation or correction.

B. All survey work for construction control purposes shall be made by the CONTRACTOR at his expense.

C. The CONTRACTOR shall establish all base lines for the location of the principal component parts of the work together with benchmarks and batter boards adjacent to the work. Based upon the information provided by the Contract Drawings, the CONTRACTOR shall develop and make all detail surveys necessary for construction. The CITY will furnish information and location of existing benchmarks.

D. The CONTRACTOR shall have the responsibility to carefully preserve the benchmarks, reference points and stakes. In case of destruction thereof by the CONTRACTOR or resulting from his negligence, he shall be held liable for any expense and damage resulting therefrom and shall be responsible for any mistakes that may be caused by the unnecessary loss or disturbance of such bench marks, reference points and stakes.

E. Existing or new control points, property markers, and monuments that will be established or are destroyed during the normal course of construction shall be re-established by the CONTRACTOR; and all reference ties recorded therefore shall be furnished to the ENGINEER. All computations necessary to establish the exact position of the work shall be made and preserved by the CONTRACTOR.

F. The ENGINEER may check all or any portion of the work, and the CONTRACTOR shall afford all necessary assistance to the ENGINEER in carrying out such checks. Any necessary corrections to the work shall be performed immediately by the CONTRACTOR and he shall accept all responsibility for the accuracy and completeness of his work.

1.10 ENVIRONMENTAL PROTECTION

A. The CONTRACTOR shall furnish all labor and equipment and perform all WORK required for the prevention of environmental pollution during and as a result of the WORK under this contract. The CONTRACTOR shall be responsible for preparing and complying with the requirements of the National Pollution Prevention Discharge Elimination System (NPDES) and Storm Water Pollution Prevention Plan (SWPPP), including preparation and submittal of the Notice of Intent (NOI) prior to start of construction. For the purpose of this contract environmental pollution is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life, affect other species of importance to man, or degrade the utility of the environment for aesthetic and recreational purposes. The control of environmental pollution requires consideration of air, water, land and involves noise, solid waste management and management of radiant energy and radioactive materials, as well as other pollutants.

B. The CONTRACTOR shall take all steps necessary to protect water quality in the connected waters around the project and shall utilize such additional measures as directed by the ENGINEER. Silt screens, hay bales, turbidity curtains, or other control measures adjacent to outfall construction shall not be removed until the turbidity of the affected waters is equal to or lower than the ambient turbidity of undisturbed segments of adjacent surface waters.

END OF SECTION

SECTION 01011

SITE CONDITIONS

PART 1 – GENERAL

1.01 GENERAL

The proposed work sites in the City of Hallandale Beach are relatively level and at an approximate elevation varying from approximately 4.5 to 5.5 feet NAVD. The area for the proposed sewage pumping station and force main is generally in a grassy, lightly treed area with some paved sidewalks and a paved driveway. The work area also included an existing fenced pumping station that will be abandoned and partially removed. Abutting the work area is a paved parking lot for City Hall and the Police Department and paved City streets.

The Contractor is invited to visit the sites prior to submittal of his proposal to verify the existing conditions and evaluate the suitability for erection of the facilities.

The Contractor shall be responsible for all site preparation, improvements and partial restoration for the installation of the pumping station, the force mains and all other facility work.

The work of this project is to install a new pump station to replace the existing pump station. New gravity sewer from the existing pump station wet well to the new pump station wet well, to connect the existing collection system to the new pump station. New force main from the new pump station to the existing 10” force main and the existing 12” force main adjacent to the existing pump station, to connects the new pump station to the existing transmission system. Abandonment/demolition of existing pump station. The Contractor’s actions may not interfere with the ability of these facilities to provide continuous, reliable service, except as specifically provided for in these Contractor Documents or as allowed by the Owner and the Engineer.

1.02 SITE INVESTIGATION AND REPRESENTATION

The Contractor acknowledges that he has satisfied himself as to the nature and location of the Work, the general and local conditions, particularly those bearing upon availability of transportation, disposal, handling and storage of materials, availability of labor, water, electric power, roads, uncertainties of weather or similar physical conditions of the ground, the character of equipment and facilities needed preliminary to and during execution of the work and all matters which in any way can affect the work or the cost thereof under this contract.

The Contractor further acknowledges that he has satisfied himself as to the character, quality and quantity of surface and subsurface materials to be

encountered from inspecting the site and from evaluating information derived from exploratory work that may have been done by the Owner or included in these Contract Documents. Any failure by the Contractor to acquaint himself with all the available information will not relieve him from responsibility for properly estimating the difficulty or cost of successfully performing the work.

1.03 INFORMATION ON SITE CONDITIONS

All information obtained by the Owner regarding site conditions, topography, subsurface information, groundwater elevations, existing construction of site facilities as applicable and similar data will be available for inspection at the office of the Engineer upon request. Such information is offered as supplementary information only. Neither the Engineer nor the Owner assumes any responsibility for the completeness or for the Contractor's interpretation of such supplementary information.

A. Subsurface Information

All information regarding subsurface conditions (no soil samples were recovered from test borings) at the project site that the Owner has obtained, may be examined by all prospective bidders prior to the receipt of proposals. Appointment for examination of such information shall be made with the Engineer. Boring Logs are appended to the Specifications. The report of soft dig explorations are presented on the drawings.

B. Bidder's Subsurface Investigation

Prospective bidders are invited, at their own expense, to make such additional subsurface investigation by boring or test pit excavation as may be desired, provided however, that such work be scheduled by appointment with the Engineer.

C. Differing Subsurface Conditions

In the event subsurface or latent physical conditions are found materially different from those indicated in these Documents and differing materially from those ordinarily encountered and generally recognized as inherent in the character of work covered in these Contract Documents, the Contractor shall promptly and before such conditions are disturbed, notify the Engineer in writing of such changed conditions.

The Engineer will investigate such conditions promptly and following this investigation, the Contractor shall proceed with the work unless otherwise instructed by the Engineer. If the Engineer finds that such conditions do so materially differ and cause an increase or decrease in

the cost of, or in the time required for performing the work, the Engineer will recommend to the Owner the amount of adjustment in cost and time he considers reasonable. The Owner will make the final decision on all Change Orders to the Contract regarding any adjustment in cost or time for completion.

D. Existing Utilities

Known utilities and structures adjacent to or encountered in the work are shown on the drawings. The locations shown are taken from existing records and the best information available from existing utility plans; however, it is expected that there may be some discrepancies and omissions in the locations and quantities of utilities and structures shown. Those shown are for the convenience of the Contractor only, and no responsibility is assumed by either the Owner or the Engineer for their accuracy or completeness. Any additional costs incurred for idle time of equipment or labor as a result of uncovering unknown utilities shall be for the Contractor's account.

E. Contractor's Responsibility For Utility, Properties And Service

Where the Contractor's operations could cause damage or inconvenience to telegraph, fiber optic communications, telephone, television, power, oil, gas, storm drainage, water, sewer or irrigation systems, the Contractor shall make all arrangements necessary for the protection of these utilities and services.

The Contractor shall notify Florida Sunshine – One Call 1-800-432-4770 to arrange for underground utility locations and mark out at least 48 hours prior to beginning and excavations or other underground work, as required by law.

The Contractor shall notify all utility officers that are affected by the construction operation at least forty-eight (48) hours in advance. Under no circumstance shall any utilities be exposed without first notifying the appropriate agency. After the appropriate notice, the existing underground utilities may be located, exposed and temporary support of such utilities shall be provided.

The Contractor shall be solely and directly responsible to the Owner and operators of such properties for any damage, injury, expense, loss, inconvenience, delay, suits, actions or claims of any character brought because of any injuries or damage which may result from the construction operations under this Contract.

Neither the Owner not its officers or agents shall be responsible to the Contractor for damages as a result of the Contractor's failure to protect utilities encountered in the work.

In the event of interruption to domestic water, sewer, storm drain or other utility services as a result of accidental breakage due to construction operations, the Contractor shall promptly notify the Owner of the utility and cooperate with the Owner in restoration of service as promptly as possible and bear all costs of repair. In no event shall interruption of any utility service be allowed outside working hours unless granted by the Owner of the utility.

In the event the Contractor encounters water service lines that interfere with trenching, he may, by obtaining prior approval of the Owner of the utility, cut the service, dig through and restore the service with similar and equal materials at the Contractor's expense.

The Contractor shall replace, at his own expense, any and all other existing utilities or structures removed or damaged during construction, unless otherwise provided for in the Contract Documents.

F. Interfering Structures

The Contractor shall take necessary precautions to prevent damage to existing structures whether on the surface, aboveground or underground. An attempt has been made to show major structures on the Drawings. While the information has been compiled from the best available sources, its completeness and accuracy cannot be guaranteed, and it is presented as a guide to avoid possible difficulties.

The Contractor shall protect existing structures from damage, whether or not they lie within the limits of the easements obtained by the Owner. Where existing fences, gates, barns, sheds, buildings or any other structure must be removed to properly carry out the work or are damaged during the work, they shall be restored at the Contractor's expense to their original condition and to the satisfaction of the property owner.

Without additional compensation, the Contractor may remove and replace, in a condition as good as or better than original, any small structures such as fences, mailboxes and signposts that interfere with the Contractor's operations.

G. Field Relocations

During the progress of construction, it is expected that minor relocations of the work will be necessary. Such relocations shall be made only by direct-ion of the Engineer. If existing structures are encountered that will prevent construction as shown, notify the Engineer before continuing with the work in order that the Engineer

may make such field revisions as necessary to avoid conflict with the existing structures. If the Contractor fails to notify the Engineer when an existing structure is encountered and proceeds with the work despite this interference, he shall do so at his own risk.

1.04 SURVEYS

Prior to commencing work, the Contractor shall satisfy himself as to the accuracy of all survey or existing site information as indicated on the drawings or specifications. Should the Contractor discover any errors, inaccuracies or omissions in the survey data, he shall immediately notify the Engineer. The commencing of any of the work by the Contractor shall be held as acceptance by him of the survey data, after which the Contractor shall have no claim against the Owner resulting from alleged errors, inaccuracies or omissions in the survey data.

1.05 EASEMENTS

A portion of the work will be located on City owned land and a portion will be on land owned by the United States Postal Service. An easement and permits have been provided by the Owner. An easement will provide for the use of property for construction purposes only to the extent indicated on the easement. The extent of the easement is shown on the drawings. It shall be the Contractor's responsibility to determine the adequacy of the easement obtained and abide by all requirements and provisions of the easement. The Contractor shall confine his construction operations to within the easement limits or make special arrangements with the OWNER for the additional area required. Any damage to property, either inside or outside the limits of the easement provided by the Owner, shall be the responsibility of the Contractor.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01015

CONTROL OF WORK

PART 1 - GENERAL

1.01 WORK PROGRESS

The Contractor shall construct the Work as shown on the Drawings and shall provide sufficient resources which will ensure the completion of the work within the time stipulated in the Proposal. If at any time such facilities appear to the Engineer to be inefficient, inappropriate or insufficient for securing the quality of work required or for producing the rate of progress aforesaid, he may request in writing the Contractor provide means to increase the facility's equipment, modify the amount or type of resource and the Contractor shall conform to such order. Failure of the Engineer to give such order shall in no way relieve the Contractor of his obligations to secure the quality of the work and rate of progress required, nor for the timely completion of the Work.

1.02 PRIVATE LAND

The Contractor shall not enter or occupy private land outside of easements or SE 5th Street rights-of-way, except by written permission of the property owner.

1.03 WORK LOCATIONS

Work shall be located substantially as indicated on the Drawings, but the Engineer reserves the right to make such modifications in locations as may be found desirable to avoid interference with existing utilities, structures or for other reasons. Where facilities are noted on the Drawings, such notation is for the Contractor's convenience and does not relieve him from laying and jointing different or additional fittings and/or appurtenances as required.

1.04 OPEN EXCAVATIONS

A. All open excavations shall be adequately safeguarded by the Contractor at his own expense, providing temporary barricades, caution signs, lights and other means to prevent accidents to persons, and damage to property. The length of open trench will be controlled by the particular surrounding conditions, but shall always be confined to limits, which minimize interference with, and danger to the public and existing facilities.

B. The Contractor shall take precautions to prevent injury to the public due to open trenches.

1.05 TEST PITS

Test pits for the purpose of locating all known and unknown underground utilities or structures sufficiently in advance of the construction shall be excavated and backfilled by the Contractor so as not to create a hazardous area. Test pits shall be backfilled immediately after their purpose has been satisfied and the surface restored and maintained in a manner satisfactory to the Engineer.

1.06 CARE AND PROTECTION OF PROPERTY

A. The Contractor shall be responsible for the preservation of all public and private property, and shall use every precaution necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect or misconduct in the execution of the work on the part of the Contractor, such property shall be restored by the Contractor, at his expense, to a condition equal to or better than existing before the damage was done, or he shall make good the damage in other manner acceptable to the Engineer.

B. All sidewalks that are disturbed by the Contractor's operations shall be restored to their original condition by the use of similar or better materials. All curbing shall be restored in a condition equal to the original construction and in accordance with the City of Hallandale Beach Engineering Standards.

C. Along the location of this work all fences, walks, bushes, trees, shrubbery, and other physical features shall be protected and restored in a thoroughly workmanlike manner. Fences and other features removed by the Contractor shall be replaced in the location indicated by the Engineer as soon as conditions permit. All grassy areas beyond the limits of construction, which have been damaged by the Contractor, shall be regraded and sodded.

D. Trees close to the work shall be boxed or otherwise protected against injury. The Contractor shall trim all branches that are liable to damage because of his operations, but in no case shall any tree be cut or removed without prior notification of the tree warden. All injuries to bark, trunk, limbs, and roots of trees shall be repaired by dressing, cutting, and painting according to approved methods, using only approved tools and materials.

E. The protection, removal and replacement of existing physical features along the line of work shall be part of the work under the Contract, and all costs in connection therewith shall be included in the unit and/or lump sum prices established under the items in the Table of Unit Prices Form.

1.07 PROTECTION AND RELOCATION OF EXISTING STRUCTURES AND UTILITIES

A. The Contractor shall assume full responsibility for the protection of all buildings, structures and utilities, public or private, including poles, signs, services to buildings, utilities in the street, gas pipes, water pipes, hydrants,

sewers, drains, and electric and telephone cables, whether or not they are shown on the Drawings. The Contractor shall carefully support and protect all such structures and utilities from injury of any kind. Any damage resulting from the Contractor's operations shall be repaired by him at his expense.

B. The Contractor shall bear full responsibility for obtaining all locations of underground structures and utilities (including existing pressure mains, water services, drain lines and sewers). Services to the building shall be maintained and all costs or charges resulting from damage thereto shall be paid by the Contractor.

C. If, in the opinion of the Engineer, additional permanent relocation of a utility owned by the City is required, he may direct the Contractor, in writing to perform the work. Work so ordered will be paid for at the contract unit prices, if applicable, or as extra work under the General Conditions. If relocation of a privately-owned utility is required, the City will notify the Utility to perform the work as expeditiously as possible. The Contractor shall fully cooperate with the City and Utility, and shall have no claim for delay due to such relocation. The Contractor shall notify public utility companies, in writing, at lest 48 hours (excluding Saturdays, Sundays and legal holidays) before excavating in any public way.

1.08 DISTRIBUTION SYSTEMS AND SERVICES

A. The Contractor shall not interrupt water, telephone, cable TV, sewer, gas, or other related utility services and disrupt the normal functioning of the system as little as possible. Contractor shall notify Engineer well in advance of any requirement for dewatering, isolating, or relocating a section of a utility, so that necessary arrangements may be made with the appropriate agency.

B. If it appears that the utility service will be interrupted for an extended period, the Engineer may order the Contractor to provide temporary service lines. Inconvenience of the users shall be the minimum, consistent with the existing conditions. The safety and integrity of the system is of prime importance in scheduling work.

1.09 PROTECTION OF CONSTRUCTION AND EQUIPMENT

A. All newly constructed work shall be carefully protected from injury in any way. No wheeling or walking or placing of heavy loads on it shall be allowed and all portions injured shall be reconstructed by the Contractor at his own expense.

B. All structures shall be protected in a manner approved by the Engineer. Should any of the floors or other parts of the structures become heaved, cracked, or otherwise damaged, all such damaged portions of the work shall be completely repaired or replace and made good by the Contractor at his own expense and to the satisfaction of the Engineer. If, in the final inspection of the Work, any defects, faults, or omissions are found, the Contractor shall

cause the same to be repaired or removed and replaced by proper materials and workmanship without extra compensation for the materials and labor required. Further, the Contractor shall be fully responsible for the satisfactory maintenance and repair of the construction and other work undertaken herein, for at least the guarantee period described in the Contract.

C. Further, the contractor shall take all necessary precautions to prevent damage to any structure due to water pressure during and after construction and until such structure is accepted and taken over by the Owner.

D. Protection of excavated material; no dirt will be allowed in storm drains or gutters.

1.10 WATER FOR CONSTRUCTION PURPOSES

A. In locations where public water supply is available, the contractor may purchase metered City water for construction purposes, at applicable rates.

C. City potable water used during this project can be metered thru a hydrant meter. There is a $ 650 deposit required for the use of a hydrant meter. The Contractor shall pay for all water consumed at the standard rate.

1.11 MAINTENANCE OF FLOW

The Contractor shall, at his own cost, provide for the flow of sewers, drains, and water courses interrupted during the progress of the work, and shall immediately cart away and remove all offensive matter. The entire procedure of maintaining existing flow shall be fully discussed with the Engineer well in advance of the interruption of any flow.

1.12 CLEAN UP /DUST CONTROL

A. During the course of the work, the Contractor shall keep the site of his operations in as clean and neat a condition as possible. At the end of each and every work day, the Contractor shall dispose of all residue resulting from the construction work and, during the course of work, he shall remove and haul away any surplus excavation, broken pavement, lumber, equipment, temporary structures, and any other refuse resulting from the construction operation, and shall leave the entire site of the work in a neat and orderly condition on a continual basis.

B. It shall be the Contractor's responsibility to control dust by watering and sweeping at the end of each and every work day. The water shall be paid for by the Contractor. Should the Contractor fail to control dust to the City Engineer's satisfaction, the City shall control the dust by whatever means necessary and the Contractor shall pay all expenses of that effort incurred by the City to control the dust.

1.13 STREET CLOSURES

Street closures shall be allowed only when the requirements of Section 01570 Traffic Regulation have been met.

1.14 MAINTENANCE OF ACCESS

Portions of the work are located in developed areas requiring the access for fire, police EMS ambulance units, and other departments to be provided for and at least one free lane be available for all emergency traffic. Contractors are to arrange operations in these areas to meet these requirements and secure approval of operating procedures from the Owner.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01025

MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.01 SUBMITTALS

A. Informational:

1. Submit schedule on OWNER's form.
2. Application for Payment.
3. Final Application for Payment.

1.02 SCHEDULE

A. Prepare a schedule for the Work in accordance with the requirements of Section 01310.

B. Unit Price Work: Reflect unit price quantity and price breakdown from the conformed Bid Form.

C. Lump Sum Work:

1. Reflect schedule format included in conformed Bid Form.
2. List Bonds and insurance premiums, mobilization, demobilization, facility startup, allowance items and contract closeout separately.
3. Break down by Divisions 2 through 16 with appropriate subdivision of each Specification.

D. An unbalanced or front-end loaded schedule will not be acceptable.

E. Summation of all the Work shall equal the Contract Price.

1.03 APPLICATION FOR PAYMENT

A. Transmittal Summary Form: Attach one Summary Form with each detailed Application for Payment. Execute certification by authorized officer of CONTRACTOR.

B. Use detailed Application for Payment Form provided by ENGINEER.

C. Include each portion of Work and the unit price breakdown for the Work to be paid on unit price basis, and a listing of OWNER selected equipment, if applicable, and allowances, as appropriate.

D. Preparation:

1. Round values to nearest dollar.

2. List each Change Order and Written Amendment executed prior to date of submission as separate line item. Totals to equal those shown on the Transmittal Summary Form.

3. Submit Application for Payment, including a Transmittal Summary Form and detailed Application for Payment Form, (4 copies), a listing of materials on hand as applicable, and such supporting data as may be requested by ENGINEER.

1.04 MEASUREMENT - GENERAL

A. Weighing, measuring, and metering devices used to measure quantity of materials for Work shall be suitable for purpose intended and conform to tolerances and Specifications as specified in National Institute of Standards and Technology, Handbook 44.

B. Whenever pay quantities of material are determined by weight, material shall be weighed on scales furnished by CONTRACTOR and certified accurate by state agency responsible. Weight or load slip shall be obtained from weigher and delivered to ENGINEER or OWNER's representative at point of delivery of material.

C. If material is shipped by rail, car weights will be accepted provided that actual weight of material only will be paid for and not minimum car weight used for assessing freight tariff, and provided further that car weights will not be acceptable for material to be passed through mixing plants.

D. Vehicles used to haul material being paid for by weight shall be weighed empty daily and at such additional times as required by ENGINEER. Each vehicle shall bear a plainly legible identification mark.

E. Materials that are specified for measurement by the cubic yard measured in the vehicle shall be hauled in vehicles of such type and size that actual contents may be readily and accurately determined. Unless all vehicles are of uniform capacity, each vehicle must bear a plainly legible identification mark indicating its water level capacity. Vehicles not meeting above requirements or loads of quantity less than the capacity of the vehicle, measured after being leveled off as above provided, will be subject to rejection, and no compensation will be allowed for such material.

F. Where measurement of quantities depends on elevation of existing ground, elevations obtained during construction will be compared with those shown on Drawings. Variations of 1 foot or less will be ignored, and profiles shown on Drawings will be used for determining quantities.

G. Units of measure shown on Bid Form shall be as follows, unless specified otherwise. All methods of measurement shall be approved by the ENGINEER.

ITEM	METHOD OF MEASUREMENT
AC	Acre – Field Measure
AL	Allowance
CY	Cubic Yard – Field Measure within limits specified or shown, or measured in vehicle by volume, as specified
EA	Each – Field Count
GAL	Gallon – Field Measure
HR	Hour
LB	Pound(s) – Weight Measure by Scale
LF	Linear Foot – Field Measure
LS	Lump Sum – Unit is one; no measurement will be made
SF	Square Foot
SY	Square Yard
TON	Ton - Weight Measure by Scale (2,000 pounds)

1.05 PAYMENT

A. General:

1. Progress payments will be made monthly.

2. The date for CONTRACTOR's submission of monthly Application for Payment shall be established at the Preconstruction Conference.

3. The CONTRACTOR shall be solely and directly responsible to the OWNER and operators of utilities, telephone, television, power, water, or sewer systems for any damage, injury, expense, loss, inconvenience, delay, suits, actions, or claims of any character brought because of any injuries or damage which may result from the construction operations under this Contract.

4. Neither the OWNER nor its officers or agents shall be responsible to the CONTRACTOR for damages as a result of the CONTRACTOR's failure to protect utilities encountered in the Work.

5. In the event of interruption to domestic water, sewer, storm drain, or other utility services as a result of accidental breakage due to construction operations, promptly notify the proper authority. Cooperate with said authority in restoration of service as promptly as possible and bear all costs of repair. In no case shall interruption of any water or utility service be allowed to exist outside working hours unless prior approval is granted.

6. In the event the CONTRACTOR encounters water service lines or sewer laterals that interfere with trenching, he may, by obtaining prior approval of the property owner, the ENGINEER and the OWNER, cut the service, dig through, and restore the service with similar and equal materials at the CONTRACTOR's expense.

7. The CONTRACTOR shall replace, at his own expense, all existing utilities or structures removed or damaged during construction, unless otherwise provided for in these Contract documents or ordered by the CITY.

8. Telephone and communication drops and systems may extend throughout the project area. Properly located cable, conduit, interface equipment, pull or junction boxes and other signal or systems equipment damaged by the CONTRACTOR shall be replaced at the CONTRACTOR's expense. Damaged cable shall be replaced as an entire run, from junction box to junction box.

9. Protect underground and aboveground existing structures from damage, whether or not they lie within the limits of the easements obtained by the OWNER. Where such existing fences, gates, sheds, buildings, or any other structure must be removed in order to properly carry out the construction, or are damaged during construction, restore to their original condition to the satisfaction of the property owner involved at the CONTRACTOR's own expense. Notify the ENGINEER of any damaged underground structure, and make repairs or replacements before backfilling.

10. Without additional compensation, the CONTRACTOR may remove and shall replace in a condition as good as or better than original, such small miscellaneous structure as fences, irrigation systems, mailboxes, and signposts that interfere with the CONTRACTOR's operations.

11. Any damage to property, either inside or outside the limits of the easements provided by the OWNER or street rights-of-way, shall be the responsibility of the CONTRACTOR as specified herein. The CONTRACTOR shall provide immediate notice to the OWNER of any damage to fencing and provide temporary fencing as required to provide a functionally similar level of security. The CONTRACTOR shall remove, protect and replace all fences or other items encountered on public or private property. Before final payment will be authorized by the

ENGINEER, the CONTRACTOR will be required to furnish the OWNER with written releases from property owners or public agencies where side agreements or special easements have been made by the CONTRACTOR or where the CONTRACTOR's operations, for any reason, have not been kept within the construction right-of-way obtained by the OWNER or the street right-of-way.

12. The CONTRACTOR shall be responsible for all damage to private property where work related activities have occurred without proper easement or authorization. The CITY may withhold payment to the CONTRACTOR pending resolution of any claims by private owners.

B. General:

No material price increases will be allowed, including gasoline, diesel, asphalt cement, or other materials.

C. Payment for Lump Sum Work covers all Work specified or shown for all specification items within the contract documents.

1.06 MOBILIZATION / DEMOBILIZATION (Bid Item No. 1)

A. Mobilization and Demobilization.

B. Payment for mobilization and demobilization will be made at the lump sum price developed from the cost of the unit price items. Mobilization includes, but is not limited to all required testing with passing results, all required bonds, video of existing site conditions and final completion, test holes for verification of existing utility/storm pipe sizes and elevations, insurance, site cleanup, sanitary facilities, labor associated with permit acquisition, CONTRACTOR staging area, project signs, project coordination, and demobilization. Partial payments for mobilization and demobilization will be made as follows:

- 25% at the beginning of the work
- 50% at 10% complete
- 75% at 25% complete
- 100% at 100% complete

1.07 MAINTENANCE OF TRAFFIC (Bid Item No.2)

A. Maintenance of traffic.

B. Payment for maintenance of traffic will be made at the lump sum price named in the Bid Schedule. Payment for maintenance of traffic will be made in equal monthly amounts during the duration of the contract time. Existing traffic signage shall be

maintained and protected at all times. There shall be no additional payment for replacement.

1.08 REMOVE & DISPOSE OF EXISTING ASPHALT PAVEMENT (Bid Item No. 3)

A. Measurement for payment to remove and dispose of existing asphalt pavement will be based upon the actual number of square yards of such asphalt pavement actually removed, all in accordance with the Contract Documents.

B. Payment for removal and disposal of existing pavement will be made at the unit price per square yard of asphalt pavement named in the Bid Schedule which price shall constitute full compensation for the complete removal and disposal of asphalt pavement.

1.09 REMOVE & DISPOSE OF EXISTING SIDEWALK/ CONCRETE (Bid Item No. 4)

A. Measurement for payment to remove and dispose of existing sidewalk, concrete paving, or pavers will be based upon the actual number of square yards of sidewalk or concrete paving actually removed and disposed all in accordance with the Contract Documents.

B. Payment for removal and disposal of existing sidewalk or concrete driveway will be made at the unit price per square yard named in the Bid Schedule which price shall constitute full compensation for the complete removal and disposal of all sidewalk or concrete pavement.

1.10 REMOVE & DISPOSE OF EXISTING TREE (Bid Item No. 5)

A. Measurement for payment to remove and dispose of existing tree will be based upon the actual number of each tree actually removed and disposed all in accordance with the Contract Documents.

B. Payment for removal and disposal of existing tree will be made at the unit price per each named in the Bid Schedule which price shall constitute full compensation for the complete removal and disposal of all trees.

1.11 FURNISH & INSTALL CONCRETE SIDEWALK AND CONCRETE ACCESS DRIVEWAY (Bid Item No. 6 - 7)

A. Measurement for payment for furnishing and installing concrete sidewalk and concrete access driveway will be based upon the actual number of square yards of concrete actually furnished and installed all in accordance with the Contract Documents.

B. Payment for furnishing and installing concrete sidewalk and concrete access driveway will be made at the unit price per square yard named in the Bid Schedule which price shall constitute full compensation for completing said work, including all earthwork, clearing, grading, compaction of subgrade, backfilling of sidewalk, construction of the sidewalk, detectable warnings/truncated domes, furnishing and

setting for expansion joint material, reinforcement, disposal of excess material, and the appurtenant items for which separate payment is not specifically included in the Bid Schedule..

1.12 FURNISH AND INSTALL SANITARY SEWER PIPING (ALL TYPES AND SIZES) (Bid Item Nos. 8 - 9)

A. Measurement for payment for furnishing and installing sanitary sewer gravity and force main ductile iron pipe constructed outside the pump station wet well and valve vault will be based upon the actual number of linear feet of such pipe actually removed and disposed of all in accordance with the Contract Documents.

B. Payment for furnishing and installing ductile iron pipe constructed outside the pump station wet well and valve vault will be made at the unit price per linear foot of pipe named in the Bid Schedule which price shall constitute full compensation for the complete installation of ductile iron pipe including excavation, dewatering, bedding, restraints, backfill, compaction, testing, clearing, restoration including sod, pavement and concrete, etc. and all else necessary for a complete and functional installation.

1.13 FURNISH AND INSTALL VALVES (Bid Item Nos. 10 - 11)

A. Measurement for payment to furnish and install valves will be based upon actual quantity, each, of such valves and boxes furnished and installed, all in accordance with the requirements of the Contract Documents and City of Hallandale Beach Public Works Department. Additional valves incorporated for testing purposes and left in place, shall be paid at the unit price, if removed after testing, no payment will be made.

B. Payment for furnishing and installing valves and boxes will be made at the unit price each, named in the Bid Schedule which price shall constitute full compensation for the completed installation of the valve, including valve box, brass tag, mounting inside wet well and extension to finish grade and concrete collar installed in unpaved areas. Test valves shall be constructed with a riser to ground level, and be marked, tagged, and photographed.

1.14 FURNISH & INSTALL FITTINGS (Bid Item No. 12)

A. Measurement for payment for furnishing and installing pipe fittings constructed outside the pump station wet well and valve vault will be based upon the unit bid price per ton named in the Bid Schedule. Weight will be based on compact fitting weight only not including megalugs all in accordance with the requirements of the Contract Documents.

B. Payment for furnishing and install fittings and transition couplings constructed outside the pump station wet well and valve vault shall be at the unit bid price per ton and shall include furnishing, complete installation including storing and transporting the fittings.

1.15 FURNISH & INSTALL CONNECTION TO EXISTING 10" FORCE MAIN (Bid Item No. 13)

A. Measurement for payment for connecting to existing force main will be based upon the number of each pipe connection, all in accordance with the requirements of the Contract Documents.

B. Payment for furnishing and installing connections to existing force main price shall constitute full compensation for the complete connection of proposed ductile iron pipe connection to existing force main including excavation, dewatering, bedding, restraints, blind flange or plug removal, tapping, cutting, backfill, compaction, testing, clearing, restoration including sod, pavement and concrete, etc. to make connection and all else necessary for a complete and functional installation.

1.16 CONNECT TO EXISTING MANHOLE THAT WAS CONVERTED FROM WET WELL (Bid Item No. 14)

A. Measurement for payment to connect to existing sanitary sewer manhole converted from wet well, will be based upon actual quantity, each, of such connections made in accordance with the contract document.

B. Payment to connect to existing manhole that was converted from wet well will be made at the unit price, each, named in the bid schedule, which price shall constitute full compensation for the completed installation of the connection, including shutting down existing main, abandonment of existing sanitary sewer lift station will be based upon the actual quantity, each, of such sanitary sewer lift stations abandoned, cutting main, by-pass pumping, caps and installation of the connection fittings and all else necessary for a complete and functional installation. This work also includes rehabilitation of the existing wet well converted to manhole being connected to, if applicable, which includes but is not limited to existing wet well to be filled with clean sand and cement grouted to the elevation shown on the contract documents, reworking the flow channels at the bottom of the existing manhole as required by proposed connection, plugging existing invert, cleaning structure, coating interior and all necessary for a complete and functional connection, all in accordance with the requirements of the Contract Documents.

C. Existing service must be maintained to all customers throughout the course of construction. Temporary piping, temporary lateral connections, tanker truck usage, dumping fees, pumps, temporary power supplies, etc. and all else necessary to maintain service to customers is included as part of this Bid Item.

1.17 FURNISH & INSTALL 10'x10' RECTANGULAR SANITARY SEWER LIFT STATION, STATION PAD, VALVE VAULT, PANELS, AND ASSOCIATED FEATURES (INCLUDES AND GRUBBING REQUIRED FOR SITE PREPARATION, INCLUDES ALL REQUIRED COSTS REQUIRED FOR GRINDER W/RAILS, GENERATOR, ELECTRICAL EQUIPMENT, FPL RELOCATION, SHUTDOWN, AND COORDINATION RELATED TO ANY CONFLICT BETWEEN THE LIFT STATION AND FPL FACILITIES (Bid Item No. 15)

A. Measurement for payment to furnish and install a sanitary sewer lift station including control panels, will be based upon the actual quantity, each, of such sanitary sewer lift stations constructed, all in accordance with the requirements of the Contract Documents, including associated work as described below.

B. Payment for lift station will be made at the lump sum price, named in the Bid Schedule, which price shall constitute full compensation for demolition and disposal of all items shown on plans, furnishing, complete installation, successful testing and operation of the pumps, piping, generator, and related items; including but not limited to: valve vault, valves, fittings, couplings, fall protection, foundations, supports, hangers, wall penetrations, new sump pumps and piping, influent pipe and connection to existing gravity sewer pipe, rehabilitation of the existing wet well and conversion to a manhole, muffin monster grinder, frame, guide rail, lifting bail-post, haul chain, electric services as noted on the plans, electrical equipment including VFDs and panels, antenna, telemetry, sensors, alarms, all instrumentation as shown on plans, emergency generator, fuel tank with one full tank of fuel and related piping, intake and exhaust systems for the generator, ventilation systems including all duct work, exhaust fans, damper, vent pole, and all other appurtenances, all required demolition as applicable, construction of the reinforced concrete structures, concrete pads for generator and fuel tank, protective coatings and paintings, any shoring required, pre and post coating certification by coating manufacturer, coordination with FP&L for power supply, coordination with any other utility/agency, relocation of existing utilities to/inside the pump station as needed including rerouting of potable water, survey, preparation of as-built drawings, and all other pump station restoration work. Any costs for all piping including the proposed discharge force mains, fittings, valves, restraints and tie-ups to be constructed inside the pump station as shown on the plans, pressure testing, and any required work for the satisfactory completion of the project not included in a separate bid item shall be considered as part of LIFT STATION UPGRADE and shall be included in this bid item. Lift station shall be complete, energized, tested satisfactory to the CITY and the ENGINEER and ready for service, all in accordance with the Contract Documents.

1.18 MILLING & RESURFACING IN SE 5TH STREET (Bid Item No. 16 - 17)

A. Measurement for payment of milling and resurfacing will be based upon the number of square yards of such asphalt pavement actually milled and resurfaced, as detailed in the Drawings, all in accordance with the requirements of the Contract Documents.

B. Payment for milling and resurfacing of asphalt pavement at the minimum thickness of 1.0” indicated will be made at the unit price per square yard for such milling and

resurfacing as named in the Bid Schedule which price will constitute full compensation for milling and disposal of existing asphalt to a minimum depth of 1.0", applying a tack coat and furnishing, placing and compacting a minimum 1.0" thick Type S-III, complete in place, including milling and saw cutting of all pavement and all cleanup of the area disturbed by this construction.

C. Milling and resurfacing shall comply with FDOT specifications. Asphalt shall be placed to assure a minimum 2% cross slope is maintained throughout the resurfacing area of the roadway.

1.19 REPLACE OF PAVEMENT MARKING AND SIGNAGE (Bid Item Nos. 18 - 19)

A. Measurement for payment for replacing all pavement marking and signage will be based upon replacing all existing stamped asphalt, striping, signage, and reflective pavement markers removed as a result of installation of pipe and paving and shall be replaced in accordance with the most recent municipal, county, state and federal codes and shall be paid for based upon the unit price per LF, SY. Additionally, the replacement of pavement marking and signage item shall include temporary pavement marking for each asphalt lift in paint type of the same quantity of pavement markings as the final pavement markings that will ultimately be all thermoplastic are also required as part of this work. If necessary the project pre construction video should be used to confirm the existing condition of the striping and signage.

1.20 UTILITY CONFLICT ALLOWANCE (Bid Item No. 20)

A. Measurement and payment for utility conflict work will be based upon the all furnishing, installing, and completing of the items and actual work required to address unforeseen conflicts. Prior to purchasing products for and performing unforeseen utility conflict construction the CONTRACTOR shall make the CITY and Engineer of Record aware of the conflict and provide a field plan and cost for the work to be performed for the OWNER and Engineers review prior to proceeding with utility conflict work. Payment for work shall only be made for the amount agreed upon for work the ENGINEER deems acceptable.

1.21 SITE DEWATERING ALLOWANCE (Bid Item No. 21)

A. Measurement and payment for Dewatering in areas will be based upon the actual Dewatering Consultant Fees paid for by the CONTRACTOR, monitoring wells, and upon the actual cost of Disposal of Contaminated Materials or other measures necessary to address contaminated areas only. The allowance for Dewatering fee shown on the Bid Schedule is an estimate of Site Dewatering Services fees required for the project and is a cost pass-through item. The OWNER will reconcile the actual cost with the CONTRACTOR by change order. The CONTRACTOR shall produce documentation verifying actual cost from subconsultants as required, or for time and material. Only Dewatering fees substantiated and approved by the ENGINEER will be paid as part of this bid item.

B. Payment shall include, but is not limited to hiring a dewatering consultant as necessary, obtaining licenses/permits from regulatory agencies, providing all labor and equipment for Contaminated Site Dewatering Services, monitoring wells, testing and providing for disposal of contaminated material as required by FDEP, SFWMD, BCEPGMD, or other regulatory agencies.

C. No Contaminated sites are known to exist near the project. The CONTRACTOR shall coordinate special dewatering measures as needed.

1.22 PERMIT FEES ALLOWANCE (Bid Item No. 22 - 23)

A. Payment for permit fees will be based upon the actual permit fees required by the CONTRACTOR from the various agencies having jurisdiction for construction of the project, in accordance with the Contract Documents.

B. The allowance amount shown on the contract is an estimate for the project and is a cost pass through item and no markups will be added to this item. The CONTRACTOR shall submit documentation with pay request verifying actual cost. Only permit fees substantiated by the CONTRACTOR and approved by the ENGINEER will be paid as part of this bid item. Any balance in this item at the end of the project shall be credited back to the OWNER.

1.23 FPL SERVICE ALLOWANCE (Bid Item No. 24)

A. Payment for electrical service modifications and utility relocations, excluding any modifications specifically shown in the contract documents, will be based upon the actual costs incurred by the contractor to modify the electrical service as required by Florida Power and Light (FP&L), in accordance with the contract documents. The allowance amount shown on the bid schedule is an estimate of electrical service modification required for the project and is a cost pass-through item and no markups will be added to this item. The contractor shall produce documentation upon request verifying actual cost. Only electrical service modifications costs substantiated by the contractor and approved by the engineer will be paid as part of this bid item.

1.24 PAYMENT / ALLOWANCES

A. Nonpayment for Rejected or Unused Products

1. Payment will not be made for the following:

a. Loading, hauling, and disposing of rejected material.

b. Quantities of material wasted or disposed of in manner not called for under Contract Documents.

c. Rejected loads of material, including material rejected after it has been placed by reason of failure of CONTRACTOR to conform to provisions of Contract Documents.

d. Material not unloaded from transporting vehicle.

e. Defective Work not accepted by OWNER.

f. Material remaining on hand after completion of Work.

B. Partial Payment for Stored Materials and Equipment

1. Partial Payment: No partial payments will be made for stored materials.

C. Allowances

1. The allowances shall be used only at the discretion of and as ordered by the OWNER.

2. Any portion of these allowances that remain after all authorized payments have been made, will be withheld from contract payments and will remain with the OWNER.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01041

PROJECT COORDINATION

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

A. Engineer will coordinate the work between City and Contractor, as required. The City may use their own staff engineer for construction management.

B. Each prime Contractor shall:

1. Coordinate work of his employees and subcontractors.
2. Expedite his work to assure compliance with schedules.
3. Coordinate his work with that of other Contractors and work by Owner.
4. Comply with orders and instructions of Engineer.

1.02 RELATED REQUIREMENTS

A. Section 01010: Summary of Work
B. Section 01200: Project Meetings
C. Section 01310: Construction Schedules
D. Section 01340: Shop Drawings, Product Data and Samples

1.03 CONSTRUCTION ORGANIZATION AND START-UP

A. Engineer shall establish on-site lines of authority and communications:

1. Schedule and conduct pre-construction meeting and progress meetings as specified in Section 01200.

2. Establish procedures for:

   a. Submittals
   b. Reports and records
   c. Recommendations
   d. Coordination of drawings
   e. Schedules
   f. Resolution of conflicts

3. <u>Interpret Contract Documents</u> - Transmit written interpretations to Prime Contractor, and to other concerned parties.

4. <u>Assist in Obtaining Permits and Approvals</u>- Verify that contractors and subcontractors have obtained inspections for work.

5. Control the Use of Site – Allocate space and time for each Prime Contractor's use of work and storage areas.

6. Inspection and testing:

   a. Inspect work to assure performance in accord with requirements of contract documents.
   b. Administer special testing and inspections of suspect work.
   c. Reject work which does not comply with requirements of contract documents.
   d. Coordinate testing laboratory services:

      1) Verify that required laboratory personnel are present.

      2) Verify that tests are made in accordance with specified standards.

      3) Review test reports for compliance with specified criteria.

      4) Recommend and administer any required re-testing.

1.04 CONTRACTOR'S DUTIES

A. Construction Schedules:

1. Prepare a detailed schedule of basic operations.

2. Monitor schedules as work progresses:

   a. Identify potential variances between scheduled and probable completion dates for each phase.
   b. Recommend to Owner adjustments in schedule to meet required completion dates.
   c. Document changes in schedule; submit to Owner, Engineer and to involved subcontractors.

3. Observe work of each subcontractor to monitor compliance with schedule.

   a. Verify that labor and equipment are adequate for the work and the schedule.
   b. Verify that product procurement schedules are adequate.
   c. Verify that product deliveries are adequate to maintain schedule.
   d. Report noncompliance to Engineer, with recommendation for changes.

B. Process Shop Drawings, Product Data and Samples:

1. Prior to submittal to Engineer, review for compliance with contract documents:

   a. Field dimensions and clearance dimensions.
   b. Relation to available space.
   c. Effect of any changes on the work of any subcontractor.

C. Maintain Reports and Records at job site, available to Engineer and Owner.

1. Daily log of progress of work.
2. Records

   a. Contracts
   b. Purchase orders
   c. Materials and equipment records
   d. Applicable handbooks, codes and standards

3. Maintain file of record documents.

1.05 CONTRACTOR'S CLOSE-OUT DUTIES

A. At completion of work, conduct an inspection to assure that:

1. Specified cleaning has been accomplished.
2. Temporary facilities have been removed from site.
3. Submit to Owner written notice of beginning of warranty period for equipment put into service.

B. Substantial Completion:

1. Conduct an inspection to develop a list of Work to be completed or corrected.
2. Assist Engineer in inspection.
3. Supervise correction and completion of work of subcontractors.

1.06 ENGINEER'S CLOSE-OUT DUTIES

A. Substantial Completion:

1. Conduct an inspection to develop a punch list of Work to be completed or corrected.

B. Final Completion:

1. When each Contractor determines that work is finally complete, conduct an inspection to verify completion of work.

C. Administration of Contract Closeout:

1. Receive and review Contractor's final submittals.
2. Transmit to Owner with recommendations for action.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

PART 4 – PROJECT CLOSEOUT

4.01 CLOSEOUT PROCEDURES

A. Comply with procedures stated in General Conditions of the Contract for issuance of Certificate of Substantial Completion.

B. Submit results of all tests.

C. Complete all punch list items.

D. When Contractor considers work has reached final completion, submit written certification that Contract Documents have been reviewed, work has been inspected and that work is complete in accordance with Contract Documents and ready for Engineer's final inspection.

E. In addition to submittals required by the conditions of the Contract, provide testing and submittals required by governing authorities and regulatory agencies, and submit a final statement of accounting giving total adjusted contract sum, previous payments and sum remaining due.

F. Engineer will issue a final change order reflecting approved adjustments to contract sum not previously made by change order.

G. Submit as-built record drawings for approval.

4.02 FINAL CLEANING

A. Execute prior to final inspection.

B. Clean site; sweep paved areas, rake clean other surfaces.

C. Remove waste and surplus materials, rubbish, and construction facilities from the project and from the site.

D. Clean adjacent drainage facilities of construction debris or sediments.

4.03 OPERATION AND MAINTENANCE DATA

Submit four copies of operating and maintenance information.

4.04 SYSTEMS DEMONSTRATION

Prior to final inspection, demonstrate operation of each system to Engineer and Owner.

4.05 RELEASE OF LIENS

Provide a release of lien from all subcontractors and materials suppliers including General Contractor's release of lien.

END OF SECTION

SECTION 01050

FIELD ENGINEERING

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

Provide and pay for field engineering services required for the project.

1. Survey work required in execution of project.

2. Civil, structural or other professional engineering services specified, or required to execute Contractor's construction methods.

1.02 RELATED REQUIREMENTS

A. Conditions of the Contract.
B. Section 01010: Summary of Work

1.03 QUALIFICATIONS OF SURVEYOR OR ENGINEER

Qualified Engineer or Registered Land Surveyor, Licensed in Florida, acceptable to Contractor and Owner.

1.04 SURVEY REFERENCE POINTS

A. Existing basic horizontal and vertical control points for the project are those designated on drawings.

B. Locate and protect control points prior to starting site work, and preserve all permanent reference points during construction.

1. Make no changes or relocations without prior written notice to Engineer.
2. Report to Engineer when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
3. Require surveyor to replace project control points which may be lost or destroyed.

a. Establish replacements based on original survey control.

1.05 PROJECT SURVEY REQUIREMENTS

A. Establish lines and levels, locate and layout, by instrumentation and similar appropriate means:

1. Site improvements
   a. Stakes for grading, fill and topsoil placement.
   b. Utility slopes and invert or centerline elevations.

B. From time to time, verify layouts by same methods.

C. Locate and mark all known underground utilities prior to entrance of any equipment on the site. All such utilities shall be protected from heavy traffic. Establish and maintain barricades around all manholes, drains, and similar underground items. Immediately notify the owner of any conflict between operations and any in ground item to remain.

D. Establish a minimum of two permanent bench marks referenced to data established by survey control points and record location with horizontal and vertical data on record documents.

1.06 RECORDS

Maintain a complete, accurate log of all control and survey work as it progresses.

1.07 SUBMITTALS

A. Submit name and address of surveyor and professional engineer to Engineer.

B. On request of Engineer, submit documentation to verify accuracy of field engineering work.

C. Submit certificate signed by Registered Land Surveyor certifying that elevations and locations of improvements are in conformance, or non-conformance, with Contract Documents.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.01 FORCE MAIN JOINTS

Record the location and elevation of each force main joint, for both as-built and payment purposes.

3.02 FITTINGS, VALVES AND STRUCTURES

Locate all fittings, valves and structures.

3.03 ALL LOCATIONS

All locations shall be used to update the design drawing CADD file and to be incorporated into the City's planned G.I.S. system. All coordinates shall be in the State Plane Coordinate System.

END OF SECTION

SECTION 01090

REFERENCE STANDARDS

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

Abbreviation and acronyms used in Contract Documents to identify reference standards.

1.02 QUALITY ASSURANCE

A. Application: When a standard is specified by reference, comply with requirements and recommendations stated in that standard, except when requirements are modified by the Contract Documents, or applicable codes establish stricter standards.

B. Publication Date: The publication in effect on the date of issue of Contract Documents, except when a specific publication date is specified.

1.03 ABBREVIATIONS, NAMES, AND ADDRESSES OF ORGANIZATIONS

Obtain copies of referenced standards direct from publication source, when needed for proper performance of Work, or when required for submittal by Contract Documents.

AA	Aluminum Association 818 Connecticut Avenue, N.W. Washington, DC 20006
AABC	Associated Air Balance Council 1000 Vermont Avenue, N.W. Washington, DC 20005
AASHTO	American Association of State Highway & Transportation Officials 444 North Capitol Street, N.W. Washington, DC 20001

ACI	American Concrete Institute Box 19150 Redford Station Detroit, MI 48219
AI	Asphalt Institute Asphalt Institute Building College Park, MD 20740
AISC	American Institute of Steel Construction 1221 Avenue of the Americas New York, NY 10020
AISI	American Iron and Steel Institute 1000 16th Street, N.W. Washington, DC 20036
ANSI	American National Standards Institute 1430 Broadway New York, NY 10018
ASME	American Society of Mechanical Engineers 345 East 47th Street New York, NY 10017
ASPA	American Sod Producers Association Association Building Ninth and Minnesota Hastings, NE 68901
ASTM	American Society of Testing & Materials 1916 Race Street Philadelphia, PA 19103
AWWA	American Water Works Association 6666 W. Quincy Avenue Denver, CO 80235
AWPA	American Wood-Preserver's Association 7735 Old Georgetown Road Bethesda, MD 20014

AWS	American Welding Society 250l NW 7th Street Miami, FL 33125
CDA	Cooper Development Association 57th Floor, Chrysler Building 405 Lexington Avenue New York, NY 10017
CII	Chlorine Institute, Inc. 2001 L Street, N.W., Suite 506 Washington, D.C. 20036
CLFMI	Chain Link Fence Manufacturers Institute 1101 Connecticut Avenue Washington, DC 20036
CRSI	Concrete Reinforcing Steel Institute 180 North LaSalle Street, Suite 2110 Chicago, IL 60601
MF	Factory Mutual System 1151 Boston-Providence Turnpike Norwood, MA 02062
FS	Federal Specification General Services Administration Specifications and Consumer Information Distribution Section (WFSIS) Washington Navy Yard, Bldg. 197 Washington, DC 20407
NEMA	National Electrical Manufacturer's Association 2101 L Street, N.W. Washington, DC 20037
NFPA	National Fire Protection Association 470 Atlantic Avenue Boston, MA 02210
NFPA	National Forest Products Association 1619 Massachusetts Avenue, N.W. Washington, DC 20036

PCA	Portland Cement Association 5420 Old Orchard Road Skokie, IL 20076
PCI	Prestressed Concrete Institute 20 North Wacker Drive Chicago, IL 60606
PS	Product Standard U.S. Department of Commerce Washington, DC 20203
TAS	Technical Aid Series Construction Specifications Institute 1150 Seventeenth Street, N.W. Washington, DC 20036
UL	Underwriter's Laboratories, Inc. 333 Pfingston Road Northbrook, IL 60062

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01200

PROJECT MEETINGS

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

A. Owner shall schedule and administer pre-construction meeting, periodic progress meetings, and specially called meetings throughout progress of the work. The City or the Engineer shall:

1. Prepare agenda for meetings.
2. Distribute written notice of each meeting four days in advance of meeting date.
3. Record the minutes; include significant proceedings and decisions.
4. Reproduce and distribute copies of minutes after each meeting.

    a. To participants in the meeting.
    b. To parties affected by decisions made at the meeting.

B. Representatives of Contractors, subcontractors and suppliers attending meetings shall be qualified and authorized to act on behalf of the entity each represents.

1.02 RELATED REQUIREMENTS

A. Section 01041: Project Coordination
B. Section 01310: Construction Schedules
C. Section 01340: Shop Drawings, Product Data and Samples

1.03 PRE-CONSTRUCTION MEETING

A. Schedule within 20 days after the Project Initiation Date.

B. Location: A central site, convenient for all parties, designated by the Owner.

C. Attendance:

1. Owner's Representative
2. Engineer and his professional consultants.
3. Engineer’s Resident Project Representative
4. Contractor's Superintendent and/or Project Manager
5. Major subcontractors
6. Others as appropriate and approved by the Owner.

D. Suggested Agenda:

1. Distribution and discussion of:

a. List of major subcontractors and suppliers.
b. Projected construction schedules.

2. Critical work sequencing.
3. Major equipment deliveries and priorities.
4. Project coordination.

   a. Designation of responsible personnel.

5. Procedures and processing of:

   a. Field decisions
   b. Proposal requests
   c. Submittals
   d. Change Orders
   e. Applications for payment

6. Adequacy for distribution of Contract Documents
7. Procedures for maintaining record documents
8. Use of premises:

   a. Office, work and storage areas
   b. Owner's requirements

9. Construction facilities, controls and construction aids
10. Temporary utilities
11. Safety and first-aid procedures
12. Security procedures
13. Housekeeping procedures
14. Miscellaneous

1.04 PROGRESS MEETINGS

A. Schedule regular periodic meetings, as required.

B. Hold called meetings as required by progress of the work.

C. Attendance:

1. Engineer, and his professional consultants as needed.
2. Subcontractors as appropriate to the agenda.
3. Suppliers as appropriate to the agenda.
4. Others

D. Suggested Agenda:

1. Review, approval of minutes of previous meeting.
2. Review of work progress since previous meeting.
3. Field observations, problems, conflicts.
4. Problems which impede construction schedule.
5. Review of off-site fabrication, delivery schedules.
6. Corrective measures and procedures to regain projected schedule.
7. Revisions to construction schedule.
8. Progress, schedule, during succeeding work period.
9. Coordination of schedules.
10. Review of submittal schedules; expedite as required.
11. Maintenance of quality standards.
12. Pending changes and substitutions.
13. Review proposed changes for:

    a. Effect on construction schedule and on completion date.
    b. Effect on other contracts relating to the project.

14. Review of record drawings
15. Other business

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01310

CONSTRUCTION SCHEDULES

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

A. Within 5 business days after the earlier of the Notice of Award of the contract or the Project Initiation Date, prepare and submit to Engineer estimated construction progress schedules for the work, with sub-schedules of related activities which are essential to it progress. This preliminary schedule will be discussed at the Pre-construction Meeting and may be commented upon by the Engineer at an earlier time.

B. Submit revised progress schedules to maintain proposed schedule within five (5) business days after the earlier of the Notice to Proceed or the Project Initiation Date and as needed by changing conditions or emerging circumstances. Additionally, submit a revised schedule within five (5) business days after receipt of comments to the preliminary schedule prior to and/or at the Pre-construction Meeting, responding to all comments.

1.02 RELATED REQUIREMENTS

A. Conditions of the Contract
B. Section 01010: Summary of Work
C. Section 01041: Project Coordination
D. Section 01200: Project Meetings
E. Section 01340: Shop Drawings, Product Data and Samples

1.03 FORM OF SCHEDULES

A. Prepare schedules in the form of:

1. Horizontal bar chart
2. Network analysis system
3. Other method accepted by Owner

B. Format of listings: The chronological order of the start of each item of work.

C. Should the Contractor elect to utilize proprietary software, such as Primevera, for the Progress Schedule and its updates, he shall provide two (2) licensed copies of said software for the City's and the Engineer's use at his sole expense.

1.04 CONTENT OF SCHEDULES

A. Construction progress schedule:

1. Show the complete sequence of construction by activity.

2. Show the dates for the beginning, and completion of each major element of construction.

B. Submittals, schedule for shop drawings, product data and samples. Show:

1. The dates for Contractor's submittals.

2. The dates approved submittals will be required from the Engineer.

C. Provide sub-schedules to define critical portions of prime schedules.

1.05 PROGRESS REVISIONS

A. Indicate progress of each activity to date of submission.

B. Show changes occurring since previous submission of schedule:

1. Major changes in scope.
2. Activities modified since previous submission.
3. Revised projections of progress and completion.
4. Other identifiable changes.

C. Provide a narrative report as needed to define:

1. Problem areas, anticipated delays, and the impact on the schedule.
2. Corrective action recommended, and its effect.
3. The effect of changes on schedules of other prime contractors.

1.06 SUBMISSIONS

A. Submit six (6) copies of the initial and revised schedules, as required in Paragraph 1.01 A and B, above.

1. Engineer will review schedules and return review copy within 10 days after receipt.

2. If required, resubmit within five (5) days after return of review copy.

B. With each application for payment, submit six (6) updated copies of progress schedule.

1.07 DISTRIBUTION

A. Distribute copies of the reviewed schedules to:

1. Job site file
2. Subcontractors
3. Other concerned parties

B. Instruct recipients to report promptly to the Contractor, in writing, any problems anticipated by the projections shown in the schedules.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01340

SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Submit Shop Drawings, Product Data and Samples required by Contract Documents or for any material or equipment which is required but not specified in the Contract or which is not the exact make and model specified in the Contract.

B. Provide installation sketches showing dimensions, pipe and fittings needed to install pump assembly in sufficient detail and quality to allow the Engineer to properly review the submittal.

1.02 RELATED REQUIREMENTS

1. Definitions and additional responsibilities of parties: Conditions of the Contract.
2. Section 01630 - Substitutions and Product Options
3. Forms Section: Article 10 – “Or Equal” Clause
   Article 20 – Shop Drawings

1.03 SHOP DRAWINGS

A. Drawings shall be presented in a clear and thorough manner. Details shall be identified by reference to sheet, detail or schedule.

B. Minimum sheet size: 8½" x 11".

1.04 PRODUCT DATA AND INSTALLATION SKETCHES

A. Preparation:

1. Clearly mark each copy to identify pertinent products or models.
2. Show performance characteristics.
3. Show dimensions and clearances required.
4. Show sketches showing dimensions, pipe and fittings for pump connections.

B. Manufacturer's standard schematic drawings and diagrams:

1. Modify drawings and diagrams by deleting information, which is not applicable to the work.

2. Supplement standard information to provide information specifically applicable to the work.

1.05 SAMPLES

Office samples shall be of sufficient size and quantity to clearly illustrate:

1. Functional characteristics of the product, with integrally related parts and attachment devices.

2. Full range of color, texture and pattern.

1.06 CONTRACTOR RESPONSIBILITIES

A. Review shop drawings, product data and samples prior to submission.

B. Determine and verify:

1. Field measurements
2. Field construction criteria
3. Catalog numbers and similar data
4. Conformance with specifications

C. Coordinate each submittal with the requirements of the work and of the Contract Documents.

D. Notify the Engineer in writing, at the time of submission, of any deviations in the submittals from the requirements of the Contract Documents.

E. Begin no fabrication or work, which requires approved submittals until the return of the approved submittals by Engineer.

F. If the Contractor considers any correction indicated on the shop drawings to constitute a change to the Contract Documents, the Contractor shall give written notice thereof to the Engineer at least seven working days prior to release for manufacture.

1.07 SUBMISSION REQUIREMENTS

A. The Contractor shall make submittals in such sequence as to cause no delay in the work.

B. Number of submittals required:

1. Shop Drawings: Submit six (6) opaque reproductions.

2. Product Data: Submit the number of copies which the Contractor requires, plus three which will be retained by the Engineer, but no more than eight total.

3. Samples: Submit the quantity stated in each specification section.

C. Submittals shall contain:

1. The date of submission and the dates of any previous submissions.
2. The project title and number.
3. Contract identification.
4. The names of:
   a. Contractor
   b. Supplier
   c. Manufacturer

5. Identification of the product, with the specification section number.
6. Field dimensions, clearly identified as such.
7. Relation to adjacent or critical features of the work or materials.
8. Applicable standards, such as ASTM or Federal Specification numbers.
9. Identification of deviations from Contract Documents.
10. Identification of revisions on resubmittals.
11. An 8-inch x 3-inch blank space for Contractor and Engineer stamps.
12. Contractor's stamp initialed or signed, certifying to review of submittal, along with verification of products, field measurements and field construction criteria and coordination of the information within the submittal with requirements of the Work and of Contract Documents. Stamp shall be no smaller than 12" x 3" or larger than 2" x 32".

D. Facsimiles or copies of facsimiles will not be accepted as shop drawing submittals without prior approval of the Engineer.

E. Requests for Information (RFI) shall be submitted on a standard form provided by the Engineer. RFIs shall indicate their importance to the timely completion of the project. RFIs will be processed as a shop drawing unless there is an urgent need for immediate response.

F. Partial submittals may not be reviewed. The Engineer will be the only judge as to the completeness of a submittal. Submittals not complete will be returned to the Contractor and will be considered as "not submitted" until resubmitted. The Engineer may, at his option, provide a list or mark the submittal directing the Contractor to the areas that are incomplete.

1.08 RESUBMISSION REQUIREMENTS

A. Make any corrections or changes in the submittals noted by the Engineer and resubmit unless otherwise noted.

B. Shop Drawings and Product Data:

1. Revise initial drawings or data, and resubmit as specified for the initial submittal.

2. Indicate any changes, which have been made other than those suggested by the Engineer by “clouding” the change and noting the revisions number along side the cloud.

C. Samples: Submit new samples as required for initial submittal.

1.09 DISTRIBUTION

Distribute shop drawings and copies of product data, which carry the Engineer's stamp:

1. Shop Drawings:

   a. Two copies to Owner.
   b. Two copies to Engineer.
   c. Two copies to Contractor.

2. Product Data:

   a. Two copies to Owner.
   b. Two copies to Engineer.
   c. Two copies to Contractor.

3. Distribute samples as directed by the Engineer.

1.10 ENGINEER'S DUTIES

A. Review submittals within 30 days or in accord with schedule.

B. Affix stamp and initials or signature, and indicate status of submittal.

C. Return submittals to Contractor for distribution, or for resubmission.

D. The Engineer will review a submittal/re-submittal a maximum of two times after which the cost of the review will be borne by the Contractor. The cost of engineering shall be equal to the Engineer's charges to the Owner under the terms of the Engineer's agreement with the Owner. The Engineer's hourly charges to the City for these excessive reviews, which will be deducted from the amount due to the Contractor, will be at the rate stated in the project's proposal.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01410

TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

Contractor will employ services of an independent testing laboratory approved by the Owner to perform specified testing. Contractor shall pay costs of services from allowance specified in the special conditions.

A. Contractor shall cooperate with laboratory to facilitate the execution of its required services.

B. Employment of the laboratory shall in no way relieve Contractor's obligations to perform the work of the contract.

1.02 RELATED REQUIREMENTS

A. Conditions of the contract: Inspection and testing required by laws, ordinances, rules, regulations, orders or approvals of public authorities.

B. Special Conditions: Allowances

C. Related requirements specified in other sections.

D. Respective sections of specifications. Certification of products.

E. Section 02221: Trenching, Excavation, Backfilling and Compacting

F. Section 02577: Surface Restoration

G. Each specification section listed: Laboratory tests required, and standards for testing.

1.03 LIMITATIONS OF AUTHORITY OF TESTING LABORATORY

A. Laboratory is not authorized to:

1. Release, revoke, alter or enlarge on requirements of contract documents.
2. Approve or accept any portion of the work.
3. Perform any duties of the Contractor.

1.04 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with laboratory personnel and/or Engineer, provide access to work or manufacturer's operations.

B. Secure and deliver to the laboratory adequate quantities of representational samples of materials proposed to be used and which require testing.

C. Provide to the laboratory material mixes which require control by the testing laboratory.

D. Furnish copies of product test reports as required.

E. Furnish incidental labor and facilities:

1. To provide access to work to be tested.
2. To obtain and handle samples at the project site or at the source of the product to be tested.
3. To facilitate inspections and tests.
4. For storage and curing of test samples.

F. Notify laboratory sufficiently in advance of operations to allow for laboratory assignment of personnel and scheduling of tests:

1. When tests or inspections cannot be performed after such notice, reimburse Owner for laboratory personnel and travel expenses incurred due to Contractor's negligence.

G. Make arrangements with laboratory and pay for additional samples and tests required for Contractor's convenience.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.01 PAYMENT

A. Testing of materials and products will be performed by an independent testing laboratory appointed and paid for under the Lump Sum Bid Item Mobilization. Testing will be performed so as to least encumber the performance of work..

B. The Contractor shall pay for costs of additional testing as required due to improper performance of work.

END OF SECTION

SECTION 01530

BARRIERS

PART 1 - GENERAL

1.01 SCOPE OF WORK

The Contractor shall furnish, install and maintain suitable and sufficient barriers as required to protect the public, the Work, existing facilities, trees and plants. Remove the barriers when no longer needed, or at completion of Work.

1.02 RELATED REQUIREMENTS

A. Section 01010: Summary of Work
B. Section 01570: Traffic Regulation

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

Materials may be new or used, suitable for the intended purpose, but must not violate the requirements of applicable codes and standards.

2.02 BARRIERS

Materials are Contractor's option, as appropriate to serve required purpose.

PART 3 - EXECUTION

3.01 GENERAL

A. Install facilities of a neat and reasonably uniform appearance, structurally adequate for the required purposes.

B. Maintain barriers during entire construction period.

C. Relocate barriers as required by the progress of construction.

3.02 FENCES

A. Provide and maintain fences (minimum 6' high) necessary to assure security of the site during the contract time to keep unauthorized people and animals from the site when construction is not in progress.

B. Provide additional security measures as deemed necessary and approved by the Engineer and/or the Owner.

C. Fence shall be No. 11 gauge, 2" mesh, galvanized chain-link fabric.

3.03 TREE AND PLANT PROTECTION

A. Preserve and protect existing trees and plants which are designated to remain.

B. Consult with the Engineer, and remove agreed-on roots and branches which interfere with construction.

C. Protect root zones of trees and plants:

1. Do not allow vehicular traffic or parking.
2. Do not store materials or products.
3. Prevent dumping of refuse or chemically injurious materials or liquids.
4. Prevent puddling or continuous running water.

D. Carefully supervise excavating, grading and filling, and other construction operations, to prevent damage.

E. Replace trees and plants designated to remain which are damaged or destroyed due to construction operations.

3.04 REMOVAL

A. Completely remove barricades, including foundations, when construction has progressed to the point that they are no longer needed and when approved by Engineer.

B. Repair damage caused by construction. Fill and grade areas of the site to the required elevations.

C. Perform thorough clean-up of the site and adjacent areas of all traces of the Contractor’s presence.

END OF SECTION

SECTION 01570

TRAFFIC REGULATION

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

A. Provide a maintenance of traffic plan to the Engineer for review and approval by permitting agencies and the City's Police and Fire Departments.

B. Provide, operate and maintain equipment, services and personnel, with traffic control and protective devices, as required to expedite vehicular traffic flow around the construction area. Conform to the Broward County and FDOT permit requirements.

C. Remove temporary equipment and facilities when no longer required, restore grounds to original, or to specified conditions, including striping.

D. Maintain safe passageway for pedestrian traffic. Conform to Broward County "Maintenance of Traffic School/Pedestrian" requirements.

E. The Contractor shall provide notification to the Engineer and the City's Police and Fire Departments of any street closures at least 48 hours in advance of such closure.

F. Additional Traffic requirements are presented on the Drawings.

1.02 RELATED REQUIREMENTS

A. Section 01041: Project Coordination.

B. Section 01530: Barriers.

1.03 TRAFFIC SIGNALS AND SIGNS

A. Provide and operate traffic control and directional signals required to direct and maintain an orderly flow of traffic in all areas under Contractor's control, or affected by Contractor's operations.

B. Provide traffic control and directional signs, mounted on barricades or standard posts according to FDOT and MUTCD standards:

1. At each change of direction of a roadway and at each crossroad.
2. At detours.
3. At parking areas.

1.04 FLAGGERS

Provide qualified and suitably equipped flaggers when construction operations encroach on traffic lanes, as required for regulation of traffic.

1.05 FLARES AND LIGHTS

A. Provide flares and lights during periods of low visibility:

1. To clearly delineate traffic lanes and to guide traffic.
2. For use by flagmen in directing traffic.

B. Provide illumination of critical traffic and parking areas.

1.06 CONSTRUCTION PARKING CONTROL

A. Control vehicular parking to preclude interference with public traffic or parking, access by emergency vehicles, Owner's operations, or construction operations.

B. Monitor parking of construction personnel's private vehicles.

1. Maintain free vehicular access to and through parking areas.
2. Prohibit parking on or adjacent to access roads, or in non-designated areas.

1.07 HAUL ROUTES

A. Consult with governing authorities, establish public thoroughfares which will be used as haul routes and site access.

B. Confine construction traffic to designated haul routes.

C. Provide traffic control at critical areas of haul routes to expedite traffic flow, to minimize interference with normal public traffic.

1.08 MAINTENANCE OF TRAFFIC

The Contractor shall submit four (4) copies of a maintenance of traffic plan to the Engineer for review. Measurement and payment shall be the lump sum bid price for complete maintenance of traffic.

PART 2 - PRODUCTS

Not Used

PART 3 – EXECUTION

3.01 GENERAL POLICIES

The following policies apply to work in all rights-of-way:

- No Maintenance of Traffic lane closures is to be set-up until work begins. The MOT subcontractor cannot set up a lane closure in the morning for work to be performed later in the day.

- The permitting contractor must remain on-site after construction work until the Maintenance of Traffic lane closures are removed from the highway or they must remove it themselves upon completion of work. The worksite cannot be abandoned with lanes closed while awaiting the MOT subcontractor to clean up.

- Should there be a lane closing MOT setup in the road without permittee personnel present, the Owner may pick up the closure and charge the permittee restitution to remove and retain the lane closure equipment.

- A 24 hour pager or service number of the person in responsible charge in which to contact during all times of roadway work and lane closures shall be included in the MOT plant package.

- The permittee may be required to submit the names, addresses, active contracting license numbers, and the certified worksite safety supervisor's current certificate of all contractors performing work on state roads upon request. Please be advised that failure to perform work as required by DOT standards may result in pursuance of legal matters against licensed contractors performing the work.

- Should the use of "Off Duty" Police officers be required, the Contractor shall coordinate with the City of Hallandale Beach Police Department.

END OF SECTION

SECTION 01600

PERMITS

PART 1 - GENERAL

1.01 GENERAL

The Owner has obtained design stage permits for this project from the following agencies and companies:

A. Florida Department of Environmental Protection (FDEP) / Broward County Environmental Protection & Growth Management Department (BCEPGMD)

1. Permit No. ADD IN PERMIT # AND ADD A COPY OF THE PERMIT

B. South Florida Water Management District (SFWMD)

1. The Contractor shall apply for and obtain a Water Use Permit – Dewatering Part. Broward County Contaminated Sites Map shows no known contaminated groundwater sites shown on their maps in the areas of this project.

C. City of Hallandale Beach Building Department

1. Permit No. ADD IN PERMIT # AND ADD A COPY OF THE PERMIT

Copies of these permits and correspondences are included at the end of this Section. The Contractor is bound by and shall comply with all applicable provisions of these permits and correspondences. The contractor shall, at his sole expense, obtain and comply with any other permits he may need to perform the work of this contract.

1.02 Fees and Security Deposits

Security deposits, should any be required, will be paid by the Contractor. Permit fees shall be paid for by the Contractor. . See SFWMD's current fee schedule for the dewatering permit. The cost of all such expenses shall be included by the Contractor in his bid for the applicable Item of Work.

1.03 Flagmen and Other Traffic Controls

The Contractor shall provide, at his sole expense, all special traffic control and maintenance of traffic provisions, including flagmen, required by any agency or right-of way owner have jurisdiction or issuing a permit.

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

NOT USED

END OF SECTION

INSERT COPY OF BCEPGMD PERMIT

INSERT COPY OF BUILDING PERMIT

END OF INSERTS

SECTION 01630

SUBSTITUTIONS AND PRODUCT OPTIONS

PART 1 -GENERAL

1.01 REQUIREMENTS INCLUDED

Furnish and install products specified, under options and conditions for substitutions stated in this section. All products must be preapproved by the Engineer and the City.

1.02 RELATED REQUIREMENTS

A. Information for bidders, general and special conditions.
B. Section 01010: Summary of Work
C. Forms Section

1.03 PRODUCTS LIST

A. Coincident with return of the signed contract and the submission of required bonds (subsequent to Commission Award), the contractor shall submit to Engineer five copies of complete list of major products which are proposed for installation.

B. Tabulate products by specification section number and title.

C. For products specified only by reference standards, list for each such product:

1. Name and address of manufacturer
2. Trade name
3. Model or catalog designation
4. Manufacturer's data:

   a. Reference standards
   b. Performance test data

1.04 CONTRACTOR'S OPTIONS

A. For products specified only by reference standard, select product meeting that standard, by any manufacturer.

B. For products specified by naming several products or manufacturers, select any one of products and manufacturers named which complies with specifications.

C. For products specified by naming only one or more products or manufacturers and stating "or equal", submit a request as for substitutions, for any product or manufacturer which is not specifically named.

D. For products specified by naming only one or two product(s) and manufacturer(s) and where it states that this is a Sole Source or No Substitution item, there is no option and no substitution will be allowed without prebid qualification.

1.05 SUBSTITUTIONS AND PREQUALIFICATION OF SIMILAR METHODS

A. Within a period of 10 days after Notice to Proceed with the contract, Engineer will consider formal requests from the Contractor for substitution of products in place of those specified.

1. After end of that period, request will be considered only in case of product unavailability or other conditions beyond the control of Contractor.

B. Submit separate request for each substitution. Support each request with:

1. Complete data substantiating compliance of proposed substitution with requirements stated in contract documents:

a. Product identification, including manufacturer's name and address.
b. Manufacturer's literature; identify:

1) Product description
2) Reference standards
3) Performance and test data

c. Samples, as applicable
d. Name, phone number of contact persons and address of two or more similar projects on which product has been used. Date of each installation with contact references and quantities installed. Indicate scope and size of reference projects.

2. Itemized comparison of the proposed substitution with product specified; list significant variations.

3. Data relating to changes in construction schedule.

4. Any effect of substitution on separate contracts.

5. List of changes required in other work or products.

6. Accurate cost data comparing proposed substitution with product specified.

7. Designation of required license fees or royalties.

8. Designation of availability of maintenance services, sources of replacement materials.

C. Substitutions will not be considered for acceptance when:

1. They are indicated or implied on shop drawings or product data submittals without a formal request from Contractor.

2. They are requested directly by a subcontractor or supplier.

3. Data relating to changes in construction schedule.

4. Any effect of substitution on separate contracts.

5. List of changes required in other work or products.

6. Acceptance will require substantial revision of contract documents or drawings.

D. Substitute products shall not be ordered or installed without written acceptance of Engineer.

E. Engineer and City will determine acceptability of proposed substitutions.

1.06 CONTRACTOR'S REPRESENTATION

A. In making formal request for substitution Contractor represents that:

1. Contractor has investigated proposed product and has determined that it is equal to or superior in all respects to that specified.

2. Contractor will provide same warranties or bonds for substitution as for product specified.

3. Contractor will coordinate installation of accepted substitution into the work, and will make such changes as may be required for the work to be complete in all respects.

4. Contractor waives claims for additional costs caused by substitution which may subsequently become apparent.

5. Cost data is complete and includes related costs under his contract, but not:

a. Costs under separate contracts.
b. Engineer's costs of redesign or revision of contract documents.

1.07 ENGINEER DUTIES

A. Review Contractor's requests for substitutions with reasonable promptness.

B. Notify Contractor, in writing, of decision to accept or reject requested substitution.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01670

TESTING PIPING SYSTEMS

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

A. Perform specified services with Contractor's qualified personnel, or employ and pay for a qualified organization to perform specified services.

B. Pressure testing of piping systems.

1.02 RELATED REQUIREMENTS

A. Section 01041: Project Coordination.
B. Section 02610: Pipe and Fittings.
C. Section 02642: Plug Valves
D. Section 02643: Sewage Air Release Valves and Appurtenances

1.03 DESCRIPTION

A. Perform testing of piping systems in accordance with the latest edition of AWWA C-600 and as specified below.

B. Provide instruments required for testing of piping systems.

1. Make instruments available to Engineer to facilitate spot checks during testing.
2. Retain possession of instruments, remove from site at completion of services.
3. All pressure gauges shall be certified to have been recently calibrated.

C. Provide all water required for flushing and testing. The Contractor shall obtain a fire hydrant meter from the City at current rates.

D. Provide all necessary pumping equipment and other equipment, materials and facilities required for proper completion of the flushing and testing specified.

E. Source and quality of water, procedure and test equipment shall be acceptable to the Engineer. Length of tested line shall not exceed 2,000 feet.

F. All tests shall be made in the presence of the Engineer. Notify Engineer at least 48 hours before any Work is to be inspected or tested.

G. If inspection or test shows defects, the piping system(s) shall be repaired or replaced and inspection repeated, until such piping is acceptable to the Engineer.

H. All pipe, fittings, valves and joints shall be carefully examined during test. Leaky joints shall be tightened by remaking the joint.

I. Sections of the system may be tested separately. It shall be distinctly understood that any defect which may subsequently develop in a section already tested and accepted shall promptly be corrected and that section retested.

J. Disposal of the water used for testing shall be subject to the approval of the Engineer.

1.04 QUALITY ASSURANCE

The organization which performs the testing shall, prior to testing, provide their qualifications and demonstrate their ability to perform the services to the satisfaction of the Engineer.

1.05 SUBMITTALS

A. Preliminary:

1. Submit three copies of documentation to confirm compliance with Quality Assurance provisions:

   a. Organization supervisor and personnel training and qualifications.
   b. Specimen copy of each of the report forms proposed for use.

B. At least fifteen days prior to Contractor's request for final inspection, submit three copies of final reports on applicable reporting forms, for review.

1. Each individual final reporting form must bear the signature of the person who recorded data and that of the supervisor of the reporting organization.

2. Identify instruments of all types which were used, and last date of calibration of each.

1.06 JOB CONDITIONS

Prior to start of testing of piping systems, verify that required "Job Conditions" are met:

1. System or system element installation is complete.
2. All required materials, water, instruments, etc. are on hand.
3. All other preparations are completed.

1.07 TESTING PROCEDURES – EXTERIOR AND INTERIOR PIPING SYSTEMS

A. Exterior and interior piping shall pass a hydrostatic pressure test and a leakage test as defined below before acceptance. The pressure and leakage test shall be made after all jointing operations are completed and after backfilling is completed. All concrete reaction blocks, or other bracing and restraining facilities, shall be in place at least 14 days before the initial filling of the line.

B. The pressure and leakage tests may be applied to an individual section of line isolated between the existing line valves, or may be applied to shorter sections of line at the Contractor's option. If shorter sections are tested, test plugs or bulkheads as required at the ends of the test section shall be furnished and installed by the Contractor at his expense, together with all anchors, braces, and other devices required to withstand the hydrostatic pressure on such plug or plugs, without imposing any hydraulic thrust on the pipe line or any part thereof. The Contractor shall be solely responsible for any and all damage to the pipe line, and/or to any other facility, which may result from the failure of test plugs furnished by him or supports therefore, in any case.

C. Tests:

1. Hydrostatic Tests.

a. The section of line to be tested shall be slowly filled with water and all air expelled from the pipe. Care shall be taken that all air valves are installed and open in the section being filled, and that the rate of filling does not exceed the venting capacity of the air valves.

b. Hydrostatic test pressure shall be as follows:

System	Pressure Test Rating
Wastewater Water	150 psig

(1) Test pressure shall:

(a) Not exceed pipe or thrust-restraint design pressures.

(b) Be of at least 2-hour duration.

(c) Not vary by more than ±5 psig (0.35 Bar) for the duration of the test.

(d) Not exceed twice the rated pressure of the valves or hydrants when the pressure boundary of the

test section includes closed gate valves or hydrants. NOTE: Valves shall not be operated in either direction at differential pressures exceeding the rated pressure.

(e) Not exceed the rated pressure of the valves when the pressure boundary of the test section includes closed valves.

(2) Each valved section of pipe shall be filled with water slowly and the specified test pressure based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge shall be applied by means of a pump connected to the pipe in a manner satisfactory to Engineer. Valves shall not be operated in either the opening or closing direction at differential pressures above the rated pressure. The system shall be allowed to stabilize at the test pressure before conducting the leakage test.

c. Examination. Any exposed pipe, fittings, valves, hydrants and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves or hydrants that are discovered following the pressure test shall be repaired or replaced with sound material and the test shall be repeated until it is satisfactory to Engineer.

d. After the pipeline has been pressurized, pressure shall be bled off by opening a valve, in the presence of the Engineer, at the end of the pipe line remote from the working end of the pipe, where the pressure gauge and refill pump are located. This will verify that there is continuity across the entire test section. Once done, the line shall be re-pressurized, stabilized and tested.

e. Unless the Owner provides the test pressure gauge, the Contractor provided pressure gauge shall possess (and the Contractor shall submit) a certification of recent calibration.

2. Leakage Test

a. A leakage test shall be conducted concurrently with the pressure test. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved Section thereof, to maintain pressure within 5 psig (0.35 Bar) of the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water. Leakage

SHALL NOT BE MEASURED BY A DROP IN PRESSURE IN A TEST SECTION OVER A PERIOD OF TIME.

b. No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{SD \times P^{1/2}}{148{,}000}$$

in which
- L = Allowable leakage, in gallons per hour
- S = Length of pipe tested in feet
- D = Nominal diameter of the pipe in inches
- P = Average test pressure during the leakage test in pounds per square inch, gauge (psig).

(1) Allowable leakage at various pressures is shown in Section 3.02.

(2) When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gal/h/in (0.0012L/h/mm) of nominal valve size shall be allowed.

(3) When hydrants are in the test section, the test shall be made against the closed hydrant.

(4) Acceptance of installation. Acceptance shall be determined on the basis of allowable leakage. If any test of pipe laid discloses leakage greater than that specified in Section "b" above, Contractor shall, at his own expense, locate and make repairs as necessary until the leakage is within the specified allowance.

(5) All visible leaks are to be repaired regardless of the amount of leakage.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.01 GENERAL

A. Prior to testing, pig and flush all piping systems with water to remove all debris in the system. Pigging of lines 12" and smaller is not required unless the line becomes contaminated.

B. For testing refer to the Testing Procedures above.

C. No separate payment for testing shall be made.

3.02 TABLE I

Allowable Leakage per 1000 ft (305 M) of Pipeline* gpht**

Nominal Pipe Diameter (")	Average Test Pressure - psig (Bar)						
	100(7)	125(9)	150(10)	175(12)	200(14)	255(16)	250(17)
3	0.23	0.25	0.28	0.30	0.32	0.34	0.36
4	0.30	0.34	0.37	0.40	0.43	0.45	0.47
6	.45	.50	.55	.59	0.64	0.68	0.71
8	.60	.67	.74	.80	0.85	0.90	0.95
10	.75	.84	.92	.99	1.06	1.13	1.19
12	.90	1.01	1.10	1.19	1.28	1.35	1.42
14	1.05	1.13	1.29	1.39	1.45	1.58	1.66
16	1.20	1.34	1.47	1.59	1.70	1.80	1.90
18	1.35	1.51	1.66	1.79	1.91	2.03	2.14
20	1.50	1.68	1.84	1.98	2.12	2.25	2.37
24	1.80	2.01	2.21	2.38	2.55	2.70	2.85
30	2.25	2.52	2.76	2.98	3.19	3.38	3.56
36	2.70	3.02	3.31	3.58	3.82	4.05	4.25
42	3.15	3.53	3.86	4.17	4.46	4.73	4.99
48	3.60	4.03	4.41	4.77	5.09	5.41	5.70
54	4.05	4.53	4.97	5.36	5.73	6.03	6.41

* If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

** To obtain leakage in liters/hour, multiply the values in the table by 3.785.

END OF SECTION

SECTION 02156

TEMPORARY AIR AND WATER POLLUTION, SOIL EROSION, AND SILTATION CONTROL

PART 1 - GENERAL

1.01 SCOPE

The Contractor shall submit a Notice of Intent to Use the Generic Permit for Discharge of Ground Water from Dewatering Operations to the Florida Department of Environmental Protection.

During the life of a contract the Contractor shall control water pollution, soil erosion, and siltation through the use of berms, dikes, dams, sediment basins, fiber mats, gravel, mulches, grasses, slope drains, and other erosion control devices or methods in accordance with the Storm Water Pollution Prevention Plan and conditions of the permit. The Contractor must maintain a copy of the Storm Water Pollution Prevention Plan on site.

The temporary erosion control measures contained herein shall be coordinated with the permanent erosion control measures specified as part of this contract to the extent practical to assure economical, effective, and continuous erosion control throughout the construction period.

Temporary control may include work outside the construction limits such as borrow pit operations, equipment and material storage sites, waste areas, and temporary plant sites.

PART 2 - MATERIALS

2.01 GRASS

Grass which will not compete with the grasses sown later for permanent cover shall be a quick-growing species (such as ryegrass, Italian ryegrass, or cereal grasses) suitable to the area providing a temporary cover.

2.02 MULCHES

Mulches may be hay, straw, fiber mats, netting, bark, wood chips, or other suitable material reasonably clean and free of noxious weeds and deleterious materials.

2.03 FERTILIZER

Fertilizer shall be a standard commercial grade and shall conform to all Federal and state regulations and to the standards of the Association of Official Agricultural Chemists.

2.04 SLOPE DRAINS

Slope drains may be constructed of pipe, fiber mats, rubble, portland cement concrete, bituminous concrete, or other materials that will adequately control erosion.

2.05 TURBIDITY CURTAIN

The Curtain shall meet the requirements of Florida Department of Transportation Standard Index No. 103 (2010) and FDOT Standard Specifications for Road and Bridge Construction Section 104.

2.06 OTHER

All other materials, such as geotextile, shall meet commercial grade standards and shall be approved by the Engineer before being incorporated into the project.

PART 3 - EXECUTION OF WORK

3.01 GENERAL

In the event of conflict between these requirements and pollution control laws, rules, or regulations of other Federal, state, or local agencies, the more restrictive laws, rules, or regulations shall apply.

3.02 SCHEDULE

Prior to the start of construction, the Contractor shall submit schedules for accomplishment of erosion control work, as are applicable for clearing and grubbing; grading; construction; paving; and structures at watercourses. The Contractor shall also submit a proposed method of erosion and dust control on haul roads and borrow pits and a plan for disposal of waste materials. Work shall not be started until the erosion control schedules and methods of operation for the applicable construction have been accepted by the Engineer.

3.03 CONSTRUCTION DETAILS

The Contractor will be required to incorporate all erosion control features into the project at the earliest practicable time as outlined in the accepted schedule. Except where future construction operations will damage slopes, the Contractor shall perform the permanent surface restoration and other specified slope protection work in stages, as soon as substantial areas of exposed slopes can be made available.

Temporary erosion and pollution control measures will be used to correct conditions that develop during construction that were not foreseen during the design stage; that are needed prior to installation of permanent control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.

Where erosion is likely to be a problem, clearing and grubbing operations should be scheduled and performed so that grading operations and permanent erosion control features can follow immediately thereafter if the project conditions permit; otherwise, temporary erosion control measures may be required between successive construction stages.

The erosion control features installed by the Contractor shall be acceptably maintained by the Contractor during the construction period.

Whenever construction equipment must cross watercourses at frequent intervals, and such crossings will adversely affect the sediment levels, temporary structures should be provided.

Pollutants such as fuels, lubricants, bitumen, raw sewage, wash water from concrete mixing operations, and other harmful materials shall not be discharged into or near rivers, streams, and impoundments or into natural or manmade channels leading thereto.

END OF SECTION

SECTION 02221

TRENCHING, EXCAVATION, BACKFILLING AND COMPACTING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Excavate for all underground piping, including services.

B. Place and compact granular beds and fills over services to rough-grade elevations.

C. Dewater excavations as required.

D. Provide daily cleanup of site, backfilling of open trenches shall be done as soon as pipe work is complete. Stored materials shall not block vehicular or pedestrian traffic. Provide access to adjacent properties, control dust and erosion.

E. Maintain turbidity and erosion control.

1.02 RELATED WORK

A. Section 01410: Testing Laboratory Services

B. Section 02577: Surface Restoration

C. Section 02610: Pipe and Fittings

1.03 SITE COMPACTION TESTING

A. Testing of compacted fill materials will be performed in accordance with Section 01410.

B. If, during progress of work, tests indicate that compacted materials do not meet specified requirements, remove defective work, replace and retest as directed by the Engineer.

C. Ensure compacted fills are tested before proceeding with placement of surface materials.

1.04 PROTECTION

A. Protect trees, shrubs and lawn areas to receive planting, rock outcropping and other features remaining as part of final landscaping.

B. Protect bench marks and existing structures, roads, sidewalks, paving and curbs against damage from vehicular or foot traffic. Install and maintain proper bridging, planking and cants to provide access to buildings.

C. Protect excavations by shoring, bracing, sheet piling, underpinning, or by other methods, as required to prevent cave-ins or loose dirt from falling into excavations.

B. Underpin or otherwise support adjacent structure(s) which may be damaged by excavation work. This includes service lines and pipe chases.

C. Notify Engineer of any unexpected subsurface conditions. Discontinue work in the area until Engineer provides notification to resume work.

D. Prevent washing or piping of soils during dewatering procedures, provide turbidity control.

E. Saw cut trench edges to protect adjacent concrete and asphalt.

F. Maintain site to prevent erosion or sediment transport from the site.

G. Keep site clean and orderly, control dust and debris.

H. In grass shoulder and easement areas, the contractor shall be responsible for locating, temporarily relocation, safeguarding and restoring irrigation lines and facilities.

PART 2 - PRODUCTS

2.01 BED AND FILL MATERIALS

A. Bed Materials: Approved granular material, crushed stone, or washed rock, ¾ inch, maximum, non-cohesive and non-plastic, free of organic matter compacted to 100% maximum density per AASHTO T-180. A minimum of 4-inches of bedding material, measured from bottom of bell to natural earth, shall be used. Bedding material shall support pipe as shown on the drawings. When excavation of rock is encountered, all rock shall be removed to a depth of at least 6-inches below the pipe and replaced with bedding material.

B. Selected Backfill: After pipe joints have been inspected and given preliminary approval, and sufficient time has elapsed for setting of joints if necessary, backfilling shall be performed by hand, together with tamping, until fill has progressed to an elevation at least one foot above the top of the pipe bell. During this initial stage of backfilling, approved granular 2-inch, maximum, materials free from lumps, clods, or muck shall be deposited in layers of approximately 6-inches thick and compacted by hand or with manually operated machine tampers actuated by compressed air, or other suitable means. Tamps and machines shall be suitable for the work, and subject to the approval of the Engineer.

C. Backfill Material: Excavated material, free from roots, muck, organic material, rocks larger than 4 inches in size, building debris or other deleterious materials.

D. Fill Under Landscaped Areas: Free from alkali, salt, and petroleum products. Use subsoil excavated from site only if conforming to specified requirements.

PART 3 - EXECUTION

3.01 PREPARATION AND LAYOUT

A. Establish extent of excavation by area and elevation. Designate and identify datum elevation.

B. Set required lines and levels.

C. Maintain bench marks, monuments and other reference points.

D. Precut pavement and concrete.

E. Notify Sunshine 811 and obtain a utility location and mark out, as required by law and the drawings.

3.02 UTILITIES

A. Before starting excavation, field establish the location and extent of underground utilities occurring in the work area and have utilities marked in the field.

B. Notify the Engineer if utility lines which are in the way of excavation are uncovered.

C. Protect and support active utility services uncovered by excavation.

D. Remove abandoned utility service lines from areas of excavation. Cap, plug or seal such lines and identify at grade.

E. Accurately locate (horizontally and vertically) and record abandoned and active utility lines and services on project record documents. Document clearance between these features and the installed force main.

F. Minor changes in alignment and grade to avoid existing utilities shall not be considered additional work.

3.03 TRENCHING

A. Ensure trenching does not interfere with normal 45-degree bearing splay of any foundation.

B. Excavate in accordance with lines and grades.

C. Cut trenches sufficiently wide to enable proper installation of services and to allow for inspection. Trim and shape trench bottom and leave free of irregularities, lumps and projections. Trenching shall comply with Florida and Federal safety requirements.

D. Do not disturb soil within branch spread of existing trees or shrubs that are to remain. If it is necessary to excavate through roots, perform work by hand and cut roots with a sharp axe.

E. When complete, request the Engineer to inspect excavations. Correct unauthorized excavation as directed, at no cost to Owner.

F. Remove excess or unsuitable excavated sub-soil from site.

G. Prevent erosion and washing of excavated materials. Materials to be used as backfill shall be stored as to prevent blocking public or private access~~,~~ and traffic or where it will become a nuisance to the public or the owner or will interfere with line of sight. The site shall be kept orderly and as clean as possible.

H. Saw cut asphalt and concrete before excavation of pavements.

I. Support existing utilities as needed to complete the work.

J. Where the trench bottom is unstable due to muck or other conditions, the deleterious material shall be removed to a minimum depth of 2 feet and replaced in select fill compacted as per Section 3.05 of this specification. The Engineer may direct removal to depths greater than 2 feet. When excavation of rock is encountered, all rock shall be removed to a depth of at least 6-inches below the pipe and replaced with bedding material.

3.04 DEWATERING

A. Keep trenches dry. Provide necessary equipment including pumps, piping and temporary drains.

B. Do not discharge drainage water lines into storm sewers without approval. Ensure water discharge does not contain silt held in suspension, provide turbidity control.

C. Direct surface drainage away from excavated areas.

D. Control the grading in and adjacent to excavations to prevent water running into excavated areas or onto adjacent properties or public thoroughfares.

E. Furnish and operate suitable pumps on a 24-hour basis to keep excavations free of water until piping has been placed and backfilling has been completed.

F. No water shall be allowed to rise over masonry or mortar until the concrete or mortar has set at least 24 hours.

G. Contractor shall obtain a Dewatering Permit from SFWMD and BCEPGMD, if necessary.

3.05 BACKFILLING

A. Do not start backfilling until piping has been inspected.

B. Ensure trenches are free of building debris, muck, wood, rocks over 2-inches in diameter and water.

C. Backfill systematically and as early as possible to allow maximum time for natural settlement and compaction.

D. After backfill has reached a point one foot above the top of the pipe with select granular material, a variation in the procedure as to manner of placing and amount of compaction of fill will be allowed, depending upon the location of the work and danger from subsequent settlement, as follows:

1. For backfilling in unimproved areas (along utility easements and in parkway strip beyond the edge of driveways and graveled parking areas): From an elevation of one foot above top of pipe to the surface of the ground, backfill may be deposited by backhoe, bulldozer or other suitable equipment. Depositing in 12-inch layers and compacting to a minimum of 100% maximum density in accordance with AASHTO T-180. All surplus excavated materials shall be disposed of by the Contractor at his expense unless otherwise directed by the Engineer. Compaction testing shall be performed as required on the drawings.

2. For backfilling beneath driveways and parking areas, alleys, and streets where non-rigid type surfacing is to be replaced: This shall also include dirt, gravel or cinder driveways and alleys.

   a. The backfill material shall be carefully deposited in uniform layers not to exceed 6 inches in thickness, and each layer shall be compacted to 100% in accordance with AASHTO T-180 with manually-operated machine tampers.

   b. If, in the opinion of the Engineer, the excavated material can be satisfactorily compacted by water jetting, this method may be used. The jetting operation shall be approved by the Engineer.

   c. In lieu of the foregoing compaction method, the backfill material and procedure used may be that as specified under method 3, below.

3. For backfilling across and beneath driveways, sidewalks, parking areas or streets where a rigid-type paving is to be replaced (concrete and asphaltic concrete and brick surfaces):

   a. All backfill material shall be approved granular material of high weight and density. The material shall be carefully deposited in uniform layers not to exceed 6 inches thick (loose measure),

and each layer shall be compacted by ramming or tamping with tools approved by the Engineer in a manner that does not disturb the pipe. Where necessary, granular base material of the type and thickness specified shall be used for the last layer prior to surfacing.

b. In lieu of ramming or tamping in 6-inch layers, the approved granular backfill may be placed in one operation and water-jetted. The jetting operation shall be as approved by the Engineer.

c. Backfill materials shall be compacted to a minimum of 100% of maximum density in accordance with AASHTO T-180.

d. Compaction testing shall be performed as required on the drawings.

3.06 MEASUREMENT AND PAYMENT

A. No separate compensation shall be made for excavation, bedding, disposal of excess materials and backfill. Work shall be paid for as part of the lump sum price for each pump station.

B. OSHA Trench Safety Compliance: The lump sum price for each pump station installation shall be used to pay for use of trench box or other approved means to comply with CS/HB 3183, Florida Trench Safety Act and OSHA Trench Safety Standards, to protect works where the excavation exceeds 5 feet in depth.

END OF SECTION

SECTION 02260

FINISH GRADING

PART 1 - GENERAL

1.01 SCOPE

The Contractor shall, under this Section:

A. Finish grade all sub-soil.

B. Cut out areas to receive stabilizing base course materials for paving and sidewalks.

C. Supply, place, roll, and finish grade all materials and topsoil prior to landscaping work.

D. Restore surface drainage and swales to the original design.

1.02 SUBMITTALS

Composition of the top soil to be used and its source, type of replacement sod and it source.

1.03 QUALITY CONTROL

The Contractor shall prevent damage to existing fencing, trees, landscaping, natural features, bench marks, pavement, utility lines, and sprinkler system. Correct damage at no cost to the Owner.

1.04 MEASUREMENT AND PAYMENT

No separate payment shall be made for landscape restoration.

PART 2 - MATERIALS

2.01 TOPSOIL

Topsoil shall be friable loam free from subsoil, roots, grass, excessive amount of weeds, stones and foreign matter; acidity range (pH) of 5.5 to 7.5; containing a minimum of 4% and a maximum of 25% organic matter.

PART 3 - EXECUTION

3.01 SUB-SOIL PREPARATION

A. Rough grade sub-soil systematically to allow for a maximum amount of natural settlement and compaction. Eliminate uneven areas and low spots. Remove debris, roots, branches, stones, etc., in excess of 2 inches in size. Remove sub-soil which has been contaminated with petroleum products.

B. Cut out areas, to sub-grade elevation, which are to receive stabilizing base for paving and sidewalks.

C. Bring sub-soil to required levels, profiles and contours. Make changes in grade gradual. Blend slopes in to level areas.

D. Slope grade away from building minimum 4 inches in 10 feet (unless indicated otherwise on Drawings).

3.02 PLACING TOPSOIL

A. Place topsoil in area where seeding, sodding and planting is to be performed. Place to the following minimum depths, up to finished grade elevations:

1. 4 ½-inches for sodded areas.

B. Use topsoil in relatively dry state. Place during dry weather.

C. Fine grade topsoil eliminating rough and low areas to ensure positive drainage. Maintain levels, profiles and contours of sub-grades.

D. Remove stones, roots, grass, weeds, debris and other foreign material while spreading.

E. Manually spread topsoil around trees, plants, buildings and other structures to prevent damage which may be caused by grading equipment.

F. Lightly compact placed topsoil.

3.03 SURPLUS MATERIAL

A. Remove surplus sub-soil and topsoil from site.

B. Leave stockpile areas and entire job site clean and raked, ready to receive landscaping.

END OF SECTION

SECTION 02430

SODDING

PART 1 – GENERAL

1.01 SCOPE

A. Provide all labor, materials and equipment necessary for complete sodding of areas affected by construction. This shall include, but not be limited to: liming, fertilizing, sodding, necessary barriers, tests and all incidentals to make the work complete.

1.02 WORK INCLUDED

A. Testing of topsoil.

B. Raking and leveling topsoil as required for sodding.

C. Liming and fertilizing of topsoil.

D. Laying and rolling of sod.

E. Maintaining sod.

1.03 SUBMITTALS

A. Submit product source and information sheets in accordance with Section 01300, “Submittals”.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Fertilizer

1. Fertilizer shall be commercial fertilizer, as manufactured by International Chemical Company or equal.

2. Said fertilizer shall have a 10-20-6 N.P.K. content and contain a minimum of 60% of organic material.

3. It shall be delivered at the site in the original sealed containers.

B. Sod

1. Sod from right-of-way swales within the work area shall be Bahia sod or replaced in-kind, whichever is finer quality.

2. Sod shall be first quality Bahia sod of firm texture having a compacted growth and good root development.

3. Sod shall be absolutely true to varietal type, live, fresh and free from weeds or objectionable vegetation, fungus, insects and disease of any kind. Sod shall be kept moist from the time it is field cut until it is laid at the proposed site.

4. The sod shall be as grown by a certified turf nursery and CONTRACTOR shall inform ENGINEER as to the source of the sod to be utilized prior to ordering and delivery of sod.

5. Sod shall be furnished and installed in rectangular sod strips measuring 12 to 16-inches in width of standard lengths of not less than 2 feet and delivered on pallets.

PART 3 - EXECUTION

3.01 INSTALLATION

A. These areas shall be fine graded to achieve the finished subgrade after compaction which shall be obtained by rolling, dragging or by an approved method which obtains an equivalent compaction to that produced by a hand roller weighing from 75 to 100 pounds per foot of width. All depressions caused by settlement or rolling shall be filled with additional existing or furnished topsoil and regraded and prepared as specified above until it presents a reasonably smooth and even finish at the required sod sub-grade.

B. All sod furnished shall be living sod containing at least 70% of thickly matter grasses as specified and free from noxious weeds. All sod shall be certified free of fire ants.

C. No broken pads or torn or uneven ends will be accepted. Standard size sections of sod shall be strong enough to support own weight and retain their size and shape when suspended vertically with a firm grasp on the upper 10% of the section. Sod shall not be harvested when its moisture content (excessively wet or dry) may adversely affect its survival.

D. Sod shall be harvested, delivered, and installed within a period of 24 hours. Sod not installed within this time period shall be subject to inspection and rejection by ENGINEER, and shall be removed from the site and a fresh sod supply shall be furnished at no extra cost to CITY.

E. The topsoil shall not be moist at time of installation; however, it shall contain sufficient moisture so as not be powdery or dusty, both as determined by the supplier's representative.

F. The overlapping of existing lawn with new sod along limit of work lines will not be permitted. Sod shall be laid in strips, edge to edge, with the lateral joints staggered. All minor or unavoidable openings in the sod shall be closed with sod plugs or with topsoil, as directed by ENGINEER. However, sod laid with joints determined to be too large shall be lifted and re-laid as specified herein at no extra cost to CITY.

G. Immediately after the sod is laid, the sod shall be watered thoroughly by hand or mechanical sprinkling until the sod and at least 2-inch of the top soil bed have been thoroughly moistened.

H. CONTRACTOR shall be responsible to furnish his own supply of water to the site at no extra cost. If possible, CITY shall furnish CONTRACTOR, upon request, with a source

and supply of water. CONTRACTOR shall apply for temporary meter and pay CITY for water used at current utility billing rates. However, if CITY's water supply is not available or not functioning, CONTRACTOR shall be responsible to furnish adequate supplies at his own cost. All work injured or damaged due to the lack of, or the use of too much water, shall be CONTRACTOR's responsibility to correct.

3.02 MAINTENANCE

A. Maintain the entire sodded areas at least a 30-day period or until final acceptance at the completion of the Contract, whichever is longer. Maintenance shall include watering as specified, weeding and removal of stones which may appear. All bare or dead spots which become apparent shall be properly prepared, limed and fertilized, and resodded at CONTRACTOR's expense as many times as necessary to secure a good growth. In the event that the sod installation is not accepted by ENGINEER, the entire area shall be maintained and cut by CONTRACTOR until final acceptance of the sod installation.

B. Take whatever measures are necessary to protect the sod while it is developing. These measures shall include furnishing of warning signs, barriers, or any other necessary measures of protection.

END OF SECTION

SECTION 02501

PIPING, GENERAL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. All applicable provisions of the Contract Requirements shall govern the work under this Section.

1.02 WORK INCLUDED

A. The CONTRACTOR shall furnish and install all piping systems shown and specified, in accordance with the requirements of the Contract Documents. Each system shall be complete with all necessary fittings, hangers, supports, anchors, expansion joints, flexible connectors, valves, accessories, heat tracing, insulation, lining and coating, testing, disinfection, excavation, backfill and encasement, to provide a functional installation.

B. The piping shown is intended to 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, connectors, etc., for a complete and functional system.

1.03 RELATED WORK

A. Division 2 as applicable.

1.04 REFERENCE STANDARDS

A. **Codes:** All codes, as referenced herein are specified in Section 01090, "Applicable Standards and Codes".

B. **Commercial Standards:**

ANSI/ASME B1.20.1 Pipe Threads, General Purpose (inch).

ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys.
ANSI/AWWA C207	Steel Pipe Flanges for Water Works Service, Sizes 4 in through 144 in.
ANSI/AWWA C606	Grooved and Shouldered Joints.
ANSI/AWS D1.1	Structural Welding Code.

ASTM A 307 Tensile.	Specification for Carbon Steel Bolts and Studs, 6,000 psi
ASTM A 325	Specification for High-Strength Bolts for Structural Steel Joints.
ASTM D 792	Test Methods for Specific Gravity and Density of Plastics by Displacement.
ASTM D 2000	Classification System for Rubber Products in Automotive Applications.

1.05 SUBMITTALS

A. The CONTRACTOR shall submit complete shop drawings and certificates, test reports, affidavits of compliance, of all piping systems, in accordance with the requirements of the Contract Documents as specified in the individual sections. The shop drawings shall include all necessary dimensions and details on pipe joints, fittings, fitting specials, valves, appurtenances, design calculations, and material lists. The submittals shall include detailed layout, spool, or fabrication drawings which show all pipe spools, spacers, adapters, connectors, fittings, and pipe supports necessary to accommodate the equipment and valves provided in a complete and functional system.

B. All expenses incurred in making samples for certification of tests shall be borne by the CONTRACTOR.

C. The CONTRACTOR shall submit as part of the shop drawings a certification from the pipe fabricator stating that all pipes will be fabricated subject to a recognized Quality Control Program. An outline of the program shall be submitted to the ENGINEER for review prior to the fabrication of any pipe

1.06 QUALITY ASSURANCE

A. **Inspection:** All pipe shall be subject to inspection at the place of manufacture. During the manufacture of the pipe, the ENGINEER 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 the Specifications.

B. **Tests:** Except where otherwise specified, 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 specified.] The CONTRACTOR shall perform all tests at no additional cost to the CITY.

C. **Welding Requirements:** All welding procedures used to fabricate pipe shall be pre-qualified under the provisions of ANSI/AWS D1.1. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.

D. **Welder Qualifications:** All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local, approved testing agency not more than 6 months prior to commencing work on the pipeline. Machines and electrodes similar to those used in the WORK shall be used in qualification tests. The CONTRACTOR shall furnish all material and bear the expense of qualifying welders.

1.07 MANUFACTURER'S SERVICE REPRESENTATIVE

A. Where the assistance of a manufacturer's service representative is advisable, in order to obtain perfect pipe joints, supports, or special connections, the CONTRACTOR shall furnish such assistance at no additional cost to the CITY.

1.08 MATERIAL DELIVERY, STORAGE, AND HANDLING

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

1.09 CLEANUP

A. 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 handed over in a clean and functional condition.

PART 2 - PRODUCTS

2.01 GENERAL

A. All pipes, fittings, and appurtenances shall be furnished in accordance with the requirements of the Contract Documents.

B. **Lining:** All requirements pertaining to thickness, application, and curing of pipe lining, are in accordance with the requirements of the applicable Sections of Division 2, unless otherwise specified.

C. **Coating:** All requirements pertaining to thickness, application, and curing of pipe coating, are in accordance with the requirements of the applicable Sections of Division 2, unless otherwise specified. Pipes above ground or in structures shall be field-painted as directed by the ENGINEER.

2.02 PIPE FLANGES (STEEL PIPE)

A. **Flanges:** Where the design pressure is 150 psi or less, flanges shall conform to either ANSI/AWWA C207 Class D or ANSI B16.5 150-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 C207 Class E, Class F, or ANSI B16.5 appropriate class.

However, AWWA flanges shall not be exposed to test pressure 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 B16.5 appropriate 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 C207. Flanges for miscellaneous small pipes shall be in accordance with the standards specified for these pipes.

B. **Blind Flanges:** Blind flanges shall be in accordance with ANSI/AWWA C207, or with the standards for miscellaneous small pipes. All blind flanges for pipe sizes 12 inches and over shall be provided with lifting eyes in form of welded or screwed eye bolts.

C. **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.

D. **Flange Bolts:** All bolts and nuts shall conform to pipe manufacturers recommendations. 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.

E. **Insulating Flanges:** Insulated flanges shall have bolt holes 1/4-inch diameter greater than the bolt diameter.

F. **Insulating Flange Sets:** Insulating flange sets shall be provided where shown. Each insulating flange set shall consist of an insulating gasket, insulating sleeves and washers and a steel washer. Insulating sleeves and washers shall be one piece when flange bolt diameter is 1-1/2-inch or smaller and shall be made of acetal resin. For bolt diameters larger than 1-1/2-inch, insulating sleeves and washers shall be 2-piece and shall be made of polyethylene or phenolic. Steel washers shall be in accordance with ASTM A 325. Insulating gaskets shall be full-face.

Insulating Flange Manufacturers, or Equal:

1. JM Red Devil, Type E;
2. Maloney Pipeline Products Co., Houston;
3. PSI Products, Inc., Burbank, California.

G. **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.

Flange Gasket Manufacturers, or Equal:

1. John Crane, style 2160.
2. Garlock, style 3000.

2.03 THREADED INSULATING CONNECTIONS

A. **General:** Threaded insulating bushings, unions, or couplings, as appropriate, shall be used for joining threaded pipes of dissimilar metals and for piping systems where corrosion control and cathodic protection are involved.

B. **Materials:** Threaded insulating connections shall be of nylon, Teflon, polycarbonate, polyethylene, or other non-conductive materials, and shall have ratings and properties to suit the service and loading conditions.

2.04 MECHANICAL-TYPE COUPLINGS (GROOVED OR BANDED PIPE)

A. **General:** Cast mechanical-type couplings shall be provided where shown. The couplings shall conform to the requirements of ANSI/AWWA C606. All gaskets for mechanical-type couplings shall be compatible with the piping service and fluid utilized, in accordance with the coupling manufacturer's recommendations. The wall thickness of all grooved piping shall conform with the coupling manufacturer's recommendations to suit the highest expected pressure. To avoid stress on equipment, all equipment connections shall have rigid-grooved couplings, or harness sets in sizes where rigid couplings are not available, unless thrust restraint is provided by other means. The CONTRACTOR shall have the coupling Manufacturer's service representative verify the correct choice and application of all couplings and gaskets, and the workmanship, to assure a correct installation.

Couplings for Steel Pipe, Manufacturers, or Equal:

1. Gustin-Bacon (banded or grooved);
2. Victaulic Style 41 or 44 (banded, flexible);
3. Victaulic Style 77 or 07 (grooved).

Ductile Iron Pipe Couplings, Manufacturers, or Equal:

1. Victaulic Style 31.

Note: Ductile iron pipe couplings shall be furnished with flush seal gaskets.

2.05 SLEEVE-TYPE COUPLINGS

A. **Construction:** Sleeve-type couplings shall be provided where shown, in accordance with ANSI/AWWA C219 unless otherwise specified, and shall be of steel with steel bolts, without pipe stop, and shall be of sizes to fit the pipe and fittings shown. The middle ring shall be not less than 1/4-inch in thickness and shall be either 5 or 7 inches long for sizes up to and including 30 inches and 10 inches long for sizes greater than 30 inches, for standard steel couplings, and 16 inches long for long-sleeve couplings. The followers shall be single-piece contoured mill section welded and cold-expanded as required for the middle rings. They shall be of sufficient strength to accommodate the number of bolts necessary to obtain

adequate gasket pressures without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket. Buried sleeve-type couplings shall be epoxy-coated at the factory as specified.

B. **Pipe Preparation:** The ends of the pipe, where specified or shown, shall be prepared for flexible steel couplings. Plain ends for use with couplings shall be smooth and round for a distance of 12 inches from the ends of the pipe, with outside diameter not more than 1/64-inch smaller than the nominal outside diameter of the pipe. The middle ring shall be tested by cold-expanding a minimum of one percent beyond the yield point, to proof-test the weld to the strength of the parent metal. The weld of the middle ring shall be subjected to air test for porosity.

C. **Gaskets:** Gaskets for sleeve-type couplings shall be rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions. Gaskets for wastewater and sewerage applications shall be Buna "N," grade 60, or equivalent suitable elastomer. The rubber in the gasket shall meet the following specifications:

1. Color - Jet Black
2. Surface - Non-blooming
3. Durometer Hardness - 74±5
4. Tensile Strength - 1000 psi Minimum
5. Elongation - 175 percent Minimum

The gaskets shall be immune to attack by impurities normally found in water or wastewater. All gaskets shall meet the requirements of ASTM D 2000, AA709Z, meeting Suffix B13 Grade 3, except as noted above. All gaskets shall be compatible with the piping service and fluid utilized.

D. **Insulating Couplings:** Where insulating couplings are required, both ends of the coupling shall have a wedge-shaped gasket which assembles over a rubber sleeve of an insulating compound in order to obtain insulation of all coupling metal parts from the pipe.

E. **Restrained Joints:** All sleeve-type couplings on pressure lines shall be harnessed unless thrust restraint is provided by other means. Harnesses shall be in accordance with the requirements of the appropriate reference standard, or as shown.

Manufacturers or Equal:

1. Dresser, Style 38;
2. Ford Meter Box Co., Inc., Style FC1 or FC3;
3. Smith-Blair, Style 411.

2.06 FLEXIBLE CONNECTORS

A. Flexible connectors shall be installed in all piping connections to engines, blowers, compressors, and other vibrating equipment, and where shown. 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, rated for minimum 150 psi working pressure, unless otherwise shown. The connectors shall be 9 inches long, face-to-face flanges, unless otherwise shown. The final material selection shall be approved by the manufacturer. The CONTRACTOR shall submit manufacturer's shop drawings and calculations.

2.07 EXPANSION JOINTS

A. All piping subject to expansion and contraction shall be provided with sufficient means to compensate for such movement, without exertion of undue forces to equipment or structures. This may be accomplished with expansion loops, bellow-type expansion joints, or sliding-type expansion joints. Expansion joints shall be of stainless steel, monel, rubber, or other materials, best suited for each individual service. The CONTRACTOR shall submit detailed calculations and manufacturer's shop drawings, guaranteeing satisfactory performance of all proposed expansion joints, piping layouts showing all anchors and guides, and information on materials, temperature and pressure ratings.

2.08 PIPE THREADS

A. All pipe threads shall be in accordance with ANSI/ASME B1.20.

PART 3 – EXECUTION

3.01 GENERAL

A. All pipes, fittings, and appurtenances shall be installed in accordance with the requirements of the applicable Section of Divisions 2. The lining manufacturer shall take full responsibility for the complete, final product and its application. All pipe ends and joints at screwed flanges shall be epoxy-coated, to assure continuous protection.

B. Where core drilling is required for pipes passing through existing concrete, core drilling locations shall be determined by radiograph of concrete construction to avoid damage to embedded raceways and rebars.

C. All exposed piping shall be painted. All piping to be painted shall be color coded in accordance with CITY's standard color code. Color samples shall be submitted to ENGINEER for final color selection.

END OF SECTION

SECTION 02502

VALVES, GENERAL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Provide all labor, materials, necessary equipment and services to complete the Water Systems work, as indicated on the drawings, as specified herein or both, except as for items specifically indicated as "NIC ITEMS".

1.02 WORK INCLUDED

A. The CONTRACTOR shall provide all tools, supplies, materials, equipment, and labor necessary for furnishing, epoxy coating, installing, adjusting, and testing of all valves and appurtenant work, complete and operable, in accordance with the requirements of the Contract Documents. Where buried valves are shown, the CONTRACTOR shall furnish and install valve boxes to grade, with covers, extensions, and position indicators.

B. The provisions of this Section shall apply to all valves and valve operators specified in the various Sections and Division 2 of these Specifications except where otherwise specified in the Contract Documents. Valves and operators in particular locations may require a combination of units, sensors, limit switches, and controls specified in other Sections of these Specifications.

1.03 RELATED WORK

A. Excavation and Backfilling for Utilities.

B. Piping, General.

C. Water Distribution System.

1.04 REFERENCE STANDARDS

A. **Codes:** All codes, as referenced herein, are specified in Section 01090, “Referred Standards”.

B. **Commercial Standards:**

ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys.
ANSI/ASME B31.1	Power Piping.
ASTM A 36	Specification for Structural Steel.

ASTM A 48	Specification for Gray Iron Castings.
ASTM A 126	Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
ASTM A 536	Specification for Ductile Iron Castings.
ASTM B 61	Specification for Steam or Valve Bronze Castings.
ASTM B 62	Specification for Composition Bronze or Ounce Metal Castings.
ASTM B 148	Specification for Aluminum-Bronze Castings.
ASTM B 584	Specification for Copper Alloy Sand Castings for General Applications.
ANSI/AWWA C500	Gate Valves for Water and Sewerage Systems.
ANSI/AWWA C502	Dry-Barrel Fire Hydrants.
ANSI/AWWA C503	Wet-Barrel Fire Hydrants.
ANSI/AWWA C504	Rubber-Seated Butterfly Valves.
ANSI/AWWA C507	Ball Valves 6 Inches Through 48 Inches.
AWWA C508	Swing-Check Valves for Waterwork Service, 2 Inches Through 24 Inches NPS.
ANSI/AWWA C509	Resilient-Seated Gate Valves for Water and Sewage Systems.
ANSI/AWWA C511	Reduced-Pressure Principle Backflow-Prevention Assembly.
AWWA C550	Protective Interior Coatings for Valves and Hydrants.
SSPC-SP-2	Hand Tool Cleaning.
SSPC-SP-5	White Metal Blast Cleaning.

1.05 SUBMITTALS

A. **Shop Drawings:** Shop drawings of all valves and operators including associated wiring diagrams and electrical data, shall be furnished as specified in Section 01340, "Submittals".

B. **Valve Labeling:** The CONTRACTOR shall submit a schedule of valves to be labeled indicating in each case the valve location and the proposed wording for the label.

1.06 QUALITY ASSURANCE

A. **Valve Testing:** Unless otherwise specified, each valve body shall be tested under a

test pressure equal to twice its design water-working pressure.

B. **Bronze Parts:** Unless otherwise specified, all interior bronze parts of valves shall conform to the requirements of ASTM B 62, or where not subject to dezincification, to ASTM B 584.

C. **Certification:** Prior to shipment, the CONTRACTOR shall submit for all valves over 12 inches in size, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, ASTM, etc.

PART 2 - PRODUCTS

2.01 VALVES, GENERAL

A. **General:** The CONTRACTOR shall furnish all valves, gates, valve-operating units, stem extensions, and other accessories as shown or specified. All valves and gates shall be new and of current manufacture. All shut-off valves, 6-inch and larger, shall have operators with position indicators. Where buried, these valves shall be provided with valve boxes and covers containing position indicators, and valve extensions. Shut-off valves mounted higher than 5 feet-6 inches above working level shall be provided with chain operators.

B. **Valve Flanges:** The flanges of valves shall be in accordance with Section 02501, "Piping, General".

C. **Gate Valve Stems:** Where subject to dezincification, gate valve stems shall be of bronze conforming to ASTM B 62, containing not more than 5 percent of zinc nor more than 2 percent aluminum. Gate valve stems shall have a minimum tensile strength of 60,000 psi, a minimum yield strength of 40,000 psi, and an elongation of at least 10 percent in 2 inches, as determined by a test coupon poured from the same ladle from which the valve stems to be furnished are poured. Where dezincification is not a problem, bronze conforming to ASTM B 584 may be used.

D. **Protective Coating:** Except where otherwise specified, ferrous surfaces, exclusive of stainless-steel surfaces, in the water passages of all valves 4-inch and larger, as well as the exterior surfaces of all submerged valves, shall be coated with 2-part thermal setting epoxy coatings. Flange faces of valves shall not be epoxy coated. The valve manufacturer shall certify in writing that such coating has been applied and tested in the manufacturing plant prior to shipment, in accordance with these Specifications.

E. **Valve Operators:** Where shown, certain valves and gates shall be furnished with electric operators, provided by the valve or gate manufacturer. All operators of a given type shall be furnished by the same manufacturer. Where these operators are supplied by different manufacturers, the CONTRACTOR shall coordinate their selection to provide uniformity of each type of electric operator. All valve operators, regardless of type, shall be installed, adjusted, and tested by the valve manufacturer at the manufacturing plant.

F. **Valve Labeling:** Except when such requirement is waived by the ENGINEER in

writing, a label shall be provided on all shut-off valves exclusive of hose bibbs and chlorine cylinder valves. The label shall be of 1/16-inch plastic or stainless steel, minimum 2 inches by 4 inches in size, and shall be permanently attached to the valve or on the wall adjacent to the valve as directed by the ENGINEER.

G. **Nuts and Bolts:** All nuts and bolts on valve flanges and supports shall be in accordance with manufacturers recommendations. Where submerged or buried, all nuts and bolts on valve flanges and valve bodies shall be stainless steel.

2.02 GATE VALVES

A. All buried valves shall be of the inside screw, non-rising stem type. Valves shall be capable of being repacked under line pressure. Valves 14-inch and larger installed vertical pipes with their stems horizontal shall be fitted with bronze slides, tracks, rollers, and scrapers to assist the travel of the gate assembly. Quick opening valves shall have quick opening levers and cams in lieu of handwheel operators.

B. **Stainless Steel Metal Seated Knife Gate Valves:**

1. Knife gate valves shall be provided with raised face and resilient seats for positive seating. Wetted parts shall be constructed of Type 316 stainless steel. Gates shall be finish-ground on both sides to prevent packing or seat damage. Valves 6 to 24 inches in size shall be furnished with cast stainless steel bodies. Valve ends shall be of the flanged design. Port design shall be full-round. Valve shall be constructed with a cast stainless steel body, yoke and packing gland. Valve shall have a thrust ball bearing yoke bushing and be provided with a stainless steel non-rising stem adapter, stainless steel valve stem extension, stainless steel valve stem guides, and a stainless steel 2-inch square drive operating nut.

2. **Manufacturers or Equal:**

   a. FNW Figure 65B

   b. DeZurik Corporation;

C. **Resilient-Seated Gate Valves:**

1. Resilient-seated gate valves conforming to ANSI/AWWA C509 shall be provided. Resilient-seated gate valves shall have cast iron bodies with flanged, bell, or mechanical joint ends, rubber-coated cast iron disc, flanged bonnet, bronze stem, O-ring seals, and operators with handwheel or square nut, unless otherwise shown.

2. **Manufacturer or Equal:**

   a. Clow Valve Co.; F-6100

   b. Kennedy Valve; Ken-Seal

c. Mueller Company; 2370

2.03 ECCENTRIC PLUG VALVES

A. **Equipment Requirements:** Plug valves shall be conforming to AWWA C517, latest revision, which shall be of the non-lubricated, eccentric type with resilient faced plugs, port areas for valves 100% of full pipe area. The body shall be of cast or ductile iron meeting or exceeding ASTM A-126 or ASTM A-536, and shall have bolted bonnet which gives access to the internals of the valve. Seats shall be welded nickel alloy or stainless-steel plate locked in the body cavity. If a plate is used, it shall be replaceable through the bonnet access. Bearings shall be permanently lubricated stainless steel, bronze or Teflon. Bearing areas shall be isolated from the flow. Valves shall have packing bonnets where the shaft protrudes from the valve and the packing shall be self-adjusting chevron type which can be replaced without removing the bonnet. All nuts, bolts, springs and washers shall be stainless steel (type 316).

B. Valves shall be designed for a working pressure of 150 PSI minimum. The valve and actuator shall be capable of satisfactory operation in either direction of flow against pressure drops up to and including 100 PSI (for plug valves over 12 inches in diameter). Valves shall be bubble tight in both directions at 100 psi differential.

Plug valves 10" in diameter and over shall have worm gear operators. The operating mechanism for buried service shall be with a 2-inch square operating nut.

C. Plug valves are to be installed with the seat pointed towards the upstream flow, when specified.

D. **Manufacturers or Equal:**

1. Clow Valve Co.;

2. DeZurik Corporation;

2.04 BALL VALVES (4-INCH AND SMALLER)

A. **General Requirements:** Unless otherwise specified or shown, general purpose ball valves in size up to 4-inch shall have manual operators with lever or handwheel. Ferrous surface of 4-inch valves, which will be in contract with water shall be epoxy-coated. All ball valves shall be of best commercial quality, heavy duty construction.

B. **Body:** All ball valves up to 1-1/2 inch (incl.) in size shall have bronze or forged brass 2- or 3-piece bodies with screwed ends for a pressure rating of not less than 300 psi WOG. Valves 2-inch to 4-inch in size shall have bronze forged brass or steel 2- or 3-piece bodies with flanged ends for a pressure rating of 125 psi or 150 psi.

C. **Balls:** The balls shall be solid brass or chrome plated bronze, or stainless steel, with large or full openings.

D. **Stems:** The valves seats shall be of Teflon or Buna N or equal, for bi-directional service and easy replacement.

E. **Ball Valve Manufacturers or Equal:**

Jamesbury Corporation;

2.05 SWING CHECK VALVES (3-INCH AND LARGER)

A. **General:** Swing check valves for water, sewage, sludge, and general service shall be of the outside lever and spring or weight type, in accordance with ANSI/AWWA C 508 - Swing-Check Valves for Waterworks Service, 2 in. through 24 in. NPS (Nominal Pipe Size), unless otherwise indicated, with full-opening passages, designed for a water-working pressure of 150 psi. They shall have a flanged cover piece to provide access to the disc.

B. **Body:** The valve body and cover shall be of cast iron conforming to ASTM A 126, with flanged ends conforming to ANSI B 16.1, or mechanical joint ends, as shown.

C. **Disc:** The valve disc shall be of cast iron, ductile iron, or bronze conforming to ASTM B 62.

D. **Seat and Rings:** The valve seat and rings shall be of bronze conforming to ASTM B 62 or B 148, or of Buna-N or equal.

E. **Hinge Pin:** The hinge pin shall be of bronze or stainless steel.

F. **Swing Check Valve Manufacturers or Equal:**

1. Kennedy Valve;

2. Mueller Company;

2.06 AIR-VACUUM AND AIR-RELEASE VALVES

A. **Air and Vacuum Valves:** Air and vacuum valves shall be capable of venting large quantities of air while pipelines are being filled, and allowing air to re-enter while pipelines are being drained. They shall be of the size shown, with flanged or screwed ends to match piping. Bodies shall be of high-strength cast iron. The float, seat, and all moving parts shall be constructed of Type 316 stainless steel. Seat washers and gaskets shall be of a material insuring water tightness with a minimum of maintenance. Valves shall be designed for minimum 150 psi water-working pressure, unless otherwise shown.

B. **Air-Release Valves:** Air-release valves shall vent accumulating air while system is in service and under pressure and be of the size shown and shall meet the same general requirements as specified for air and vacuum valves except that the vacuum feature will not be required. They shall be designed for a minimum water-working pressure of 150 psi, unless otherwise shown.

C. **Combination Air Valves:** Combination air valves shall combine the characteristics of air and vacuum valves and air release valves by exhausting accumulated air in systems under pressure and releasing or re-admitting large quantities of air while a system is being filled or drained, respectively. They shall have the same general requirements as specified for air and vacuum valves.

D. **Air Vacuum and Release Manufacturers or Equal:**

1. APCO (Valve and Primer Corporation);

2. Golden-Anderson Valve Division (GA Industries, Inc);

2.07 CORPORATION STOPS (Ball Valve Type)

A. Unless otherwise shown, corporation stops shall be made of brass alloy for key operation, with screwed ends with corporation thread or iron pipe thread, as required. AWWA taper thread for inlet thread and compression type fittings for outlet.

B. **Corporation Stop Manufacturer or Equal:**

1. Ford Meter Box Company;

2. James Jones Company;

3. Mueller Company.

2.08 VALVE OPERATORS

A. Electric Motor Operators

1. All motorized valves shall be furnished by the CONTRACTOR through the valve manufacturers as a complete package. Motor driven valve operators shall be furnished and installed in accordance with the applicable requirements shown on the process and instrumentation diagrams and electrical elementary diagrams. Operators shall comply with AWWA requirements for electrical operators.

2. Electric operators including the motor, all required gearing, integral continuous duty rated reversing starter, AC line surge suppressors, controls and switches shall be as manufactured by **Rotork, or equal.**

3. The motorized operators for modulating service shall be furnished with an integral position indicator/transmitter/controller. The above unit shall be internally powered, factory calibrated and furnished with adjustable zero, span, gain and deadband controls.

4. The position indicator/transmitter shall provide a linear, isolated, 4-20 mA, 24 VDC output to remote instrumentation and controls proportional to 0-100

percent travel span. An external DC power source shall not be required.

5. The position controller shall accept a linear 4-20 mA, 24 VDC input signal proportional to 0-100 percent travel span and shall generate appropriate outputs to the reversing starter to open/close the valve until the desired portion has been reached as determined by the position feedback signal to the position controller. Input signal isolation shall be provided.

6. The controller shall be furnished with circuitry to "lock in the last position" upon loss of control signal. CONTRACTOR shall be responsible for proper transmitter/controller calibration in accordance with the manufacturer's recommendations.

7. Operator capacity shall be adequate to continuously operate the valve under all operating conditions. Unless otherwise indicated, or specified, motor operators shall be furnished complete with motors, limit switch operating mechanisms, travel limit switches, torque switches, transmitters, controllers, starters, lighting and surge suppression, terminal blocks, gear reducers, handwheel, gearing, necessary components, and incidental accessories as follows:

   a. All phases of the power supply shall be monitored. The contractor shall open de-energizing the motor upon detection of single phasing.

   b. Logic circuits shall be protected against spurious voltage spikes, using opto-isolators in circuits connected to any remote input or output signals.

8. **Enclosure:** The starter for 240-volt single phase motor operators and all local devices shall be mounted on a common NEMA 4 and PVC coated cast aluminum enclosure. The enclosure shall be permanently affixed to the valve operator housing.

9. **Valve Stops:** Valve stops for the operators shall be positive in action. Closing shall be complete, and opening full. Stops shall be field adjustable to the required settings. The torque switches shall prevent any excessive mechanical stress or electrical overloading any direction of travel.

10. Limit switches and gearing shall be an integral part of the motorized valve operator. The limit switch gearing shall be of the intermittent type, totally enclosed in its own gear case, grease lubricated to prevent direct and foreign matter from entering the gear train and shall be made of bronze or stainless steel. Limit switches shall be of the adjustable type capable of being adjusted to trip at any point between the normal position (full open, or full closed) and 75 percent of the travel to the opposite position.

11. **Local (Motor) Devices:** Local devices shall include, but not be limited to the following:

a. Torque Switches: Torque switches, responsive to high torque encountered in either direction of travel. A torque switch which has tripped due to mechanical load shall not reset when the operator motor has come to a halt.

b. Limit Switches: Travel limit switches, for opening and closing direction of travel. Contract operations shall be as indicated on the Drawings. If not shown on the Drawings, the operator shall be furnished with a minimum of two DPDT switches. All switches shall be furnished with 5 ampere contacts. Switches shall be connected such that when the valve is fully open, or fully closed, the "open" or "close" light shall be illuminated. All limit switch contacts shall be wired out to a terminal strip so that the electrician in the field does not have to connect to the switches.

c. Local/remote selector switch with phase motor relay and auxiliary to provide dry contacts for collective indication of placement in the "remote" operating mode, the unit is powered, and that all safety/overload interlocks are satisfied to provide the above signal. For further requirements refer to electrical elementary control schematic.

d. Open/close push-button for local manual operation (modulating service).

e. Position indicator calibrated to 0-100 percent travel span.

f. Terminals for remote indication of full open, full closed and overload (torque).

12. **Operating Unit Gearing:** The actuator shall be double reaction unit with the capability of quickly changing the output speed with a gear change. The power gearing shall consist of generated spur or helical gears of heat-treated steel, and worm gearing where required by the type of operator. Quarter turn or traveling unit operators do not specifically require worm gearing. The worm shall be of hardened alloy steel and the worm gear shall be of alloy bronze. All power gearing shall be grease-lubricated. Ball or roller bearings shall be used throughout for all motor operators. A mechanical dial position indicator to display valve position in percent of valve opening shall be provided. The gearing shall comply with AWWA requirements.

13. **Stem Nuts:** The actuator for other than quarter turn valves shall have a stem nut of high tensile bronze or other material compatible with the valve stem and suited to the application. The nut arrangement, where possible, shall be of the two-piece type to simplify field replacement. The stem nut for rising stem valves must be capable of being removed from the top of the actuator without removing the actuator from the valve, disconnecting the electrical wiring, or disassembling any of the gearing within the actuator.

14. **Manual Operation:** A handwheel shall be provided for manual operation. The handwheel shall not relocate during hand operation nor shall a fused motor prevent manual operation.

15. When in manual operating position, the volt motor driven unit will remain in this position until motor is energized at which time the valve operator will automatically return to electric operation and shall remain in motor position until handwheel operation is desired. This movement from motor operation to handwheel operation shall be accomplished by a positive declutching knob or lever which will disengage the motor and motor gearing mechanically not electrically. Hand operation must be reasonable fast and require no more than 100 lbs. of rim effort at the maximum required torque. It shall not be possible for the unit to be simultaneously in manual and motor operation.

16. **240 Volt Single Phase Motors:** All motors on valves shall be designed for 240 volts 1-phase 60 Hz power. The motor shall be specifically designed for valve actuator service and shall be of high torque, squirrel cage reversible, totally enclosed, non-ventilated construction, with motor leads brought into the limit switch compartment without having external piping or conduit box. Motor insulation shall be NEMA Class B with maximum continuous temperature rating of 120◦ C (rise + ambient). Motors shall be sized to have a rated running time at the rated running torque of 15 minutes without exceeding the temperature rating of the insulation system. Running load torque shall be not more than 20 percent of the rated seating/unseating torque.

17. Speed-torque curves for the motors and torque calculations for seating, unseating, and running conditions shall be submitted. The maximum valve torque (seating/unseating) shall be less than 50 percent of stall torque or starting torque potential of the motor whichever is greater.

18. **Operator Type:**

    1. Type A: Remote set-point using a 4-20 mable analog signal

        (a) Local Operation

            (1) LOCAL/REMOTE selector

            (2) OPEN/CLOSE push-buttons

            (3) Position set-point potentiometer/indicator

            (4) LOCAL accepts local position set-point

            (5) OPEN/CLOSE indication

            (6) Fault (torque) indication

(b) Remote operation

(1) REMOTE - accept a remote 4-20 mA position set-point

(2) Position transmitter 4-20mA signal to RTU (Remote Transmitter Unit)

(3) Available Ready of Auto to RTU

(4) Fault torque status to RTU

19. **Valve Closure Time:**

Valve closure time shall be 1 minute.

20. **Spare Parts:**

a. The CONTRACTOR shall furnish loose, one-unit valve operator, complete with all the devices specified herein and with all the features and characteristics similar to the equipment supplied in this Contract. The spare operator shall be delivered to the CITY still in crates.

PART 3 - EXECUTION

3.01 VALVE INSTALLATION

A. **General:** All valves, gates, operating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the manufacturer's written instructions and as shown and specified. All gates shall be adequately braced to prevent warpage and bending under the intended use. Valves shall be firmly supported to avoid undue stresses on the pipe.

B. **Access:** All valves shall be installed to provide easy access for operation, removal, and maintenance and to avoid conflicts between valve operators and structural members or handrails.

C. **Valve Accessories:** Where combinations of valves, sensors, switches, and controls are specified, it shall be the responsibility of the CONTRACTOR to properly assemble and install these various items so that all systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on shop drawing submittals.

D. **Butterfly Valves:** All exposed butterfly valves shall be installed with a means of removing the complete valve assembly without dismantling the valve or operator.

END OF SECTION

SECTION 02507

PRIME AND TACK COATS

PART 1 - GENERAL

1.01 WORK INCLUDED:

A. The work specified in this section consists of an application of bituminous material on previously prepared base in accordance with these specifications and in conformity with the line, grades, dimensions and notes shown on the Drawings. No separate bid item is provided in the proposal for prime and tack coats. The cost shall be included in the bid price for the related pavement construction.

A. Tack coat will be required prior to overlaying existing pavement.

1.02 RELATED WORK:

A. Asphaltic Concrete Pavement.

PART 2 - PRODUCTS

2.01 MATERIALS:

B. Prime coat shall be in accordance with Section 300, Florida Department of Transportation Standard Specifications for Road and Bridge Construction, Latest Edition. Prime coat shall have full compatibility with surface treatment asphalt. The sand for cover shall be clean dry sand.

C. Tack coat shall be in accordance with Section 300, Florida Department of Transportation Standard Specifications for Road and Bridge Construction, Latest Edition.

2.02 EQUIPMENT:

A. The pressure distributor used for placing the tack or prime coat shall be equipped with pneumatic tires having sufficient width of rubber in contact with the road surface to avoid breaking the bond of or forming a rut in the surface. The distance between the centers of openings of the outside nozzles of the spray bar shall be equal to width of the application required, within an allowable variation of 2-inches. The outside nozzle at each end of the spray bar shall have an area of opening of not less than 25 percent, nor more than 75 percent in excess of other nozzles which shall have uniform openings. When the application covers less than the full width, the normal opening of the end nozzle at the junction line may remain the same as those of the interior nozzle.

PART 3 - EXECUTION

3.01 PREPARATION:

A. Before applying any bituminous material, all loose material, dust, dirt, and foreign material, which might prevent proper bond with the existing surface, shall be removed. Particular care shall be taken to clean the outer edges of the strip to be treated in order to insure that the prime or tack coat will adhere.

B. When the prime or tack coat is applied adjacent to curb and gutter, or another concrete surface (except where they are to be covered with a bituminous wearing coarse) such concrete surfaces shall be protected by heavy paper or other protective material while the primer or tack coat is being applied. Any bituminous material deposited on such concrete surfaces shall be removed immediately.

3.02 WEATHER LIMITATIONS:

A. No bituminous material shall be applied when the air temperature is less than 50 degrees Fahrenheit in the shade, or when the weather conditions or the condition of the existing surface is unsuitable. In no case shall bituminous material be applied while rain is falling or when there is water on the surface to be covered.

3.03 APPLICATION OF PRIME COAT:

A. After the base has been finished the full width of surface shall be swept with a power broom supplemented with hand brooms and mechanical blowers prior to the application of prime coat. Care shall be taken to remove all loose dust, dirt and objectionable matter. If deemed necessary, the base shall be lightly sprinkled with water immediately in advance of the prime coat. The prime coat shall be applied to the full width of the base.

B. The temperature of the prime material shall be such as to insure uniform distribution. The material shall be applied with a pressure distributor as specified above. The amount to be applied shall be sufficient to coat the surface thoroughly and uniformly without any excess to form pools or to flow off the base. For limerock base, the rate of application shall not be less than .10 gallons per square yard; for shell base, the rate of application shall not less then .15 gallons per square yard.

C. If the roadway is to be opened for use following the application of the prime material, a light uniform application of clean sand shall be applied and rolled. The sand shall be nonplastic, shall be free from slit and rock particles and shall not contain any sticks, vegetation, grass roots, or organic matter. After the sand covering has been applied, the surface may be opened to traffic.

3.04 APPLICATION OF TACK COAT:

A. In general, a tack coat will not be used on primed bases except in areas which have become excessively dirty and cannot be cleaned or where the prime has cured and lost all of its bonding effect.

B. No tack coat shall be applied until the primed base or leveling course has been cleaned and is free from sand, dust or other objectionable material.

C. The tack coat shall be applied with a pressure distributor as specified above. It shall be heated to a suitable consistency and applied in a thin uniform layer at the rate of between .04 gallons and .08 gallons per square yard.

D. The tack coat shall be applied sufficiently in advance of the laying of the wearing surface to permit drying, but shall not be applied so far in advance or over such an area as to lose its adhesiveness as a result of being covered with dust or other foreign material. Suitable precautions shall be taken by the CONTRACTOR to protect the surface while the tack coat is drying and until the wearing surface is applied.

END OF SECTION

SECTION 02510

ASPHALTIC CONCRETE PAVEMENT

PART 1 – GENERAL

1.01 SCOPE

A. Construct asphaltic concrete pavement in accordance with the lines, grades and typical sections as indicated on the Drawings, specified herein and as required for a complete installation.

1.02 SUBMITTALS

A. The CONTRACTOR shall submit his proposed formulae for the asphaltic concrete paving for review in accordance with Section 01340 - Submittals.

1.03 QUALITY CONTROL

A. The phrase "DOT Specifications" shall refer to the Florida Department of Transportation Standard Specifications for Road and Bridge Construction. The DOT Specifications, are referred to herein and are hereby made a part of this Contract to the extent of such references, and shall be as binding upon the Contract as though reproduced herein in their entirety.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Limerock Base: The limerock base shall consist of two courses of Miami Oolite limerock in accordance with Sections 200 and 911 of the DOT Specifications.

B. Prime Coat: The material used for the prime coat shall be in accordance with Sections 300 and 916, Florida Department of Transportation Standard Specifications for Road and Bridge Construction, Latest Edition.

C. Asphaltic Concrete: The materials and construction of the asphaltic concrete patch and surface courses shall be Type SP-9.5 Superpave Asphaltic Concrete conforming to Sections 330, 334, and 916 of the DOT Specifications.

D. Reclaimed Asphalt: Reclaimed asphalt shall be utilized.

E. Tack Coat: The material used for the tack coat shall be emulsified asphalt conforming to DOT Sections 300 and 916.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Subgrade: Roadway subgrades shall be stabilized to the minimum depth shown on the Drawings to a Limerock Bearing Ratio (LBR) of 40 or as required by the Authority Having Jurisdiction. Stabilizing shall be as defined in Section 160 of the DOT specifications. The stabilizing material shall be applied in such quantity that, after mixing and blending, the subgrade will have the required LBR. Stabilizing material shall be mixed or blended in the subgrade material by plowing, scarifying, disking, harrowing, blading and mixing with rotary tillers until the mixed materials are of uniform bearing value throughout the width and depth of the layer being processed. The minimum acceptable density at any location will be 98% of maximum dry density as determined by AASHTO T-180.

B. At least three density determinations shall be made on each day's final compaction operations on each course, and the density determinations shall be made at more frequent intervals if deemed necessary by the ENGINEER.

C. Limerock Base: The limerock base shall be constructed in accordance with Section 200 of the DOT Specifications, to the thickness and width indicated on the Drawings. Pavement base shall be constructed in two lifts.

D. After spreading of the base material is completed, the entire surface shall be scarified and shaped so as to produce the exact grade and cross section after compaction. For double course base, this scarifying shall extend a depth sufficient to penetrate slightly the surface of the first course. The maximum depth of each lift shall be 6-inches.

E. When the material does not have the proper moisture content to insure the required density, wetting or drying shall be required. If the material is deficient in moisture, water will be added and uniformly mixed in by disking the base course to its full depth. If the material contains an excess of moisture, it shall be allowed to dry before being compacted. Wetting and drying operations shall involve manipulation of the entire width and depth of the base as a unit. As soon as proper conditions of moisture are attained, the material shall be compacted to an average density not less than 98% of maximum dry density as determined by AASHTO T-180. Where the base is being constructed in more than one course, the density shall be obtained in each lift of the base.

F. During final compacting operations, if blading of any areas is necessary to obtain the true grade and cross section, the compacting operations for such areas shall be completed prior to making the density determination on the finished base.

G. Unless otherwise directed by the ENGINEER, the surface shall be "hard-planed" with a blade grader immediately prior to the application of the prime coat to remove the thin glaze or cemented surface and to allow free penetration of the prime material. The materials planed from the base shall be removed from the base area.

H. If cracks or checks appear in the base, either before or after priming, which in the opinion of the ENGINEER, would impair the structural efficiency of the base course, the CONTRACTOR shall remove such cracks or checks by reclarifying, reshaping, adding base material where necessary and recompacting, at no additional cost to the CITY.

I. Mixing Base and Subgrade: If at any time the subgrade material shall become mixed with the base course material, the CONTRACTOR shall, without additional compensation, dig out and remove the mixture, reshape and compact the subgrade and replace the materials removed with clean base material, which shall be shaped and compacted as specified above.

J. Prime Coat: The prime coat shall be applied in accordance with Section 300 of the DOT Specifications.

K. Asphaltic Concrete: The spreading, compacting and jointing the wearing surface shall be in accordance with Sections 330 and 334 of the DOT Specifications to the thickness indicated on the Drawings.

L. Tack Coat: Apply tack coat at a rate between 0.02 and 0.10 gallons per square yard, and perform the Work in accordance with Section 300 of the DOT Specifications.

3.02 PAVEMENT REPAIR

A. All damage to pavement as a result of work under this Contract shall be repaired in a manner satisfactory to the ENGINEER and at no additional cost to the CITY. The repair shall include the preparation of the subgrade, the placing and compacting of the limerock base, the priming of the base, the placing and maintaining of the surface treatment, all as specified herein.

B. The width of all repairs shall extend at least 12 inches beyond the limit of the damage. The edge of the pavement to be left in place shall be cut to a true edge with a saw or other approved method so as to provide a clean edge to abut the repair. The line of the repair shall be reasonably uniform with no unnecessary irregularities.

END OF SECTION

SECTION 02526

CONCRETE PAVEMENT, CURB AND WALKWAYS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Concrete pavement, curbs and sidewalk shall be constructed to the lines and grades and dimensions required for a complete installation as shown on the Drawings and specified herein.

1.02 SUBMITTALS

A. Shop drawings for reinforcing, joint material and mix designs shall be submitted for review in accordance with the Section 01340.

PART 2 - PRODUCTS

2.01 CONCRETE

A. Concrete shall be Class B, conforming to the Section 00300, unless noted or specified otherwise.

2.02 REINFORCING AND WELDED WIRE FABRIC

A. Joint reinforcing and welded wire fabric shall conform to the section entitled "Concrete Reinforcement".

2.03 JOINT SEALER FOR PAVEMENT

A. Joint sealer shall be a one or two part polysulfide base self leveling sealant for horizontal surfaces that has been developed for foot and vehicular traffic. The sealant shall conform to the requirements of the Contract Documents.

2.04 PREFORMED JOINT FILLER

A. Preformed joint filler shall be sponge rubber and conform to the requirements of AASHTO Designated M148, Type 1.

PART 3 - EXECUTION

3.01 SUBGRADE CONDITION

A. The finished subgrade shall be maintained in a smooth, compact condition and any areas which are disturbed prior to placing of the concrete shall be restored at the CONTRACTOR'S expense. The subgrade shall be moist at the time the concrete is placed. Water shall be uniformly applied ahead of the paving operations as directed by the ENGINEER. If the CONTRACTOR does not maintain the subgrade in the

required moist condition, a vapor barrier sheet will be required between the subgrade and the concrete.

B. The subgrade shall be accurately trimmed to the required elevation with a 1/4-inch tolerance. High areas shall be trimmed to proper elevation. Low areas may be filled with suitable material and compacted to the specified density or filled with concrete integrally with the placing of the pavement.

3.02 SETTING FORMS

A. The forms shall be accurately set to line and grade and such that they rest firmly, throughout their entire length, upon the compacted subgrade surface. Forms shall be joined neatly and tightly and braces to test the pressure of the concrete and the finishing operations. The alignment and grade of all forms shall be approved before and immediately prior to the placing of concrete.

3.03 MIXING CONCRETE

A. Concrete shall be mixed in accordance with the Section 03460.

3.04 PLACING CONCRETE

A. The concrete shall be distributed on the subgrade to such depth, that, when it is consolidated and finished, the slab thickness required by the Drawings will be obtained at all points and the surface will at no point be below the grade specified for the finished surface, after application of the allowable tolerance. The concrete shall be deposited on the subgrade in a manner which will require as little rehandling as possible.

B. Fabric reinforcement shall be placed at mid slab depth, and the fabric shall be maintained at this location during the placing and finishing operations.

C. Concrete shall be thoroughly consolidated against and along the faces of all forms, by means of hand-operated, spud-type vibrators. Vibrators shall not be permitted to come in contact with the subgrade or a side form. Vibration at any one location shall not continue so long as to produce puddling or the accumulation of excessive grout on the surface. In no case shall the vibrator be operated longer than 15 seconds in any one location.

3.05 STRIKING-OFF, CONSOLIDATING AND FINISHING CONCRETE

A. Immediately after the placing, the concrete shall be struck off, consolidated and finished, to produce a finished pavement conforming to the cross section, width and surface. Sequence of operations shall be as follows: strike-off; vibratory consolidation; screeding; floating; removal of laitance; straightedging; and final surface finish.

3.06 STRAIGHTEDGING AND SURFACE CORRECTIONS

A. After floating has been completed and the excess water removed, but while the concrete is still in a plastic state, the surface of the concrete shall be tested for trueness with an accurate 10 foot straightedge. The straightedge shall be furnished by the CONTRACTOR. The straightedge shall be held in successive positions parallel to the road center line, in contact with the surface, and the whole area tested from one side of the slab to the other as necessary. any depressions shall be immediately filled with freshly mixed concrete and struck-off; consolidated and refinished. High areas shall be cut down and refinished. Straightedge testing and surface correction shall continue until the entire surface appears to conform to the required grade and cross section.

3.07 FINAL FINISH

A. As soon as the water sheen has disappeared from the surface of the pavement and just before the concrete becomes nonplastic, a light broom finish shall be given to the surface.

3.08 EDGING

A. After the final finish has been applied, but before the concrete has become nonplastic, the edges of the pavement along each side of the strip being placed, on each side of construction joints and along any structure extending into the pavement, shall be carefully rounded to a 1/4 inch radius except as otherwise indicated. A well-defined and continuous radius shall be produced and a smoother, dense mortar finish obtained. All concrete shall be completely removed from the top of the joint filler.

B. All joints shall be checked with a straightedge before the concrete has become nonplastic and, if one side of the joint is higher then the other or the entire joint is higher or lower then the adjacent slabs, corrections shall be made as necessary.

3.09 JOINTS

A. Construction Joints

1. Construction joints shall be located as shown on the Drawings and/or as directed by the ENGINEER.

B. Expansion Joints Around Structures

1. Expansion joints shall be formed by placing premolded expansion joint material about all structures and features projecting through, into or against the pavement. Unless otherwise indicated, such joints shall be 1/2 inch in width.

C. Transverse Expansion Joints

1. Open type transverse expansion joints shall be provided at all sidewalk returns and at 50 feet intervals and wherever indicated on the Drawings. Open type joints shall be formed by staking a 1/4 inch thick metal bulkhead in place and placing concrete on both sides. After the concrete has set sufficiently to preserve the width and shape of the joint, the bulkhead shall be remove. After the sidewalk has been finished over the joint, the slot shall be opened and edged with a tool having a 1/2 inch radius. Transverse expansion joints shall be cleaned and filled with joint filler strips 1/4 inch thick conforming to the requirements of AASHTO M-153.

D. Scored Joints

1. Scored joints shall be either formed or sawed at 5 foot intervals and shall extend to a depth of at least one fourth of the sidewalk slab thickness.

3.10 CURING

A. After the finishing operations have been completed and as soon as the concrete has hardened sufficiently that marring of the surface will not occur, the entire surface and the edges of the newly placed concrete shall be covered and cured with membrane curing compound.

B. Curing compound shall be uniformly applied to the surfaces to be cured, in a single coat, continuous film, at the rate of one gallon to not more than 200 square feet, by a mechanical sprayer.

C. Curing compound shall not be applied during periods of rainfall. Curing compound shall not be applied to the inside faces of joints to be sealed. Should the film become damaged from any cause within the required curing period, the damaged portions shall be repaired immediately with additional compound. Upon removal of side forms, the sides of the slabs exposed shall immediately be coated to provide a curing treatment equal to that provided for the surface.

3.11 CURB AND SIDEWALK CONSTRUCTION

A. The concrete curbs and sidewalks shall be constructed on a prepared smooth subgrade of uniform density. Large boulders and other obstructions shall be removed to a minimum depth of 6 inches below the finished subgrade elevation and the space shall be backfilled with sand, base course material or other suitable material which shall be thoroughly compacted by rolling or tamping. The CONTRACTOR shall furnish a template and shall thoroughly check the subgrade prior to depositing concrete.

B. Concrete for curbs, and sidewalks shall be formed, mixed, placed and finished in conformance with the requirements of Division 3, except as modified herein. Concrete shall be cured with a clear membrane curing compound which shall be

applied at a uniform rate of one gallon per 200 square feet in accordance with the requirements specified herein. Sidewalks shall be given a light broom finish.

3.12 CURBS

A. Curbs shall be constructed in uniform sections ten feet in length except where shorter sections are necessary for closures or arcs. The sections shall be separated by sheet metal templates set perpendicular to the face and tip of the curve and not less than 2 inches longer than the depth of the curb. The templates shall be held firmly during the placing of the concrete and shall be allowed to remain in place until the concrete has set sufficiently to hold its shape, but shall be removed while the forms are still in place.

B. After the concrete has sufficiently set for a minimum of 12 hours, the CONTRACTOR shall remove the forms and backfill the spaces on each side. The earth shall be compacted in satisfactory manner without damage to the concrete Work. Minor defects shall be filled with a mortar composed of one part portland cement and two parts fine aggregate.

3.13 PAVEMENT CURB AND SIDEWALK REPAIR

A. All damage to pavement, curb or sidewalk as a result of work under this Contract shall be repaired in a manner satisfactory to the ENGINEER and at no additional cost to the OWNER. The repair shall include all work as specified herein.

B. The width of all repairs shall extend at least 12 inches beyond the limit of the damage. The edge of the pavement curb or sidewalk to be left in place shall be cut to a true edge with a saw or other approved method so as to provide a clean edge to abut the repair. The line of the repair shall be reasonably uniform with no unnecessary irregularities.

END OF SECTION

SECTION 02577

SURFACE RESTORATION

PART 1 - GENERAL

1.01 SCOPE

The work shall include completing of surface restoration as specified herein. This work includes protection and/or removal and replacement of roadway and driveway surface and pavement, striping, signs, concrete curb, gutter, driveway aprons and/or sidewalk, and landscaping restoration of features damaged by the Work. Surface restoration shall follow completion of backfilling within 7 calendar days. Restoration shall conform to the conditions of the permits and City of Hallandale Beach.

As used herein, "driveway" shall mean concrete driveway aprons and asphalt or concrete driveways and "curb and gutter" shall mean free standing concrete curb, gutter, or combination curb and gutter.

In order to protect himself from being held liable for any existing damage to roadway, concrete and asphalt driveways, sidewalks or curb and gutter, landscaping, etc., the Contractor is advised to notify in writing the authority having jurisdiction over the street where such damage exists prior to proceeding with any work in the vicinity and to document the damaged areas in the prework video tape record. A copy of all such notices shall be forwarded to the Engineer.

1.02 REFERENCES

Work and materials shall conform to the applicable requirements from the following references:

A. Florida Department of Transportation "Standard Specifications for Road and Bridge Construction", Latest Edition.

1. FDOT Section 300 - Prime and Base Courses
2. FDOT Section 320 - Hot Mix Asphalts - Plant Methods and Equipment
3. FDOT Section 331 - Type S Asphaltic Concrete
4. FDOT Section 911-3 - Composition of Limerock Material for Limerock Base and Limerock Stabilized Base
5. FDOT Section 346 - Portland Cement Concrete
6. FDOT Section 520 - Concrete Gutter, Curb Elements and Traffic Separator
7. FDOT Section 522 - Concrete Sidewalk and Driveway
8. FDOT Section 570 - Performance Turf
9. FDOT Section 580 - Landscaping
10. FDOT Section 711 - Thermoplastic Pavement Markings
11. FDOT Section 981 - Turf Materials

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

1. AASHTO T-180 - Test for Moisture-Density Relations of Soils Using a 10 lb. Rammer and an 18-Inch Drop Modified Protector Test.

C. Section 02221, Trenching, Excavation, Backfilling and Compaction

D. Minimum Standards, City of Hallandale Beach

PART 2 –MATERIALS

2.01 ROADWAY MATERIALS

A. SUBGRADE

Subgrade shall be compacted in accordance with the requirements in Section 02221. The top 12 inches of the subgrade shall be compacted to a minimum of 100 percent of the maximum density (AASHTO T-180). All subgrade material shall have an L.B.R. of 40, minimum.

B. BASE COURSE

The base course shall consist of Grade No. 2 limerock conforming to Section 911-3 of FDOT "Standard Specifications for Road and Bridge Construction". Base course material for paved areas over trenches shall be twice the minimum thickness required: for streets – 2 times 8 inches = 16 inches; for driveways – 2 times 6 inches = 12 inches, as per the above referenced FDOT specification. Base courses shall be compacted and tested in lifts not to exceed 6 inches in thickness and shall be not less than 100 percent of maximum density as per AASHTO T-180.

C. PRIMER

Primer shall be hot bituminous material in accordance with Section 300-2 of FDOT Standard Specifications, Latest Edition. Alternate primers shall be acceptable only with prior approval of the City.

D. TACK COAT

Tack coat shall be in accordance with Section 300-2.3 of FDOT Standard Specifications, Latest Edition.

E. SURFACE COURSE

The surface course shall be a minimum 1 inch of SP-9.5 asphaltic concrete in accordance with all applicable requirements of Sections 320 and 332 of FDOT "Standard Specifications for Road and Bridge Construction," Latest Edition.

2.02 GRASS, SHRUBBERY, TREES, ETC.

All planted vegetation which is removed, damaged or destroyed by project construction shall be replaced by like kind and in the same manner. Grass restoration shall be done with sod. See also Paragraph 3.05, below.

2.03 CONCRETE AND CONCRETE FEATURES

Concrete and precast and cast in place concrete features shall conform to the applicable provisions specified in Paragraph 4.03 and Division 3 of these Contract Documents, the drawings and the standard specifications of Broward County Engineering and FDOT, as applicable.

PART 3 - EXECUTION OF WORK

3.01 PUBLIC PAVEMENT

A. Base Course: The base course shall be constructed to the details shown on the Plans at the Engineer's direction. Any variance from the Plan details shall not be allowed without the prior written consent of the Engineer.

The limerock shall be transported to the point where it is to be used, over rock previously placed, if practicable, and dumped on the end of the preceding spread. In no case shall rock be dumped directly on the subgrade. The limerock shall be spread uniformly in lifts not exceeding 6 inches, maximum, compacted and tested with equipment approved by the Engineer. All segregated areas of fine or coarse rock shall be removed and replaced with well-graded rock.

The equipment to be used shall include a self-propelled blade grader weighing not less than 3 tons, with wheel base not less than 15 feet and blade length not less than 10 feet; scarifiers shall have teeth spaced not to exceed 4-½ inches apart; at least one three-wheel roller weighing not less than 10 tons; provision for furnishing water at the site of work by tank truck or hose at a rate not less than 50 gallons per minute. Alternate equipment approved by the Engineer may be used where narrow widths preclude use of larger equipment.

After spreading is completed, the entire surface shall be scarified and shaped so as to produce the exact grade and cross section after compaction. The full depth of base shall be compacted to an average density of 100% of maximum density as determined by AASHTO T-180 (Modified Proctor). The minimum density acceptable at any location shall be 100%.

The finished surface of rock base shall be true to the required cross section throughout. Any irregularities in the surface greater than ¼-inch, as determined by placing a 10 foot straightedge parallel or perpendicular with the centerline, shall be corrected by scarifying to a depth of 3-inches, removing or adding rock

as may be required and again watering, rolling and compacting the scarified area. Any area of new pavement which experiences ponding one hour after

cessation of rainfall that exceeds one square yard in area or ½ inch in depth shall be corrected at the contractor's sole expense.

Compaction test reports of subgrade or base rock shall be submitted for approval to the Engineer prior to installation of final asphalt wearing surface.

B. Priming: Before any bituminous material is applied, all loose material, dust, dirt and other foreign material which might prevent proper bond shall be removed from the base for the full width of application. The surface to be primed shall have the glazed finish removed by "hard-planing" prior to the application.

The bituminous material to be used shall be RC-70 or other material approved by the Engineer. The temperature of the material shall be between 100°F and 150°F; the exact temperature being such as will insure uniform distribution.

The surface to be primed shall be clean and dry. No bituminous material shall be applied when the temperature of the air is less than 60°F in the shade, or when, in the opinion of the Engineer, the weather conditions or the condition of the existing surface is unsuitable. The rate of application shall not be less than 0.10 gal. per square yard, and shall be sufficient to coat the surface thoroughly and uniformly without having any excess to puddle or flow off the base. Application shall be by self-propelled pressure distributor, operating under a pressure not less than 20 lbs. per square inch.

The prime shall be allowed to stand, without sanding, for a period of at least 4 hours. A uniform application of clean sand shall be applied prior to opening the primed base to traffic, in which case the sand shall be rolled with a traffic roller in conjunction with traffic to cure the prime coat. The sand to be used shall be free of silt, rock, particles, sticks, trash, vegetation, or other deleterious material.

C. Asphaltic Surface Course: Saw cut and square edges of existing asphalt. After the prime coat has had adequate time to cure, and prior to the installation of a final surface course, the Contractor shall clean the prepared base of all loose sand and other deleterious materials. If, in the opinion of the Engineer, the prepared surface is unsuitable to receive the final surface course without tacking, a tack coat shall be applied in accordance with FDOT Section 300-7. Once the surface has been properly prepared, the Contractor shall install a minimum of 1 inch of Type SP Asphaltic Concrete in accordance with the details shown on the Plans. Said Type SP Asphaltic Concrete shall conform to all of the applicable requirements of Sections 320 and 332 of the Florida Department of Transportation "Standard Specifications for Road and Bridge Construction," Latest Edition.

3.02 STATE OR COUNTY OWNED PUBLIC PAVEMENT

Restoration within all State or County owned and maintained rights-of-way shall be made in strict compliance with the construction permit. Where the trench is parallel in a lane of traffic the entire effected lane shall be resurfaced.

All work shall be subject to final inspection and approval of the Florida Department of Transportation or the County and shall be completed as expeditiously as possible.

3.03 DRIVEWAYS, PARKING LOTS AND MISCELLANEOUS PAVEMENT

Driveways, parking lots and miscellaneous pavement shall be replaced in kind and restored to a condition equal to or better than that which existed previously. The pavement shall be restored in accordance with the specifications in Section 3.01, except that the minimum thickness of the base course shall be 6 inches (12 inches over the trench area). *The Contractor is to restore all improvements damaged by his operations at no extra cost whether shown or not shown by the Plans.*

3.04 UNIMPROVED AREAS

Unimproved areas shall be restored to a condition equal to that which existed prior to this construction including grading elevations and ground cover.

3.05 RIGHT-OF-WAYS AND/OR EASEMENTS IN GRASS AND SHRUBBERY PLOTS (SWALES)

Rights-of-way and/or easements in grass and shrubbery plots (swales) shall be restored to the condition existing prior to making the excavation. All shrubbery, ornamental trees and other plantings shall be fully protected. If it is found necessary to remove any grass, shrubbery or plants to accomplish the work, they shall be satisfactorily replaced before the work will be accepted or paid for. Grass shall be replaced with sod.

The area to be sodded shall be leveled and prepared to provide a smooth, even surface. All stones, roots and other debris over 2" in largest dimension shall be removed. The surface shall be loosened to provide a proper bed of sand on black dirt. No compaction of swale areas will be allowed. Thickness of sod of two (2) inches should be taken into consideration when preparing swales.

Sod must be placed within 72 hours from excavating and preparing swale. In the event rain erodes surface of swales, the area must be prepared again to provide a smooth, even surface and surface shall be loosened again to provide a proper bed of sand and black dirt at no additional cost to the City.

Sod material shall be strongly rooted St. Augustine Floratan grass of good quality and free from weeds. It shall be alive and viable, not dormant. Sod shall be placed with 24 hours from time of striping and shall be placed with tightly fitting joints. After laying, sod shall be covered with sufficient top dressing to fill voids remaining and

thoroughly watered to wash top dressing into sodded surface. Unmixed sand shall be used for top dressing.

Finished elevation of new sod along edges of road and driveway aprons must be such to allow rainwater to flow freely to swale areas. Finished elevation of new sod along edges of existing sod must match the elevation of the existing sod. Completed sod surface shall be even and firm and shall be flush with top of abutting walks, paving, concrete borders, catch basins, and the like.

The contractor shall water immediately after placing and at least four times per week for fourteen (14) days, to insure proper growth. All sod material that is dead or in poor condition when the project is inspected for acceptance will be replaced at the contractor's expense.

The contractor shall be responsible to locate and safeguard any irrigation lines within the swale area and repair of any irrigation line damaged by contractor is the contractor's responsibility.

The contractor shall be responsible for safeguarding the asphalt or concrete along the edges of the road and driveway aprons during the regrading and preparation of the swale. Any damage to the road or driveway aprons must be repaired at the contractor's expense.

3.06 CLEANUP

Cleanup is an essential part of the project and this portion of the work will not be considered complete. *Final payment made shall not be granted until the cleanup is complete to the satisfaction of the Engineer.*

3.07 STRIPING AND SIGNS

Pavement striping, traffic control devices, and signs shall be restored in accordance with Broward County Minimum Standards and as follows:.

A. Pavement Stripes and Markings

For temporary pavement stripes and directional arrows, apply paint materials listed on the Qualified Products List, according to Section 710, FDOT SSR&BC and meet the material requirements of Sections 971-1 and 971-19.

For permanent pavement stripes and directional arrows, use thermoplastic materials listed on the Qualified Products List according to Section 711, FDOT SSR&BC and meet the material requirements of Sections 971-1 and 971-17.

Parking pavement stripes shall be paint traffic stripes meeting the requirements of Section 710 of the FDOT SSR&BC.

Place raised retro-reflective pavement markers: amber on yellow line and traffic separation; colorless/red at gore and on white line of road sharp curves. Use RPM materials and bituminous adhesives listed on the Qualified Products list, according to Section 706, FDOT SSR&BC.

Each job site must be left clean and restored to existing or better condition.

B. Signs

Furnish and erect roadway signs, with supporting posts at the locations shown in the plans, in accordance with manual on Uniform Traffic Control Devices, latest edition and Standard Highway Signs Manual published by the U.S. Department of Transportation, 2000 and Section 700 of FDOT SSR&BC. Provide posts for all frangible sign assemblies consisting of galvanized steel U-Channel as listed on the Qualified Products List. Reflectorize all signs.

All existing signs and supports that will be replaced shall be removed and delivered to the City of Hallandale Beach Public Works Department at 630 NW 2nd Street. No additional compensation will be granted for removal and delivery to the City.

PART 4 - CONCRETE DRIVEWAY APRONS, SIDEWALKS AND/OR CURB AND/OR CURB AND GUTTER RESTORATION

4.01 SCOPE

The work to be performed under this item shall include replacement of concrete features which have been removed and/or damaged during the course of construction of the work performed under this Contract. The sidewalk shall be replaced to the same dimensions as the original feature.

4.02 REFERENCES

All sidewalks constructed shall meet the requirements of the Florida Accessibility Code for Building Construction, latest edition, and to Florida Department of Transportation (FDOT) Standard Specifications for Road and Bridge Construction, Section 520 and 522 "Concrete Gutter, Curb Elements and Traffic Separator" and “Concrete Sidewalk & Driveways”.

4.03 ACCEPTABLE MATERIALS

The concrete used shall be Class I (2,500 psi in 28 days) in accordance with FDOT Standard Specification Section 347. Concrete in Hallandale Beach right-of-way shall be 3,000 psi in 28 days.

4.04 EXECUTION OF WORK

A. Concrete Sidewalk

All material, labor, forms, tools and equipment for restoration of the sidewalk shall be supplied by the Contractor. All disturbed sidewalk shall be replaced with 4-inch thick to the widths required. The sidewalk finish shall match as near as possible the original finish. Broken or cracked sidewalk shall be removed and disposed of as directed by the Engineer/*Program Manager*. Subgrade shall be fully compacted, scored joints shall be placed at a maximum of 5 foot intervals, 3/4" expansion joints shall be placed at changes in direction and at maximum 20 foot intervals.

B. Concrete Driveways

Concrete driveways, and sidewalks crossing driveways, shall be restored in full sections or blocks rather than trench width plus two feet (shoulders), if the original construction was divided into such sections or blocks. The existing driveway (or sidewalk) shall be cut with an abrasive disc saw to trim the edges to straight and true lines, with edges parallel and rectangular in plan. The interior concrete shall then be broken up and removed from the site.

Driveways, and sidewalk crossing driveways, shall be replaced with a concrete slab having a minimum thickness of 6 inches. Steel reinforcement is not required unless the existing driveway is so reinforced, in which case the replaced driveway shall also be reinforced to match the existing. Reinforcing for sidewalk is specified above.

Such forms as are necessary shall be set up and the subgrade regraded for a slab 6 inches thick. The subgrade shall be thoroughly compacted and wet down prior to placing the concrete. The surface shall be given a surface and edging to match, as nearly as possible, that of the existing driveway (or sidewalk). The finish and edging shall be obtained through the use of screeds, trowels, edgers and any other tools normally required by the trade in performing this kind of work.

All forms for driveways (or sidewalks) including those for expansion joints, shall be metal and shall be clean and well-oiled prior to placing concrete. The forms shall be set in place far enough in advance of concrete placing for the Engineer to check line and grade. Abrupt changes in line and grade will not be permitted, and forms shall be set to insure smooth curvature and alignment both vertically and horizontally. Forms shall be left in place for a minimum of 24 hours after concrete has been placed.

Replacement driveways (and sidewalks) shall match the elevation and alignment of existing driveways (and sidewalk) wherever a connection is made.

Concrete power or special concrete treatment shall be replaced to match the existing driveway. No additional compensation shall be paid for this work.

C. Concrete Curbs and Gutters

Curb and gutter shall be restored in lengths equal to trench width plus 2 feet (shoulders), or 10 feet, whichever is greater, unless otherwise shown on the drawings, permitted or ordered by the Engineer.

Removal of existing curb and gutter, installation of forms, preparation of subgrade, and the final finish shall be performed as specified hereinabove for driveways. The shape and final finish shall match that of the existing curb and gutter.

PART 5 – SWALE AND SURFACE DRAINAGE RESTORATION

5.01 GENERAL (See Section 3.05)

Where the Contractor is to construct a new main in a swale area, the swale shall be replaced to its original design including elevations, grades, and grass restoration with sod. Surfaces shall be restored to maintain existing surface drainage.

END OF SECTION

SECTION 02600

MISCELLANEOUS PIPING

PART 1 – GENERAL

1.01 SCOPE

A. This Section consists of furnishing water, sewer, storm water piping complete with fittings, couplings, adapters, valves, and other appurtenances required during construction due to piping relocation or replacement.

1.02 GENERAL INFORMATION AND DESCRIPTION

A. The pipe and fittings shall be furnished by fully qualified manufacturers experienced in the fabrication, casting and manufacture of the pipe materials specified herein. The pipe and fittings shall be designed, fabricated and installed in accordance with the best practice of the trade and the standards specified herein.

B. Pipe materials shall be the same as the existing pipe being replaced or relocated.

C. No material furnished under this specification shall be shipped to the job site until all submittals have been reviewed.

1.03 SUBMITTALS

A. The CONTRACTOR shall submit Shop Drawings in accordance with the procedures and requirements set forth in Section 01340 - Submittals.

B Each submittal shall be complete in all aspects incorporating all information and data listed herein and all additional information required to evaluate the proposed piping material's compliance with the Contract Documents. Partial or incomplete submissions will be returned to the CONTRACTOR without review. Data to be submitted shall include, but is not limited to: catalog data consisting of specifications, illustrations and a parts schedule that identifies the materials to be used.

C. The CONTRACTOR shall submit to the ENGINEER certified shop tests in accordance with the Section 01340 - Submittals.

D. The CONTRACTOR shall submit to the ENGINEER certified letters of compliance in accordance with the Section 01340 - Submittals.

PART 2 – PRODUCTS

2.01 GENERAL

A. All pipe and fittings shall be marked with the manufacturer's name or trade mark, size, class or pressure rating, and the date of manufacture in accordance with the standards specified herein.

B. PLUG VALVES:

1. Plug valves shall be conforming to AWWA C517, latest revision, which shall be of the non-lubricated, eccentric type with resilient faced plugs, port areas for valves 100% of full pipe area. The body shall be of cast or ductile iron meeting or exceeding ASTM A-126 or ASTM A-536, and shall have bolted bonnet which gives access to the internals of the valve. Seats shall be welded nickel alloy or stainless steel plate locked in the body cavity. If a plate is used, it shall be replaceable through the bonnet access. Bearings shall be permanently lubricated stainless steel, bronze or Teflon. Bearing areas shall be isolated from the flow. Valves shall have packing bonnets where the shaft protrudes from the valve and the packing shall be self-adjusting chevron type which can be replaced without removing the bonnet. All nuts, bolts, springs and washers shall be stainless steel (type 316).

2. Valves shall be suitable for underground service and designed for working pressure of 150 P.S.I. minimum. The valve and actuator shall be capable of satisfactory operation in either direction of flow against pressure drops to and including 100 P.S.I.

3. The exterior valve surfaces shall be 100% polyamine epoxy coated.

4. The valves shall be tested in accordance with ANSI/AWWA C517. The CONTRACTOR shall furnish certified copies of reports with every valve stating that the valve has met the requirements of the tests.

5. Plug valve shall be as manufactured by DeZurik Company, or equal.

C. CLEANOUT: PVC cleanouts shall have screw type access plug. Long radius wye connections and fittings shall be used in order to access cleanout operations.

D. PIPE-T0-PIPE CONNECTONS:

Non-pressure pipe-to-pipe connections shall be made by flexible couplings as manufactured by Fernco or equal.

2.03 WATER PIPE, FITTINGS, AND VALVES

A. POLYVINYL CHLORIDE PIPE

1. All PVC pipe shall be continuously and permanently marked with the manufacturer's name, pipe size, and pressure rating in psi.

2. The CONTRACTOR shall also require the manufacturer to mark the date of extrusion on the pipe. This dating shall be done in conjunction with records to be held by the manufacturer for 2 years, covering quality control tests, raw material batch number, and other information deemed necessary by the manufacturer.

3. PVC pipe shall conform to ASTM D1785 and shall be made from a 12454B compound which is a Type 1, Grade 1 plastic as defined by ASTM D1784. Rerun or reclaimed materials will not be acceptable.

4. Pipe to be used for potable water applications shall comply with the National Sanitation Foundation Standard No. 14 and shall have markings on the pipe to indicate that it has been tested and is in compliance.

5. Wall Thickness shall be a minimum of Schedule 80, unless otherwise noted in the piping schedule.

B. JOINTS

1. Pipe joints shall be provided as specified in the pipe schedule.

2. For above ground piping, joints shall be socket welded for nominal pipe sizes less than three inches in diameter. Where threaded connections are required, socket type threaded adapters shall be provided. For above ground piping, three (3) inches in diameter and larger, joints shall be flanged. Socket type flange adapters shall be provided.

3. All PVC pipe less than four inches in diameter intended for buried service shall be socket weld joint.

4. All PVC pipe four (4) inches in diameter and larger, unless otherwise scheduled, intended for buried service shall be push-on type in accordance with AWWA C-900 and shall utilize ductile iron retainers for restraining pipe joints. Retainers shall be cast from 60-42-10 ductile iron and shall have a sufficient number of ductile tie bolts to restrain working and tests pressures as required. The retainer clamp shall be of two piece construction with serrations on the I.D. sufficient to hold the required pressures. The retainers shall be Series 1500 or 6500 as manufactured by EBAA Iron, Inc.

5. Socket type joints shall be made up in accordance with ASTM D2855 with a PVC solvent cement complying with ASTM D2564. The cement shall have a minimum viscosity of 2000 cps.

6. Where flanges are to be used, flanges shall be van stone type with full faced vinyl gaskets.

C. FITTINGS

1. <u>Ductile Iron Fitting:</u> Fittings shall be ductle iron mechanical joint (MJ) type, complete with glands, gaskets, bolts and nuts, and shall conform to

ANSI/AWWA C110/A21,10. Inside surfaces shall be cement lined according to AWWA C104. Fitting shall be pressure rated at 250 psi, minimum.

2. PVC FITTINGS

   a. Socket type pipe fittings for Schedule 40 pipe shall conform to ASTM D2466.

   b. Socket type pipe fittings for Schedule 80 pipe shall conform to ASTM D2467.

   c. Fittings shall have the same schedule designation, joint type and be made of the same PVC compound as the connecting pipe.

D. GATE VALVES LESS THAN THREE INCH (3") IPS, BRONZED: Gate valves for use with pipe less than three inches (3") in diameter shall be rated for two hundred (200) psi working pressure, non-shock, block pattern, screwed bonnet, non-rising stem, brass body, and solid wedge. They shall be standard threaded for PVC pipe and have a malleable iron handwheel. Gate valves less than three inches (3") in diameter shall be Nibco-Scott T-133 or T-136 with no substitutions allowed.

E. GATE VALVES THREE INCH (3") TO TWELVE INCH (12”):

   1. The valves shall be resilient seated and shall conform in design, material, and workmanship to the standards of AWWA C509. Gate valves shall open counterclockwise and shall be of iron body, non-rising stem, and mechanical cut-in joint ends. All resilient seat valves must be bi-directional.

   2. Valves shall be coated with a two-part thermosetting epoxy coating on inside of valve and on valve disc. The coating shall conform with the requirements of AWWA C-550. After the factory test and inspection, all ferrous parts of the valves except finished or bearing surfaces shall be painted with two (2) coats of asphalt varnish, Federal Specification TT-V-51A or approved equal.

   3. Gate valves four inches (4") through twelve inches (12") in size shall be Mueller A-2360-20 or Clow F6111, or equal.

F. BUTTERFLY VALVES:

   1. Valves shall conform to all requirements of AWWA C504 Standard Class 150B. Valves shall have mechanical - joint-type ends conforming to AWWA C111 and cast iron body conforming to ASTM A126 Class B standards.

   2. Valve bodies shall have two shaft bearing hubs cast integrally with the valve bodies. Valve bearings shall be sleeve type bearings with nylon bearings that are self-lubricating and do not have a harmful effect on water. Valve disc shall be cast iron conforming ASTM A-126 Class B with 316 stainless steel disc edge.

   3. Valves shall be Mueller 3211-20, Clow F-5370, or equal.

G. END CONNECTIONS:

The dimensions of end connections shall conform to AWWA Standard C111-85. The end flanges of flanged valves shall conform in dimensions and drilling to ANSI Standard B16.1 for cast iron flanges and flanged fittings, Class 125, unless specifically provided otherwise. The bolt holes shall straddle the vertical center-line.

H. TAPPING VALVES, SLEEVES AND CROSSES:

1. Tapping valves shall be resilient wedge type meeting ANSI/AWWA C509 and shall be connected by a machined projection on the outlet flanges of the tapping sleeves and crosses. The outlet ends shall conform in mechanical joint connections, except that the outside of the valves shall be larger than normal size to permit full diameter cuts.

2. Tapping valves shall comply in all other respects to the gate valve requirement of these specifications. All tapping valves must have a cast-in-alignment ring and be capable of accepting a full size cutter. Tapping valves shall be Clow or American Darling only.

3. All tapping sleeves shall have duck-tipped end gaskets, flanged outlet with American one hundred, twenty-five pounds (125 lbs) standard template, mechanical joints in the main line, factory tested for 400 psi and with working pressure of two hundred (200) psi, complete with bolts, glands, gaskets, and nuts. They shall be Mueller H-615, Clow F-5205, or equal.

4. All tapping crosses shall have duck tipped end gaskets, flanged outlet with American one hundred twenty-five (125 lbs) standard template, mechanical joints in the main line, factory tested for four hundred (400) psi and with working pressure of two hundred (200) psi, complete with bolts, glands gaskets and nuts. They shall be Mueller H-715, Clow F-5220, or equal.

I. VALVE BOXES AND COVERS

1. Valve boxes and covers for all size valves shall be of cast iron construction and adjustable screw-on type. The lid shall have cast in the metal the word “WATER” for the water lines. All valve boxes shall be six-inch (6") nominal diameter and shall be suitable for depths of the particular valve. The stem of the buried valve shall be within twenty-four inches (24") of the finished grade unless otherwise approved by the ENGINEER. Valve boxes shall be Opelicka No. 19, no substitutes.

2. Cast iron valve box shall not rest directly upon the body of the valve or upon the pipe. The box shall be placed in proper alignment and to such an elevation that its top will be at the final grade. Backfilling around both units shall be placed and compacted to the satisfaction of the ENGINEER.

J. SERVICE CONNECTIONS

1. Two-inch PVC pipe for water services shall be schedule 80 and shall be solvent welded except for threaded nipples and bushings and conform to ASTMD 1785 and ASTMD 2467.

2. Curb stops shall be ball valves manufactured by Ford Meter Company or CITY approved equal, except for 1-inch and 2-inch meters instead of curb stops, and shall be installed in meter boxes. Control gate valves shall be Nibco Scott T-133 or T-136. No substitutions.

3. Corporation stops shall be Mueller H-10046 or equal.

K. TAPPING SADDLES: Double strap tapping saddles shall be constructed of tough malleable iron heavily galvanized bodies with neoprene gaskets cemented to body and iron pipe thread, designed to withstand a working pressure of five hundred (500) psi and accurately fit the pipe for which it is intended. The straps shall be forged steel with curvature accurately designed to fit pipe. All nuts and straps including threads shall be heavily cadmium plated. Tapping saddles shall be Mueller K-10509, Clow F-1280, Smith Blair, or approved equal.

L. DRESSER COUPLINGS: Dresser couplings shall be regular black couplings with plain gaskets. They shall be Dresser Style 90 with no substitutions allowed. Polyethglene liner shall be used to fully encased the dresser couplings.

M. MEGATAPE: Megatape and locating metal wire to be buried 18 inches below finished grade over the water main and sewage force mains or service lines on PVC pipe (no exceptions).

N. LINE STOP FITTING: Valve cut-in on the existing water main shall be performed under pressure using line stop fittings. The body of the fittings shall be carbon steel conforming to ASTM A-36. The flange shall be steel flanges Class D, conforming to AWWA C207 with stainless steel bolts and nuts. The line stop fitting shall be manufactured by International Piping Services Company (1-407-843-2800), or equal.

O. FIRE HYDRANTS:

1. All fire hydrants shall be of the dry-barrel type and shall conform in design, material and workmanship to AWWA C502. Hydrants shall have five and one-quarter inch main valve opening and a three way nozzle arrangement. The connection pipe shall be ductile iron pipe conforming to AWWA C151, Class 52.

2. The depth of bury, measured from the bottom of the connecting pipe to the ground line of the hydrant shall be three feet six inches minimum. Exact depth at each location shall be determined by depth of line to which the hydrant is connected.

3. Inlet connection shall be six-inch mechanical joint. Typical installation detail is shown in the Contract drawing.

4. Two - 2-1/2 inch hose nozzles and one - 4-1/2 inch pump nozzle connection threads shall conform to NFPA No. 194 (ANSI B26) Standard for Screw Threads and Gaskets for Fire Hose Couplings.

5. Hydrants shall be furnished with accessories to include mechanical joint follower rings with set screws and at least one adjustable hydrant wrench with spanner included with every ten hydrants supplied. Barrel extension sections shall not be allowed on new fire hydrants, except by special permission from the ENGINEER. All fire hydrants shall be Mueller Super Centurion Model A-423 or American Darting Model B84B, with no substitutions allowed..

6. There shall be no shrubbery planted within 6 feet of any fire hydrant.

PART 3 - EXECUTION

3.01 GENERAL

A. Proper and suitable tools and appliances for the safe convenient handling and laying of pipe shall be used and, in general, conform with manufacturer's recommendations. At the time of laying, the pipe shall be examined carefully for defects, and should any pipe be discovered to be defective after being laid, it shall be removed and replaced with sound pipe by the CONTRACTOR at his expense.

B. Pipe and fittings shall, at all times, be handled with great care to avoid damage. In loading and unloading, they shall be lifted with cranes or hoists or slid or rolled on skidways in such manner as to avoid shock. Under no circumstances shall this material be dropped or allowed to roll or slide against obstructions. Pipe and other material shall be distributed along the right-of-way in advance of installation only to the extent approved by the ENGINEER. Such materials shall be so placed as to keep obstruction to traffic minimum.

C. Upon satisfactory completion of the pipe bedding, a continuous trough for the pipe barrel and recesses for the pipe bells, or couplings, shall be excavated by hand digging. When the pipe is laid in the prepared trench, true to line and grade, the pipe barrel shall receive continuous, uniform support with no pressure being exerted on the pipe joints from the trench bottom.

D. Pipe shall be installed in accordance with the manufacturer's recommendation. Before being lowered into the trench, the pipes and accessories shall be carefully examined and the interior of the pipes shall be thoroughly cleaned of all foreign matter and other methods acceptable to the ENGINEER. During suspension of work, for any reason, at any time, a suitable stopper shall be placed in the end of the pipe last laid to prevent mud or other foreign material from entering the pipe. Any pipe which is disturbed or found defective shall be immediately removed and replaced with sound pipe.

E. Lines shall be laid straight and true to the lines, matching existing grade.

F. Any work within the pipe and fittings shall be performed with care to prevent damage to the interior wall of the pipe. Damaged interior walls shall be repaired or the pipe section or fitting replaced as required by the ENGINEER. No cables, lifting arms, hooks or other devices shall be inserted into the pipe or fitting. All lifting, pulling or pushing mechanisms shall be applied to the exterior of the pipe or fitting.

G. After pipe has been laid, reviewed and found satisfactory, sufficient backfill shall be placed along the pipe barrel to hold the pipe securely in place during the conduction of the required tests.

3.02 INSTALLATION OF POLYVINYL CHLORIDE (PVC) PIPE

A. Each length of pipe, immediately prior to being placed in position in the trench, shall be inspected, cleaned and prepared for installation. Gaskets shall be thoroughly checked for brakes, cuts or other damage, and shall be free of oil, grease, dirt or other foreign matter. Pipe joints shall be assembled with care. Lubricant, if required, shall be as recommended by the manufacturer of the pipe, and shall have no deteriorating effects on the gasket and pipe materials. If assembly is underwater, lubricant recommended by the manufacturer for underwater use is required. Good alignment of the pipe if required for assemble. Align the spigot to the bell of the previously laid pipe and insert the spigot into the bell until it uniformly contacts the gasket. Apply steady pressure until the spigot easily slips through the gasket. Do no push or swing the spigot into the bell. Small diameter pipe and fittings may be assembled manually. Mechanical means such as bars and blocks, rackets or jacks shall be used for joining larger pipe and fittings. Power equipment, such as backhoe bucket, shall not be used to assemble pipe and fittings, since excessive force may damage the gasket or bell.

B. Cutting the pipe in the field shall be done by the CONTRACTOR in a neat and workmanlike manner using manual or power saws. The pipe shall be marked around its entire circumference before cutting to assure a square cut. After cutting, the end shall be beveled using a beveling tool, rasp, or other approved equipment, to the proper taper. Mark the proper insertion depth on the cut and beveled end before installing the cut pipe into the pipeline. Pipe laying shall proceed up-grade from the lowest point of the proposed system, with spigot ends pointing in the direction of flow. All pipe shall be laid straight, true to the lines and matching existing grade, in each section between manholes. The pipe shall be laid so that the identification markings are located on the top of the installed pipelines. At all times when work is not in progress, the exposed ends of all pipes shall be fully protected by an approved stopper to prevent groundwater, dirt, rocks or other substances from entering the pipe.

C. Each individual length of pipe shall be solidly and evenly bedded and haunched throughout its length on a prepared bed on the floor of the trench and not supported in position on blocks or wedges. Pipe shall only be laid when the two preceding lengths have been thoroughly embedded in place to prevent any movement or disturbance of the finished joint. Any pipe which is disturbed or found to be defective after laying shall be taken up and relaid or replaced.

D. Mechanical joints shall be made up using annealed high strength cast iron bolts and rubber gaskets as recommended by the manufacturer. All types of mechanical joint pipes shall be laid and jointed in full conformance with the manufacturer's recommendations, which shall be submitted to the ENGINEER for review and approval before work is begun. Only especially skilled workers shall be permitted to make up mechanical joints. Torque wrenches set as specified in AWWA Standard C111 latest revision shall be used. Spanner-type wrenches may be used with the approval of the ENGINEER.

E. Push-on joints shall be made in strict, complete compliance with the manufacturer's recommendations. Lubricant, if required, shall be an inert, non-toxic, water soluble compound incapable of harboring, supporting, or culturing bacterial life. Manufacturer's recommendations shall be submitted to the ENGINEER for review and approval before work is begun.

F. Concrete blocks and restrained joints shall be placed at all bends, lees plugs and other fittings, valves, and pipelines as shown on the Drawings or as directed by the ENGINEER.

3.03 VALVE INSTALLATION

A. All valves, stem extensions, valve boxes, and accessories shall be installed in accordance with the manufacturer's written instructions and as shown and specified.

B. The CONTRACTOR shall not open or close valves unless otherwise approved by the ENGINEER.

3.04 VALVE CUT-INS ON WATER MAINS

A. Water system shall be maintained under pressure during entire construction. All valve additions shall be performed while the system is in service. No line shall be shut down during construction by CONTRACTOR or others unless approved by the OWNER.

3.05 GRAVITY SEWER INSTALLATION

A. Gravity sewer installation shall be in accordance with manufacturer's procedures.

3.06 HYDRANT INSTALLATION

A. All fire hydrants shall be installed in strict accordance with the manufacturer's published recommendations, AWWA Standards, and all applicable codes, and the applicable provisions of Section 02502. All installations shall be to the satisfaction of the local fire and building department.

B. All hydrant isolating valves with slip joints, friction type, or caulked joint connections shall be harnessed to the main pipe by means of welded steel harness sets, or clamps and steel rods, designed for this purpose. Dry barrel fire hydrants shall be set on a bed of pea gravel not less than 18 inches deep and 3 feet square, for drainage, or as required by local regulations and conditions.

C. All 6-inch valve additions can be performed with partial-localized system isolation with the approval of the ENGINER and proper notifications/coordination with he City (i.e. 48 hours minimum prior notice).

D. Existing concrete thrust blocks shall be removed and replaced in accordance to the requirements of the miscellaneous details in the drawings.

E. Restrained joints shall be placed at all joints of fire hydrant, pipe connections, and vales.

3.07 TESTING WATER MAIN LINES

A. Water mains shall be tested in accordance with ANSI/AWWA Standard C600.

B. HYDROSTATIC TESTS:

1. After a new water main has been laid and backfilled, it shall be pumped to a pressure of 150 p.s.i. and all visible leaks stopped by approved methods.

2. A leakage test shall then be conducted at the above-mentioned pressure, and no installation will be acceptable by the OWNER until the leakage is less than the number of gallons per hour as determined by the formula:

$$L = \frac{S \cdot D \cdot P^{1/2}}{148{,}000}$$

in which L equals the allowable leakage in gallons per hour; S is the length of line in feet being tested; D is the nominal diameter of the pipe in inches; and P is the average test pressure during the leakage test in pounds per square inch. The test is usually maintained for two hours, but it may be continued for one additional hour if it becomes apparent that the leakage is equal to or greater than the amount allowable. Water supplied to the main during the test to maintain the required pressure shall be measured by a 5/8-inch meter installed on the discharge side of the test pump, or by pumping from a calibrated container. A hose bib connection will be provided to accept the test gauge supplied by the OWNER.

3. The section of main being tested shall be limited to a maximum length of 2000 feet. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gallon / hour / inch of nominal valve size shall be allowed. Any questions pertaining to procedures used during the test shall be decided by the ENGINEER.

4. The CONTRACTOR shall supply and install temporary air release valves for purposes of facilitating proper hydrostatic testing conditions. Location of the ARV's shall be as per the instructions given by the ENGINEER. The CONTRACTOR shall be responsible to remove the ARV's upon the

successful completion of the testing and shall be responsible for all associated site restorations resulting from his/her work.

C. DISINFECTION:

1. After the water mains have satisfied the leakage requirements, they shall be flushed through openings of the required size as detailed in ANSI/AWWA Standard C601 latest revision. The main shall then be disinfected in accordance with the provisions of the applicable sections of the above-named specifications. On main breaks, cut-ins, etc., a liberal application of calcium hypochlorite shall be made.

2. Mains shall not be put into domestic service until the necessary bacteriological samples have been approved by the applicable regulatory agencies.

3.08 TESTING WATER SERVICE LINES

A. HYDROSTATIC TESTING: Hydrostatic testing of water service lines shall be done in conjunction with the testing of the lateral or main line. No additional leakage allowance will be made for service lines.

B. DISINFECTION: Disinfection of service lines shall be done in conjunction with the disinfection of the lateral or main line. Sufficient sampling points shall be taken from service line connections to assure uniform results throughout the system being tested.

END OF SECTION

SECTION 02730

WASTEWATER FLOW CONTROL

1.01 SCOPE OF WORK

A. The work specified in this Section includes all labor, materials, accessories, equipment and tools for performing all operations required to bypass pump sewage around a manhole, wet well or sewer section in which work is to be performed. The CONTRACTOR shall be prepared to bypass pump sewage as a part of his operations.

B. The work specified in this Section also includes all labor, materials, accessories, equipment and tools for performing all operations required to bypass pump sewage around a section of force main or gravity sewer in which work is to be performed, or around a manhole/wet well into which a force main or gravity sewer discharges if work is to be performed at the manhole/wet well. The CONTRACTOR shall be prepared to bypass pump sewage as a part of his operations.

C. The CONTRACTOR shall provide all pumps, piping, and other equipment to accomplish this task; perform all construction; obtain all permits; pay all costs; and perform complete restoration of all existing facilities to equal or better condition to the satisfaction of the CITY.

1.02 GENERAL

A. When sewer line flows at the upstream manhole of the line being repaired or replaced are above the maximum allowable requirements for television survey, or do not allow the proper sewer or manhole repair / replacement, the flows shall be reduced to the levels indicated by one of the following methods: manual operation of pumping stations by CITY forces, by the CONTRACTOR plugging / blocking of the flows, or by the CONTRACTOR pumping / bypassing of the flows as acceptable to the CITY.

B. In some applications, the wastewater flow may be plugged and contained within the capacity of the collection system. This shall only be done when it has been determined the system can accommodate the surcharging without any adverse impact.

C. For the initial television survey, before and after any repair / replacement with the exception of joint testing and sealing, the sewer line shall be blocked completely. No flow, except infiltration/inflow, will be allowed through the respective sewer line being televised on the television survey.

D. For all other television surveys, including warranty surveys and joint testing and sealing operations, the depth of flow within the sewer shall not exceed that shown below for the respective pipe sizes as measured in the manhole.

1. Maximum Depth of Flow - Warranty Television Survey

6" - 10" Pipe ..... 20% of pipe diameter

12" - 24" Pipe ..... 25% of pipe diameter

Above 24" Pipe ..... 30% of pipe diameter

2. Maximum Depth of Flow – Joint Testing/Sealing

6" - 12" Pipe ..... 25% of pipe diameter

15" - 24" Pipe ..... 30% of pipe diameter

Above 24" Pipe ..... 35% of pipe diameter

E. When sewer line flows at the upstream manhole of the line being repaired or replaced, in the opinion of the CITY, are too excessive to plug while the rehabilitation is being performed, the CONTRACTOR shall submit a written plan and pump/bypass the flow as acceptable to the CITY.

F. When flows of sewage through a force main being repaired, or discharging by gravity or force main to a manhole/wet well being repaired or replaced, are in the opinion of the CITY too excessive to plug or stop while the rehabilitation is being performed, the CONTRACTOR shall submit a written plan and pump/bypass the flow as acceptable to the CITY.

1.03 SUBMITTALS

A. The CONTRACTOR shall submit complete, detailed plans for this aspect of the work to the CITY for review.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 PLUGGING AND BLOCKING

A. A sewer line plug shall be inserted into the line at a manhole upstream from the section being surveyed, repaired or replaced. The plug shall be so designed that all or any portion of the operation flows can be released. During the survey portion of the operation, flows shall be shut off or reduced to within the maximum flow limits specified. During repairs or replacement, the flows shall be shut off or pumped / bypassed, as acceptable to the CITY. After the work tasks have been completed, flows shall be restored to normal.

3.02 PUMPING AND BYPASSING

A. When pumping/bypassing is required, as determined by the CITY, the CONTRACTOR will supply the necessary pumps, conduits and other equipment to divert the flow of sewage around the manhole/wet well section in which work is to be performed. The bypass system shall be of sufficient capacity to handle existing flows plus additional flow that may occur during periods of rain storms. The CONTRACTOR will be responsible for furnishing the necessary labor and supervision to set up and operate the pumping and bypassing system. A "setup" consists of the necessary pumps, conduits and other equipment to divert the flow of sewage around a manhole/wet well section, from the start to finish of work

performed in the manhole/wet well section.

B. Pumps shall have automatic control to turn on and off depending on the water level. The CONTRACTOR shall provide a 24 hour 7 day emergency contact telephone number for anybody to contact a responsible person in his organization in case of an emergency and shall respond without delay to rectify the situation. Pumps and equipment shall be continuously monitored by a maintenance person capable of starting, stopping, refueling and maintaining these pumps during the rehabilitation. If pumping is required on a 24-hour basis, engines shall be equipped in a manner to keep noise to a minimum. Bypass pumps shall meet the noise requirements per City Ordinances.

C. In the case of bypassing force main/gravity sewer flows, whether such flows normally discharge into a manhole/wet well being repaired/replaced or pass through a force main/gravity sewer being repaired/replaced, bypass shall be accomplished by one of two methods.

1. In the absence of surface conditions that prevent temporary bypass piping, the force main/gravity sewer shall be accessed by excavation and temporary piping shall be installed to bypass the repair/replacement in a manner acceptable to the CITY. In general, for manhole repairs/replacement, the CONTRACTOR shall excavate to the force main outside the manhole, cut the force main, attach bypass piping, and bypass flow to the next downstream manhole. For force main repairs, the CONTRACTOR shall excavate to the force main on each side of the repair, cut the force main on each side of the repair, attach bypass piping on each side of the repair, and bypass flow around the repair. Upon the conclusion of bypass activities and repair work, the CONTRACTOR shall install closure pieces to permanently rejoin and restore the force main to full function.

2. Where surface conditions prevent the use of temporary bypass piping, and where the CITY cannot accomplish the bypass operations in-house, the CITY shall shut down the associated lift station and the CONTRACTOR shall pump from the wet well into tanker trucks for transport to a designated location. The number of tanker trucks deemed necessary for this operation shall be agreed to in advance by the CITY.

3.03 FLOW CONTROL PRECAUTIONS

A. Surcharging Sewers. Where the raw sewage flow is blocked or plugged, sufficient precautions must be taken to protect the public health. No septic conditions shall be allowed due to CONTRACTOR's operations. The sewer lines shall also be protected from damage. The following occurrences shall not be allowed:

1. No sewage shall be allowed to back up into any homes or buildings.

2. No sewage shall overflow any manholes, cleanouts or any other access to the sewers.

3. Users upstream of the repair area shall be able to use all their water and

sewer utilities without interruption.

B. If any of the above unallowable conditions occur or are expected to occur, the CONTRACTOR shall bypass pump to alleviate one or all of the conditions. Additionally, the CONTRACTOR is required to observe the conditions upstream of the plug and be prepared to immediately start bypass pumping, if needed. It is CONTRACTOR's responsibility to pay for all damage claims.

C. Pumps. Any sump pumps, bypass pumps, trash pumps or any other type pump which pulls sewage/water or any type of material out of the manhole/wet well or sewer shall discharge this material into another manhole/wet well, or appropriate vehicle or container acceptable to the CITY.

Under no circumstances shall this material be discharged, stored or deposited on the ground, swale, road or open environment.

D. Traffic Control. The CONTRACTOR shall take appropriate steps to ensure that all pumps, piping and hoses that carry raw sewage are protected from traffic. Traffic control shall be performed in accordance with Section 01570 - Traffic Regulation and Maintenance of Traffic.

E. Sewage Spills. In the event, during any form of "Sewage Flow Control", that raw sewage is spilled, discharged, leaked or otherwise deposited in the open environment, due to the CONTRACTOR's work, the CONTRACTOR is responsible for any cleanup of solids and disinfection of the area affected. This work will be performed at the CONTRACTOR's expense with no additional cost to the CITY. The CONTRACTOR is also responsible for notifying the sewer system maintenance personnel and complying with any and all regulatory requirements in regards to the size spill with no additional cost to the CITY.

END OF SECTION

SECTION 02830

CHAINLINK FENCES AND GATES

PART 1 - GENERAL

1.01 SCOPE

Furnish and install all fencing indicated on the Contract Drawings. Also specified in this Section is the removal of fencing as required for the construction performed under this Contract.

1.02 SUBMITTAL AND SERVICES

The Contractor shall furnish shop drawings for the materials, construction and installation of the fence in accordance with Section 01340. Provide samples of materials (fabric, wire, accessories), if so requested.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. General - Products from approved qualified manufacturers having a minimum of five years .successful experience manufacturing vinyl clad, aluminum and aluminized steel chain link fences and gates. Contractor shall obtain chain link fence, gates, accessories, fittings and fastenings from a single source.

B. Privacy Slats - Fabric privacy slats shall be from an approved qualified manufacturer having a minimum of five years .successful experience manufacturing similar vinyl materials. Contractor shall obtain privacy slats, accessories, fittings and fastenings from a single source.

2.02 MATERIALS

A. Fabric

1. The fabric and fabric ties shall be aluminum No. 6 gauge wire woven in a two (2) inch mesh. The fabric and fabric ties shall be green hot dipped vinyl coated before weaving, as per ASTM A 491 and shall match the color of the privacy slats. The weight of the vinyl coating shall be determined as per ASTM A 428.

2. Size: Helically wound and woven with 1 inch diamond mesh, 6 gauge.

3. Selvage of fabric twisted at the top and knuckled at the bottom.

B. Vinyl Privacy Slats

1. Fabric Privacy Slats - Material: Polyethylene is preferred and is specified below. Contractor may submit equivalent PVC slats that meet the intent and quality of the polyethylene specified herein. Burdon will be upon contractor to demonstrate equivalence.

2. U.V. treated 100% high density.

3. Construction: Knit Raschel with at least 90 % density.

4. Tensile Strength: Warp - 102 lbs, Weft - 220 lbs. E. Flammability: 340 degrees C.

5. Color: Green and shall match the color of the fabric and framework coatings.

6. Fabrication: 3-ply reinforced hem on top and bottom, sewn with 2 rows of #130 blended UV treated polyester thread.

7. Grommets: #2 brass, every 12", on all sides of each section.

C. Framework

1. All post and other appurtenances used in the construction of fence shall be hot dipped aluminized steel with a minimum of 1.8 ounces per square foot of surface. Sizes referred to are nominal O.D. as commonly used in the trade. All of the framework and accessory items shall be green vinyl coated to match the green color of the fabric and privacy slats. All posts without arms shall be crowned to shed water.

2. Steel Pipe – Type II: Cold formed and welded steel pipe complying with ASTM F 1043, Group 1C, with minimum yield strength of 50,000 psi, sizes as indicated.

D. Line Posts

The intermediate line posts shall be 2-1/2 inch O.D. and shall have a minimum wall thickness of 0.130 inches. Provide top cap that guides and braces the top rail.

E. End and Corner Posts

All end and corner posts shall be 4 inch O.D and shall have a minimum thickness of 0.226 inches. Provide top cap.

F. Swing Gates

1. Gate Posts: All swing gate posts shall be 6-5/8 inch O.D and shall have a minimum thickness of 0.280 inches, hot dip aluminized steel. Provide top cap.

2. Gate frames: Fabricate chain link swing gates in accordance with ASTM F 900 using aluminized steel tubular members, as shown. Fusion or stainless steel welded connections forming rigid one-piece unit. Aluminum-coated frames fused

as specified above (after fabrication). Coating before fabrication will not be allowed.

3. Chain link fence fabric: Same as specified above. Install fabric with hook bolts and tension bars at all 4 sides (no substitution). Attach to gate frame at not more than 15 inches on center.

4. Hardware materials: Hot-dipped vinylized steel or malleable iron shapes to suit gate size. Field coat moveable parts (e.g. hinges, latch, keeper. and drop bar) with vinyl coating touch up kit. provided by manufacturer, to match adjacent finishes.

5. Hinges: Structurally capable of supporting gate leaf and allow opening and closing without binding. Non-lift-off type hinge design shall permit gate to swing 180° inward or 180° outward.

6. Latch: Forked type capable of retaining gate in closed position and have provision for padlock. Latch shall permit operation from either side of gate.

7. Keeper: Provide keeper for each gate leaf over 5' wide. Gate keeper shall consist of mechanical device for securing free end of gate when in full open position.

8. Double gates: Provide drop rod to hold inactive leaf. Provide gate stop pipe to engage center drop rod. Provide locking device and padlock eyes as an integral part of latch, requiring one padlock for locking both gate leaves.

G. Bottom Wire

The bottom tension wire shall be seven (7) gauge coil spring aluminized steel. Tension wire shall be stretched taut from terminal to terminal post and securely fastened to each inter-mediate post six (6) inches above the grade line. Tension wire shall be attached to the fence fabric with aluminized steel hog rings every twelve (12) inches.

H. Top Rail

All rails shall be 1-5/8 inch O.D., schedule 40 and shall have a minimum thickness of 0.111 inches. Top rail to be provided with outside type six (6) inch long couplings and joined at approximate twenty (20) feet intervals. The top rail is to pass through line post tops to form a continuous brace end to end of each stretch of fence.

I. Braces

Brace pipe shall be the same as top rail and shall be installed midway between the top rail and ground and extend from the terminal post to the first adjacent line post. Brace pipe shall be securely fastened to posts with malleable iron rail end cap and have beveled edge pressed steel brace band with bolt, then trussed from line post to

base of terminal post with a 3/8 inch truss rod and tightener. On runs of fence requiring two (2) line post or less, omit truss rod assembly and install a continuous center brace rail.

J. Miscellaneous Hardware

1. Chain link fence accessories: CONTRACTOR shall provide items required to complete fence system. Aluminize each ferrous metal item and finish to match framing.

2. Stops, latches, keepers, post caps, barb wire supporting arms, fasteners and other miscellaneous hardware shall be of steel, malleable iron or ductile iron. All items shall be hot dip aluminized after fabrication.

3. Post caps: Formed steel, cast malleable iron, or aluminum alloy weather tight closure cap for tubular posts. CONTRACTOR shall provide one cap for each post.

4. Top rail and brace rail ends: Pressed steel per ASTM F626, for connection of rail and brace to terminal posts.

5. Top rail sleeves: 7 inch expansion sleeve with spring, allowing for expansion and contraction of top rail.

6. Brace and tension (stretcher bar) bands: Pressed steel. At square post provide tension bar clips.

7. Wire ties: 6-gauge galvanized steel wire for attachment of fabric to line posts. Double wrap 6 gauge for rails and braces. Hog ring ties of 6-gauge for attachment of fabric to tension wire.

8. Tension (stretcher) bars: One piece lengths equal to 2 inches less than full height of fabric with a minimum cross-section of 3/16 inch x ¾ inch or equivalent fiberglass rod. Provide tension (stretcher) bars where chain link fabric meets terminal posts.

9. Truss rods and tightener: Aluminized steel rods with minimum diameter of 5/16 inches, capable of withstanding a tension of minimum 2,000 Ibs.

10. Nuts and bolts shall be aluminum or aluminized steel , either of appropriate size and strength.

PART 3 - EXECUTION

3.01 POSTS

Posts shall be evenly spaced in the line of fence at a maximum of ten (10) feet on center. Installation shall be made in a workmanlike manner with skilled mechanics experienced in erection of this type of fence. The fence shall be erected on line and to grade as shown on the Drawings. All posts shall be set in concrete foundations in the ground to a minimum of four (4) times the diameter of the post. The concrete shall be 2,500 psi minimum compressive strength as specified in Section 03640. The exposed surface of the concrete shall be crowned to shed water.

3.02 SWING GATES

A. CONTRACTOR shall install gate posts in accordance with manufacturer's instructions and as shown and specified.

B. Gate posts and hardware: Set keeper, stops, and sleeves into concrete. Check each post for vertical and top alignment, and maintain in position during placement and finishing operations.

C. CONTRACTOR shall install gates plumb, level, and secure for full opening without interference.

D. CONTRACTOR shall attach hardware by means that will prevent unauthorized removal.

E. CONTRACTOR shall adjust hardware for smooth operation.

F. CONTRACTOR shall touch up hardware.

3.03 GENERAL

A. CONTRACTOR shall attach hardware by means that will prevent unauthorized removal.

B. CONTRACTOR shall touch up hardware.

3.04 FABRIC FASTENING

All fabric to be stretched taut from terminal to terminal and secured to same with a heavy aluminized 3/4 inch tension bar and heavy beveled edge tension band with bolts, one (1) band less than the height of fence. Fasten chain link fabric to rails, intermediate posts with a No. 6 gauge aluminum tie a maximum of fourteen (14) inch at all points. All the tie ends to be wrapped on it's own end a minimum of two (2) times and turned in to eliminate any hazardous condition. CONTRACTOR shall install fabric on security side and attach so that fabric remains in tension after pulling force is released. Leave approximately 2 inches between finish grade and bottom

selvage. CONTRACTOR shall pull fabric taut; thread tension (stretcher) bars through fabric and attach to terminal posts with bands or clips.

3.05 ACCESSORIES

A. Tie wires: CONTRACTOR shall bend ends of wire to minimize hazard to persons and clothing.

B. .Fasteners: CONTRACTOR shall install nuts on side of fence opposite fabric side for added security.

C. CONTRACTOR shall touch up hardware.

3.06 VINYL PRIVACY SLATS

A. Fabric: CONTRACTOR shall install fabric inside the enclosure and attach so that fabric remains in tension after pulling force is released. Leave approximately 2 inches between finish grade and bottom of fabric. Entire fence and gates to be screened.

B. Tie Raps: CONTRACTOR shall use 50 lb. high density UV stabilized polyethylene for the top and sides. Use 120 lb. high density UV stabilized polyethylene for the bottom.

3.07 REMOVAL OF EXISTING FENCING

The Contractor shall remove existing fencing as shown (where existent) on the Drawings. Removed fencing shall remain property of the Owner, unless otherwise noted.

3.08 CLEANUP

Upon completion of the installation, all debris created by the installation shall be removed from the premises of the Owner or disposed of as directed by the Owner.

END OF SECTION

SECTION 03460

PRECAST AND CAST IN PLACE CONCRETE FOR SEWAGE PUMP STATION WET WELLS, VAULTS & CHAMBERS

PART 1 - GENERAL

1.01 SCOPE

The Contractor shall furnish all materials and shall construct precast concrete wet wells and valve vaults, as shown on the Drawings and as required for a complete installation.

1.02 DESCRIPTION

Wet Wells shall be precast concrete manholes and Valve Vaults shall be precast concrete boxes, each with water-stops, sleeves and openings as noted on the Drawings. Box outs for wall pipes shall conform accurately to the sizes and elevations of the adjoining pipes. The structures shall be watertight.

1.03 RELATED ITEMS SPECIFIED ELSEWHERE

Sewage Pump Station Structure Rehabilitation is specified in Section 03769.
Access Hatches and Valve Floor Boxes are specified in Section 05200.
Painting and coatings are specified in Section 09900.

1.04 REFERENCE STANDARDS

Work for concrete structures shall comply to applicable sections of the latest edition of the following references:

A. Building Code Requirements for Reinforced Concrete, American Concrete Institute, ACI 318.

B. Florida Building Code.

C. Florida Department of Transportation (FDOT), Standard Specifications for Road and Bridge Construction, Sections 345, 400, 415, and applicable reference sections.

D. ASTM C478, Precast Reinforced Concrete Manhole Sections.

PART 2 - PRODUCTS

2.01 PRECAST MANHOLES

Precast manholes for Wet Wells shall conform to the requirements of ASTM C 478 with reinforcement of ASTM A 615, Grade 60 bars and the following modifications thereto:

1. The minimum wall thickness shall be 12 inches.

2. The minimum inside diameter shall be 10 feet.

3. Cement to be used in precast manholes and grout shall be ASTM C 150, Type II.

4. The date and name of manufacturer shall be marked inside each precast section.

5. No more than 2 lift holes may be cast or drilled in each section.

6. Provide a square flat slab top with reinforcing, as shown on the drawings.

7. Provide base slab reinforcing, as shown on the drawings.

2.02 CLASS OF CONCRETE

Structural concrete shall be Class IV as per Section 345 of the FDOT Standard Specifications for Road and Bridge Construction. Maximum aggregate size is 3/4 inch, use Type II cement, with 10 to 15 percent pozzolans conforming to ASTM C618, use water reducing agent for work ability requirements.

Tremie concrete shall have a minimum average strength of 2,500 psi, well graded durable aggregate, 2" maximum size. The water/cement ratio shall not be greater than 0.6.

Prior to placement of concrete, the Contractor shall furnish the Engineer, for approval, a statement of the materials and mix proportions (including admixtures) he intends to use. The statement shall include evidence satisfactory to the Engineer that the materials and the proportions will produce concrete conforming to this specification. The materials and proportions so stated shall constitute the "job mix". After a job mix has been approved, neither the source, character of grading the aggregates, nor the type or brand of cement or admixture shall be changed without approval.

2.03 REINFORCING STEEL

Rebar shall be Grade 60 conforming to ACI 318 requirements. Bars shall be fabricated as per code requirements, free from dirt, rust, grease, oil or cracks at time of concrete placement. Rebar shall be properly secured and supported according to code requirements.

2.04 INTERIOR AND EXTERIOR COATINGS

All coatings shall be per Section 09900.

2.05 WALL PENETRATION SEAL

Shall be a modular mechanical type, consisting of interlocking sealing links of an elastomer such as ethylene propylene and piene monomer (EPDM) shaped to continuously fill the annular space between the pipe and wall sleeve. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and sleeve. The watertight seal shall be effective against a hydrostatic head of at least 40 feet. The seal shall also be constructed so as to provide electrical insulation between the pipe and wall, thus reducing chances of cathodic reaction between these two members. Metal hardware shall be 18-8 stainless steel. The seal shall be similar to the Link-Seal modular wall and casing seal manufactured by Thunderline Corporation or the equivalent by other manufacturers.

The Contractor shall be responsible for the selection of the required inside diameter of each wall opening or sleeve for each pipe and the correct sizing of seal.

2.06 VALVE VAULT

The rectangular vault shall be fabricated and reinforced as shown on the drawings. The date and name of manufacturer shall be marked inside each precast section. No more than 2 lift holes may be cast or drilled in each section. Provide base slab reinforcing, as shown on the drawings.

2.07 WET WELL AND VAULT TOP SLABS

Top slabs shall be fabricated and reinforced as shown on the drawings. Access hatches and, where required, floor boxes for valves, shall be cast into the concrete slab. For hatches, also cast in the required drip rim drains.

PART 3 - EXECUTION

3.01 EXECUTION AND TESTING

The Engineer or his representative shall have free entry to the construction site, precast plant, or plant and equipment furnishing concrete. Proper facilities shall be provided for the Engineer to inspect materials, equipment and processes and to obtain samples of the concrete. All tests and inspections will be conducted so as not to interfere unnecessarily with manufacture and delivery of the concrete.

Concrete shall be uniform and thoroughly mixed before placement. Variations in the slump of more than 1 inch will be considered evidence of inadequate mixing or improper proportioning and shall be rejected or corrected.

3.02 EXCAVATION

Excavated surfaces too steep to be safe and stable if unsupported shall be supported as necessary to safeguard the work and workmen, to prevent sliding or settling of the adjacent ground, and to avoid damaging existing improvements. The width of the excavation shall be increased if necessary to provide space for sheeting, bracing, shoring, and other supporting installations. All construction shall be in accordance with all State and Federal safety regulations.

Sheeting and bracing shall be continuously maintained to prevent damage to property, injury to persons, or erosion and cave-ins. Bracing and sheeting shall be completely removed as the backfilling progresses. All voids caused by the removal of sheeting shall be backfilled immediately with sand or other approved fill material and compacted.

3.03 DEWATERING

The excavation shall be dewatered for placement of poured-in-place concrete and backfill. In cases where floating of structures can occur, the site shall be continuously dewatered until backfill is placed to prevent floating or the structure is filled with water to provide equalization. Dewatering procedure shall be such as to prevent movement of soil causing erosion, settlement, silting downstream, or turbidity control requirements.

Dewatering is not required for placement of precast sections provided floating of the structure is prevented and tremie concrete.

3.04 FOUNDATION PREPARATION

Base slabs or tremie concrete shall be placed on stable material. All mud, organic material and muck shall be removed. The subgrade shall be stabilized with gravel or drain rock. The foundation shall be level and free from soft spots before placement of the base slab. Tremie concrete shall be pumped in place, not dropped from above. The top surface of tremie concrete shall be level and even.

3.05 BACKFILLING

A. Excavations shall be dewatered during excavation to at least 1' below bottom of excavation unless backfill is with approved, well graded gravel and sand mix material.

B. Do not backfill over existing subgrade surfaces which are muddy or spongy. Deleterious materials shall be removed.

C. Backfill and compact carefully around pipes and below structure and tanks to completely fill voids and achieve specified density uniformly.

D. Place and compacted approved fill to specified density in lifts not-to-exceed 12 inches.

E. The moisture content of fill material shall be within 2% of the optimum moisture content based on the modified proctor maximum dry density test (AASHTO-180). The percent compaction shall be at least 90% of the modified proctor maximum dry density. Backfill to be under paved areas shall be at least 95% of maximum density. Imported gravel shall be vibrated to proper density.

F. Backfill all areas to grades, contours, levels and elevations. Compact all areas of fill in each lift, including final lift to finish grade.

G. Backfill shall be done systematically and as early as possible to allow maximum time for natural settlement and compaction. Do not backfill against walls below grade until concrete has a minimum compression strength of 3,000 psi or adequate bracing is provided as approved by the Engineer.

H. Unsuitable or excess materials shall be removed from the site and disposed of by the Contractor as part of the bid price.

3.06 SETTING PRECAST SECTIONS

Precast reinforced concrete sections shall be set so as to be vertical and with sections in true alignment.

All holes in sections; used for their handling, shall be thoroughly plugged with mortar. The mortar shall be one (1) part cement to one and one-half (1½) parts sand; mixed slightly damp to the touch (just short of "balling"); hammered into the holes until it is dense and an excess of paste appears on the surface; and then finished smooth and flush with the adjoining surfaces.

Sections shall be sealed with Ram Neck caulking. At the joints and the inside and the outside shall also be sealed with cement mortar grout.

Set the structure on a compacted bedding of at least 6 inches thickness of crushed or broken stones, as is also used for pipe bedding.

3.03 FINISH

The inside and the outside-of the chambers shall be finished as shown and noted on the Contract Drawings.

3.04 PIPE TO MANHOLE WALL SEAL

Seal to a watertight condition the annular space between the force main and the manhole wall with a cast in sleeve and either a Link-Seal (as specified under Paragraph 2.03, above) or using a standard pipe to manhole gland as is normal for sanitary sewer construction.

END OF SECTION

SECTION 03769

SEWAGE PUMP STATION STRUCTURE REHABILITATION

1.0 SCOPE

The intent of this section is rehabilitation of existing sewage pump station wet well structures. The Contractor shall coordinate with the requirements both in this Section and on the Drawings and he shall perform the more stringent procedure, unless otherwise directed by the Engineer. In addition to rehabilitation, existing fill concrete to funnel sewage to the existing pump inlets shall be removed, as needed for the new submersible pump installation and new fill concrete shall be installed, as shown on the Drawings or as required by the pump manufacturer.

2.0 GENERAL

Rehabilitation includes the following:

A. The sealing of the structure base, walls, corbel/cone and chimney of brick, block or precast sections from inflow and infiltration.

B. Sand blasting existing wet well areas and pressure cleaning other areas of the structure.

C. Structural repair of deteriorated areas.

D. Applying new protective linings/coatings as specified.

E. Removal of existing piping and appurtenances as specified.

F. Grouting, sealing and anchoring new piping and appurtenances.

2.1 NOTICES

The Contractor shall inform the City and the Engineer of the date of commencement and anticipated completion of the work one week before actual work beings. Sewage service must be maintained during rehabilitation work. The Contractor shall coordinate all work and scheduling with the City.

2.2 SAFETY

The Contractor shall conform to all work safety requirements of pertinent regulatory agencies and shall secure the site for working condition incompliance with the same. The Contractor shall erect such signs and other devices as are necessary for the safety of the work site and traffic control. The Contractor shall perform all work in accordance

with the applicable OSHA standards. Emphasis is placed upon the requirements for entering confined spaces, scaffolding, and the handling and storage of chemicals.

3.0 STRUCTURE SEALING

Structure sealing includes the sealing of the base, walls, corbel, cover, cone and chimney with chemical grouting or for low head open defect conditions, hydraulic cement, Preco Plug or approved equal. This type of sealing shall be done during high groundwater conditions, unless the point of leakage has been previously identified.

A. Chemical Grout Sealing:

1. Equipment: The basic equipment shall consist of chemical pumps, chemical containers, injection nozzles, hoses, valves, and all necessary equipment and tools required to seal manholes or other below grade structures. The chemical injection pumps shall be equipped with pressure meters that will provide for monitoring pressure during the injection of the chemical sealants. When necessary, liquid bypass lines equipped with pressure-regulating bypass valves will be incorporated into the pumping system.

2. Sealing Procedures: At each point of leakage within the structure a hole shall be carefully drilled from within the structure and shall extend through the entire structure wall. In cases where there are multiple leaks around the circumference of the structure, fewer holes may be drilled, providing all leakages are stopped from these holes. Grout ports or sealant injection devices shall be placed in the previously drilled holes in such a way as to provide a watertight seal between the holes and the injection device. A hose, or hoses, shall be attached to the injection devise from an injection pump. Chemical sealing materials as specified shall then be pumped through the hose until material refusal is recorded on the pressure gage mounted on the pumping unit or a predetermined quantity of sealant has been injected. Care shall be taken during the pumping operation to insure that excessive pressures do not develop and cause damage to the manhole structure. Upon completion of the injection, the ports shall be removed and the remaining holes filled with mortar and troweled flush with the surface of the structure walls or other surfaces. The mortar used shall be a non-shrink patching mortar, Preco plug or approved equal.

3. Sealing Procedures (Brick and Block Manholes): When chemical grouting is used to seal random or isolated leaks or leaking section of a brick or block manhole, it shall be done in accordance with 3(a)2, above.

4. Non-Structural Large Crack Sealing: Seal large cracks by placing oakum, saturated in Scotch-Seal 5600 chemical grout and activate with water. Use "activated oakum technique" as recommended by Scotch-Seal 5600 manufacturer or approved equal methodology.

5. Chemical Joint Sealing Materials: Chemical joint sealing materials used on this project shall be AV-100 or AV-118, Duriflex gel as manufactured by Avanti International, Houston, Texas, AV-254 Gelseal urethane gel manufactured by Avanti International or Scotch Seal Chemical Grout 5610 (gel) urethane gel as manufactured by 3m. AV-257 shall be used with AV-118 or AV-100 at a rate of 3 gallons of AV-257 per 30-gallon batch of grout, AV-254 or 5610 five gallons per 35 gallons of water shall be used. Contractor may incorporate additions for shrinkage control, root control and strength enhancements as site conditions dictate such as AV-257 Icoret, Celite 292, Dechlorenic. Material use and mixing shall be in accordance with the manufacturer's recommendations. Unless otherwise directed by the Engineer a 30 second cup gel time shall be used.

4.0 REMOVAL OF PIPING AND APPURTENANCES

Removal of piping, anchors and accessories shall be done in a manner that will cause as little damage to the structure as possible. Pipes and anchors shall be drilled or sawed out with as little hammering as possible. Care shall be made to preserve existing reinforcement as much as possible and not structurally damage the structure. The cleaned surface shall receive a coating of Sikadur 32, Hi-Mod or approved equal, epoxy bonding/grouting adhesive before application of grout. Application of the bonding agent shall be done in accordance with manufacturer's instructions.

Pipe and/or appurtenances shall be grouted in place with a nonshrink grout, Sika Grout 212, or approved equal. Grout shall reach a compressive strength of at least 2,500 psi before loading or pressurizing of pipe. Grouted areas shall be ground smooth with adjacent concrete. Grouted structure patches shall be free from water leakage through the structure.

5.0 JOINT SEALING

Joint sealing includes the sealing of joints using one of the following methods and procedures.

A. Chemical Grout Sealing: Use the same procedures and materials as required in Section 3.0.

B. Expanded Gasket: Use the elastomeric polyurethane resin-soaked oakum method, using dry twisted jute oakum or resin rod with polyurethane resin (water activated).

C. Hydraulic Cement: Under low head open joint conditions, hydraulic cement such as Preco Plug or approved equal may be used in accordance with the manufacturer's instructions. The surface shall be cleaned and free from standing water upon application.

6.0 MANHOLE FRAME REPLACEMENT AND/OR SEALING

Not Used

7.0 MANHOLE COVER SEALING

Not Used

8.0 MANHOLE, FRAME, CHIMNEY OR CORBEL REPAIR OR REPLACEMENT

Not Used

9.0 CONCRETE STRUCTURAL CRACK REPAIR

Structural crack repair shall consist of drilling out the crack, cleaning the crack of loose materials, and filling the crack with approved two-part epoxy resin.

Where infiltration is present the Contractor shall inject a two-part gel into the defective area to suppress the leakage prior to beginning work.

10.0 INTERIOR SURFACE REHABILITATION

Clean concrete and brick surfaces to remove laitance, loose particles, oil, grease or other contaminants. Wet well areas shall be cleaned by sandblasting/hydro grit at 4,000 psi. The surface shall have a pH of 7 or above before application of surface treatment.

Exposed reinforcement shall receive a polyamide epoxy primer and two coats of polyamide epoxy coating.

Apply cement surface treatment to areas that have ½-inch or more of deteriorated surface, in accordance with manufactures recommendations, at a depth to match the non-deteriorated surfaces or ½-inch minimum thickness. Approved cement surface preparations are Mainstay ML-72, Sewper Coat, Fosroc SP15 or approved equal. Non-deteriorated areas do not require a cementations coating unless required by the interior epoxy coating manufacturer as a pre-epoxy surface preparation.

Create a smooth base for new submersible pumps as detailed or recommended by the pump manufacturer. Use high strength cement/polymer blend, Fosroc SD-2 or approved equal, 1/2-inch minimum thickness. Build filets with concrete or cementitious material as detailed or as recommended by the pump manufacturer on the floor of the wet well.

The wet wells shall receive an epoxy interior coating, 60 mils minimum dry film thickness, such as Mainstay DS-4, Fosroc HBS100 or approved equal, that is compatible with the cement surface treatment used and compatible for application in existing damp subsurface structures, subject to capillary movement of moisture through the wall. The Contractor shall apply pre-epoxy application materials as may be

recommended by the epoxy supplier, such as Sikgard 75 to prepare the surface for application. The surface shall be visually inspected after application. If any pinholes exist additional applications shall be made until the condition is corrected.

Non-wet areas shall receive treatment as indicated in Section 09900. Interior resurfacing shall have a 5-year warranty.

11.0 FINAL ACCEPTANCE

After the specified work has been completed, the structures shall be visually inspected and tested by the Contractor (as required) in the presence of the Engineer and found to be acceptable.

Structure Sealing Test: Structure sealing shall be visually inspected for water tightness against leakage of water into or through the structure. All visible leaks and defects observed during inspection shall be repaired to the Engineers' satisfaction.

END OF SECTION

SECTION 05200

MISCELLANEOUS METALS

PART 1 - GENERAL

Miscellaneous metals necessary for a complete installation, not specified herein, shall be equal in quality to the specified material suitable for the intended use, and shall conform to the details and notes shown on the Plans. All minor items implied, usually included or required for the construction of a complete operating system, shall be installed whether specified or shown on the Plans, or not.

1.01 SCOPE

The Contractor shall furnish and install all miscellaneous metal, including access hatches, as shown on the Drawings and specified herein, required for complete installation.

1.02 STANDARDS

Work shall comply with requirements and recommendations of the standards listed in the Special Conditions.

1.03 RELATED WORK

Section - 01010	Summary of Work
Section - 01340	Shop Drawings, Product Data and Samples
Section - 03460	Sewage Pump Station
Section - 09900	Protective Coatings

1.04 SHOP DRAWINGS

The Contractor shall submit shop drawings for review in accordance with the Contract Document. No fabrication shall be started until shop drawings have been reviewed by the Owner. The drawings shall be made in conformity with standard practice and indicate: fabrication, assembly and erection details, size of member, profiles, fastenings, supports and anchors, patterns, clearances, connection to other work.

PART 2 - PRODUCTS

2.01 MATERIALS

All materials shall be of best quality and entirely suited for the particular service. Metals shall be free from defects and have structural properties to safely render required service.

Fastenings shall, insofar as practicable, be non-corrosive, non-staining and concealed. Exposed welds shall be ground smooth to form a neat uniform fillet without weakening base metal. Unexposed welds shall have all slag removed before applying shop coating. Molded, bent or shaped members shall be formed with clean, sharp rises, without dents, scratches, cracks or other defects. All anchors, bolts, shims and accessory items shall be provided as required for building into or fastening to adjacent work. All ferrous metals shall be galvanized, except as otherwise specified.

Unless otherwise specified the miscellaneous metal work shall be equal to or exceed the requirements of the following standards:

	ASTM Designation
Carbon and Low Alloy Steel	
Plates and Structural Fabrication	A 36, A 529 or A 283 Grade C
Sheet Steel	A 570 Grade C
Bars and Rods	A 36 or A 306 Grade 60
Pipe - general use process pipe	A 53 or A 120 Schedule 40
process pipe	A 524 Grade I
Fasteners	
Standard Strength Bolts	A 307 Grade A
High Strength Bolts	A 325
Eyebolts	A 489
Steel Coatings	
Zinc - Electrodeposited	A 164
Hot Dipped	A 123 and A 386
Cadmium	A 165
Stainless Steel	
Plate and Steel	A 167 Type 304
Bars and Shapes	A 276 Type 304

Fasteners	A 167 and A 276 Type 316
<u>Cast Iron</u>	
Gray	A 48 Class 30 B
Malleable	A 47
Ductile	A 536 Grade 60-40-18
<u>Wrought Iron</u>	
Plates	A 42
Sheets	A 162
Shapes and Bars	A 207
Pipe	A 72
<u>Bronze</u>	
Rods, Bars, and Shapes	B 138 Alloy B Soft
Fasteners	
Yellow Brass Cap Screws and Other Small Fasteners	B 16, B 36, or B 134
Silicon Bronze Bolts	B 97, B 98, B 99 and B 124
<u>Aluminum</u>	
Structure Shapes	B 308 Alloy 6061-T6
Castings	B 26 , B 85 and B 108
Extruded Bars, Rods and Tubes	B 221 Bars - Alloy 6061 Other - Alloy 6063
Plates and Sheet	B 209 Plates - Alloy 6061 Sheets - Alloy 3003

Materials with more than one specification or grade listed shall conform to specification or grade providing the highest strength and appropriated mechanical properties for the fabrication technique used.

2.02 PROTECTIVE COATING

All ferrous metal, except stainless steel and galvanized surfaces, shall be properly cleaned and given one shop coat of primer compatible with the coating system specified in Section 09900. Metal work to be encased in concrete shall be shop primed unless specified to be stainless steel or galvanized. Castings that are to be left unpainted shall be cleaned and coated with a coal-tar-pitch varnish.

Hot-dip galvanizing or zinc coatings applied on products fabricated from rolled, pressed or forged steel shapes, plated, bars and strips shall comply with ASTM A 123. Hot-dip galvanizing or zinc coatings on assembled steel products shall comply with ASTM A 386. The weight of coatings shall be designated in Table 1 for the class and thickness of material to be coated.

Galvanized surfaces for which a shop coat of paint is specified shall be chemically treated to provide a bond for the paint. Except for bolts and nuts, all galvanizing shall be done after fabrication.

Aluminum to be placed adjacent to masonry or dissimilar metals shall be protected with an isolating coating of bitumastic and/or felt.

2.03 HATCHES/ACCESS DOORS

A. Access doors shall be two or three leaf type, as required and as shown on the drawings, and shall be Type JD-AL as manufactured by the Bilco Co., New Haven CT, W2S or W3S as manufactured by Halliday Products, Inc., Orlando FL, the equivalent manufactured by U.S. Foundry and Manufacturing Corporation, Medley FL, or approved equal.

B. Access door assemblies shall be sized as indicated on the drawings. Openings indicated shall be clear openings with no intermediate ribs to stiffen the frame and the doors and their hardware shall not interfere with the open space. The door panel shall not protrude into the channel frame when in the open position. Doors shall open to 90 degrees and automatically lock with a Type 316 stainless steel hold open arm with an aluminum release handle with vinyl release handle grip. Doors shall close flush with the frame.

C. Performance characteristics:

1. Covers: Shall be reinforced to support a minimum live load of 300 psf with a maximum deflection of 1/150th of the span.

2. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.

3. Operation of the cover shall not be affected by temperature.

4. Entire door, including all hardware components, shall be highly corrosion resistant.

5. Door leafs shall be interlocked so that they have to be opened in a defined sequence: north first, south last.

D. Covers: Shall be ¼ inch aluminum, diamond pattern.

E. Frame: Channel frame shall be ¼ inch extruded aluminum with bend down anchor tabs or a continuous integral anchor flange around the perimeter. Frame shall drain water out through a 1-1/2-inch drainage pipe coupling.

F. Access doors shall be watertight and equipped with stainless steel accessories, stainless steel slamlock with operating key, cast aluminum drop handle, padlock staple and an automatic hold open arm with vinyl release handle grip.

G. Hinges: Shall be specifically designed for horizontal installation and shall be through bolted to the cover with tamperproof Type 316 stainless steel lock bolts and shall be through bolted to the frame with Type 316 stainless steel bolts and locknuts.

H. Drain Coupling: Provide a 1-1/2 inch drain coupling, located as shown.

I. Lifting mechanisms: Manufacturer shall provide the required number and size of stainless steel compression spring operators enclosed in stainless steel telescopic or aluminum tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the cover when closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube, if utilized by the door submitted, shall interlock with a flanged support shoe fastened to a formed ¼ inch gusset support plate.

J. A removable exterior turn/lift handle with a spring loaded ball detent shall be provided to open the cover and the latch release shall be protected by a flush, gasketed, removable screw plug.

K. Hardware:

1. Hinges: Heavy forged aluminum or Type 316 stainless steel hinges, each having a minimum ¼ inch diameter and a Type 316 stainless steel pin, shall be provided and shall pivot so the cover does not protrude into the channel frame.

2. Covers shall be equipped with a hold open arm which automatically locks the cover in the open position.

3. Covers shall be fitted with the required number and size of compression spring operators. Springs shall be made of Type 316 or Type 17-4 PH

stainless steel. Spring tubes shall be constructed of aluminum, stainless steel or a reinforced nylon 6/6-based engineered composite material.

4. A Type 316 stainless steel snap lock with fixed handle shall be mounted on the underside of the cover.

5. Hardware: Shall be Type 316 stainless steel throughout, unless otherwise specified or approved, Including the lifting mechanism assemblies; hold-open and guide arm and guides; safety chains and spring latch; and all brackets, hinges, pins and fasteners. Access doors shall be equipped with safety catch chains, etc. to prevent accidental dropping of the doors.

L. Recessed Lock Box: Access door assemblies shall be supplied with a Recessed Padlock hasp lock box. Padlock Hasps shall feature a flushed hinged lid and a fully welded receptacle that is designed to receive a standard padlock. The recessed lock box shall be used in conjunction with an owner-supplied padlock to prevent unauthorized entry. It shall have an independently hinged cover that is opened when access to the padlock is desired. The recessed lock box shall be designed to facilitate a trip free walking surface.

1 The recessed lock box shall be cast aluminum and shall be continuously welded to the underside of the access cover.

2 The hinge and attaching hardware shall be Type 316 stainless steel.

3 The padlock hole in the recessed lock box shall be 3/8 inches in diameter.

M. Finishes: Factory finish shall be mill finish aluminum with bituminous coating applied to the exterior of the frame to prevent galvanic action with the concrete. Parts of access door units which will be in contact with concrete shall be coated with one coat of coal tar epoxy.

N. Specific Requirements:

1. Wet Well Assembly: Provide a three leaf door assembly, hinged at the east side, with an 8 foot (north to south) by 4 foot (east to west) clear opening.

2. Valve Vault Assembly: Provide a two leaf door assembly, hinged at the north and south sides, with a 8 foot (north to south) by 6 foot (east to west) clear opening.

O. Manufacturer's Warranty

Unit shall carry a twenty-five year minimum guarantee against defects in material and/or workmanship. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge.

2.04 LADDER

Ladder shall be a series L1B or L1D as manufactured by Halliday Products Inc. of Orlando, Florida or approved equal, shall be constructed entirely of aluminum. The rails shall be ½ inch x 2 ¾ inch aluminum extrusion and shall be spaced 16 inches apart. The wall mounted standoffs shall be 3/8 inch x 2 ½ inch flat bar and welded to the rails at a maximum of 60 inches on center. The standoffs shall be a minimum of 7 inches and manufactured to fit flush with the wall. Slip resistant 1 3/8 inch diameter ribbed rungs shall be spaced at 12 inches on center and welded to the outside of each rail. Factory finish shall be mill finish aluminum with bituminous coating applied to all contact surfaces to prevent galvanic action with the concrete.

2.05 STRUCTURAL AND MISCELLANEOUS ALUMINUM

All structural and miscellaneous aluminum shapes, bars and plates shall be Alloy 6061-T6. All fasteners for aluminum to be placed adjacent to concrete, masonry or dissimilar metals shall be protected with one (1) coat of bitumastic paint.

2.06 SAFETY CHAINS

Safety chains shall be 316 stainless steel proof coil chain. Chains shall be straight link style, 3/16 inch diameter, with at least twelve (12) links per foot, and with snap hooks on each end. Snap hooks shall be boat type and eye bolts for attachment of chains shall be stainless steel 3/8 inch bolt with 3/4 inch eye diameter, anchored as required. Two (2) chains four (4) inches longer than the anchorage spacing shall be supplied for each guarded area.

2.07 VALVE AND FLOOR BOXES

A. Valve and floor boxes for both buried valves and the wet well knife gate valve shall be:

1. Cast iron construction, adjustable type, as shown.

2. Cast in the cover the word "SEWER".

B. Floor box for the wet well knife gate valve shall be cast in place type with integral bronzed bushed stem guide, as manufactured by Clow/Kennedy/M&H or equal. Ferrous surfaces exposed to wet well gasses shall be coated with Protecto 401.

2.08 FASTENERS

A. General

Bolts, screws, nuts, washers, anchors and other fasteners shall be first quality and shall conform to the material specifications named herein. All necessary bolts, anchor bolts, nuts, washers, plates and bolt sleeves shall be furnished by the

Contractor in accordance herewith. Anchor bolts shall have suitable washers and, where so required, their nuts shall be hexagonal.

Stainless steel and silicon bronze bolts shall have a raised letter or symbol on the bolts indicating the manufacturer.

Concrete and masonry inserts shall be drill-in type as manufactured by Phillips Drill Company, Michigan City, Indiana; Hilti, Tulsa, Oklahoma; or equal. Powder or gun-driven, fiber, and plastic inserts shall not be used unless specifically noted. The use of these devises in the webs of prestressed concrete members is prohibited.

B. Material

All bolts, anchor bolts, nuts, washers, plates, and bolt sleeves shall be type A 316 stainless steel unless otherwise indicated or specified.

If any bolts, anchor bolts, nuts and washers, are specified to be galvanized, they shall be zinc coated, after being threaded, by the hot dip process in conformity with ASTM A 123, or A 153, as is appropriate.

C. Concrete Insert

Concrete inserts shall be designed to support safely, in the concrete that is used, the maximum load that can be imposed by the bolts used in the inserts.

D. Dissimilar Metal

All dissimilar metal shall be connected with appropriate fasteners and shall be insulated with a dielectric or approved equal. Unless otherwise specified, aluminum shall be fastened with Type 304 stainless steel bolts and insulated with micarta, nylon, rubber, or equal.

E. Anchor Bolts

Anchor bolts shall be set accurately and be carefully held in suitable templates of approved design. Where indicated on the Drawings, specified, or required, anchor bolts shall be provided with square plates at least four (4) inches by 1/8 inch (4” x 1/8”) or shall have square heads and washers and be set in the concrete forms with suitable pipe sleeves, or both. Drill-in type anchors shall not be substituted for anchor bolts.

2.09 SHOP PAINTING

Non-Stainless ferrous surfaces of valves and appurtenances shall receive a coating of rust-inhibitive primer as specified in Section 09900.

PART 3 - EXECUTION

3.01 FABRICATION

A. General

All workmanship shall be first class and conform to recognized and accepted best practice. All structural materials shall be thoroughly straightened in the shop by methods that will not injure them before templates are placed on same for laying out and before any work is done upon them. Finished members shall be absolutely straight and free from open joints and distortions of any kind. All shearings shall be neatly finished. Flame cutting may be used in the preparation of the various members provided this operation is performed by a machine. All necessary fillets, connections, brackets, posts, and other details not shown on the drawings, but necessary for the work, shall be furnished by the Contractor. Fabrication shall be by welding except where riveted construction is specifically allowed by the Specifications or Owner.

B. Grating and Plates

Gratings, checkered plates and other applicable items shall be fabricated based on verified field measurements and examination of adjoining work and conditions.

C. Steel

Steel fabrication shall meet the applicable requirements of the AISC Specification for Design, Fabrication, and Erection of Structural Steel for Buildings.

D. Aluminum

Aluminum fabrication shall meet the applicable requirements of the Aluminum Construction Manual, Specifications for Aluminum Structures.

E. Welding

All welding shall be in accordance with the latest revised standards and recommendations of the American Welding Society. The welding of all joints shall produce complete fusion with the parent metal and shall be used insofar as practicable. Tack welding will not be permitted on exposed surfaces. Finished welded joints shall be reasonably smooth and free from grooves, depressions or other irregularities. Any other irregularities shall be corrected by welding and/or grinding. All scale or flux shall be removed after each pass. Bronze shall be welded by either the inert gas shielded arc method or by brazing with the proper flux and filler metal. All flush welds of butt joints shall be ground smooth where exposed to view.

3.02 PRODUCT HANDLING

A. All materials, especially access hatches and ladders, shall be delivered in manufacturer's original packaging.

B. Store materials in a dry, protected, well-vented area. The contractor shall thoroughly inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier's freight bill of lading.

C. Remove protective wrapping immediately after installation.

3.03 INSTALLATION

All miscellaneous items shall be installed in conformance with specifications and details as shown on the drawings, or processed shop drawings. Installation and erection shall conform to the best practice with each item set plumb, level, true to line and securely anchored in its proper place. Install access doors and ladders in strict accordance with manufacturer's directions.

When installing the access hatches, extend the drip rim drain to the edge of the concrete with Schedule 40 PVC pipe and fittings embedded in the concrete.

The wet well access door shall be delivered by the Contractor to the location where the wet well top slab is being precast. It shall be cast into the top slab. Similarly, the valve vault access door shall be cast into the valve vault structure.

3.03 PROTECTION OF ALUMINUM FROM CONTACT WITH CONCRETE AND DISSIMILAR METALS:

Where dissimilar metals are in contact or where aluminum is in contact with concrete, mortar, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be properly insulated to prevent electrolytic action. Aluminum embedded in concrete or masonry shall be coated with zinc chromate, or as recommended by the aluminum product manufacturer. Aluminum faced on concrete, mortar, masonry, wet or pressure-treated wood or absorptive materials subject to wetting, shall be coated with a bituminous paint or asphalt varnish. Aluminum in contact with dissimilar metals shall be coated as recommended by the manufacturer. Repair all damaged shop coatings in the field to restore a fully protective coating.

END OF SECTION

SECTION 09900

PROTECTIVE COATINGS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This Section covers the work required to provide all labor, materials, equipment and incidentals to perform all of the necessary surface preparation and painting required to complete this contract in its entirety.

B. It is the intent of this specification to paint all concrete, exposed miscellaneous ferrous metals, pipes, fittings, valves, equipment and all other work obviously required to be painted unless otherwise specified. Minor items omitted in the schedule of work shall be included in the work of this Section where they come within the general intent of the Specifications as stated herein.

C. The following surfaces or items are not required to be coated:

1. Aluminum: gratings, checkered plates, hatches, handrails, toeboards, stairways and walkways.

2. Stainless Steel, brass and bronze.

3. Piping buried in the ground or embedded in concrete.

4. Ducts, pipes and other miscellaneous items covered with insulation or plastic coated.

5. Concealed surfaces of pipe and crawl spaces.

6. Finish hardware.

7. Non-ferrous architectural metals, unless specifically noted otherwise.

8. Packing glands and other adjustable parts and nameplates of mechanical equipment.

9. Concrete slabs and equipment pads.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Individual specification sections.

B. Section 03769 for rehabilitation coatings.

1.03 ABBREVIATIONS

The abbreviations and definitions listed below, when used in this Section, shall have the following meanings:

ANSI	-	American National Standards Institute
ASTM	-	American Society of Testing Materials
AWWA	-	American Water Works Association
DFT	-	Dry Film Thickness
FPP	-	Fiberglass Reinforced Plastic
HCI	-	Hydrochlric Acid
MDFT	-	Minimum Dry Film Thickness
MDFTPC	-	Minimum Dry Film Thickness Per Coat
mil	-	Thousandths of an Inch
MIL-P	-	Military Specification - paint
NACE	-	National Association of Corrosion Engineers
NSF	-	National Sanitary Foundation
OSHA	-	Occupational Safety and Health Act
SFPG	-	Square Feet Per Gallon
SFPGPC	-	Square Feet Per Gallon Per Coat
SP	-	Surface Preparation
SSPC	-	Steel Structures Painting Council

1.04 SUBMITTALS

A. Submittals will be made with the coating system data sheet included at the end of this section.

B. The following shall be submitted for each proposed coating system; manufacturer's specifications, surface preparation details, application procedures, technical data sheets, and dry film thickness or coverage.

C. Unless otherwise specified, hereinafter and before any painting work is started, prepare with type of paint and application specified, and on similar substrate to which paint is to be finally applied, samples not less than 8" in size.

D. Furnish additional samples as required until colors, finishes and textures are acceptable. Retain accepted samples to be used as the quality standard for final finishes.

E. Before proceeding with the work under this Section, finish one complete space or item of each color scheme required showing selected colors, finishes and textures are acceptable. Retain accepted samples to be used as the quality standard for final finishes.

F. Schedule of Painting Operations: The Contractor shall submit for review a complete schedule of painting operations 10 days after the Notice to Proceed.

1.05 QUALITY ASSURANCE

A. The paint manufacturer shall provide a representative to visit the job site at intervals during surface preparation and painting as may be required for product application quality assurance and to determine compliance with manufacturer's instructions and these Specifications, and as may be necessary to resolve field problems attributable to, or associated with, the manufacturer's products furnished under this Contract.

B. A site visit report shall be prepared and submitted by paint manufacturer's representative documenting compliance with the manufacturer's recommended applications.

1.06 INSPECTION

A. The Contractor shall give the Engineer a minimum of three days advance notice of the completion of any surface preparation work or start of coating application work.

B. Before application of the prime coat and each succeeding coat, all surfaces to be painted shall be inspected by Engineer. Any and all defects or deficiencies shall be corrected by the Contractor before application of any subsequent coating.

C. Coating applications shall be checked for required MDFT as per these specifications. All coated surfaces failing to meet the MDFT requirements shall be rejected.

D. For all coatings subject to immersion, full cure must be obtained for the completed system. Consult the coating manufacturer’s written instructions for these requirements. The coating shall not be immersed for any purpose until completion of the curing cycle.

E. Inspection by the Engineer of the waiver of inspection of any particular portion of the work shall not be construed to relieve the Contractor of his responsibility to perform the work in accordance with these specifications.

1.07 PAINT DELIVERY AND STORAGE

All materials shall be new and shall be delivered to the project site in unopened containers that plainly show, at the time of use, the designated name, date of manufacture, color, and name of manufacturer. Paints shall be stored in a suitable protected area that is heated or cooled as required to maintain temperatures within the range recommended by the paint manufacturer.

1.08 PROJECT SITE CONDITIONS

The location of this project in Broward County, Florida, requires observance and conformance with EPA Volatile Organic Compound (VOC) restrictions. EPA limits the content of VOC's in painting materials to 2.5 lbs./gallon. Information regarding the VOC content of proposed paints will be required during submittals.

1.09 WARRANTY

Contractor shall warrant to the Owner and guarantee the work under this Section against defective workmanship and materials for a period of two years commencing on the date of Final Acceptance of the Work.

PART 2 - PRODUCTS

2.01 GENERAL

Products containing lead will not be allowed. Oil shall be pure boiled linseed oil.

2.02 PAINT MATERIALS

A. Products shall be as manufactured by Tnemec Company, Inc., or approved equals.

B. The following paint products are by Tnemec Company, Inc., as applicable, and are used for the basis of establishing the desired quality expected for the project.

Product Type	Tnemec Product Name
High-Build Acrylic Polyurethane	Series 75 Endura-Shield
Coal Tar Epoxy	Tneme-Tar 46-413 or 46H-413
Polyamine Epoxy (Non Potable)	Series 104 H.S. Epoxy
Vinyl Ester	Series 120 Vinester
Filler and Surfacer	Series 120-5003 Vinester F&S
Polyamide Epoxy	Series 66 or 69 Hi-Build Epoxoline
Polyamide Epoxy Floor System	Series 67 and S67, Tneme-Tread
Acrylic Emulsion	Series 180 Tneme-Crete
Modified Epoxy Masonry Filler	Series 54-562
Waterborne Acrylic Epoxy	Series 113 H.B. Tneme
Vinyl Acrylic	Series 51-792 PVA
Aliphatic Acrylic Polyurethane	Series 73, Endura-Sheild

2.03 COLORS

A. Provide as selected by the Owner.

B. Formulate with colorants free of lead, lead compounds, or other materials which might be affected by presence of hydrogen sulfide or other gas likely to be present at the project.

C. Proprietary identification of colors if for identification only. Any authorized manufacturer may supply matches.

2.04 TESTING GAUGES

A. Furnish a magnetic type dry film thickness gauge, to test coating thickness specified in mils, as manufactured by:

1. Nordson Corp., Anaheim, CA, Mikrotest
2. Or equal

B. Furnish an electrical holiday detector, low voltage, wet sponge type to test finish coat, except zinc primer, high-build elastomeric coatings, and galvanizing, for holidays and discontinuities as manufactured by:

1. Tinker and Rasor, San Gabriel, CA, Model M-1
2. Or equal

C. Furnish a high voltage holiday detector for elastomeric coatings in excess of 25 mils dry film thickness. Unit to be as recommended by the coating manufacturer.

PART 3 - EXECUTION

3.01 PROTECTION OF SURFACES NOT TO BE PAINTED

A. Mask or otherwise protect hardware, lighting fixtures, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates and other surfaces not intended to be painted which cannot be removed.

B. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.

C. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting processes. Openings in motors shall be masked to prevent paint and other materials from entering motors.

3.02 ENVIRONMENTAL CONDITIONS

Coatings shall not be applied in temperatures exceeding the manufacturer's recommended maximum and minimum allowable, nor under adverse conditions such as dust, smoke-laden atmosphere, damp or humid weather.

3.03 SAFETY

A. Coating shall be performed in strict accordance with the safety recommendations of the coating manufacturer; with the safety recommendations of the national Association of Corrosion Engineers contained in the publication, Manual for Painter Safety; Federal, state and local agencies having jurisdiction.

B. Ultimate responsibility for safety is Contractor's.

3.04 PREPARATION OF SURFACES

A. All surfaces to be coated shall be prepared as specified herein and shall be dry and clean before coating. Specific surface preparation shall be specified for the individual coating systems.

B. Steel shall be blasted unless otherwise specified. Blasting shall be done with a centrifugal wheel or compressed air blasting equipment, using proper abrasives to attain an average profile depth of 1.5 mils.

Do not re-use sand or flint abrasives. Short abrasives must be thoroughly clean of contamination before re-use. Blow dust and grit from surface with clean, dry air. Coat within 8 hours or before rust contamination occurs.

C. All concrete shall have cured for 28 days.

3.05 COATING SYSTEM INDEX

The following is a general index to the coating system descriptions described herein:

System Number	Title
1	Exterior of New Pre-Cast Concrete
2	Interior of new Pre-Cast Concrete
3	Exposed Metal - Highly Corrosive
4	Submerged Metal - Domestic Sewage
5	Exposed Metal - Moderate Corrosive Conditions
6	Existing Concrete Tank Lining - Domestic Sewage
7	Existing Concrete Exposed
8	Exposed Concrete Floor

9 Concrete Floors
10 Exterior Concrete
11 Interior Concrete and Masonry Block Walls
12 Interior Bypsum Drywall
13 Metal Stairs
14 Aluminum and Dissimilar Metal Insulation

3.06 COATING SYSTEMS

A. System No. 1 - Exterior of New Pre-Cast Concrete

Surface Preparation: All curing oils, form oils, laitence, soluble salts and loose concrete must be removed. Concrete must be dry and thoroughly clean before coating.

Prime Coat: None required.

Top Coat: Coal tar epoxy at 8.0 mils DFT per coat.

MDFT: 16 mils DFT for two-coat system. Allow minimum 24 hours drying time between coats.

Color: First Coat - Red
Second Coat - Black

B. System No. 2 - Interior of New Pre-Cast Concrete

Surface Preparation: Concrete: All curing oils, form oils, laitence, soluble salts and loose concrete must be removed. Concrete must be dry and thoroughly clean before coating. Concrete shall be cured 28 days.

Piping and Valves: Abrasive blast clean to an SSPC-SSP10 (near white metal).

Filler/Surfacer: Concrete substrate surface with cracks and/or voids greater than 2: in depth or width or areas where underlying aggregate has been exposed shall be patched with filler and surfacer. Material shall be applied in accordance with the manufacturer's application instructions.

Prime Coat: Vinyl Ester 12.0 to 18.0 mils DFT.

Top Coat: Vinyl Ester 12.0 to 18.0 mils DFT.

MDFT: Minimum 30 mils DFT for two-coat system. Time between coats and method of application shall be as per manufacturer's written instructions.

Color: First Coat - Beige (5002)
Second Coat - Gray (5001)

C. System No. 3 - Exposed Metal - Highly Corrosive

Surface Preparation: Abrasive blast clean to an SSPC-SP10 (near white metal).

Prime Coat: Polyamine epoxy at 6.0 to 8.0 mils DFT.

Top Coat: High build acrylic polyurethane at 2.0 to 4.0 mils DFT.

MDFT: 9 mils DFT for two-coat system.

Color: As selected by Owner from manufacturer's standard available colors.

D. System No. 4 - Submerged Metal - Domestic Sewage

Surface Preparation: Abrasive blast, or centrifugal wheel blast, SSPC-SP5.

Prime Coat: Polyamide, anti-corrosive, epoxy primer, 1 coat, 2.5 MDFT.

Top Coat: Coat-tar epoxy, 2 coats, 16 MDFT.

MDFT: 18.5 mils MDFT for system.

E. System No. 5 - Exposed Metal - Moderate Corrosive Conditions

Surface Preparation: Abrasive blast or centrifugal wheel blast SSPC-SP10.

Prime Coat: Polyamide, anti-corrosive, epoxy primer, 1 coat, 2.5 MDFT.

Top Coat: Polyamide epoxy, Tnemic Series 66 or 69, 2 coats, 8 MDFT

MDFT: 10.5 mils DFT for three coats.

F. System No. 6 - Existing Concrete Tank Lining - Domestic Sewage

Surface Preparation: Abrasive blast, 4,000 psi (see Section 03700).

Surface Restoration: Approved cement resurfacing treatment (see Section 03700).

Prime Coat: Coal-tar epoxy primer in accordance with manufacturer's recommendations (see Section 03700) compatible with surface restoration treatment.

Top Coat: Coal-tar epoxy compatible with surface restoration treatment (see Section 03700).

MDFT: 60 MDFT for system.

G. System No. 7 - Existing Concrete Exposed

Surface Preparation: Abrasive blast, 4,000 psi (see Section 03700).

Coating: 3 coats, Polyamide epoxy, Tnemec Series 66 or 69 Hi-Build Epoxoline.

MDFT: 12 mils DFT for three-coat application.

H. System No. 8 - Exposed Concrete Floor

Surface Preparation: Brush-off blast or acid etch.

Prime Coat: 1 coat Tnemec Series 67 Tneme-Tread, 2 mils.

Top Coat: 2 coats Tnemec Series S67 Tneme-Tread, MDFT 2 mils per coat.

MDFT: 6 mils DFT total system thickness.

I. System No. 9 - Concrete Floor

Surface Preparation: Brush-off blast or acid etch, on paneled surfaces SS PL-SP2 or SP3 hand or power tool cleaning of failed surfaces*.

Prime Coat: One thinned (20%) coat series 67 Tneme-Tread apply at a minimum rate of 390 SF per gallon.

Top Coat: One coat Series 67 Tneme-Tread epoxy polyamide gloss, at a minimum rate of 260 SF per gallon.

* *Apply test patch on existing, painted surfaces to check adhesion.*

J. System No. 10 - Exterior Concrete
Surface Preparation: Clean and dry, remove all loose material.

Coating: 2 coats Tnemec Series 180, Acrylic Emulsion minimum 170 SF per gallon.

K. System No. 11 - Interior Concrete and Masonry Block Walls

Surface Preparation: Clean and remove protrusions, loose materials, loose paint, oil, grease and other contaminants. Apply test patch to check adhesion on existing paint. Dry before application.

Prime Coat: 1 coat Tnemec 54-562 modified epoxy masonry filler. Apply at a minimum rate of 80 to 100 SF per gallon over block or porous concrete. Primer not required on dense concrete.

Top Coat: 1 coat Series 113 H.B. Tneme - Tufcoat water-base acrylic epoxy. Apply at a minimum rate of 120 to 170 SF per gallon.

L. System No. 12 - Interior Gypsum Drywall

Surface Preparation: Clean

Prime Coat: 1 coat Tnemec Series 51-792 PVA sealer, apply at a minimum rate of 400 SF per gallon.

Top Coat: 1 coat series 113 H.B. Tneme - Tufcoat water-base acrylic epoxy. Apply at a minimum rate of 120 to 170 SF per gallon.

M. System No. 13 - Metal Stairs

Surface Preparation: SSPC-SP6 blast cleaning.

Prime: Tnemec Series 66 Hi-Build Epoxoline, 3 mils MDFT.

Top Coat: Tnemec Series 71 Endura Shield, 2 mils MDFT.

N. System No. 15 - Aluminum and Dissimilar Metal Insulation

Surface Preparation: Roughened surface.

Top Coat: Coal tar epoxy at 10.0 mils DFT

MDFT: 10.0 mils DFT for one-coat system.

Color: Black

3.07 UNIDENTIFIED SURFACES

Any surfaces not specifically named in the schedule and not specifically excepted shall be prepared, primed and coated in the manner and with materials consistent with these Specifications. The Engineer shall select which of the manufacturer's products, whether the type is indicated herein or not, shall be used for such unnamed surfaces. This painting shall be done within the scope of the contract.

3.08 WORKMANSHIP

A. On metal surfaces apply each coat of paint at the rate specified by the manufacturer to achieve the minimum dry mil thickness required. If material has thickened or must be diluted for application by spray gun, the coating shall built up to the same film thickness achieved with undiluted material. One gallon of paint as originally furnished by the manufacturer shall not cover a greater area when applied by spray gun than when applied unthinned by the application of an additional coat(s). On masonry, application rates will vary according to surface texture; however, in no case shall the manufacturer's stated coverage rate be exceeded. On porous surfaces, it shall be the painter’s responsibility to achieve a protective and decorative finish either by decreasing the coverage rate or by applying additional coats of paint.

B. All safety equipment shall be painted in accordance with OSHA Standards as approved.

C. Materials shall be mixed in proper containers of adequate capacity. All materials shall be thoroughly stirred before use and shall be kept stirred while using. No unauthorized thinners or other materials shall be added to any paint.

D. Only skilled painters shall be used on the work and specialists shall be employed where required.

E. Steel members, metal castings, mechanical and electrical equipment and other metals, which are shop primed before delivery at the site, will not require a prime coat on the job. All piping and other bare metals to be painted shall receive one coat of primer before exposure to the weather, and this prime coat shall be the first coat as specified in the painting schedule.

F. Finish surfaces shall not show brush marks or other irregularities. Undercoats shall be thoroughly and uniformly sanded with No. 00 sandpaper or equal to remove defects and provide a smooth, even surface.

G. Before final acceptance of the work, all damaged surfaces of coatings shall be cleaned and repainted as directed by the Engineer.

3.09 APPLICATION SCHEDULE

A. System No. 1 - Exterior of new Pre-Cast Concrete - This system shall be used on the exterior of all new pre-cast concrete valve vaults, wet wells and manholes.

B. System No. 2 - Interior of new Pre-Cast Concrete - This system shall be used in the interior of al new pre-cast concrete valve vaults, wet wells, manholes, and all interior ductile and cast iron piping and equipment. Pre-cast concrete shall be coated prior to installation. Coating shall extend through the pre-cast joints.

C. System No. 3 - Exposed Metal - Highly Corrosive - This system shall be used on all metal surfaces exposed to weather including equipment, conduits, piping, exposed metal frames and elsewhere as scheduled. Galvanized piping does not require painting.

D. System No. 4 - Submerged Metal - Domestic Sewage - This system shall be used for wet well piping, wet well ferrous metals, and below-grade valve pit piping.

E. System No. 5 - Exposed Metal - Moderate Corrosive Conditions - This system shall be used for interior piping, structural steel and interior dry pit metals.

F. System No. 6 - Existing Concrete Tank Lining - Domestic Sewage - This system shall be used in existing wet wells.

G. System No. 7 - Existing Concrete Exposed - Not Used

H. System No. 8 - Exposed Concrete Floor - Not Used

I. System No. 9 - Concrete Floors - Not Used

J. System No. 10 - Exterior Concrete - Not Used

K. System No. 11 - Interior Concrete and Masonry Block Walls - Not Used

L. System No. 12 - Interior Gypsum Drywall - Not Used

M. System No. 13 - Metal Stairs - Not Used

N. System No. 14 - Aluminum and Dissimilar Metal Insulation - This system shall be used on all aluminum in contact with concrete. Insulate all contacting dissimilar metals with this system.

3.10 CLEAN UP

A. It shall be the responsibility of the Contractor to collect and dispose of property, all waste materials from the site in accordance with all requirements of the Federal, state and local environment protection agencies.

B. At completion of the work, remove all paint where spilled, splashed, splattered, sprayed or smeared on all surfaces, including glass, light fixtures, hardware, equipment, painted and unpainted surfaces.

C. After completion of all paintings, the Contractor shall remove from the job site all painting equipment, surplus materials and debris resulting from this work.

3.11 MANUFACTURER'S SERVICES

Furnish paint manufacturer representative to visit job site at intervals during surface preparation and painting as may be required for product application quality assurance, and to determine compliance with manufacturer’s instructions and these specifications, and as may be necessary to resolve field problems attributable to, or associated with, manufacturer’s products furnished under this Contract.

3.12 COATING SYSTEM DATA SHEET

To be included with submittal. See form on next page.

END OF SECTION

COATING SYSTEM DATA SHEET
(to be included with submittal)

Coating System Number (From Spec):

Coating System Title (From Spec):

Coating Supplier Name & Address:

Local Representative Name & Address:

Manufacturer Representative Authorized to Certify
Proper Installation Name & Address:

Surface Preparation:

Coating Material (Generic)	Product Number/Name (Proprietary)	Coats/Minimum Coverage	Color

Notes:

SECTION 11300

SUBMERSIBLE SEWAGE PUMPS

PART 1 - GENERAL

1.01 SCOPE

A. Furnish, install, and test the combined assembly, submersible motor and pumping units and appurtenances, as indicated on the Drawings and as herein specified.

B. The work shall include all equipment, controls, accessories and appurtenances necessary to provide a complete operating system. All Work shall conform to all requirements for installation, materials, and equipment, approvals of State, local, Underwriter's Laboratories, Incorporated, or other applicable codes, whether or not called for in detail on the drawings or in these specifications.

C. Electrical wiring and starting equipment shall be as shown on the drawings, as specified herein and as specified in Division 16. The pump control panel, although specified in Division 16, shall be provided by the pump manufacturer, for single source responsibility.

D. The complete pumping system for each station shall be provided by a single supplier for single-source responsibility. The complete pumping system includes guide rails, brackets, base elbows, pumps and control panel.

E. Furnish and install a diaphragm protected pressure gauge assembly on the discharge of each submersible pumping units in the Valve Vault, as indicated on the Drawings and as herein specified.

1.02 RELATED WORK

Section - 01010	Summary of Work
Section - 01340	Shop Drawings, Product Data and Samples
Section – 02501	Piping
Section – 02502	Valves
Section – 02507	Prime and Tack Coats
Section – 02600	Piping
Section - 05200	Miscellaneous Metal (including Wet Well and Valve Vault Access Hatches)
Section - 09900	Protective Coatings
Division 16	Electrical Work

1.03 REFERENCE STANDARDS

A. Hydraulic Institute Standards, latest edition.

B. All construction and installation to conform to the Florida Building Code, electrical, mechanical, concrete, etc.

C. National Electric Code, NEC, including Class 1 Group C/D Atmosphere Requirements.

1.04 SUBMITTALS

A. Shop Drawings in accordance with Section 01340.

B. Pump station drawing submitted in shop drawings shall reflect all pertinent details and specifications as described within, with location plan.

C. Factory certified shop performance test curves in accordance with Section 01340.

D. Certification of factory service representative that equipment has been installed to manufacturer's recommendations and is ready for start-up.

E. Four (4) customized set of Operation and Maintenance Manuals (in 3 ring binders) in accordance with Section 01340.

1.05 WARRANTY REQUIREMENTS

A. All equipment supplied under this Section shall have a base warranty from the Contractor and each equipment manufacturer covering a period of one year from start up and acceptance for beneficial use. Warranty period for each station's equipment shall commence on the date of start up and acceptance for beneficial use.

B. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the basic warranty period, it shall be repaired at no additional cost to the Owner.

1.06 ADDITIONAL WARRANTY REQUIREMENTS

A. <u>Pumps</u>

1. Concurrent with the basic warranty period specified in paragraph 1.05, the manufacturer shall warrant the pumping equipment for each time period or duration of actual operational running time, whichever occurs first, participating in the cost of repair or replacement, in accordance with the following schedule:

Warranty Period	Time After Start-Up and acceptance for beneficial use of the Pumping Equipment (Months)	Time of Actual Pump Operation (Hours)	Manufacturer's Share of the Cost of Repair or Replacement (Percent)
1	0-18	0 - 3,000.0	100
2	19 - 39	3,000.1 - 6,500.0	50
3	40 - 60	8,800.1 - 10,000.0	25

2. The warranty shall cover defects in workmanship and material and cover all costs for both labor and parts required to inspect and repair pumping equipment delivered to the pump manufacturer's authorized repair and maintenance service center.

   During the basic warranty period required by Paragraph 1.05 and Warranty Period One, the manufacturer shall be responsible for removing and re-installing the pumping equipment in the wet well. The manufacturer shall be responsible for removal and re-installation of the pump power and control cables and all transportation or shipping costs for delivery of the pumping equipment to a service center and return to the pump station site during warranty period number one. If warranty service is required after warranty period number one, the manufacturer shall be responsible for all transportation or shipping costs for delivery of the pumping equipment to the service center and return to the site.

3. The manufacturer's obligation under this warranty shall be to repair or replace the defective pumping equipment at the pro-rated share of cost stated above, exclusive of any shipping costs for which the manufacturer is responsible, as stated above.

B. Control Panels and Starters

Warranty requirements for control panels, starters and any other associated electrical equipment are specified in Division 16 of these Specifications.

C. Guide Rail Systems, and Other Accessory Equipment

The manufacturer shall repair and/or replace defective guide rail systems, other accessory items, or any of their defective components which are supplied under this Specification at no additional cost to the Owner during the basic one year warranty period. Extended warranty requirements for time periods, after the expiration of the basic warranty period specified in Paragraph 1.05 shall not be applicable to the guide rail system, and other accessory items.

D. Agreement to Warranty Conditions

1. The Contractor shall, as a part of the required shop drawing and product submittal data, deliver a certified statement of agreement to the above listed conditions of warranty for equipment and materials to be supplied and installed under this Section of the Specifications. If this statement is not submitted, the equipment shall not be approved for use in the Work.

2. Warranty of equipment must be by the pump manufacturer. Warranty agreements by the manufacturer's local supplier shall not be acceptable, except for removal, shipping and re-installation efforts.

3. As required herein, a typewritten or printed copy of the product warranty(ies), including the above provisions and applicable dates of commencement and expiration of each warranty period, shall be supplied with other required product data.

1.07 MANUFACTURER'S RECOMMENDATIONS

Where installation procedures or any part thereof are required to be in conformance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Engineer prior to the installation.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS AND RATING DATA

A. Pump shall be Model 6VCX, as manufactured by F.E. Myers, Ashland Ohio, or Model 150 DLFU 637 as manufactured by Ebara International Corp., Rock Hill, SC. Or approved equal.

B. Rating Data:

Number of Pumps	3
Electrical Service Characteristics	460V, 3 Ph, 60 Hz.
Pump Suction by Discharge Size (inches)	6 Nominal Dia.
Minimum Sized Sphere that will pass thru the impeller without clogging (inches)	3

Characteristics with Initial Impeller:

Design Point:	
Flow	1,250 gpm
TDH	112 feet
Appx. Shut Off Head, Min.	137 feet
Max. Motor Synchronous Speed	1,750 rpm
Motor Brake Horse Power, minimum	60 HP
Motor Service Factor, minimum	1.0
Run Out on Curve: Max. Flow @ 70 Ft. TDH	1,500 gpm
Output at Periods of Low Force Main Usage:	
Max. Flow @ 64 Ft. TDH	1,330 gpm

Output at Periods of Maximum Force Main
Usage and 2 Pumps On @ PS 8, Each Pump
Min. Flow @ 137 Ft. TDH 500 gpm
Clear Opening of Wet Well Access Hatch (feet) 8 across x 4 long

Characteristics With Largest Future Upgraded Impeller that Will Not Overload the 60 HP Motor or Cause Cavitation Anywhere on Its Curve:

@ 1,250 GPM Design Point, Minimum TDH 112 feet
Appx. Shut Off Head, Min 165 feet
Output at Periods of Low Force Main Usage
Max. Flow @ 58 Ft. TDH 2,400 gpm

C. Pump and motor shall be UL, FM (or approved equal agency) certified to be explosion proof in a Class 1, Division 1, Group D environment, as defined by the National Electrical Code.

D. It is the intent of this specification that the pump shall be upgradable by simply increasing the impeller size. For this reason, the specified motor is larger than is required by the initial rating point and impeller.

2.02 GENERAL

A. The sewage pumps shall be submersible type, non-clog, centrifugal pumps suitable for pumping raw unscreened sewage. Each unit shall consist of a pump with a submersible motor, a discharge connection, and guide rail. Each pump shall be arranged to automatically clamp the pump discharge to the discharge connection when the pump is lowered along the guide rail. Pumps shall be designed for operating in a potential sewer gas environment. Pumps must be physically sized to allow triplex installation and successful operation in the diameter wet well and top slab/access hatch indicated on the plans and the above table. Contractor shall field verify all dimensions.

B. The pump operation must approximate the design point at near-optimal efficiency and be able to operate at the high end of the specified operating range for both volume and head and be able to operate safely at the low end of the range. The required horsepower shall not exceed the motor rated horsepower over any portion of the operating range.

C. Pump shall be provided with a stand base designed to support the weight of the pump and stresses imposed thereon by vibration, shock, and all possible direct and eccentric loads. The base shall be attached by stainless steel, drilled-in expansion-type anchor bolts.

D. All rotating parts shall be statically and dynamically balanced.

E. All normal maintenance shall be permitted without breaking piping or motor connections.

F. Pump connections shall be flanged, ANSI Class 125 pound flanges, minimum.

G. All mating surfaces where watertight sealing is required shall be machined and fitted with rubber O-rings.

H. The required net positive suction head shall not exceed the available net positive suction head at any point in the operating range, including run out condition.

I. A guide rail system shall allow connection of the pump to the discharge pipe by gravity. Sealing shall be accomplished automatically by the weight of the pump against the mating flanges. The pump manufacturer shall guarantee no significant leaks at the discharge connection. If a replaceable O-ring is utilized to affect the pump discharge show to base elbow seat seal, such O-ring shall be securely attached, via a dovetailed groove, to the pump portion and not to the base elbow portion.

J. Pumps shall meet or exceed Design Specifications at all points on the curve, and shall be capable of continuous operation at shut-off or run-out condition at the low end of the head range indicated in the above listed table, without thermally overloading the motor or causing pump vibration or cavitation.

K. Unit shall be provided with an adequately designed cooling system permitting partially operation without external jackets, fans or other external mechanical cooling.

L. Access Frame and Guides:

1. The access frame and covers (hatches) are specified under Section 05200.

2. Provide an upper guide pipe holder and level sensor cable holder. The guide member shall be stainless steel and shall be furnished with upper brackets for attachment to the top slab of the wet well, and lower guide holders, which shall be integral with discharge connection.

M. All pumps shall be equipped with the necessary accessories, including stainless steel lifting attachments, cable, and hardware.

N. All electrical work shall comply with NEC and local codes and standards.

O. All nuts, bolts and miscellaneous fasteners installed within the pump station wet well or valve box shall be 316 stainless steel.

2.03 MATERIALS

A. Pumps shall be the standard configuration of the specified manufacturer and model with the options and requirements specified in this Section:

1. Myers Model 6VCX:

a. The motor stator shall be equipped with three (3) thermal sensor switches embedded in the end coils of the stator winding. These shall be connected in series and shut the pump down should temperature exceed 140 degrees C. Reset shall be automatic.

b. Motor and seal assembly shall be equipped with a complete moisture detection system.

2. Ebara Model 150 DLFU 637

   a. The motor stator shall be equipped with three (3) thermal sensor switches embedded in the end coils of the stator winding. These shall be connected in series and shut the pump down should temperature exceed 140 degrees C. Reset shall be automatic.

   b. Motor and seal assembly shall be equipped with a complete moisture detection system.

B. Miscellaneous Items.

   a. Attachment and Anchor Bolts:

      1. All attachment bolts and anchor bolt shall be of ample size and strength for the purpose intended and shall be 316 stainless steel.

      2. All anchor bolts shall be set in accordance with the manufacturer's instructions.

   b. Data Plates shall be of stainless steel suitably attached to the pump with stainless steel fasteners and shall contain:

      1. Manufacturer's Name.

      2. Pump Size and Type.

      3. Serial Number.

      4. Speed.

      5. Impeller Diameter.

      6. Design Capacity and Head.

      7. Other Pertinent Data.

   c. The pump shall have an approved primer and a polyamide epoxy protective coating, minimum 17 mils DFT, for operation in raw sewage, and brackish infiltration into the sewer lines.

2.04 MOTOR AND APPURTENANCES

A. Squirrel-cage, induction, shell type design, 1.15 minimum service factor. UL listed, explosion proof for Class 1 Division 1, Groups C and D.

B. Designed for continuous duty, capable of sustaining a minimum of eight (8) starts per hour.

C. The Stator shall be equipped with three (3) thermal sensor switches embedded in the end coils of the stator winding. These shall be connected in series and shut the pump down should temperature exceed 140 degrees C. Reset shall be automatic.

D. Motor and seal assembly shall be equipped with a complete moisture detection system.

E. Pump motor cable:

1. Cable shall be one piece, sufficiently long to reach from pump to control panel, as indicated on Drawings, plus ten additional feet of slack, minimum

2. No junctions within the wet well, whether above or below the waterline, will be acceptable.

2.05 LIQUID LEVEL SENSORS:

A. Liquid level controls shall include mercury switch level sensors in corrosion and shock resistant plastic casing suspended on flexible cables. The sensors shall be supported by 316 stainless steel brackets. The floats shall be capable of being disconnected and replaced by means of a gas and moisture tight connector.

B. Required functions are as shown on the Drawings and in the Electrical specification of Division 16.

2.06 GUIDE RAILS, LIFTING CHAINS, CABLE HANGER AND ANCHOR BOLTS

A. Furnish one (1) guide rail system for each pump to permit raising and lowering the pump. Guide rails shall be of adequate length to extend from the lower guide holder on the pump discharge connection to the upper guide holder mounted on the access hatch frame. Guide rails shall be of 304 stainless steel. Provide stainless steel intermediate supports, as needed.

B. Lifting chains shall be made of Type 304 stainless steel. Each chain shall come equipped with two (2) stainless steel bolts for connecting chain to pump's lifting handle.

C. Cable hanger shall be constructed of Type 304 stainless steel.

D. Anchor bolts shall be manufactured of Type 316 stainless steel.

E. The pump shall be supplied with a cast iron base elbow assembly. The seal of the pump at the discharge flange is to be accomplished by simple downward linear motion of the weight of the pump guided to and pressing against the discharge connection.

2.07 PERFORMANCE FACTORY SHOP TESTS

A. General

1. Pumps shall be factory tested by the pump manufacturer in compliance with Hydraulic Institute Standards. All tests shall be certified correct by the manufacturer, as to procedures and results

2. The pump manufacturer shall possess, or have readily available access to suitable testing facilities adequate for performing the shop tests required hereinafter. If an alternate manufacturer is proposed, as part of the shop drawing submittal, the Contractor shall submit a description of the proposed manufacturer's testing facilities, including hydraulic, mechanical, electrical and instrumental elements. The description shall cover initial and periodical calibration provisions for all instruments. The descriptive matter may contain illustrative photographs, drawings and such other matter as may be appropriate to describe said tests.

B Performance Tests - Pump:

1. The pump shall be given a performance test during which the pump shall be run at normal rated speed over the specified range of the rate of flow and then held at shutoff head for at least one minute and at the rating point for 30 minutes.

2. Each pump shall be started with the casing filled with water and against shutoff head, to prove that the motor will reach and maintain synchronous speed. Such test shall show that the pump has the general characteristics of the head, efficiency, horsepower and such other properties as appear on the approved curves submitted as required herein. Such test shall also prove the specified head, efficiencies, horsepower and other properties at the rating point. Such test shall also establish that the pump is free from overheating, cavitation and excessive vibration over the specified range of the rates of flow.

3. Electrical starters and other control equipment necessary for testing shall be furnished by the pump manufacturer. All instruments used shall be calibrated to industry standards.

4. Ampere, Kw input and voltage readings shall be recorded at each data point (flow, TDH)

C Test Results

The manufacturer shall submit a shop test report, containing method, equipment and results for approval. The pump test shall follow the format recommended by the standards of the Hydraulic Institute. The Contractor shall note therein that submission of the shop test results and written notification by the Engineer of his acceptance thereof is necessary before equipment can be shipped to the site. The number of copies required shall be similar to that for shop drawings.

2.07 PRESSURE GAUGE ASSEMBLIES

A. Each pressure gauge not specified in other sections of this specification shall be direct mounted, cast aluminum case, with a 42" diameter dial and furnished with a clear glass crystal window, 2" shut-off (isolation) valve, and a bronze pressure snubber. Provide diaphragm seals between shut-off (isolation) valve and pressure gauge on all wastewater lines. All gauges shall be weatherproofed. The face dial shall be white finished aluminum with jet-black graduations and figures. The face dial shall indicate the units of pressure being measured (e.g., feet of water, inches of mercury, psi(g), etc.) or be dual scale. Each pump discharge line shall be furnished with gauges sized 0 to 160 feet or range as shown on the Drawings. Pressure gauges shall be equal to Model 500

as manufactured by H.O. Trerice Company, Detroit, Michigan; Marshalltown Instruments, Marshalltown, Iowa; US Gauge, Ashcroft or equal.

B Diaphragm seals shall be installed on pressure gauge connection to all wastewater and chemical lines or where shown on the Drawings, to protect pressure switches used to monitor pressures on wastewater and chemical lines. The diaphragm shall be "thread attached" to both piping and pressure switches. Diaphragm seals shall be constructed of cadmium-plated carbon steel, except for the lower housing which shall be specifically chosen according to the fluid pressure being monitored. Diaphragm seals shall have a flushing connection and be Type SB by Mansfield and Green; No. 877 Trerice; Marshalltown; or equal.

C. After the pressure gauge and snubber have been filled, mounted on the diaphragm seal and calibrated, they shall be safety wired together to prevent relative rotation that will alter the calibration.

PART 3 - EXECUTION

3.01 DELIVERY, STORAGE AND HANDLING

Material delivered to the site shall be inspected for damage, unloaded and stored with a minimum of handling. Material shall not be stored on the ground and shall be stored in accordance with the manufacturer’s recommendations. The insides of pipe and fittings shall be kept free from dirt and debris. Gasket and plastic materials shall be kept protected from exposure to direct sunlight over extended periods. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar material required to install the pipes shall be stored in accordance with the manufacturer’s recommendations and shall be discarded if the storage period exceeds the recommended shelf or pot life. Storage facilities for plastic pipe, fittings, joint material and solvents shall be classified and marked in accordance with NFPA No. 704, with classification as indicated in NFPA Nos. 49 and 325M. Material shall be handled in such a manner as to insure delivery to the trench in a sound, undamaged condition. Pipes shall be carried to the trench, not dragged.

3.02 INSTALLATION

A. The equipment shall be installed by the Contractor in accordance with the manufacturer's drawings and instructions and shall include:

1. Furnishing all special tools necessary to disassemble, service, repair and adjust the equipment.

2. Providing one (1) year's supply of all recommended lubricants.

B. Manufacturer's Service Representative shall provide competent personnel for a minimum period of one (1) day in one (1) trip to:

1. Check installation of equipment.

2. Provide start-up of equipment.

3. Run specified tests.

4. Train plant personnel in operation and maintenance of his equipment.

C. All wet wells shall be cleaned of any and all debris by a jet vac prior to starting pumps and/or accepting station by the Contractor with City representative present.

D. Pressure Gauge Assemblies: Pressure gauges shall not be installed until after the time of pump field testing unless otherwise requested by the Owner.

3.03 FIELD TESTING, START-UP AND ADJUSTING EQUIPMENT

A. General

After all pumps have been completely installed and working under the direction of the Contractor, conduct, in the presence of the Engineer, such tests as are necessary to indicate that pumps conform to the Specifications. Field tests shall include all pumps included under this Section. The Contractor shall supply all electrical power, labor, equipment and incidentals required to complete the field tests.

Prior to acceptance, an operational test of the pump and control system be performed to determine if the installed equipment meets the purpose and intent of the Specifications. Tests shall demonstrate that the equipment is not electrically, mechanically, structurally to otherwise defective; is in safe and satisfactory operating condition and conforms with the specified operating characteristics. Field testing and start-up shall consist of the following:

(1) Preliminary Field Test.
(2) Running Test.
(3) Final Test.

Where successful results allow, it is intended to run the tests consecutively, so that the entire sequence may be expeditiously completed. The Contractor shall adhere to provisions contained herein for proper testing and start-up of the equipment and shall follow the Engineer's and equipment manufacturer's recommendations for testing. The Contractor shall be completely responsible for all testing and the furnishing of required manpower, energy and suppliers to accomplish testing start-up as outlined herein. The Contractor shall provide the necessary test equipment and instrumentation, recently calibrated to industry standards. The Engineer's will be the sole judge of whether equipment of facilities pass tests and will direct the Contractor to continue testing until tests prove successful.

Systems tests shall be made in conjunction with other related systems which shall, as much as is practical, be tested together.

Tests shall be made with clean water. Test shall demonstrate satisfactory service under specified operating conditions.

All systems shall be tested by the Contractor and witnessed by the Engineer to prove that the equipment and appliances are properly installed, meet their operating criteria and are free from defects, leaks, overheating, overloading and undue vibration. During this phase of testing, the manufacturer's representative for each piece of equipment shall be present as called for in these Specifications or as required.

The Contractor shall furnish all labor, lubricants, water, light, power and all other materials, equipment, hoses and instruments deemed by the Engineer to be necessary and required for the tests. The Contractor shall be completely responsible for testing equipment installed under his Contract. Included shall be the cost of furnishing all personnel required to operate the equipment and supply power whenever the equipment is required to operate.

If the tests are stopped for any reason the Contractor shall protect equipment and structures from damage.

The Contractor shall make all necessary changes, adjustments and replacements at his own expense. The successful operation of the equipment during this test shall not constitute acceptance of the individual pieces of equipment. However, until the equipment has performed satisfactorily during final test, acceptance will not be considered.

If any deficiencies are revealed during any test, such deficiencies shall be corrected and/or the defective equipment replaced and the tests shall be reconducted, all at the Contractor's sole expense.

If the pump performance does not meet the Specifications, corrective measures shall be taken or pumps shall be removed and replaced with pumps which satisfy the conditions specified, at the Contractor's sole expense.

B. Preliminary Field Test:

As soon as feasible after the installation of equipment but prior to the running and final tests, the Contractor shall make preliminary field tests of the equipment and appliances furnished, to assure that the equipment is ready for testing, power is properly hooked up and the rotation of the impeller is correct.

The preliminary field test shall be witnessed by the Engineer. The Contractor shall furnish labor, lubricants, instruments and all other accessories and supplies required to perform the test.

C. Running Tests:

1. General

After installation of the sewage pumps, they shall be given a running test in the presence of the Engineer, during which time they shall demonstrate their ability to:

a. Operate without vibration or overheating at the specified conditions.
b. Perform as specified.
c. Load test, check amperage, phase to voltage test and insulation test.
d. Flow rate test, during the force main portion of the test, based on timed draw down of the wet well and force main pressure reading.

2. Recirculation

The wet well shall be filled with clear water. The main force main discharge valve shall be closed, the bypass valve partially closed, as needed, and the backpressure on the pump set to maintain, initially, the specified TDH across the pump, as determined by the static head difference between discharge pressure gauge and the

wet well static level. Each pump shall be started and run (discharging into the wet well) for an aggregate successful period of 10 hours. Pump test shall only occur during normal working hours. During this 10 hour test, decrease backpressure at the valve to achieve full load amps on the pumps' motors or the maximum flow recommended by the pump manufacturer for safe operation of the pump. Operate the pump at this rate for a period of 2 hours. Also, briefly close the valve to record the parameters at shut off.

At each setting of the valve, wet well level, etc., simultaneous pressure readings and also voltage and amperage readings shall be taken for each phase. During the 2 hour high flow test, readings shall be taken every 15 minutes otherwise, readings shall be taken every 30 minutes. The rated motor nameplate current and power shall not be exceeded at any point. Tests shall include checks for excessive vibration, leaks in all piping and seals, correct operation of control systems and equipment, proper alignment, excessive noise levels and power consumption. At the completion of the test, manually turn the pump to the "off" position.

Running test shall be performed prior to connecting the southern portion of the on-site force main to the existing force main. The open end of this pipeline shall be temporarily plugged or capped and braced, so that it will not leak or blow off during the running tests.

3. Force Main

After successful completion of the Recirculation running test to the wet well and when authorized by the Engineer and Owner, and after the force main installed by Contract No. 2 has been successfully installed and accepted by the Owner, and after the Contractor has connected the northern portion of the on-site force main to this SE 5th Avenue force main, the Contractor shall completely fill the force main to the existing force main on SW 2nd Avenue, open the force main discharge valves, close the bypass valve and pump to the western force main system (if available) and conduct the next test. Data shall similarly be taken during this test, as well.

Duration of the Running Test to the western system shall be for at least three (3) wet well full to empty cycles.

E. <u>Final Tests:</u>

Operate the pumps, as needed, to set up and verify all pump control functions, manual and automatic, as shown on the Drawings and as specified in Division 16.

The Final Acceptance Test shall demonstrate that all items of these Specifications have been met by the equipment as installed and shall include, but not be limited to the following tests:

1. That the quick release lift-out feature functions properly and allows the pump to be raised and lowered without draining the wet well.

2. That all units have been properly installed and are in correct alignment.

3. That units operate without overheating or overloading any parts and without objectionable vibration.

4. That there are no mechanical defects in any of the parts.

5. That the pumps can deliver the specified pressure and quantity of flow.

6. That the pump sensors and controls perform satisfactorily as to sequence control, correct start and stop elevations and proper level alarm functions.

E. Motors:

The Contractor shall check all motors, to the extent practical, for correct clearance and alignment and for correct lubrication, in accordance with the manufacturer's instructions. The Contractor shall check the direction of rotation of all motors and reverse connections, if necessary.

F. General

1. All defects revealed by or noted during the tests shall be corrected or equipment replaced promptly at no additional expense to the Owner.

2. Contractor shall furnish all labor, piping, equipment and materials necessary for conducting the tests.

3. In case the Contractor is unable to demonstrate to the satisfaction of the Owner that the units will satisfactorily perform the service required, the units may be rejected. Contractor shall remove and replace the equipment at his own expense.

4. Prior to acceptance by the City, four (4) as-built shop drawings, curves, details and assembly and maintenance instructions books shall be submitted.

END OF SECTION

SECTION 16010

BASIC ELECTRICAL REQUIREMENTS

PART 1 -- GENERAL

1.01 RELATED SECTIONS

A. Requirements specified within this section apply to all sections in Division 16, ELECTRICAL. Work specified herein shall be performed as if specified in the individual sections.

1.02 DESIGN REQUIREMENTS

A. All electronic boards as part of electrical equipment shall meet the atmospheric conditions of the space the equipment is installed in. All electronic boards which are not installed in a conditioned environment shall be fungus-resistant.

B. All electrical equipment shall be rated for the conditions the equipment is installed in.

1.03 STANDARDS, CODES, PERMITS, AND REGULATIONS

A. Perform all work; furnish and install all materials and equipment in full accordance with the latest applicable rules, regulations, requirements, and specifications of the following:

1. Local Laws and Ordinances.
2. State and Federal Laws.
3. National Electrical Code (NEC).
4. State Fire Marshal.
5. Underwriters' Laboratories (UL).
6. National Electrical Safety Code (NESC).
7. American National Standards Institute (ANSI).
8. National Electrical Manufacturer's Association (NEMA).
9. National Electrical CONTRACTOR'S Association (NECA) Standard of Installation.
10. Institute of Electrical and Electronics Engineers (IEEE).
11. Insulated Cable Engineers Association (ICEA).
12. Occupational Safety and Health Act (OSHA).
13. National Electrical Testing Association (NETA).

14. American Society for Testing and Materials (ASTM).

a. Florida Building Code, including Local County amendments.

B. Conflicts, if any, which may exist between the above items, will be resolved at the discretion of the ENGINEER.

C. Wherever the requirements of the Specifications or Drawings exceed those of the above items, the requirements of the Specifications or Drawings govern. Code compliance is mandatory. Construe nothing in the Contract Documents as permitting work not in compliance with these codes.

D. Obtain all permits and pay all fees required by any governmental agency having jurisdiction over the work. Arrange all inspections required by these agencies. On completion of the work, furnish satisfactory evidence to the ENGINEER that the work is acceptable to the regulatory authorities having jurisdiction.

1.04 ELECTRICAL COORDINATION

A. Work Provided Under this Contract:

1. Provide and install complete electrical power system shown on drawings and as per specifications for lift station A-13 with local utility company (FPL – phone number is listed on electrical drawing E01) for installation of new service to each lift station complete in place.

2. Provide and install all electrical equipment indicated on the drawings and as described in the specifications including new utility meter, main/MTS, lift station control panel, control transformers, SPD (Surge Protection Device), etc. complete in place.

3. Provide and install all new underground conduit and wiring indicated on the drawings complete in place.

4. Provide and install new grounding system complete in place.

5. Provide and install all electrical required to support instrumentation and control system as shown on the drawings complete in place.

6. Provide all miscellaneous electrical including switches, terminations, fittings, wiring, conduit, junction box, terminal junction box, etc., not specified but obviously necessary for a complete working system in place.

7. Provide an Electrical Systems Analysis and Arc Flash Study per Specification 16015.

B. Temporary Power:

1. Provide temporary power for all office trailers and for all construction areas. Coordinate with local power and telephone utility for temporary construction power and telephone service during construction.

1.05 SUBMITTALS

A. The following information shall be provided for all electrical equipment:

1. A copy of each specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check-marks (√) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined shall signify compliance on the part of the Contractor with the specifications. The submittal shall be accompanied by a detailed, written justification for each deviation.

2. Electrical equipment submittals shall be made by specification section. Submit one package per specification section and do not group multiple specification sections under one submittal package.

3. Provide complete conduit and equipment layouts: a scaled plan layout of the electrical room(s) showing spatial relationships of all equipment as well as the overall size of the room. Minimum scale shall be ¼”=1’-0”.
4. Provide a conduit plan for major power, instrumentation and control conduits, both interior and exterior, showing routing, size and stub up locations for buried or in slab conduits.

B. As part of the electrical submittal, the contractor shall provide a minimum of ¼”=1’-0” scaled layout of the electrical equipment in the electrical room or major electrical equipment in a mechanical room showing sizes of all equipment and their spatial relationship. Non-electrical equipment shall be approved before finalizing the electrical layout in mechanical rooms.

1.06 ENVIRONMENTAL CONDITIONS

A. All chemical rooms and areas shall be designated as corrosive.

B. All indoor chemical and process equipment areas shall be considered wet locations.

C. Electrical equipment in rooms designated as Classified by NFPA 70 (national electrical code) as Division 1 or Division 2 shall meet all requirements set forth for that classification as described in NEC article 500.

1.07 INSPECTION OF THE SITE AND EXISTING CONDITIONS

A. The Electrical Drawings were developed from past record drawings and information supplied by the Owner. Verify all scaled dimensions prior to submitting bids.

B. Before submitting a bid, visit the site and determine conditions at the site and at all existing structures in order to become familiar with all existing conditions and electrical system which will, in any way or manner, affect the work required under

this Contract. No subsequent increase in Contract cost will be allowed for additional work required because of the Contractor's failure to fulfill this requirement.

C. Carry out any work involving the shutdown of the existing services to any piece of equipment now functioning in existing areas at such time as to provide the least amount of inconvenience to the Owner. Do such work when directed by the Engineer.

D. After award of Contract, locate all existing underground utilities at each area of construction activity. Protect all existing underground utilities during construction. Pay for all required repairs without increase in Contract cost, should damage to underground utilities occur during construction.

1.08 RESPONSIBILITY

A. The Contractor shall be responsible for:

1. Complete systems in accordance with the intent of these Contract Documents.

2. Coordinating the details of facility equipment and construction for all Specification Divisions which affect the work covered under Division 16, ELECTRICAL.

3. Furnishing and installing all incidental items not actually shown or specified, but which are required by good practice to provide complete functional systems.

1.09 INTENT OF DRAWINGS

A. Electrical plan Drawings show only general location of equipment, devices, and raceway, unless specifically dimensioned. The Contractor shall be responsible for the proper routing of raceway, subject to the approval of the Engineer.

B. Electrical equipment sizes and characteristics have been based on Square D and Eaton.
If the CONTRACTOR chooses to and is allowed to substitute, the CONTRACTOR shall be responsible for fitting all the equipment in the available space as shown on the Drawings or re-designing the space, at no additional cost to the owner, and shall reimburse the engineer for time and materials spent in reviewing revised design.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Provide materials and equipment listed by UL wherever standards have been established by that agency. If a UL listing is not available, equipment shall have a label and listing from a nationally recognized testing laboratory (NRTL) acceptable to the authority having jurisdiction (AHJ) over the project location.

B. Equipment Finish:

1. Provide manufacturers' standard finish and color, except where specific color is indicated.

2. If manufacturer has no standard color, provide equipment with ANSI No. 61, light gray color.

PART 3 -- EXECUTION

3.01 GENERAL

A. Electrical Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.

B. Install work in accordance with NECA Standard of Installation, unless otherwise specified.

3.02 LOAD BALANCE

A. Drawings and Specifications indicate circuiting to electrical loads and distribution equipment.

B. Balance electrical load between phases as nearly as possible on switchboards, panel boards, motor control centers, and other equipment where balancing is required.

C. When loads must be reconnected to different circuits to balance phase loads, maintain accurate record of changes made, and provide circuit directory that lists final circuit arrangement.

3.03 CHECKOUT AND STARTUP

A. Voltage Field Test:

1. Check voltage at point of termination of power company supply system to project when installation is essentially complete and is in operation.

2. Check voltage amplitude and balance between phases for loaded and unloaded conditions.

3. Record supply voltage (all three phases simultaneously on the same graph) for 24 hours during normal working day.

   a. Submit Voltage Field Test Report within 5 days of test.

4. Unbalance Corrections: Make written request to power company to correct condition if balance (as defined by NEMA) exceeds 1 percent, or if voltage varies throughout the day and from loaded to unloaded condition more than plus or minus 4 percent of nominal.

   a. Obtain a written certification from a responsible power company official that the voltage variations and unbalance are within their normal standards if corrections are not made.

B. Equipment Line Current Tests:

1. Check line current in each phase for each piece of equipment.

2. Make line current check after power company has made final adjustments to supply voltage magnitude or balance.

3. If any phase current for any piece of equipment is above rated nameplate current, prepare Equipment Line Phase Current Report that identifies cause of problem and corrective action taken.

C. Startup:

1. Demonstrate satisfactory operation of all 240-volt electrical equipment. Participate with other trades in all startup activities.

2. Assist the I&C Contractor in verifying signal integrity of all control and instrumentation signals.

D. Conflicts, if any, that may exist between the above items will be resolved at the discretion of the Engineer.

E. Wherever the requirements of the Specifications or Drawings exceed those of the above items, the requirements of the Specifications or Drawings govern. Code compliance is mandatory. Construe nothing in the Contract Documents as permitting work not in compliance with these codes.

F. Obtain all permits and pay all fees required by any governmental agency having jurisdiction over the work. Arrange all inspections required by these agencies. On completion of the work, furnish satisfactory evidence to the Engineer that the work is acceptable to the regulatory authorities having jurisdiction.

END OF SECTION

SECTION 16015

ELECTRICAL SYSTEMS ANALYSIS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The requirements of this specification shall apply to the existing modified and new electrical distribution system installed under this contract. The end result shall be a fully protected and properly coordinated system with proper arc flash safety labels and personal protective equipment recommendations.

B. Contractor shall furnish short-circuit and protective device coordination studies as described herein. The coordination study shall begin with the existing panel/switchboard feeder protective device and include all of the electrical protective devices down to, and including, the main breaker and feeder circuit in each 480V and 208 Volt panelboard.

C. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D.

1.02 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

   a. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems

   b. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings

   c. IEEE 242: Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.

   d. IEEE 399: Recommended Practice for Industrial and Commercial Power System Analysis.

   e. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems

   f. IEEE 1584-2002: Guide for Performing Arc Flash Hazard Calculations.

2. American National Standards Institute (ANSI):

   a. C57.12.00, Standard General Requirements for Liquid-immersed Distribution, Power, and Regulating Transformers.

   b. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures

c. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis

d. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories

e. ANSI C37.5 – Methods for Determining the RMS Value of a Sinusoidal Current Wave and Normal-Frequency Recovery Voltage, and for Simplified Calculation of Fault Currents

3. National Fire Protection Association:

a. NFPA 70E: National Electrical Safety Code Chapter 1.

b. NFPA 70: National Electrical Code.

4. Occupational Safety & Health Administration (OSHA):

a. 29-CFR, Part 1910, sub part S.

1.03 SUBMITTALS

A. Shop drawings: the results of the short-circuit; protective device coordination and arc flash hazard analysis studies shall be summarized in a preliminary and final summary report. Submit five (5) three-ring binder bound copies of the complete preliminary and final study reports. The preliminary short circuit and device coordination study report shall be submitted within 30 days of notice to proceed and shall be a basis for approval of all other electrical equipment in the power distribution system. The contractor is expected to review the results of the preliminary short circuit and device coordination study report against all other applicable shop drawings, including industrial control panels, prior to shop drawing submittal to coordinate appropriate fault duty ratings of all electrical equipment. The final short circuit and device coordination study report shall incorporate all comments from shop drawing submittals and include the arc-flash hazard analysis. The contractor shall ensure proper arc-flash warning labels are applied to all appropriate electrical equipment installed under this contract when the final study has been approved.

1.04 QUALITY ASSURANCE

A. Short circuit, protective device coordination, and arc flash studies shall be prepared by the manufacturer furnishing the electrical power distribution equipment or a professional electrical engineer registered in the State of Florida, hired by the manufacturer, in accordance with IEEE 242 and IEEE 399.

B. Manufacturer shall have unit responsibility for the equipment and protective device coordination.

1.05 SEQUENCING AND SCHEDULING

A. An initial, complete short circuit and arc flash study must be submitted and reviewed before Engineer will approve Shop Drawings for breakers, distribution panels,

transfer switches and circuit breaker panelboard equipment. Failure to do so will delay the approval of major equipment submittals.

B. The short circuit, protective device coordination and arc flash studies shall be updated prior to Project Substantial Completion. Utilize characteristics of as-installed equipment actual wire run lengths and materials.

PART 2 - PRODUCTS

2.01 GENERAL

A. Contractor shall furnish all field data as required for the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to eliminate unnecessary delays and assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

B. Source combination may include present and future utility supplies, motors, and generators.

C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner or Contractor.

D. Equipment and component titles used in the studies shall be identical to the equipment and component titles shown on the Drawings.

E. Perform studies using digital computer with a software package such as SKM Power*Tools for Windows™ DAPPER™, CAPTOR™ and ARC FLASH™, or approved equal.

F. Perform complete fault calculations for all busses on utility and generator power sources. Perform load flow and voltage drop studies for major feeders and loads with long feeder runs. Analysis shall include expected fault currents at industrial control panels manufactured in accordance with UL 508A and NEC article 409.

G. Fault source combinations shall include large motors, large transformers, utility and generator.

H. Utilize proposed and existing load data for the study obtained from Contract Documents and field survey. Coordinate with local power utility for available fault currents from utility services.

I. Existing Equipment:

1. Include fault contribution of existing motors, services, generators and equipment, as appropriate, in the study.

2. Obtain required existing equipment data from the field and FPL.

J. Provide a comprehensive report document containing the short circuit, device coordination and arc flash studies. As a minimum the report structure shall contain the following:

1. Executive Summary.

2. Methodology.

3. One Line Diagram(s).

4. Short Circuit Analysis.

5. Short Circuit Analysis Results/Conclusions/Recommendations.

6. Device Coordination Analysis.

7. Recommended protective devices settings.

8. Arc Flash Analysis.

9. Arc Flash PPE recommendations.

2.02 SHORT CIRCUIT STUDY

A. General:

1. Use cable impedances based on copper conductors. Use actual conductor impedances if know. If unknown, use typical conductor impedances based on IEEE Standards 141, latest edition.

2. Use bus impedances based on copper bus bars.

3. Use cable and bus resistances calculated at 25 degrees C.

4. Use 600-volt cable reactances based on use of typical data of conductors to be used in this project.

5. Use transformer impedances 92.5 percent of "nominal" impedance based on tolerances specified in ANSI C57.12.00.

B. Provide:

1. Calculation methods and assumptions.

2. Selected base per unit quantities.

3. One-line diagrams annotated with results of short circuit analysis including:
   a. Three phase, line-to-line and single line to ground faults.
   b. Equipment Short Circuit Rating.

4. Source impedance data, including electric utility system and motor fault contribution characteristics.

5. DAPPER™ Short circuit report, demand load report, load flow report and input data reports.

6. Results, conclusions, and recommendations.

C. Calculate short circuit interrupting and momentary (when applicable) duties for an assumed symmetrical three-phase bolted fault, bolted line-to-ground fault, and bolted line-to-line fault at each:

1. Electric utility's supply termination point.

2. Main breakers, generator breakers and feeder breakers.

3. Low voltage switchgear, switchboard and/or distribution panelboard.

4. Switchboards.

5. Fire Pumps.

6. Standby generator.

7. Automatic Transfer Switch.

8. All branch circuit panelboards.

9.. Industrial control panels manufactured in accordance with UL 508A and NEC article 409.

10. Other significant locations throughout the system.

11. Lift Station

12. Future load contributions as shown on one-line diagram.

D. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short circuit ratings Verify all equipment, main breakers, ATS, and protective devices are applied within their ratings.

2. Adequacy of switchgear, switchboards, motor control centers, unit substations and panelboard bus bar bracing to withstand short-circuit stresses

3. Adequacy of transformer windings to withstand short-circuit stresses

4. Cable and busway sizes for ability to withstand short-circuit heating besides normal load currents.

5. Notify Owner in writing, of existing, circuit protective devices improperly rated for the calculated available fault current

E. Through the General Contractor, furnish expected fault currents for industrial control panels, constructed and installed under other divisions and specifications of this

contract, to the panel builder for his coordination with meeting the requirements of UL 508A and NEC article 409.

2.03 PROTECTIVE DEVICE COORDINATION STUDY

A. Proposed protective device coordination time-current curves for distribution system, graphically displayed on log-log scale paper. Time Current Curve plots from SKM CAPTOR™ program are acceptable.

B. Each curve sheet to have title and one-line diagram with legend identifying the specific portion of system associated with time-current curves on that sheet.

C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.

D. Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

E. Perform device coordination on time-current curves for low voltage distribution system(s).

F. Provide Individual protective device time-current characteristics on log-log paper or software generated graphs.

G. Plot Characteristics on Curve Sheets:

1. Electric utility's relays or protective device (if applicable).

2. Electric utility's fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands (if applicable).

3. Medium voltage equipment relays (if applicable).

4. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.

5. Low voltage equipment circuit breaker trip devices, including manufacturer’s tolerance bands.

6. Transformer full-load current, magnetizing inrush current, and ANSI transformer withstand parameters.

7. Transformer damage curves.

8. Conductor damage curves.

9. ANSI transformer with stand parameters.

10. Significant symmetrical and asymmetrical fault currents.

11. Ground fault protective devices and settings (if applicable).

12. Pertinent motor starting characteristics and motor damage points.

13. Pertinent generator short circuit decrement curve and generator damage point.

14. Circuit breaker panelboard main breakers, where appropriate.

15. Motor circuit protectors for major motors

H. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

I. Primary Protective Device Settings for Delta-Wye Connected Transformer:

1. Secondary Line-to-Ground Fault Protection: Primary protective device operating band within the transformer's characteristics curve, including a point equal to 58 percent of ANSI C57.12.00 withstand point.

2. Secondary Line-To-Line Faults: 16 percent current margin between primary protective device and associated secondary device characteristic curves.

J. Separate medium voltage relay characteristics curves from curves for other devices by at least 0.4-second time margin.

2.04 ARC FLASH ANALYSIS

A. Perform incident energy calculations in accordance with IEEE 1584-2002 Guide for Performing Arc Flash Hazard Calculations for all equipment analyzed in the short circuit study. Tabular results and recommended labels from SKM ARC FLASH™ are acceptable.

B. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model.

C. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, bussway and unit substations, variable frequency drives, industrial control panels) where work could be performed on energized parts.

D. The Arc-Flash Hazard Analysis shall include all medium voltage and low voltage locations. Arc-Flash Hazard Analysis on low voltage systems 50V and below is not required.

E. Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm2.

F. The Arc Flash Hazard analysis shall include calculations for maximum and minimum contributions of fault current magnitude. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume a minimum motor load. Conversely, the maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

G. Arc flash computation shall include both line and load side of main breaker calculations, where necessary.

H. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2.

I. Furnish recommendations for Personal Protective Equipment, in accordance with OSHA standards, and proper labels to be located on the electrical equipment in accordance with NEC Article 110.16.

J. Use manufacturer data for: enclosure type; gap between exposed conductors or buss way; grounding type; number of phases and connection; and working distance.

2.05 TABULATIONS

A. Input Data:

1. Utility three-phase and line-to-ground available contribution with associated X/R ratios.

2. Short circuit reactances of rotating machines and associated X/R ratios.

3. Cable type, construction, size, quantity per phase, length, impedance and conduit type.

4. Bus data, including impedance.

5. Transformer primary & secondary voltages, winding configurations, kVA rating, impedance, and X/R ratio.

B. Short Circuit Data:

1. Source fault impedance and generator contributions.

2. X to R ratios.

3. Asymmetry factors.

4. Motor contributions.

5. Short circuit kVA.

6. Symmetrical and asymmetrical fault currents.

C. Recommended Protective Device Settings:

1. Phase and ground relays:

a. Relay name.

b. Device number.

c. Description.

d. TCC catalog number.

e. Short circuit ratings.

f. Current transformer ratio.

g. Current tap.

h. Time dial setting (as applicable).

i. Instantaneous pickup setting (as applicable).

j. Ground fault setting (as applicable).

k. Specialty, non-overcurrent device settings.

l. Recommendations on improved relaying systems, if applicable

2. Circuit Breakers:

a. Breaker name.

b. Breaker Description.

c. Model number.

d. TCC catalog number.

e. Short circuit rating.

f. Frame/Sensor rating.

g. Adjustable pickups and time delays (long time, short time, ground).

h. Adjustable time-current characteristic.

i. Adjustable instantaneous pickup.

j. Recommendations on improved trip systems, if applicable

3. Motor Circuit Protectors (MCP):

a. MCP name.

b. MCP Description.

c. Model number.

d. TCC catalog number.

e. Short circuit rating.

f. Frame/Sensor rating.

g. Instantaneous settings.

4. Fuses:

a. Fuse name.

b. Fuse Description.

c. Model number.

d. TCC catalog number.

e. Short circuit rating.

f. Fuse rating.

D. Incident energy and flash protection boundary calculations.

1. Arcing fault magnitude

2. Device clearing time

3. Duration of arc

4. Arc flash boundary

5. Working distance

6. Incident energy

7. Hazard Risk Category

8. Recommendations for arc flash energy reduction

2.06 STUDY ANALYSES

A. Written Summary:

1. Scope of studies performed.

2. Explanation of bus and branch numbering system.

3. Prevailing conditions.

4. Selected equipment deficiencies.

5. Results of short circuit and coordination studies.

6. Comments or suggestions.

B. Suggest changes and additions to equipment rating and/or characteristics.

C. Notify Engineer in writing of existing circuit protective devices improperly rated for new fault conditions.

PART 3 - EXECUTION

3.01 GENERAL

A. Adjust relay and protective device settings according to values established by coordination study.

B. Make minor modifications to equipment as required to accomplish conformance with the short circuit and protective device coordination studies.

C. Notify Engineer in writing of any required major equipment modifications.

END OF SECTION

SECTION 16050

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1- GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American National Standards Institute (ANSI):

   a. C55,1, Standard for Shunt Power Capacitors.

   b. C62.11, Standard for Metal-Oxide Surge Arrestors for AC Circuits.

   c. Z55.1, Gray Finishes for Industrial Apparatus and Equipment.

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

   a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

   b. A240, Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.

   c. A570, Standard Specification for Steel, Sheet, and Strip, Carbon, Hot-Rolled, Structural Quality.

3. Federal Specifications (FS):

   a. W-C-596, Connector, Receptacle, Electrical.

   b. W-S-896E, Switches, Toggle, Flush Mounted.

4. National Electrical Contractor's Association, Inc. (NECA): 5055, Standard of Installation.

5. National Electrical Manufacturers Association (NEMA):

   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

   b. AB 1, Molded Case Circuit Breakers and Molded Case Switches.

   c. CP I, Shunt Capacitors.

   d. ICS 2, Industrial Control Devices, Controllers, and Assemblies.

   e. KS 1, Enclosed Switches.

   f. LA I, Surge Arrestors.

g. PB 1, Panelboards.

h. ST 20, Dry-Type Transformers for General Applications.

i. WD I, General Requirements for Wiring Devices.

6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).

7. Underwriters Laboratories, Inc. (UL):

a. 67, Standard for Panelboards.

b. 98, Standard for Enclosed and Dead-Front Switches.

c. 198C, Standard for Safety High-Intermpting-Capacity Fuses, Current-Limiting Types.

d. 198E, Standard for Class Q Fuses.

e. 486E, Standard for Equipment Wiring Terminals.

f. 489, Standard for Molded Case Circuit Breakers and Circuit Breaker Enclosures.

g. 508, Standard for Industrial Control Equipment.

h. 810, Standard for Capacitors.

i. 943, Standard for Ground-Fault Circuit Interrupters.

j. 1059, Standard for Terminal Blocks.

k. 1561, Standard for Dry-Type General-Purpose and Power Transformers.

1.02 SUBMITTALS

A. Shop Drawings:

1. Device boxes for use in hazardous areas.

2. Junction and pull boxes used at, or below, grade.

3. Hardware.

4. Terminal junction boxes.

5. Panelboards and circuit breaker data.

6. Fuses.

7. Contactors.

8. Transformers.

9. All other miscellaneous material part of this project.

10. Wire pulling compound.

1.03 QUALITY ASSURANCE

A. UL Compliance: Materials manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL listing mark.

B. Hazardous Areas: Materials and devices shall be specifically approved for hazardous areas of the class, division, and group shown and of a construction that will ensure safe performance when properly used and maintained.

1.04 SPARE PARTS

A. Furnish, tag, and box for shipment and storage the following spare parts:

1. Fuses, 0 to 600 Volts: Six of each type and each current rating installed.

PART 2- PRODUCTS

2.01 OUTLET AND DEVICE BOXES

A. Cast Stainless Steel Box:

1. Box: Cast stainless steel.
2. Cover: Gasketed, weatherproof, cast stainless steel, with stainless steel screws.

3. Hubs: Threaded.

4. Lugs (Cast Mounting) Manufacturer:

a. Calbrite, stainless steel.

2.02 JUNCTION AND PULL BOXES

A. Outlet Boxes Used as Junction or Pull Box: As specified under Article OUTLET AND DEVICE BOXES.

B. Large Stainless Steel Box: NEMA 250, Type 4X.

1. Box: 14-gauge, ASTM A240, Type 316 stainless steel.

2. Cover: Hinged with screws.

3. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.

4. Manufacturers:

a. Hoffman Engineering Co.

b. No equal.

C. Large Nonmetallic Box, use only where shown on plan:

1. NEMA 250, Type 4X.

2. Box: High-impact, fiberglass-reinforced polyester or engineered thermoplastic, with stability to high heat.

3. Cover: Hinged with screws.

4. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.

5. Conduit hubs and mounting lugs.

6. Manufacturers:
   a. Crouse-Hinds; Type NJB.

   b. No equal.

2.03 WIRING DEVICES

A. Switches:

1. NEMA WD I and FS W-S-896E.

2. Specification grade, totally-enclosed, ac type, with quiet tumbler switches and screw terminals.

3. Capable of controlling 100 percent tungsten filament and fluorescent lamp loads.

4. Rating: 20 amps, 120/277 volts.

5. Color:
   a. Office Areas: Ivory.

6. Switches with Pilot Light: 125-volt, neon light with red jewel, or lighted toggle when switch is ON.

7. Manufacturers:

   a. Hubbell.

B. Receptacle, Single and Duplex:

1. NEMA WD 1 and FS W-C-596.

2. Specification grade, two-pole, three-wire grounding type with screw type wire terminals suitable for No. 10 AWG.

3. High strength, thermoplastic base color.

4. Color:
   a. Office Areas: Ivory.

5. Contact Arrangement: Contact to be made on two sides of each inserted blade without detent.

6. Rating: 125 volts, NEMA WD 1, Configuration 5-20R, 20 amps.

7. Manufacturers:

   a. Hubbell.

C. Receptacle, Ground Fault Circuit Interrupter: Duplex, specification grade, tripping at 5 mA.

1. Color: Ivory.

2. Rating: 125 volts, NEMA WD 1, Configuration 5-20R, 20 amps, capable of interrupting 5,000 amps without damage.

3. Size: For 2-inch by 4-inch outlet boxes.

4. Standard Model: NEMA WD 1 with No. 12 AWG copper USE/RHH/RHW-XLPE insulated pigtails and provisions for testing.

5. Feed-Through Model: NEMA WD 1, with No. 12 AWG copper USE/RHH/RHW-XLPE insulated pigtails and provisions for testing.

6. Manufacturers:

   a. Hubbell.

2.04 DEVICE PLATES

A. General: Sectional type plates not permitted.

B. Plastic:
   1. Material: Specification grade, 0.10-inch minimum thickness, noncombustible, thermosetting.

   2. Color: To match associated wiring device.

   3. Mounting Screw: Oval-head metal, color matched to plate.

C. Metal:

1. Material: Specification grade, one-piece, 0.040-inch nominal thickness 316 stainless steel.

2. Finish: ASTM A167, Type 316.

3. Mounting Screw: Oval-head, finish matched to plate.

D. Cast Metal:

1. Material: Malleable ferrous metal, with gaskets.

2. Screw: Oval-head stainless steel.

E. Engraved:

1. Character Height: 3/16 inch.

2. Filler: Black.

F. Weatherproof:

1. For Receptacles: Gasketed, stainless steel, with individual cap over each receptacle opening.

2. Mounting Screw: Stainless steel.

a. Cap Spring: Stainless steel.

b. Manufacturers:

(1) Hubbell.

3. For Switches: Gasketed, cast metal incorporating external operator for internal switch.

a. Mounting Screw: Stainless steel.

b. Manufacturers:

(1) Crouse-Hinds; DS-181 or DS-185.

G. Raised Sheet Metal: 1/2-inch high zinc- or cadmium-plated steel designed for one-piece drawn type sheet steel boxes.

2.05 CIRCUIT BREAKER, INDIVIDUAL, 0 TO 600 VOLTS

A. NEMA AB I, UL 489 listed for use at location of installation.

B. Minimum Interrupt Rating: As shown or as required.

C. Thermal-magnetic, quick-make, quick-break, indicating type, showing ON/OFF and TRIPPED indicating positions of the operating handle.

D. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.

E. Locking: Provisions for padlocking handle.

F. Multipole breakers to automatically open all poles when an overload occurs on one-pole.

G. Enclosure: NEMA 250, Type 12, Industrial Use, 4X - outdoors, wet locations and corrosive areas, unless otherwise shown.

H. Interlock: Enclosure and switch shall interlock to prevent opening cover with switch in the ON position.

I. Do not provide single-pole circuit breakers with handle ties where multipole circuit breakers are shown.

2.06 FUSE, 0 TO 600 VOLTS

A. Current-limiting, with 200,000 ampere rms interrupting rating.

B. Provide to fit mountings specified with switches and features to reject Class H fuses.

C. Motor and Transformer Circuits, 0- to 600-Volt:

1. Amperage: 0 to 600.

2. UL 198E, Class RK-1, dual element, with time delay.

3. Manufacturers:

a. Bussmann; Type LPS-RK.

b. Littlefuse; Type LLS-RK.

D. Motor and Transformer Circuits, 0- to 250-Volt:

1. Amperage: 0 to 600.

2. UL 198E, Class RK-1, dual element, with time delay.

3. Manufacturers:

a. Bussmann; Type LPN-RK.

b. Littlefuse; Type LLN-RK.

E. Feeder and Service Circuits, 0- to 600-Volt:

1. Amperage: 0 to 600.

2. UL 198E, Class RK-I, dual element, with time delay.

3. Manufacturers:

a. Bussmann; Type LPS-RK.

b. Littlefuse; Type LLS-RK.

F. Feeder and Service Circuits, O- to 250-Volt:

1. Amperage: 0 to 600.

2. UL 198E, Class RK-I, dual element, with time delay.

3. Manufacturers:

a. Bussmann; Type LPN-RK.

b. Littleluse; Type LLN-RK.

G. Feeder and Service Circuits, 0- to 600-Volt:

1. Amperage: 601 to 6,000.

2. UL 198C, Class L, double O-rings and silver links.

3. Manufacturers:

a. Bussmann; Type KRP-C.

b. Littlefuse; Type KLPC.

2.07 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCHES

A. Contact Rating: NEMA ICS 2, Type A600.

B. Selector Switch Operating Lever: Standard.

C. Indicating Lights: LED type Push-to-test.

D. Pushbutton Color:

1. ON or START: Red.

2. OFF or STOP: Green.

E. Pushbuttons and selector switches lockable in the OFF position where indicated.

F. Legend Plate:

1. Material: Aluminum.

2. Engraving: 11 character/spaces on one line, 14 character/spaces on each of two lines, as required, indicating specific function.

3. Letter Height: 7/64 inch.

G. Manufacturers:

1. Heavy-Duty, Oiltight Type:

a. Square D; Type T.

2. Heavy-Duty, Watertight, and Corrosion-Resistant Type:

a. Square D; Type SK.

2.08 TERMINAL JUNCTION BOX

A. Cover: Hinged, unless otherwise shown.

B. Terminal Blocks: Provide separate connection point for each conductor entering or leaving box.

1. Spare Terminal Points: 25 percent.

C. Interior Finish: Paint with white enamel or lacquer.

2.09 TERMINAL BLOCK (0 TO 600 VOLTS)

A. UL 486E and UL 1059.

B. Size components to allow insertion of necessary wire sizes.

C. Capable of termination of all control circuits entering or leaving equipment, panels, or boxes.

D. Screw clamp compression, dead front barrier type, with current bar providing direct contact with wire between the compression screw and yoke.

E. Yoke, current bar, and clamping screw of high strength and high conductivity metal.

F. Yoke shall guide all strands of wire into terminal.

G. Current bar shall ensure vibration-proof connection.

H. Terminals:

1. Capable of wire connections without special preparation other than stripping.

2. Capable of jumper installation with no loss of terminal or rail space.

3. Individual, rail mounted.

I. Marking system allowing use of preprinted or field-marked tags.

J. Manufacturers:

1. Weidmuller.

2. Ideal.

3. Electrovert.

2.10 MAGNETIC CONTROL RELAY

A. NEMA ICS 2, Class A600 (600 volts, 10 amps continuous, 7,200VA make, 720VA break), industrial control with field convertible contacts.

B. Time Delay Relay Attachment:

1. Pneumatic type, timer adjustable from 0.2 to 60 seconds (minimum).

C. Latching Attachment: Mechanical latch having unlatching coil and coil clearing contacts.

D. Manufacturers:

1. Square D.

2.11 MAGNETIC CONTACTOR

A. NEMA ICS 2, UL 508.

B. Electrically operated, electrically held.

C. Main Contacts:

1. Power driven in one direction with gravity dropout.

2. Silver alloy with wiping action and arc quenchers.

3. Continuous-duty, rated 30 amperes, 600-volt.

4. Three-pole.

D. Control: Two-wire.

E. One normally open and one normally closed auxiliary contacts rated 10 amperes at 480-volt.

F. Enclosure: NEMA 250, Type 12, unless otherwise shown.

G. Manufacturers:

1. Allen-Bradley; Bulletin 500 Line.

2.12 SUPPORT AND FRAMING CHANNELS

A. Material:
   1. Dry indoors - galvanized.

   2. All Other Areas: ASTM A167, Type 316 stainless steel or fiber-reinforced epoxy, as required.

B. Finish:
   1. Dry indoors - galvanized.

   2. All Other Areas: ASTM A167, Type 316 stainless steel or fiber-reinforced epoxy, as required.

C. Inserts: Continuous.

D. Beam Clamps: Gray cast iron.

E. Manufacturers:

   1. Unistrut.

2.13 NAMEPLATES

A. Material: Laminated plastic.

B. Attachment Screws: Stainless steel.

C. Color: White, engraved to a black core.

D. Engraving:

   1. Pushbuttons/Selector Switches: Name of drive controlled on one, two, or three lines, as required.
   2. Panelboards: Panelboard designation, service voltage, and phases.

E. Letter Height:

   1. Pushbuttons/Selector Switches: 1/8 inch.

   2. Panelboards: 1/4 inch.

2.14 TRANSIENT VOLTAGE SURGE SUPPRESSION/ SURGE PROTECTION DEVICE

A. This section describes the material and installation requirements for transient voltage surge suppression devices (TVSS) or surge protection device (SPD) in switchboards, panelboards, and motor control centers for the protection of all AC electrical circuits.

B. SPD shall be listed and component recognized in accordance with UL 1449 and UL 1283.

C. SPD shall be installed and warranted by and shipped from the electrical distribution equipment manufacturer’s factory.

D. SPD shall provide surge current diversion paths for all modes of protection; L-L, L-N, L-G, N-G in WYE systems, and L-L, L-G in DELTA systems.

E. SPD shall be modular in design. Each module shall be fused with a surge rated fuse.

F. A UL approved disconnect switch shall be provided as a means of disconnect in the switchboard device only.

G. SPD shall meet or exceed the following criteria:

1. Maximum surge current capability (single pulse rated) shall be:

   a. Service entrance switchboard 300kA

   b. Branch panelboards 150kA

   c. Control Panel 150kA

2. UL 1449 Listed and Recognized Component Suppression Voltage Ratings shall not exceed the following:

Voltage	L-N	L-G	N-G
208Y/120	400V	400V	400V
480Y/277	800V	800V	800V

H. SPD shall have a minimum EMI/RFI filtering of -44dB at 100kHz with an insertion ration of 50:1 using MIL STD. 220A methodology.

I. SPD shall be provided with 1 set of NO/NC dry contacts.

J. SPD shall have a warranty for a period of five years, incorporating unlimited replacements of suppressor parts if they are destroyed by transients during the warranty period. Warranty will be the responsibility of the electrical distribution equipment manufacturer.

K. Approve manufactures are:

1. Square D Company XTE Series

PART 3 - EXECUTION

3.01 GENERAL

A. Install equipment in accordance with NECA 5055.

3.02 OUTLET AND DEVICE BOXES

A. Install suitable for conditions encountered at each outlet or device in the wiring or raceway system, sized to meet NFPA 70 requirements.

B. Size:

1. Depth: Minimum 2 inches, unless otherwise required by structural conditions. Box extensions not permitted.

   a. Hollow Masonry Construction: Install with sufficient depth such that conduit knockouts or hubs are in masonry void space.

   b. Ceiling Outlet: Minimum 4-inch octagonal sheet stainless steel device box, unless otherwise required for installed fixture.

   c. Switch and Receptacle: Minimum 2-inch by 4-inch stainless steel device box.

2. Locations:

   a. Drawing locations are approximate.

   b. To avoid interference with mechanical equipment or structural features, relocate outlets as directed by ENGINEER.

   c. Light Switch: Install on lock side of doors.

   d. Light Fixture: Install in symmetrical pattern according to room layout unless otherwise shown.

C. Mounting Height:

1. General:

   a. Measured to centerline of box.

   b. Where specified heights do not suit building construction or finish, mount as directed by ENGINEER.

2. Light Switch: 48 inches above floor.

3. Thermostat: 54 inches above floor.

4. Telephone Outlet: 6 inches above counter tops or 15 inches above floor.

5. Wall Mounted Telephone Outlet: 52 inches above floor.

6. Convenience Receptacle:

   a. General Interior Areas: 15 inches above floor.

   b. General Interior Areas (Counter Tops): Install device plate bottom or side flush with top of splashback, or 6 inches above countertops without splashback.

   c. Industrial Areas, Workshops: 48 inches above floor.

d. Outdoor, All Areas: 24 inches above finished grade.

7. Special-Purpose Receptacle: 54 inches above floor or as shown.

D. Install plumb and level.

E. Flush Mounted:

1. Install with concealed conduit.

2. Install proper type extension rings or plaster covers to make edges of boxes flush with finished surface.

3. Holes in surrounding surface shall be no larger than required to receive box.

F. Support boxes independently of conduit by attachment to building structure or structural member.

G. Install bar hangers in frame construction, or fasten boxes directly with wood screws on wood, bolts and expansion shields on concrete or brick, toggle bolts on hollow masonry units, and machine screws threaded into steelwork.

H. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.

I. Provide plaster rings where necessary.

J. Boxes embedded in concrete or masonry need not be additionally supported.

K. Install 316 stainless steel mounting hardware in industrial areas.

L. Boxes Supporting Fixtures: Provide means of attachment with adequate strength to support fixture.

M. Open no more knockouts in sheet steel device boxes than are required; seal unused openings.

N. Box Type (Steel Raceway System):

1. Exterior Locations:
   a. Exposed Raceways: Cast metal.

   b. Concealed Raceways: Cast metal.

   c. Concrete Encased Raceways: Cast metal.

   d. Class I, II, or III Hazardous Areas: Cast metal.

O. Box Type (Rigid Aluminum Raceway System): Cast aluminum.

P. Box Type (Nonmetallic Raceway System):

1. Corrosive Locations: Nonmetallic.

2. Exposed Raceways: Nonmetallic.

3. Concealed Raceways: Nonmetallic.

4. Concrete Encased Raceways: Nonmetallic.

Q. Box Type, Corrosive Locations (PVC-Coated Rigid Galvanized Steel Raceway System): PVC coated cast metal.

3.03 JUNCTION AND PULL BOXES

A. Install where shown and where necessary to terminate, tap-off, or redirect multiple conduit runs.

B. Install pull boxes where necessary in raceway system to facilitate conductor installation.

C. Install in conduit runs at least every 150 feet or after the equivalent of three right-angle bends.

D. Use outlet boxes as junction and pull boxes wherever possible and allowed by applicable codes.

E. Installed boxes shall be accessible.

F. Do not install on finished surfaces.

G. Install plumb and level.

H. Support boxes independently of conduit by attachment to building structure or structural member.

I. Install bar hangers in frame construction, or fasten boxes directly with wood screws on wood, bolts and expansion shields on concrete or brick, toggle bolts on hollow masonry units, and machine screws or welded threaded studs on steelwork.

J. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.

K. Boxes embedded in concrete or masonry need not be additionally supported.

L. At or Below Grade:

1. Install boxes for below grade conduits flush with finished grade in locations outside of paved areas, roadways, or walkways.

2. If adjacent structure is available, box may be mounted on structure surface just above finished grade in accessible but unobtrusive location.

3. Obtain ENGINEER's written acceptance prior to installation in paved areas, roadways, or walkways.

4. Use boxes and covers suitable to support anticipated weights.

M. Flush Mounted:

1. Install with concealed conduit.

2. Holes in surrounding surface shall be no larger than required to receive box.

3. Make edges of boxes flush with final surface.

N. Mounting Hardware:

1. Noncorrosive Interior Areas: Galvanized.

2. All Other Areas: Stainless steel.

O. Location/Type:

1. Finished, Indoor, Dry: NEMA 250, Type 1.

2. Unfinished, Indoor, Dry: NEMA 250, Type 12.

3. Unfinished, Indoor and Outdoor, Wet and Corrosive: NEMA 250, Type 4X.

4. Unfinished, Indoor and Outdoor, Wet, Dust, or Oil: NEMA 250, Type 13.

5. Unfinished, Indoor and Outdoor, Hazardous: NEMA 250, Type 7 and Type 9, where indicated.

6. Underground Conduit: Concrete Encased.

7. Corrosive Locations: Nonmetallic or stainless steel.

8. If inside lift station wetwell, junction box shall be explosionproof.

3.04 WIRING DEVICES

A. Switches:

1. Mounting Height: See Paragraph OUTLET AND DEVICE BOXES.

2. Install with switch operation in vertical position.

3. Install single-pole, two-way switches such that toggle is in up position when switch is on.

B. Receptacles:

1. Install with grounding slot down except where horizontal mounting is shown, in which case install with neutral slot up.

2. Ground receptacles to boxes with grounding wire only.

3. Weatherproof Receptacles:

   a. Install in cast stainless steel box.

   b. Install such that hinge for protective cover is above receptacle opening.

4. Ground Fault Interrupter: Install feed-through model at locations where ground fault protection is specified for "downstream" conventional receptacles.

5. Special-Purpose Receptacles: Install in accordance with manufacturer's instructions.

C. Multioutlet Surface Raceway System:

1. Install in accordance with manufacturer's instructions.

2. Wire alternate outlets to each circuit where two-circuit, three-wire supply is shown.

3.05 DEVICE PLATES

A. Securely fasten to wiring device; ensure a tight fit to the box.

B. Flush Mounted: Install with all four edges in continuous contact with finished wall surfaces without use of mats or similar materials. Plaster fillings will not be acceptable.

C. Surface Mounted: Plate shall not extend beyond sides of box unless plates have no sharp corners or edges.

D. Install with alignment tolerance to box of 1/16 inch.

E. Engrave with designated titles.

F. Types (Unless Otherwise Shown):

1. Office: Stainless Steel.

2. Exterior: Weatherproof.

3. Interior:

   a. Surface Mounted, Sheet Steel Boxes: Stainless Steel.

3.06 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCH

A. Heavy-Duty, LED Type: Locations (Unless Otherwise Shown): Nonhazardous, indoor, dry locations, including motor control centers, control panels, and individual stations.

B. Heavy-Duty, Watertight, and Corrosion-Resistant Type:

1. Locations (Unless Otherwise Shown): Nonhazardous, outdoor, or normally wet areas.

2. Mounting: NEMA 250, Type 4X enclosure

3.07 TERMINAL JUNCTION BOX

A. Install in accordance with Paragraph JUNCTION AND PULL BOXES.

B. Label each block and terminal with permanently attached, nondestructible tag.

C. Do not install on finished outdoor surfaces.

D. Location:

1. Finished, Indoor, Dry: NEMA 250, Type 1.

2. Unfinished, Indoor, Dry: NEMA 250, Type 12.

3. Unfinished, Indoor and Outdoor, Wet and Corrosive: NEMA 250, Type 4X.

4. Unfinished, Indoor and Outdoor, Wet, Dust, or Oil: NEMA 250, Type 13.

3.08 SUPPORT AND FRAMING CHANNEL

A. Furnish 316 stainless steel unistrut for mounting and supporting electrical equipment and raceway systems.

3.09 MOTOR SURGE PROTECTION

A. Ground in accordance with NFPA 70.

B. Low Voltage: Ground terminals to equipment bus.

END OF SECTION

SECTION 16110

RACEWAYS

PART 1 - GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO): Division I, Standard Specifications for Highway Bridges, Fourteenth Edition.
2. American National Standards Institute (ANSI):
   a. C80.1, Rigid Steel Conduit-Zinc Coated.
   b. C80.3, Electrical Metallic Tubing-Zinc Coated.
   c. CS0.5, Rigid Aluminum Conduit.
   d. C80.6, Intermediate Metal Conduit (IMC)-Zinc Coated.
3. American Society for Testing and Materials (ASTM):
   a. A123 El, Standard Specification for Zinc-Coated (Galvanized) Coatings on Iron and Steel Products.
   b. C857, Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
4. National Electrical Contractor's Association, Inc. (NECA): 5055, Standard of Installation.
5. National Electrical Manufacturers Association (NEMA):
   a. RN 1, Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
   b. TC 2, Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
   c. TC 3, PVC Fittings for Use with Rigid PVC Conduit and Tubing.
   d. TC 6, PVC and ABS Plastic Utilities Duct for Underground Installation.
   e. VE 1, Metallic Cable Tray Systems.
6. National Fire Protection Association (NFPA): 70, National Electrical Code. (NEC)
7. Underwriters Laboratories, Inc. (UL):
   a. 1, Standard for Safety Flexible Metal Conduit.
   b. 6, Standard for Safety Rigid Metal Conduit.
   c. 360, Standard for Safety Liquid-Tight Flexible Steel Conduit.
   d. 514B, Standard for Safety Fittings for Conduit and Outlet Boxes.
   e. 514C, Standard for Safety Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.
   f. 651, Standard for Safety Schedule 40 and 80 PVC Conduit.
   g. 651A, Standard for Safety Type EB and Rigid PVC Conduit and HDPF Conduit.
   h. 797, Standard for Safety Electrical Metallic Tubing.
   i. 870, Standard for Safety Wireways, Auxiliary Gutters, and Associated Fittings.
   j. 1242, Standard for Safety Intermediate Metal Conduit.
   k. 1660, Standard for Safety Liquid-Tight Flexible Nonmetallic Conduit.

1.02 SUBMITTALS

A. Shop Drawings:

1. Manufacturer's Literature:

a. Rigid galvanized steel conduit.
b. Electric metallic tubing.
c. Rigid aluminum conduit.
d. PVC Schedule 40 conduit.
e. PVC-coated rigid galvanized steel conduit.
f. Flexible metal, liquid-tight conduit.
g. Flexible, nonmetallic, liquid-tight conduit.
h. Conduit fittings.
i. Wireways.

2. Precast Manholes and Handholes:
   a. Dimensional drawings and descriptive literature.
   b. Traffic loading calculations.
   c. Accessory information.
3. Cable Tray Systems:
   a. Dimensional drawings, calculations, and descriptive information.
   b. NEMA load/span designation and how it was selected.
   c. Support span length and pounds-per-foot actual and future cable loading at locations, with safety factor used.
   d. Location and magnitude of maximum simple beam deflection of tray for loading specified.
   e. Layout drawings and list of accessories being provided.
4. Conduit Layout:
   a. Plan and section type, showing arrangement and location of conduit and duct bank required for:
      1) Low and medium voltage feeder and branch circuits.
      2) Instrumentation and control systems.
      3) Communications systems.
      4) Empty conduit for future use.
   b. Reproducible mylar; scale not greater than 1 inch equals 20 feet.
      1) Equipment and machinery proposed for bending metal conduit.
      2) Method for bending PVC conduit less than 30 degrees.

1.03 UL COMPLIANCE

A. Materials manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL listing mark.

PART 2 - PRODUCTS

2.01 CONDUIT AND TUBING

A. Rigid Galvanized Steel Conduit (RGS):

1. Meet requirements of ANSI C80.1 and UL6.
2. Material: Hot-dip galvanized, with chromated protective layer.

B. PVC Schedule 40 Conduit:

1. Meet requirements of NEMA TC 2 and UL 651.
2. UL listed for concrete encasement, underground direct burial, concealed or direct sunlight exposure, and 90 degrees C insulated conductors.

C. Flexible Metal, Liquid-Tight Conduit:

1. UL 360 listed for 105 degrees C insulated conductors.
2. Material: Galvanized steel, with an extruded PVC jacket.

2.02 FITTINGS

A. Rigid Galvanized Steel and Intermediate Metal Conduit:

1. General:
   a. Meet requirements of UL 514B.
   b. Type: Threaded, galvanized. Set screw fittings not permitted.
2. Bushing:
   a. Material: Malleable iron with integral insulated throat, rated for 150 degrees C.
   b. Manufacturers:
      1) Thomas & Betts; Type BIM.
      2) O.Z./Gedney; Type HB.
3. Grounding Bushing:
   a. Material: Malleable iron with integral insulated throat rated for 150 degrees C, with solderless lugs.
   b. Manufacturers:
      1) Appleton; Series GIB.
      2) O.Z. Gedney; Type HBLG.
4. Conduit Hub:
   a. Material: Malleable iron with insulated throat.
   b. Manufacturers:
      1) O.Z. Gedney; Series CH.
      2) T & B; Series 370.
5. Conduit Bodies:
   a. Material: Malleable iron, sized as required by NFPA 70.
   b. Manufacturers (For Normal Conditions):
      1) Appleton; Form 35 threaded Unilets.
      2) Crouse-Hinds; Form 7 or 8 threaded condulets.
      3) Killark; Series O Electrolets.
   c. Manufacturers (For Hazardous Locations):
      1) Appleton.
      2) Crouse-Hinds.
      3) Killark.
6. Couplings: As supplied by conduit manufacturer.
7. Conduit Sealing Fitting Manufacturers:
   a. Appleton; Type EYF, EYM, or ESU.
   b. Crouse-Hinds; Type EYS or EZS.
   c. Killark; Type EY or EYS.
8. Drain Seal Manufacturers:
   a. Appleton; Type SF.
   b. Crouse-Hinds; Type EYD or EZD.
9. Drain/Breather Fitting Manufacturers:
   a. Appleton; Type ECDB.
   b. Crouse-Hinds; ECD.
10. Expansion Fitting Manufacturers:
   a. Deflection/Expansion Movement:

1) Appleton; Type DF.
2) Crouse-Hinds; Type XD.

b. Expansion Movement Only:
1) Appleton; Type XJ.
2) Crouse-Hinds; Type XJ.

11. Cable Sealing Fittings:
a. To form watertight nonslip cord or cable connection to conduit.
b. For Conductors With OD of 1/2 Inch or Less: Neoprene bushing at connector entry.
c. Manufacturers:
1) Crouse-Hinds; CGBS.
2) Appleton; CG-S.

B. PVC Conduit and Tubing:

1. Meet requirements of NEMA TC-3.
2. Type: PVC, slip-on.

C. Flexible Metal, Liquid-Tight Conduit:

1. Metal insulated throat connectors with integral nylon or plastic bushing rated for 105 degrees C.
2. Insulated throat and sealing O-rings.
3. Long design type extending outside of box or other device at least 2 inches.
4. Manufacturer: T & B; Series 5300.

D. Watertight Entrance Seal Device:

1. New Construction:
a. Material: Oversized sleeve, malleable iron body with sealing ring, pressure ring, grommet seal, and pressure clamp.
b. Manufacturer: O.Z./Gedney; Type FSK or WSK, as required.
2. Gored-Hole Application:
a. Material: Assembled dual pressure disks, neoprene sealing ring, and membrane clamp.
b. Manufacturer: O.Z./Gedney; Series CSM.

E. Hazardous Locations: Approved for use in the atmosphere involved.

1. Manufacturer: Crouse-Hinds; Type EYSR.

2.03 ACCESSORIES

A. Duct Bank Spacers:

1. Type: Nonmetallic, interlocking, for multiple conduit sizes.
2. Suitable for all types of conduit.
3. Manufacturer: Underground Device, Inc.; Type WUNPEECE.

B. Identification Devices:

1. Raceway Tags:
a. Material: Permanent, nylon.

b. Shape: Round.
c. Raceway Designation: Pressure stamped, embossed, or engraved.
d. Tags relying on adhesives or taped-on markers not permitted.

2. Electric Detectable Warning Tape:
   a. Material: Polyethylene, 4-mil gauge with solid aluminum foil core.
   b. Color: Red, unless otherwise noted.
   c. Width: Minimum 6-inch.
   d. Designation: Warning on tape that electric circuit is located below tape.
   e. Manufacturers:
      1) Blackburn.
      2) Griffolyn Co.
      3) Or approved equal.
3. Buried Raceway Marker:
   a. Material: 6”x6”x12” concrete monument, consisting of double-ended arrows, straight for straight runs and bent at locations where runs change direction.
   b. Designation: Incise to depth of 3/32 inch, ELECTRIC CABLES. in letters 1/4-inch high.
   c. Minimum Dimension: 1/4-inch thick, 10 inches long, and 3/4-inch wide.

C. Raceway Coating:

1. Material: Bitumastic or plastic tape coating.
2. Manufacturers:
   a. Koppers bitumastic; No. 505.
   b. Scotchwrap; No. 51, plastic tape.

D. Wraparound Duct Band:

1. Material: Heat-shrinkable, cross-linked polyolefin, precoated with hot-melt adhesive.
2. Manufacturer: Raychem; Type TWDB.

PART 3 - EXECUTION

3.01 GENERAL

A. Conduit and Tubing sizes shown are based on the use of copper conductors. Reference Section 16120, CONDUCTORS, concerning conduit sizing for aluminum conductors.

B. All installed Work shall comply with NECA 5055.

C. Crushed or deformed raceways not permitted.

D. Maintain raceway entirely free of obstructions and moisture.

E. Immediately after installation, plug or cap raceway ends with watertight and dust-tight seals until time for pulling in conductors.

F. Aluminum Conduit: Do not install in direct contact with concrete.

G. Sealing Fittings: Provide drain seal in vertical raceways where condensate may collect above sealing fitting.

H. Avoid moisture traps where possible. When unavoidable in exposed conduit runs, provide junction box and drain fitting at conduit low point.

I. Group raceways installed in same area.

J. Proximity to Heated Piping: Install raceways minimum 12 inches from parallel runs.

K. Follow structural surface contours when installing exposed raceways. Avoid obstruction of passageways.

L. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes.

M. Block Walls: Do not install raceways in same horizontal course with reinforcing steel.

N. Install watertight fittings in outdoor, underground, or wet locations.

O. Paint threads, before assembly of fittings, of galvanized conduit or IMC installed in exposed or damp locations with zinc-rich paint or liquid galvanizing compound.

P. All metal conduit to be reamed, burrs removed, and cleaned before installation of conductors, wires, or cables.

Q. Do not install raceways in concrete equipment pads, foundations, or beams.

R. Horizontal raceways installed under floor slabs shall lie completely under slab, with no part embedded within slab.

S. Install concealed, embedded, and buried raceways so that they emerge at right angles to surface and have no curved portion exposed.

3.02 INSTALLATION IN CAST-IN-PLACE STRUCTURAL CONCRETE

A. Minimum cover 1-1/2 inches.

B. Provide support during placement of concrete to ensure raceways remain in position.

C. Floor Slabs:

1. Outside diameter of conduit not to exceed one-third of the slab thickness.
2. Separate conduit by minimum six times conduit outside diameter, except at crossings.

3.03 CONDUIT APPLICATION

A. Diameter: Minimum 3/4 inch.

B. Exterior, Exposed:

1. PVC Coated Rigid galvanized steel.

C. Interior, Exposed:

1. PVC Coated Rigid galvanized steel.

D. Aboveground, Embedded in Concrete Walls, Ceilings, or Floors: PVC Schedule 40.

E. Direct Earth Burial: PVC Schedule 40.

F. Concrete-Encased Raceways: PVC Schedule 40.

G. Under Slabs-On-Grade: PVC Schedule 40.

3.04 CONNECTIONS

A. For motors, wall or ceiling mounted fans and unit heaters, dry type transformers, electrically operated valves, instrumentation, and other equipment where flexible connection is required to minimize vibration:

1. Conduit Size 4 Inches or Less: Flexible metal, liquid-tight conduit.
2. Conduit Size Over 4 Inches: Nonflexible.
3. Corrosive Areas: Flexible, nonmetallic, liquid or PVC-coated metallic, liquid-tight.
4. Length: 18-inch minimum, 60-inch maximum, of sufficient length to allow movement or adjustment of equipment.

B. Lighting Fixtures in Dry Areas: Flexible steel, nonliquid-tight conduit.

C. Outdoor Areas, Process Areas Exposed to Moisture, and Areas Required to be Oiltight and Dust-Tight: Flexible metal, liquid-tight conduit.

D. Transition From Underground or Concrete Embedded to Exposed: PVC Coated Rigid galvanized steel conduit.

E. Under Equipment Mounting Pads: Rigid galvanized steel conduit.

F. Exterior Light Pole Foundations: Rigid galvanized steel conduit.

3.05 PENETRATIONS

A. Make at right angles, unless otherwise shown.

B. Notching or penetration of structural members, including footings and beams, not permitted.

C. Fire-Rated Walls, Floors, or Ceilings: Fire-stop openings around penetrations to maintain fire-resistance rating.

D. Apply single layer of wraparound duct band to all metallic conduit in contact with concrete floor slabs to a point 2 inches above concrete surface.

E. Concrete Walls, Floors, or Ceilings (Aboveground): Provide nonshrink grout dry-pack, or use watertight seal device.

F. Entering Structures:

1. General: Seal raceway at the first box or outlet with minimum 2 inches thick expandable plastic compound to prevent the entrance of gases or liquids from one area to another.
2. Concrete Roof or Membrane Waterproofed Wall or Floor:
   a. Provide a watertight seal.
   b. Without Concrete Encasement: Install watertight entrance seal device on each side.
   c. With Concrete Encasement: Install watertight entrance seal device on the accessible side.
   d. Securely anchor malleable iron body of watertight entrance seal device into construction with one or more integral flanges.
   e. Secure membrane waterproofing to watertight entrance seal device in a permanent, watertight manner.
3. Heating, Ventilating, and Air Conditioning Equipment:

   a. Penetrate equipment in area established by manufacturer.
   b. Terminate conduit with flexible metal conduit at junction box or condulet attached to exterior surface of equipment prior to penetrating equipment.
   c. Seal penetration with silicone type sealant as specified in Section 07270, FIRE STOPPING.
4. Corrosive-Sensitive Areas:
   a. Seal all conduit passing through chlorine and ammonia room walls.
   b. Seal all conduit entering equipment panel boards and field panels containing electronic equipment.
   c. Seal penetration with silicone type sealant as specified in Section 07270, FIRE STOPPING.
5. Existing or Precast Wall (Underground): Core drill wall and install a watertight entrance seal device.
6. Nonwaterproofed Wall or Floor (Underground, without Concrete Encasement):
   a. Provide Schedule 40 galvanized pipe sleeve, or watertight entrance seal device.
   b. Fill space between raceway and sleeve with an expandable plastic compound on each side.

7. Manholes and Handholes:
   a. Metallic Raceways: Provide insulated grounding bushings.
   b. Nonmetallic Raceways: Provide bell ends flush with wall.
   c. Install such that raceways enter as near as possible to one end of wall, unless otherwise shown.

3.06 SUPPORT

A. Support from structural members only, at intervals not exceeding NFPA 70 requirements, and in any case not exceeding 10 feet. Do not support from piping, pipe supports, or other raceways.

B. Multiple Adjacent Raceways: Provide ceiling trapeze. For trapeze-supported conduit, allow 40 percent extra space for future conduit.

C. Provide and attach wall brackets, strap hangers, or ceiling trapeze as follows:

1. Wood: Wood screws.
2. Hollow Masonry Units: Toggle bolts.
3. Concrete or Brick: Expansion shields, or threaded studs driven in by powder charge, with lock washers and nuts.

4. Steelwork: Machine screws.

D. Nails or wooden plugs inserted in concrete or masonry for attaching raceway not permitted. Do not weld raceways or pipe straps to steel structures. Do not use wire in lieu of straps or hangers.

3.07 BENDS

A. Install concealed raceways with a minimum of bends in the shortest practical distance.

B. Make bends and offsets of longest practical radius.

C. Install with symmetrical bends or cast metal fittings.

D. Avoid field-made bends and offsets, but where necessary, make with acceptable hickey or bending machine. Do not heat metal raceways to facilitate bending.

E. Make bends in parallel or banked runs from same center or centerline with same radius so that bends are parallel.

F. Factory elbows may be installed in parallel or banked raceways if there is change in plane of run, and raceways are same size.

G. PVC Conduit:

1. Bends 30-Degree and Larger: Provide factory-made elbows.
2. 90-Degree Bends: Provide rigid steel elbows.
3. Use manufacturer's recommended method for forming smaller bends.

H. Flexible Conduit: Do not make bends that exceed allowable conductor bending radius of cable to be installed or that significantly restricts conduit flexibility.

3.08 EXPANSION/DEFLECTION FITTINGS

A. Provide on all raceways at all structural expansion joints, and in long tangential runs.

B. Provide expansion/deflection joints for 50 degrees F maximum temperature variation.

C. Install in accordance with manufacturer's instructions.

3.09 PVC CONDUIT

A. Solvent Welding:

1. Provide manufacturer recommended solvent; apply to all joints.
2. Install such that joint is watertight.

B. Adapters:

1. PVC to Metallic Fittings: PVC terminal type.
2. PVC to Rigid Metal Conduit or IMC: PVC female adapter.

C. Belied-End Conduit: Bevel the unbelled end of the joint prior to joining.

3.10 TERMINATION AT ENCLOSURES

A. Cast Metal Enclosure: Provide manufacturer's premolded insulating sleeve inside metallic conduit terminating in threaded hubs.

B. Sheet Metal Boxes, Cabinets, and Enclosures:

1. Rigid Galvanized Conduit:
   a. Provide one lock nut each on inside and outside of enclosure.
   b. Install grounding bushing.
   c. Provide bonding jumper from grounding bushing to equipment ground bus or ground pad; if neither ground bus nor pad exists, connect jumper to lag bolt attached to metal enclosure.
   d. Install insulated bushing on ends of conduit where grounding is not required.
   e. Provide insulated throat when conduit terminates in sheet metal boxes having threaded hubs.
2. Flexible Metal Conduit: Provide two screw type, insulated, malleable iron connectors.
3. PVC Schedule 40 Conduit: Provide PVC terminal adapter with lock nut.

C. Motor Control Center, Switchboard, Switchgear, and Free-Standing Enclosures: Terminate conduit entering bottom with grounding bushing; provide a grounding jumper extending to equipment ground bus or grounding pad.

3.11 UNDERGROUND RACEWAYS

A. Grade: Maintain minimum grade of 4 inches in 100 feet, either from one manhole, handhole, or pull box to the next, or from a high point between them, depending on surface contour.

B. Cover: Maintain minimum 2-foot cover above conduit and concrete encasement, unless otherwise shown.

C. Make routing changes as necessary to avoid obstructions or conflicts.

D. Couplings: In multiple conduit runs, stagger so that couplings in adjacent runs are not in same transverse line.

E. Union type fittings not permitted.

F. Spacers:

1. Provide preformed, nonmetallic spacers, designed for such purpose, to secure and separate parallel conduit runs in a trench or concrete encasement.
2. Install at intervals not greater than that specified in NFPA 70 for support of the type conduit used, but in no case greater than 10 feet.

G. Support conduit so as to prevent bending or displacement during backfilling or concrete placement.

H. Installation with Other Piping Systems:

1. Crossings: Maintain minimum 12-inch vertical separation.
2. Parallel Runs: Maintain minimum 12-inch separation.
3. Installation over valves or couplings not permitted.

I. Metallic Raceway Coating: At couplings and joints and along entire length, apply wraparound duct band with one-half tape width overlap to obtain two complete layers.

J. Concrete Encasement: As specified in Section 03300, CAST-IN-PLACE CONCRETE.

1. Concrete Color: Gray, dust top of concrete ductbank with powdered red concrete dye before concrete sets and trowel dry onto top of ductbank.

K. Backfill:

1. As specified in Section 02225, TRENCH BACKFILL.
2. Do not backfill until inspected by ENGINEER.

3.12 EMPTY RACEWAYS

A. Provide permanent, removable cap over each end.

B. Provide PVC plug with pull tab for underground raceways with end bells.

C. Provide nylon pull cord.

D. Identify, as specified in Paragraph IDENTIFICATION DEVICES, with waterproof tags attached to pull cord at each end, and at intermediate pull point.

3.13 IDENTIFICATION DEVICES

A. Raceway Tags:

1. Identify origin and destination.
2. Install at each terminus, near midpoint, and at minimum intervals of every 50 feet of exposed Raceway, whether in ceiling space or surface mounted.
3. Provide nylon strap for attachment.

B. Electric Detectable Warning Tape: Install approximately 12 inches above underground or concrete-encased raceways. Align parallel to, and within 12 inches of, centerline of runs.

C. Buried Raceway Markers:

1. Install at grade to indicate direction of underground raceways.
2. Install at all bends and at intervals not exceeding 100 feet in straight runs.

3.14 PROTECTION OF INSTALLED WORK

A. Protect products from effects of moisture, corrosion, and physical damage during construction.

B. Provide and maintain manufactured watertight and dust-tight seals over all conduit openings during construction.

C. Touch up painted conduit threads after assembly to cover nicks or scars.

D. Touch up damage to coating on PVC-coated conduit with patching compound approved by manufacturer.

END OF SECTION

SECTION 16120

CONDUCTORS

PART 1 -- GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American National Standards Institute (ANSI): 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V.

2. American Society for Testing and Materials (ASTM):
   a. A167, Standard Specification for Stainless and Heat Resisting Chromium-Nickel-P1ated Steel Plate, Sheet, and Strip.

   b. B3, Standard Specification for Soft or Annealed Copper Wire.

   c. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

   d. B263, Standard Test Method for Determination of Cross- Sectional Area of Stranded Conductors.

2. Association of Edison Illuminating Companies (AEIC):

   a. CS 5, Crosslinked Polyethylene Insulated Shielded Power Cables Rated 5 Through 35 kV.

   b. CS 6, Ethylene- Propylene-Rubber-Insulated Shielded Power Cables Rated 5 Through 69 kV.

4. Insulated Cable Engineer's Association, Inc. (ICEA): T-29-250, Procedure for Conducting Vertical Cable Tray Flame Test With a Theoretical Heat Input of 210,000 Btu/hour.

5. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

   a. 48, Standard Test Procedures and Requirements or High-Voltage Alternating Current Cable Terminations.

   b. 404, Standard for Cable Joints for Use with Extruded Dielectric Cable Rated 5,000V through 46,000V and Cable Joints for Use with Laminated Dielectric Cable Rated 2,500V through 500,000V.

6. National Electrical Contractors Association, Inc. (NECA): 5055, Standard of Installation.

7. National Electrical Manufacturers' Association (NEMA):

   a. CC 1, Electric Power Connectors for Substations.

b. WC 3, Rubber-insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

c. WC 5, Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

d. WC 7, Crosslinked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

e. WC 8, Ethylene-Propylene-Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

f. WC 55, Instrumentation Cables and Thermocouple Wire.

8. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).

9. Underwriters Laboratories, Inc. (UL):
   a. 13, Standard for Safety Power-Limited Circuit Cables.

   b. 44, Standard for Safety Rubber-Insulated Wires and Cables.

   c. 62, Standard for Safety Flexible Cord and Fixture Wire.

   d. 486A, Standard for Safety Wire Connector and Soldering Lugs for Use with Copper Conductors.

   e. 486B, Standard for Safety Wire Connectors and Soldering Lugs for Use with Aluminum Conductors.

   f. 510, Standard for Safety Insulating Tape.

   g. 854, Standard for Safety Service-Entrance Cables.

   h. 910, Standard for Safety Test Method for Fire and Smoke Characteristics of Electrical and Optical-Fiber Cables Used in Air Handling Spaces.

   i. 1072, Standard for Safety Medium-Voltage Power Cables.

   j. 1277, Standard for Safety Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.

   k. 1581, Standard for Safety Reference Standard for Electrical Wires, Cables, and Flexible Cords.

1.02 SUBMITTALS

A. Shop Drawings:

1. Wire and cable descriptive product information.

2. Wire and cable accessories descriptive product information.

3. Cable fault detection system descriptive product information.

4. Manufactured wiring systems descriptive product information.

5. Manufactured wire systems rating information.

6. Manufactured wire systems dimensional drawings.

7. Manufactured wire systems special fittings.

8. Busway descriptive product information.

9. Busway rating information.

10. Busway dimensional drawings.

11. Busway special fitting information.

12. Busway-equipment interface information for equipment to be connected to busways.

B. Quality Control Submittals:

1. Certified Factory Test Report for conductors 600 volts and below.

2. Certified Factory Test Report per AEIC CS6, including AEIC qualification report for conductors above 600 volts.

1.03 UL COMPLIANCE

A. Materials manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL listing mark.

PART 2 - PRODUCTS

2.01 CONDUCTORS 600 VOLTS AND BELOW

A. Conform to applicable requirements of NEMA WC 3, WC 5, and WC 7.

B. Conductor Type:

1. 120- and 277-Volt Lighting, No. 10 AWG and Smaller: Stranded copper.

2. 120-Volt Receptacle Circuits, No. 10 AWG and Smaller: Stranded copper.

3. All Other Circuits: Stranded copper.

C. Insulation: Type XHHW-2 insulation for all power and control application. No other type of wire shall be used without written approval from the City Instrumentation, Controls and Electrical manager.

D. Flexible Cords and Cables:

1. Type SOW-A50 with ethylene propylene rubber insulation in accordance with UL 62.

2. Conform to physical and minimum thickness requirements of NEMA WC 8.

2.02 600-VOLT RATED CABLE

A. General:

1. Type: TC, meeting requirements of UL 1277, including Vertical Tray Flame Test at 20,000 Btu/hr, and NFPA 70, Article 340, or UL 13 Listed Power Limited Circuit Cable meeting requirements of NFPA 70, Article 725.

2. Permanently and legibly marked with manufacturer's name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.

3. Suitable for installation in open air, in cable trays, or conduit.

4. Minimum Temperature Rating: 90 degrees C dry locations, 75 degrees C wet locations.

5. Overall Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.

B. Wire and Connectors:

1. Cable shall be rated for 600 volts and shall meet the requirements below:

2. Conductors shall be stranded

3. All wire shall be brought to the job in unbroken packages and shall bear the data of manufacturing; not older than 12 months.

4. Type of wire shall be XHHW-2, rated 75 degrees C suitable for wet locations except where required otherwise by the drawings.

5. No wire smaller than No. 12 gauge shall be used unless specifically indicated.

6. Conductor metal shall be copper.

7. All conductors shall be megger tested after installation and insulation must be in compliance with the Insulated Power Cable Engineers Association Minimum Values of Insulation Resistance.

C. Type I-Multiconductor Control Cable:

1. Conductors:

a. No. 14 AWG, seven-strand copper.

b. Insulation: 15-mil PVC with 4-mil nylon.

c. UL 1581 listed as Type XHHW-2 rated VW-I.

d. Conductor group bound with spiral wrap of barrier tape.

e. Color Code: In accordance with NEMA WC 5, Method 1, Sequence K-2.

2. Cable: Passes the ICEA T-29-520 210,000 Btu/hr Vertical Tray Flame Test.

3. Cable Sizes:

No. of Conductors	Max. Outside Diameter (inches)	Jacket Thickness (mils)
3	0.41	45
5	0.48	45
7	0.52	45
12	0.72	60
19	00.83	60
25	1.00	60
37	1.15	80

5. Manufacturers:

a. Okonite Co.

b. Rome Cable.

D. Type 2-Multiconductor Power Cable:

1. Conductors:

a. Class B stranded, coated copper.
b. Insulation: Chemically crosslinked ethylene-propylene with Hypalon jacket.

b. UL 1581 listed as Type EPR, rated VW-1.

c. Color Code: Conductors, size No. 8 AWG and smaller, colored conductors, NEMA WC5 Method 1, color 5 per Article POWER CONDUCTOR COLOR

d. CODING. Conductors, size No. 6 AWG and larger, NEMA WC5, Method 4.

2. Cable pass the ICEA T-29-520 210,000 Btu/hr Vertical Tray Flame Test.

3. Cable Sizes:

Conductor Size	Minimum Ground Wire Size	No. of Conductors	Max.Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
12	12	2 3 4	0.42 0.45 0.49	45 45 45
10	10	2 3 4	0.54 0.58 0.63	60 60 60
8	10	3 4	0.66 0.72	60
6	8	3 4	0.74 0.81	60
4	6	3 4	0.88 0.97	60 80
2	6	3 4	1.01 1.11	80
1/0	6	3 4	1.22 1.35	80
2/0	4	3 4	1.32 1.46	80
4/0	4	3 4	1.56 1.78	80

3. Manufacturers:

   a. Okonite Co.

   b. Pome Cable.

E. Type B-No. 16 AWG, Twisted, Shielded Pair, Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 55 requirements.

1. Outer Jacket: 45-mil nominal thickness.

2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer overlapped to provide 100 percent coverage.

3. Dimension: 0.31-inch nominal OD.

4. Conductors:

   a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8

   b. 20 AWG, seven-strand tinned copper drain wire.

   c. Insulation: 15-mil nominal PVC.

d. Jacket: 4-mil nominal nylon.

e. Color Code: Pair conductors black and red.

5. Manufacturers:

a. Okonite Co.

b. Alpha Wire Corp.

6. The following test shall be performed on instrumentation and control system cables. All tests shall be end-to-end test of installed cables with the ends supported in free air, not adjacent to any ground object. All test data shall be recorded on forms acceptable to the Engineer. Complete records of all tests shall be made and delivered to the Engineer.

a. Continuity tests shall be performed by measuring wire/shield loop resistances of signal cable as the wires, taken one at a time, are shorted to the channel shield. No loop resistance measurement shall carry by more than ±2 ohms from the calculated average loop resistance valve.

b. Insulation resistance tests shall be performed by using a 500 volt megohmeter to measure the insulation resistance between each channel wire and channel shield, between individual channel shields in a multi-channel cable, between each individual channel and the overall cable shield in multi-channel cable, between each wire and ground, and between each shield and ground. Values of resistance less than 10 megohms shall be unacceptable.

F. Type B1-No. 16 AWG, Twisted, Shielded Triad Instrumentation Cable: Single triad, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 55 requirements.

1. Outer Jacket: 45-mil nominal.

2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.

3. Dimension: 0.32-inch nominal OD.

4. Conductors:

a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.

b. 20 AWG, seven-strand, tinned copper drain wire.

c. Insulation: 15-mil nominal PVC.

d. Jacket: 4-mil nylon.

e. Color Code: Triad conductors black, red, and white.

5. Manufacturers:

   a. Okonite Co.

   b. Alpha Wire Corp.

G. Type B2-No. 18 AWG, Multi-Twisted, Shielded Pairs with a Common, Overall Shield Instrumentation Cable: Designed for use as instrumentation, process control, and computer cable, meeting NEMA WC 55 requirements.

1. Conductors:

   a. Bare soft annealed copper, Class B, seven-strand concentric, in accordance with ASTM B8

   b. Tinned copper drain wires.

   c. Pair drain wire size AWG 20, group drain wire size AWG 18.

   d. Insulation: 15-mil PVC.

   e. Jacket: 4-mil nylon.

   f. Color Code: Pair conductors black and red with red conductor numerically printed for group identification.

   g. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer.

2. Cable Shield: 2.35-mil, double-faced aluminum/synthetic polymer, overlapped for 100 percent coverage.

3. Cable Sizes:

Number of Pairs	Maximum Outside Diameter (inches)	Nominal Jacket Thickness (mils)
4	0.50	45
8	0.68	60
12	0.82	60
16	0.95	80
24	1.16	80
36	1.33	80
50	1.56	80

4. Manufacturers:

   a. Okonite Co.

   b. Alpha Wire Corp.

H. Type B3-No. 18 AWG, Multi-twisted Pairs with a Common Overall Shield Instrumentation Cable: Designed for use as instrumentation, process control, and computer cable meeting NEMA WC 55.

1. Conductors:

   a. Bare soft annealed copper, Class B, seven-strand concentric, in accordance with ASTM B8.

   b. Tinned copper drain wire size 18 AWG

   c. Insulation: 15-mil nominal PVC.

   d. Jacket: 4-mil nylon.

   e. Color Code: Pair conductors black and red, with red conductor numerically printed for group identification.

2. Cable Shield: 2.35-mil, double-faced aluminum/synthetic polymer, overlapped for 100 percent coverage.

3. Cable Sizes:

Number Of Pairs	Maximum Outside Diameter (inches)	Nominal Jacket Thickness (mils)
4	0.46	45
8	0.63	60
12	0.75	60
16	0.83	60
24	1.06	80
36	1.21	80
50	1.42	80

3. Manufacturers:

   a. Okonite Co.

   b. Alpha Wire Corp.

2.03 GROUNDING CONDUCTORS

A. Equipment: Stranded copper with green, Type USE/RHH/RHW-XLPE or XHHW-2, insulation.

B. Direct Buried: Bare stranded copper.

2.04 ACCESSORIES FOR CONDUCTORS 600 VOLTS AND BELOW

A. Tape:

1. General Purpose, Flame Retardant: 7-mil, vinyl plastic, Scotch Brand 33, rated for 90 degrees C minimum, meeting requirements of UL 510.

2. Flame Retardant, Cold and Weather Resistant: 8.5-mil, vinyl plastic, Scotch Brand 88.

3. Arcs and Fireproofing:

   a. 30-mil, elastomer

   b. Manufacturers and Products:
      1) Scotch; Brand 77, with Scotch Brand 69 glass cloth tape binder.
      2) Plytnount; Plyarc 30, with Plymount Plyglas glass cloth tape binder.

B. Identification Devices:

1. Sleeve: Permanent, PVC, yellow or white, with legible machine-printed black markings.

2. Marker Plate: Nylon, with legible designations permanently hot stamped on plate.
3. Grounding Conductor: Permanent green heat-shrink sleeve, 2-inch minimum.

C. Connectors and Terminations:

1. Nylon, Self-Insulated Crimp Connectors:

   a. Manufacturers and Products:

      1) Thomas & Betts; Sta-Kon.

      2) Burndy; Insulink.

      3) ILSCO.

2. Nylon, Self-Insulated, Crimp Locking-Fork, Torque-Type Terminator:

   a. Manufacturers and Products:

      1) Thomas & Betts; Sta-Kon.

      2) Burndy; Insulink.

      3) ILSCO.

D. Cable Lugs:

1. In accordance with NEMA CC I.

2. Rated 600 volts of same material as conductor metal.

3. Insulated, Locking-Fork, Compression Lugs:

   a. Manufacturers and Products:

1) Thomas & Betts; Sta-Kon.

2) ILSCO; ILSCONS.

4. Un-insulated Crimp Connectors and Terminators:

a. Manufacturers and Products:

1) Square D; Versitide.

2) Thomas & Betts; Color-Keyed.

3) ILSCO.

5. Un-insulated, Bolted, Two-Way Connectors and Terminators:

a. Manufacturers and Products:

1) Thomas & Betts; Locktite.

2) Burndy; Quiklug.

3) ILSCO.

E. Cable Ties: Nylon, adjustable, self-locking, and reusable.

1. Manufacturers and Product: Thomas & Betts; TY-RAP.

F. Heat Shrinkable Insulation: Thermally stabilized, crosslinked polyofin.

1. Manufacturers and Product: Thomas & Betts; SHRINK-KON.

2.05 PULLING COMPOUND

A. Nontoxic, non-corrosive, noncombustible, nonflammable, wax-based lubricant; UL listed.

B. Suitable for rubber, neoprene, PVC, polyethylene, hypalon, CPE, and lead-covered wire and cable.

C. Suitable for zinc-coated steel, aluminum, PVC, bituminized fiber, and fiberglass raceways.

D. Manufacturers and Products:

1. Ideal Co.; Yellow 77.

2. Polywater, Inc.

3. Cable Grip Co.

2.06 WARNING TAPE

A. As specified in Section 16110, RACEWAYS.

2.07 SOURCE QUALITY CONTROL

A. Conductors 600-Volts and Below: Test in accordance with UL 44 and 854 Standards.

PART 3 - EXECUTION

3.01 GENERAL

A. Conductor installation to be in accordance with NECA 5055.

B. Conductor and cable sizing shown is based on copper conductors, unless noted otherwise.

C. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii.

D. Tighten screws and terminal bolts in accordance with UL 486A for copper conductors.

E. Cable Lugs: Provide with correct number of holes, bolt size, and center-to-center spacing as required by equipment terminals.

F. Bundling: Where single conductors and cables in manholes, hand holes, vaults, and other indicated locations are not wrapped together by some other means, bundle conductors from each conduit throughout their exposed length with cable ties placed at intervals not exceeding 18 inches on center.

G. Ream, remove burrs, and clear interior of installed conduit before pulling wires or cables.

H. Concrete-Encased Raceway Installation: Prior to installation of conductors, pull through each raceway a mandrel approximately 1/4-inch smaller than raceway inside diameter.

3.02 POWER CONDUCTOR COLOR CODING

A. Conductors 600 Volts and Below:

1. No. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering an area 1-1/2 to 2 inches wide.

2. No. 8 AWG and Smaller: Provide colored conductors.

3. Colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green
240/120 Volts Single-Phase, Three-Wire	Grounded Neutral One Hot Leg Other Hot Leg	White Black Red
208Y/120 Volts Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B	White Black Red

	Phase C	Blue
240/120 Volts Three-Phase, Four-Wire Delta, Center Tap Ground on Single-Phase	Grounded Neutral Phase A High (wild) Leg Phase C	White Black Orange Blue
480Y/277 Volts Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	Gray Brown Orange Yellow
NOTE: Phase A, B, C implies direction of positive phase rotation. Coordinate with local code for wire color and adjust accordingly.		

4. Tracer: Outer covering of white with an identifiable colored strip other than green in accordance with NFPA 70.

3.03 CIRCUIT IDENTIFICATION

A. Circuits Appearing in Circuit Schedules: identify power, instrumentation, and control conductor circuits, using circuit schedule designations, at each termination and in accessible locations such as manholes, hand holes, panels, switchboards, motor control centers, pull boxes, and terminal boxes.

B. Circuits Not Appearing in Circuit Schedules:

1. Assign circuit name based on device or equipment at load end of circuit.

2. Where this would result in same name being assigned to more than one circuit, add number or letter to each otherwise identical circuit name to make it unique.

C. Method:

1. Conductors No. 3 AWG and Smaller: Identify with sleeves.

2. Cables, and Conductors No. 2 AWG and Larger:

   a. Identify with marker plates.

   b. Attach marker plates with nylon tie cord.

3. Taped-on markers or tags relying on adhesives not permitted.

3.04 CONDUCTORS 600 VOLTS AND BELOW

A. Install 10 AWG or 12 AWG conductors for branch circuit power wiring in lighting and receptacle circuits.

B. Do not splice incoming service conductors and branch power distribution conductors No. 6 AWG and larger unless specifically indicated or approved by ENGINEER.

C. Connections and Terminations:

1. Install wire nuts only on solid conductors.

2. Install nylon self-insulated crimp connectors and terminators for instrumentation, control, and power circuit conductors No. 6 AWG and smaller.

3. Install un-insulated crimp connectors and terminators for instrumentation, control, and power circuit conductors No. 4 AWG through No. 2/0 AWG.

4. Install un-insulated, bolted, two-way connectors and terminators for power circuit conductors No. 4/0 AWG and larger.

5. Install un-insulated bolted, two-way connectors for motor circuit conductors No. 12 and larger.

6. Tape insulates all un-insulated connections.

7. Place no more than one conductor in any single-barrel pressure connection.

8. Install crimp connectors with tools approved by connector manufacturer.

9. Install terminals and connectors acceptable for type of material used.

10. Compression Lugs

    a. Attach with a tool specifically designed for purpose.
    b. Tool shall provide complete controlled crimp and shall not release until crimp is complete.

    c. Do not use plier type crimpers.

D. Do not use soldered mechanical joints.

E. Splices and Terminations:

1. Indoors: Use general purpose, flame retardant tape.

2. Outdoors: Use flame retardant, cold- and weather-resistant tape.

F. Cap spare conductors and conductors with UL listed end caps.

G. Cabinets, Panels, and Motor Control Centers:

1. Remove surplus wire, bridle and secure.

2. Where conductors pass through openings or over edges in sheet metal, remove bums, chamfer edges, and install bushings and protective strips of insulating material to protect the conductors.

H. Control and Instrumentation Wiring:

1. Where terminals provided will accept such lugs, terminate control and instrumentation wiring, except solid thermocouple leads, with insulated, locking-fork compression lugs.

2. Terminate with methods consistent with terminals provided, and in accordance with terminal manufacturer's instructions.

3. Locate splices in readily accessible cabinets or junction boxes using terminal strips.

4. Where connections of cables installed under this section are to be made under Section 13000, PROCESS INSTRUMENTATION AND CONTROL SYSTEMS, leave pigtails of adequate length for bundled connections.

5. Cable Protection:

-

   a. Under Infinite Access Floors: May be installed without bundling.

   b. All Other Areas: Install individual wires, pairs, or triads in flex conduit under the floor or grouped into bundles at least 1/2-inch in diameter.

   c. Maintain integrity of shielding of instrumentation cables.

   d. Ensure grounds do not occur because of damage to jacket over the shield.

I. Extra Conductor Length: For conductors to be connected by others, install minimum 6 feet of extra conductor in freestanding panels and minimum 2 feet in other assemblies.

3.05 FIELD QUALTTY CONTROL

A. Visual and Mechanical Inspection:

1. Inspect Each Individual Exposed Power Cable No. 6 and Larger For:

   a. Physical damage.

   b. Proper connections in accordance with single-line diagram.

   c. Cable bends not in conformance with manufacturer's minimum allowable bending radius where applicable.

   d. Color coding conformance with specifications.

   e. Proper circuit identification.

2. Mechanical Connections For:

   a. Proper lug type for conductor material.

   b. Proper lug installation.

   c. Bolt torque level in accordance with NETA ATS, Table 10. 1, unless otherwise specified by manufacturer.

3. Shielded Instrumentation Cables For:

   a. Proper shield grounding.

   b. Proper terminations.

   c. Proper circuit identification.

4. Control Cables For:

   a. Proper termination.

   b. Proper circuit identification.

5. Cables Terminated Through Window Type CTs: Verify that neutrals and grounds are terminated for correct operation of protective devices.

B. Electrical Tests for Conductors No. 6 and Larger:

1. Insulation Resistance Tests:

   a. Test each conductor with respect to ground and to adjacent conductors per IEEE 118 procedures for 1 minute.

   b. Evaluate ohmic values by comparison with conductors of same length and type.

   c. Investigate values less than 50 megohms.

   d. Utilize 1,000V dc megohmmeter for 600V insulated conductors.

2. Continuity test by ohmmeter method to ensure proper cable connections.

END OF SECTION

SECTION 16405

ELECTRIC MOTORS

PART 1 - GENERAL

1.01 RELATED SECTIONS

A. This section applies only when referenced by a motor-driven equipment specification. Application, horsepower, enclosure type, mounting, shaft type, synchronous speed, and any deviations from this section will be listed in the equipment specification. Where such deviations occur, they shall take precedence over this section.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Anti-Friction Bearing Manufacturers' Association (AFBMA):

   a. 9, Load Ratings and Fatigue Life for Ball Bearings.

   b. 11, Load Rating and Fatigue Life for Roller Bearings.

2. American National Standards Institute (ANSI): C50.41, Polyphase Induction Motors for Power Generating Stations.

3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

   a. 85, Test Procedure for Airborne Sound Measurements on Rotating Machines.

   b. 112, Standard Test Procedures for Polyphase Induction Motors and Generators.

   c. 114, Standard Test Procedures for Single-Phase Induction Motors.

   d. 620, Guide for Construction and Interpretation of Thermal Limit Curves for Squirrel-Cage Motors Over 500 Horsepower.

   e. 841, Recommended Practice for Chemical Industry Severe-Duty Squirrel-Cage Induction Motors, 600V and Below.

4. National Electrical Manufacturers Association (NEMA):
   a. MG 1, Motors and Generators.

b. MG 13, Frame Assignments for Alternating Current Integral Horsepower Induction Motors.

c. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).

5. National Fire Protection Association (NFPA): 70, National Electrical Code. (NEC)

6. Underwriters Laboratories (UL):

a. 547, Thermal Protectors for Electric Motors.

b. 674, Electric Motors and Generators Used in Hazardous (Classified) Locations.

1.03 DEFINITIONS

A. CISD-TEFC: Chemical industry, severe-duty enclosure.

B. DIP: Dust-ignition-proof enclosure.

C. EXP: Explosion-proof enclosure.

D. ODP: Open drip-proof enclosure.

E. TEFC: Totally enclosed, fan cooled enclosure.

F. TENV: Totally enclosed, nonventilated enclosure.

G. WPI: Open weather protected enclosure, Type I.

H. WPII: Open weather protected enclosure, Type II.

I. Motor Nameplate Horsepower: That rating after any derating required to allow for extra heating caused by the harmonic content in the voltage applied to the motor by its controller.

1.04 SUBMITTALS

A. Shop Drawings:

1. Descriptive information.

2. Nameplate data in accordance with NEMA MG 1.

3. Additional Rating Information:

a. Service factor.

b. Locked rotor current.

c. No load current.

d. Safe stall time for motors 200 horsepower and larger.

e. Multispeed load classification (e.g., variable torque).

f. Adjustable frequency drive motor load classification (e.g., variable torque) and minimum allowable motor speed for that load classification.

4. Enclosure type and mounting (e.g. horizontal, vertical).

5. Dimensions and total weight.

6. Conduit box dimensions and usable volume as defined in NEMA MG 1 and NFPA 70.

7. Bearing type.

8. Bearing lubrication.

9. Bearing life.

10. Space heater voltage and watts.

11. Description and rating of motor thermal protection.

12. Motor sound power level in accordance with NEMA MG 1.

13. Maximum brake horsepower required by the equipment driven by the motor.

14. Description and rating of submersible motor moisture sensing system.

B. Quality Control Submittals:

1. Factory test reports, certified.

2. Manufacturer's Certificate of Proper Installation, 100 horsepower and larger.

3. Operation and Maintenance Manual.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. General Electric.

B. Reliance.

C. MagneTek.

D. Siemens.

E. Baldor.

F. U.S.Motors.

G. Westinghouse.

H. Toshiba.

2.02 GENERAL

A. For multiple units of the same type of equipment, furnish identical motors and accessories of a single manufacturer.

B. In order to obtain single source responsibility, utilize a single supplier to provide a drive motor, its driven equipment, and specified motor accessories.

C. Meet requirements of NEMA MG 1.

D. Frame assignments in accordance with NEMA MG 13.

E. Provide motors for hazardous (classified) locations that conform to UL 674 and have an applied UL listing mark.

F. Motors shall be specifically designed for the use and conditions intended, with a NEMA design letter classification to fit the application.

G. Lifting lugs on all motors weighing 100 pounds or more.

H. Operating Conditions:

1. Maximum ambient temperature not greater than 50 degrees C.

2. Motors shall be suitable for operating conditions without any reduction being required in the nameplate rated horsepower or exceeding the rated temperature rise.

3. Overspeed in either direction in accordance with NEMA MG 1.

2.03 HORSEPOWER RATING

A. As designated in motor-driven equipment specifications.

B. Constant Speed Applications: Brake horsepower of the driven equipment at any head capacity point on the pump curve not to exceed motor nameplate horsepower rating, excluding any service factor.

C. Adjustable Frequency, Adjustable Speed Applications: Driven equipment brake horsepower at any head capacity point on the pump curve not to exceed motor nameplate horsepower rating, excluding any service factor.

2.04 SERVICE FACTOR

A. 1.15 minimum at rated ambient temperature, unless otherwise indicated.

2.05 VOLTAGE AND FREQUENCY RATING

A. System Frequency: 60-Hz.

B. Voltage Rating: Unless otherwise indicated in motor-driven equipment specifications:

Size	Voltage	Phases
1/2 hp and smaller	115	1
3/4 hp through 400 hp	460	3
450 hp and larger	4,000	3

C. Suitable for full voltage starting.

D. One hundred horsepower and larger also suitable for reduced voltage starting with 65 or 80 percent voltage tap settings on reduced inrush motor starters.

E. Suitable for accelerating the connected load with supply voltage at motor starter supply terminals dipping to 90 percent of motor rated voltage.

2.06 EFFICIENCY AND POWER FACTOR

A. For all motors except single-phase, under 1 horsepower, multispeed, short-time rated and submersible motors, or motors driving gates, valves, elevators, cranes, trolleys, and hoists:

1. Efficiency:

   a. Tested in accordance with NEMA MG 1, paragraph 12.54.1.

   b. Guaranteed minimum at full load in accordance with Table 1 or as indicated in motor-driven equipment specifications.

2. Power Factor: Guaranteed minimum at full load in accordance with Table 1 or as indicated in motor-driven equipment specifications.

2.07 LOCKED ROTOR RATINGS

A. Locked rotor kVA Code F or lower if motor horsepower not covered by NEMA MG 1 tables.

B. Safe stall time 15 seconds or greater.

2.08 INSULATION SYSTEMS

A. Single-Phase, Fractional Horsepower Motors: Manufacturer's standard winding insulation system.

B. Motors Rated Over 600 Volts: Sealed windings in accordance with NEMA MG 1.

C. Three-Phase and Integral Horsepower Motors, Unless Otherwise Indicated in Motor-Driven Equipment Specifications: Class F with Class B rise at nameplate horsepower and designated operating conditions, except EXP and DIP motors which must be Class B with Class B rise.

2.09 ENCLOSURES

A. All enclosures to conform to NEMA MG 1.

B. Unless otherwise noted, all motors shall be TEFC and shall furnish with a drain hole with porous drain/weather plug.

C. Explosion-Proof (EXP):

1. TEFC listed to meet UL 674 and NFPA 70 requirements for Class 1, Division 1, Group C and D hazardous locations.

2. Drain holes with drain and breather fittings.
3. Integral thermostat opening on excessive motor temperature in accordance with UL 547 and NFPA 70.

4. Thermostat leads to terminate in a terminal box separate from main terminal box.

D. Dust-Ignition-Proof (DIP):

1. TEFC listed to met UL 674 and NFPA 70 requirements for Class II, Division 1, Group E, F, G.

2. Integral thermostat opening on excessive motor temperature in accordance with UL 547 and NFPA 70.

3. Thermostat leads to terminate in a terminal box separate from main terminal box.

E. Submersible: In accordance with Paragraph SPECIAL MOTORS.

F. Chemical Industry, Severe-Duty (CISD-TEFC): In accordance with Paragraph SPECIAL MOTORS.

2.10 TERMINAL (CONDUIT) BOXES

A. Oversize main terminal boxes for all motors.

B. Diagonally split, rotatable to each of four 90-degree positions. Threaded hubs for conduit attachment.

C. Except ODP, furnish gaskets between box halves and between box and motor frame.

D. Minimum usable volume in percentage of that specified in NEMA MG 1-11.06 and 20.62 and NFPA 70, Article 430:

Voltage	Horsepower	Percentage
Below 600	15 thru 125	500
Below 600	150 thru 300	275
Below 600	350 thru 600	225
Above 600	All Sizes	200

E. Terminal for connection of equipment grounding wire in each terminal box.

2.11 BEARINGS AND LUBRICATION

A. Horizontal Motors:

1. 3/4 horsepower and Smaller: Permanently lubricated and sealed ball bearings, or regreasable ball bearings in labyrinth sealed end bells with removable grease relief plugs.

2. 1 Through 400 horsepower: Regreasable ball bearings in labyrinth sealed end bells with removable grease relief plugs.

3. Above 400 horsepower: Regreasable antifriction bearings in labyrinth sealed end bells with removable grease relief plugs.

4. Minimum 100,000 hours L-10 bearing life for ball and roller bearings as defined in AFBMA 9 and 11.

B. Vertical Motors:

1. Thrust Bearings:

a. Antifriction bearing.

b. Manufacturer's standard lubrication 100 horsepower and larger.

c. Oil lubricated 125 horsepower and larger.

d. Minimum 50,000 hours L-10 bearing life.

2. Guide Bearings:

a. Manufacturer's standard bearing type.

b. Manufacturer's standard lubrication 200 horsepower and larger.

c. Oil lubricated 250 horsepower and larger.

d. Minimum 100,000 hours L-1O bearing life.

C. Regreasable Antifriction Bearings:

1. Readily accessible, grease injection fittings.

2. Readily accessible, removable grease relief plugs.

D. Oil Lubrication Systems:

1. Oil reservoirs with sight level gauge.

2. Oil fill and drain openings with opening plugs.

3. Provisions for necessary oil circulation and cooling.

2.12 NOISE

A. Measured in accordance with IEEE 85 and NEMA MG 1.

B. Motors controlled by adjustable frequency drive systems shall not exceed sound levels of 3 dBA higher than NEMA MG 1.

2.13 BALANCE AND VIBRATION CONTROL

A. In accordance with NEMA MG 1-12.06.

2.14 EQUIPMENT FINISH

A. External Finish: Prime and finish coat manufacturer's standard. Field painting in accordance with Section 09900, PAINTING AND PROTECTIVE COATINGS.

B. Internal Finish: Bore and end turns coated with clear polyester or epoxy varnish.

2.15 SPECIAL FEATURES AND ACCESSORIES

A. Screen Over Air Openings: Stainless steel on motors with ODP, WPI, and WPII enclosures meeting requirements for Guarded Machine in NEMA MG 1.

B. Winding Thermal Protection:

1. Thermostats:

a. Motors for constant speed and adjustable speed application 30 through 75 horsepower.

b. Bi-metal disk or rod type thermostats embedded in stater windings (normally closed contact).

c. Automatic reset contacts rated 120 volts ac, 5 amps minimum, opening on excessive temperature. (Manual reset will be provided at motor controller.)

C. Nameplates:

1. Raised or stamped letters on stainless steel or aluminum.

2. Display all motor data required by NEMA MG 1-10.37 and NEMA MG 1-10.38 in addition to bearing numbers for both bearings.
3. Premium efficiency motor nameplates to also display NEMA nominal efficiency, full load power factor, and maximum allowable kVAR for power factor correction capacitors.

2.16 SPECIAL MOTORS

A. Requirements in this article take precedence over conflicting features specified elsewhere in this section.

B. Submersible Pump Motors:

1. Manufacturers:

a. Reliance.

b. Flygt.

2. At 100 Percent Load:

Horsepower	Guaranteed Minimum Efficiency	Guaranteed Minimum Power Factor
5 thru 10	80	82
10.1 thru 50	85	82
50. 1 thru 100	87	82
Over 100	89	82

3. Insulation System: Manufacturer's standard Class B or Class F.

4. Motor capable of running dry continuously.

5. Enclosure:

a. Hermetically sealed, watertight, for continuous submergence up to 65-foot depth.

b. Listed to meet UL 674 and NFPA 70 requirements for Class 1, Division 1, Group D hazardous atmosphere.

c. Seals: Tandem mechanical.

6. Bearing and Lubrication:

a. Permanently sealed and lubricated, replaceable antifriction guide and thrust bearings.

b. Minimum 15,000 hours L-10 bearing life.

7. Inrush kVA/horsepower no greater than NEMA MG 1 and NFPA 70, Code F.

8. Winding Thermal Protection:

a. Thermal sensor and switch assembly, one each phase, embedded in stater windings and wired in series.

b. Switches normally closed, open upon excessive winding temperature, and automatically reclose when temperature has cooled to safe operating level.

c. Switch contacts rated at 5 amps, 120 volts ac.

9. Motor Seal Failure Moisture Detection:

a. Probes or sensors to detect moisture beyond seals.

b. Probe or sensor monitoring module for mounting in motor controller, suitable for operation from 120-volt ac supply.

c. Monitoring module with control power transformer, probe test switch and test light, and two independent 120-volt ac contacts, one opening and one closing when the flux of moisture is detected.

10. Bearing Overtemperature Protection for Motors Larger than 100 Horsepower:

a. Sensor on lower bearing housing monitoring bearing temperature.

b. Any monitoring relay necessary to provide 120-volt ac contact opening on bearing overtemperature.

11. Winding thermal protection, moisture detection, and bearing overtemperature specified above may be monitored by a single device providing two independent 120-volt ac contacts, one closing and one opening on malfunction.

12. Connecting Cables:

a. One cable containing power, control, and grounding conductors.

b. Each cable suitable for hard service, submersible duty with watertight seal where cable enters motor.

c. Length: 30 feet minimum, coordinate proper length.

d. UL 1 listed and sized in accordance with NFPA 70.

2.17 FACTORY TESTING

A. Tests:

1. In accordance with IEEE 112 for polyphase motors and IEEE 114 for single-phase motors.

2. Routine (production) tests on all motors in accordance with NEMA MG 1, plus no load power at rated voltage and polyphase, rated voltage measurement of locked rotor current. Test multispeed motors at all speeds.

3. For energy efficient motors, test efficiency at 50, 75, and 100 percent of rated horsepower:

   a. In accordance with IEEE 112, Test Method B, and NEMA MG 1, paragraphs 12.54 and 12.57.

   b. For motors 500 horsepower and larger where facilities are not available to test by dynamometer (Test Method B), determine efficiency by IEEE 112, Test Method F.

4. Power factor:

   a. Speed.

   b. Current at rated horsepower.

   c. kW input at rated horsepower.

   d. On motors of 100 horsepower and smaller, furnish a certified copy of a motor efficiency test report on an identical motor.

B. Test Report Forms:

   1. Routine Tests: IEEE 112, Form A-1.

PART 3 - EXECUTION

3.01 INSTALLATION

A. In accordance with manufacturer's instructions and recommendations.

B. Align motor carefully and properly with driven equipment.

C. Secure equipment to mounting surface with anchor bolts. Provide anchor bolts meeting manufacturer's recommendations and of sufficient size and number for the specified seismic conditions.

3.02 FIELD QUALITY CONTROL

A. General: Inspection and testing limited to motors rated 5 horsepower and larger.

B. Visual and Mechanical Inspection:

1. Proper electrical and grounding connections.

2. Shaft alignment.

3. Blockage of ventilating air passageways.

4. Operate Motor and Check For:

a. Excessive mechanical and electrical noise.

b. Overheating.

c. Correct rotation.

d. Check vibration detectors, resistance temperature detectors, or motor inherent protectors for function ability and proper operation.

e. Excessive vibration.

5. Check operation of space heaters.

C. Electrical Tests:

1. Insulation Resistance Tests:

a. In accordance with IEEE 43 at test voltages established by NETA ATS, Table 10.2 for:

1) Motors above 200 horsepower for l0-minute duration with resistances tabulated at 30 seconds, 1 minute, and 10 minutes.

2) Motors 200 horsepower and less for 1-minute duration with resistances tabulated at 30 and 60 seconds.

b. Insulation resistance values equal to, or greater than, ohmic values established by manufacturers.

2. Calculate polarization index ratios for motors above 200 horsepower. Investigate index ratios less than 1.5 for Class A insulation and 2.0 for Class B insulation.

3. Insulation resistance test on insulated bearings in accordance with manufacturer's instructions.

4. Measure running current and voltage, and evaluate relative to load conditions and nameplate full-load amperes.

5. Overpotential Tests:

a. Applied dc voltage in accordance with IEEE 95.

b. Limited to 4,000-volt motors rated 1,000 horsepower and greater.

c. Test results evaluated on pass/fail basis.

3.03 SUPPLEMENTS

A. Table supplements, following "END OF SECTION," are a part of this Specification.

END OF SECTION

TABLE 1									
MOTOR PERFORMANCE REQUIREMENTS									
		% Guar. Min. Full Load Efficiency				%Guar. Min. Full Load Power Factor			
		Horizontal		Vertical		Horizontal		Vertical	
hp	Nom.Speed rpm	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC
1	1800	80.0	81.5			Mfr.'s Std.	Mfr.'s Std.		
	1200	78.5	79.3			Mfr.'s Std.	Mfr.'s Std.		
1.5	3600	79.3	81.5			Mfr.'s Std.	Mfr.'s Std.		
	1800	79.3	82.0			Mfr.'s Std.	Mfr.'s Std.		
	1200	82.5	84.0		82.0	Mfr.'s Std.	Mfr.'s Std.		Mfr.'s Std.
2	3600	82.0	84.0			Mfr.'s Std.	Mfr.'s Std.		
	1800	81.5	83.7			Mfr.'s Std.	Mfr.'s Std.		
	1200	85.5	85.5	83.7	83.7	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	82.9	82.5	82.9	81.7	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
3	3600	82.0	84.0	82.0	82.0	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1800	84.8	86.5	84.8	84.8	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1200	87.5	88.1	87.5	86.6	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	84.1	82.9	84.1	82.9	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
5	3600	84.8	86.5	84.8	84.8	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1800	86.5	86.5	84.8	84.8	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1200	87.5	88.1	87.5	86.6	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	87.5	86.5	87.5	86.6	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
7.5	3600	86.5	88.1	84.8	86.6	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1800	89.3	89.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1200	88.5	88.5	88.4	87.5	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	87.5	86.5	87.5	86.6	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
10	3600	89.3	89.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1800	89.3	89.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1200	89.5	89.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	89.3	88.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
15	3600	88.5	89.8	88.4	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1800	91.0	91.0	90.9	90.2	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1200	90.2	90.2	90.2	89.3	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	89.3	88.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
20	3600	91.0	90.6	90.9	89.3	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1800	91.7	91.7	91.7	90.9	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1200	91.0	90.6	90.2	89.3	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	90.2	89.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
25	3600	91.7	91.0	91.7	90.2	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1800	92.4	92.4	92.4	91.7	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1200	91.7	91.0	90.9	89.3	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	90.2	89.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
30	3600	91.7	91.4	89.5	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1800	92.4	92.4	92.4	91.7	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1200	91.7	91.0	91.7	90.2	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	91.7	91.7	90.9	90.9	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
40	3600	91.7	91.7	90.2	89.3	86.6	86.1	87.0	89.0
	1800	93.6	93.0	92.8	91.7	78.2	78.2	83.0	84.5
	1200	92.4	92.4	91.7	90.9	81.5	81.5	81.5	81.5
	900	91.7	91.0	90.9	90.2	70.0	70.5	70.0	70.5
50	3600	92.0	92.0	90.2	89.3	85.1	86.7	89.0	89.0
	1800	93.6	93.0	92.8	91.7	79.5	79.4	82.5	82.5
	1200	92.4	92.4	91.7	90.9	81.5	81.5	81.5	81.5
	900	91.7	91.7	90.9	90.9	78.5	72.9	78.5	80.0
60	3600	92.7	93.0	91.7	90.9	85.8	88.3	87.5	89.0
	1800	93.6	94.1	93.5	92.8	80.5	79.9	80.5	80.5
	1200	93.0	93.0	92.8	91.7	81.5	81.5	81.5	81.5
	900	92.4	91.7	91.7	90.9	79.5	73.2	79.5	79.5
70	3600	93.6	93.6	91.7	91.7	87.1	88.5	88.5	88.5
	1800	94.5	94.5	93.5	93.5	81.0	81.5	81.0	81.5
	1200	93.6	93.5	93.5	92.8	82.0	82.0	82.0	82.0
	900	92.8	92.4	92.8	91.7	80.5	74.5	80.5	81.0
100	3600	93.6	93.3	91.7		87.0	88.2	87.0	88.5

TABLE 1									
MOTOR PERFORMANCE REQUIREMENTS									
		% Guar. Min. Full Load Efficiency				%Guar. Min. Full Load Power Factor			
		Horizontal		Vertical		Horizontal		Vertical	
hp	Nom.Speed rpm	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC
	1800	95.1	94.5	94.0	93.5	81.0	81.0	81.0	81.0
	1200	93.6	93.6	92.8	92.8	82.1	81.7	85.5	85.5
	900	93.5	92.4	92.8	91.7	77.0	77.3	77.0	80.0
125	3600	93.6	93.7	91.7	91.7	86.4	89.1	87.0	90.5
	1800	94.5	94.7	93.5	92.8	85.4	85.5	87.5	86.0
	1200	93.6	94.1	93.5	92.8	82.7	82.3	85.5	85.5
	900	93.5	93.0	92.8	92.4	78.5	78.5	78.5	78.5
150	3600	93.6	93.7	92.4	91.7	86.5	90.0	86.5	90.5
	1800	95.0	95.2	94.5	94.0	82.5	85.0	84.5	85.0
	1200	94.5	94.5	93.5	94.0	81.5	81.5	81.5	81.5
	900	93.5	93.0	92.8	92.4	78.0	78.5	78.0	78.5
200	3600	94.3	94.3	92.4	93.0	87.8	89.4	91.0	91.0
	1800	95.0	95.2	94.0	94.0	85.2	86.5	87.0	87.0
	1200	94.5	94.5	93.5	93.5	79.0	82.5	79.0	82.5
250	3600	94.3	94.7	91.7	92.4	85.0	86.5	85.0	96.5
	1800	85.4	95.4	94.5	94.5	79.0	79.0	79.0	79.0
	1200	95.0	94.5	94.5	93.5	82.0	82.0	82.0	82.0
300	3600	93.7	94.3			89.8	89.9		
	1800	95.4	95.2	94.5	94.0	80.0	80.0	800	80.0
	1200	93.7	93.7			84.5	90.1		
350	3600	94.3	94.7			89.4	85.9		
	1800	94.7	94.7			85.9	85.9		
400	3600	94.3				88.4			
	1800	9437				86.8			
450	3600	94.7				89.1			
500	3600	94.7				88.3			

SECTION 16450

GROUNDING

PART 1 -- GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American National Standards Institute (ANSI): C2, National Electrical Safety Code (NESC).

2. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).

1.02 SUBMITTALS

A. Shop Drawings:

1. Product Data:
   a. Exothermic weld connectors.
   b. Mechanical connectors.

1.03 UL COMPLIANCE

A. Materials manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL listing mark.

PART 2 -- PRODUCTS

2.01 GROUND ROD

A. Material: Copper clad.

B. Diameter: 3/4 inch.

C. Length: 20 feet.

2.02 GROUND CONDUCTORS

A. As specified in Section 16120, CONDUCTORS.

2.03 CONNECTORS

A. Exothermic Weld Type:

1. Outdoor Weld: Suitable for exposure to elements or direct burial.

2. Indoor Weld: Utilize low-smoke, low-emission process.

3. Manufacturers:
   a. Erico Products, Inc.; Cadweld amd Cadweld Exolon.
   b. Thermoweld.

B. Mechanical Type: Split-bolt, saddle, or cone screw type; copper alloy material.

1. Manufacturers:
   a. Burndy Corp.
   b. Thomas and Betts Co.

2.04 GROUNDING WELLS

A. Ground rod box complete with cast iron riser ring and traffic cover marked GROUND ROD.

B. Manufacturers:

1. Christy Co.; No. G5.

2. Lightning and Grounding Systems, Inc.; I-R Series.

PART 3 - EXECUTION

3.01 GENERAL

A. Grounding shall be in compliance with NFPA 70 and ANSI C2.

B. Ground electrical service neutral at service entrance equipment to supplementary grounding electrodes.

C. Ground each separately derived system neutral to nearest effectively grounded building structural steel member or separate grounding electrode.

D. Bond together system neutrals, service equipment enclosures, exposed non-current-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and cables, receptacle ground connections, and metal piping systems.

E. Shielded Power Cables: Ground shields at each splice or termination in accordance with recommendations of splice or termination manufacturer.

F. Shielded Control Cables:

1. Ground shield to ground bus at power supply for analog signal.

2. Expose shield minimum I inch at termination to field instrument and apply heat shrink tube.

3. Do not ground control cable shield at more than one point.

3.02 WIRE CONNECTIONS

A. Ground Conductors: Install in conduit containing power conductors and control circuits above 50 volts.

B. Nonmetallic Raceways and Flexible Tubing: Install an equipment grounding conductor connected at both ends to non current-carrying grounding bus.

C. Connect ground conductors to raceway grounding bushings.

D. Extend and connect ground conductors to ground bus in all equipment containing a ground bus.

E. Connect enclosure of equipment containing ground bus to that bus.

F. Bolt connections to equipment ground bus.

G. Bond grounding conductors to metallic enclosures at each end, and to intermediate metallic enclosures.

H. Junction Boxes: Furnish materials and connect to equipment grounding system with grounding clips mounted directly on box, or with 3/8-inch machine screws.

3.03 MOTOR GROUNDING

A. Extend equipment ground bus via grounding conductor installed in motor feeder raceway; connect to motor frame.

B. Nonmetallic Raceways and Flexible Tubing: Install an equipment grounding conductor connected at both ends to non current-carrying grounding bus.

C. Motors Less Than 10 hp: Furnish mechanical-type terminal connected to conduit box mounting screw.

D. Motors 10 hp and Above: Tap motor frame or equipment housing; furnish mechanical-type terminal connected with minimum 5/16-inch brass threaded stud with bolt and washer.

E. Circuits 20 Amps or Above: Tap motor frame or equipment housing; install solderless terminal with minimum 5/16-inch diameter bolt.

3.04 GROUND RODS

A. Install full length with conductor connection at upper end.

B. Install with connection point below finished grade, unless otherwise shown.

3.05 GROUNDING WELLS

A. Install inside buildings, asphalt, and paved areas.

B. Install riser ring and cover flush with surface.

C. Place 9 inches crushed rock in bottom of each well.

3.06 CONNECTIONS

A. General:

1. Above grade Connections: Use either exothermic weld or mechanical-type connectors.

2. Below grade Connections: Install exothermic weld type connectors.

3. Remove paint, dirt, or other surface coverings at connection points to allow good metal-to-metal contact.

4. Notify ENGINEER prior to backfilling ground connections.

B. Exothermic Weld Type:

1. Wire brush or file contact point to bare metal surface.

2. Use welding cartridges and molds in accordance with manufacturer's recommendations.

3. Avoid using badly worn molds.

4. Mold to be completely filled with metal when making welds.

5. After completed welds have cooled, brush slag from weld area and thoroughly clean joint.

C. Mechanical Type:

1. Apply homogeneous blend of colloidal copper and rust and corrosion inhibitor before making connection.

2. Install in accordance with connector manufacturer's recommendations.

3. Do not conceal mechanical connections.

3.07 METAL STRUCTURE GROUNDING

A. Ground metal sheathing and exposed metal vertical structural elements to grounding system.

B. Bond electrical equipment supported by metal platforms to the platforms.

C. Provide electrical contact between metal frames and railings supporting pushbutton stations, receptacles, and instrument cabinets, and raceways carrying circuits to these devices.

3.08 TRANSFORMER GROUNDING

A. Bond neutrals of transformers within buildings to system ground network, and to any additional indicated grounding electrodes.

B. Bond neutrals of substation transformers to substation grounding grid and system grounding network.

C. Bond neutrals of pad-mounted transformers to four locally driven ground rods and buried ground wire encircling transformer and system ground network.

3.09 SURGE PROTECTION EQUIPMENT GROUNDING

A. Connect surge arrestor ground terminals to equipment ground bus.

3.10 INSTRUMENT GROUND - SURGE SUPPRESSION

A. Connect all instrument surge protection with #6 insulated copper ground wire (in conduit where above grade) to closest plant ground system.

3.11 BONDING

A. Bond to Main Conductor System:

1. All roof mounted ventilators, fans, air handlers, masts, flues, cooling towers, handrails, and other sizeable metal objects.

2. Roof flashing, gravel stops, insulation vents, ridge vents, roof drains, soil pipe vents, and other small metal objects if located within 6 feet of main conductors or another grounded object.

3. Provide air terminals as required.

B. Bond steel columns or major framing members to grounding system per National Electrical Code.

C. Bond each main down conductor to grounding system.

3.12 GROUNDING SYSTEM

A. Grounding Conductor:

1. Completely encircle building structure.

2. Bury minimum 30” below finished grade.

3. Minimum 2 feet distance from foundation walls.

B. Interconnect ground rods by direct-buried copper cables.

C. Connections:

1. Install ground cables continuous between connections.

2. Exothermic welded connections to ground rods, cable trays, structural steel, handrails, and buried and nonaccessible connections.

3. Provide bolted clamp type mechanical connectors for all exposed secondary connections.

4. Use bolded offset parapet bases or through-roof concealed base assemblies for air terminal connections.

5. Provide interconnections with electrical and telephone systems and all underground water and metal pipes.

6. Provide electric service arrestor ground wire to building water main.

3.13 FIELD QUALITY CONTROL

A. Visual and Mechanical Inspection:

1. Equipment and circuit grounds in motor control centers, panelboards, switchboards, and switchgear assemblies for proper connection and tightness.

2. Ground bus connections in motor control centers, panelboards, switchboards, and switchgear assemblies for proper termination and tightness,

3. Effective transformer core and equipment grounding.

4. Accessible connections to grounding electrodes for proper fit and tightness.

5. Accessible exothermic-weld grounding connections to verify that molds were fully filled and proper bonding was obtained.

B. Electrical Tests:

1. Fall-Of-Potential Test:

   a. In accordance with IEEE 81, Section 8.2.1.5 for measurement of main ground system's resistance.
   b. Main ground electrode system resistance to ground to be no greater than 5 ohms.

2. Two-Point Direct Method Test:

   a. In accordance with IEEE 81, Section 8.2. 1.1 for measurement of ground resistance between main ground system, equipment frames, and system neutral and derived neutral points.

   b. Equipment ground resistance shall not exceed main ground system resistance by 0.50 ohm.

END OF SECTION

SECTION 16810

CONTROL PANELS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Provide, install, and test all control panels and appurtenances as shown on the Drawings and as hereinafter specified.

1.02 STANDARDS

A. Control panels shall be in accordance with the National Electric Code and NEMA as applicable.

1.03 QUALITY ASSURANCE

A. The control panel manufacturer shall have total system control responsibility. The manufacturer shall have local experience in providing control panels of the types and functions as specified herein.

B. All control panels shall be either UL 508 listed or constructed by an UL approved shop and labeled accordingly.

1.04 CONTROL PANEL FUNCTIONS

A. The panel builder shall provide functions as described using his own standard schematics and arrangements. All wires shall be numbered and brought to numbered terminals. Complete schematics and outline Drawings shall be provided for approval.

PART 2 - PRODUCTS

2.01 CONSTRUCTION

A. All panels furnished shall be of the arrangement and design as shown on the Drawings and specified herein.

B. Panel construction shall be NEMA 4X 316 stainless steel with drip shield kit, 316 stainless steel, with door gasket and three (3) point stainless steel latch, handle with nylon rollers and drip edge. Internal components shall be mounted on a back panel and selector switches, lights, etc., mounted on an interior dead-front panel. Enclosure shall be painted white and have sun shields on top and sides.

C. Access doors or panels shall have continuous stainless steel hinges. Fabrication shall be of 11 gauge thick, sheet steel with stainless steel hardware, suitably braced internally for structural rigidity and strength. Front panels or sections containing instruments shall be not less than 7 gauge thick stretcher leveled sheet steel or 1/4 inch thick anodized aluminum, reinforced to prevent warping or distortion. All sections shall be descaled, degreased, filled, ground and finished with two rust-resistant

phosphate prime coats and two (2) air dry silicone alkyd finish coats of enamel which shall be applied by either the hot air spray or conventional cold spray methods. The final finish shall be smooth, free of runs, and uniform in tone and thickness. Unless otherwise noted, the colors to be used shall be selected by the owner from color chips supplied by the panel manufacturer. All cutouts shall be properly finished, including deburring and touch-up painting.

D. Nameplates shall be provided for all flush mounted equipment. The nameplates shall be constructed of black and white laminated, phenolic material having engraved letters approximately 1/4 inch high, extending through the black face into the white layer. Nameplates shall be attached to panels by self-tapping stainless steel screws.

E. Print storage pockets shall be provided on the inside of each panel. Its size shall be sufficient to hold all of the prints required to service the equipment. Reduced drawings shall be provided to be stored in these pockets.

F. All panel equipment shall be mounted and wired on or within the cabinet. All wiring within the panel shall be grouped together with harnesses or ducts and secured to the structure. All wiring shall be numbered in accordance with the numbering system used on the wiring/connection diagrams. Power and low voltage DC signal wiring shall be routed in separate wire ways. Crossing of the two system wires shall be at right angles. Parallel troughs of different systems shall be separated by a minimum of 12 inches. Wiring through for supporting internal wiring shall be plastic type with snap-on covers. The side walls shall be open-top type to permit wire changing without disconnecting. Wiring troughs shall not be filled to more than 60 percent visible fill. Wiring through covers shall be match marked to identify placement. If component identification is shown on covers for visibility, the ID shall also appear on the mounting sub-panel.

G. Power wire shall be minimum 12 AWG stranded, insulated for not less than 600 volts unless specified otherwise. Control wire shall be 14 AWG stranded, insulated and twisted shielded wire shall be 16 AWG. Use type XHHW-2 for outside to panel application and type MTW for wiring inside the panel. No THHN or other type of wire shall be used inside the control panel without the City approval. Wire color shall be, Line Power - Black; Neutral or common - White; AC Control - Red; DC Control - Blue; Equipment or Chassis Ground - Green; specified externally powered circuits - Orange.

H. All wiring shall terminate in a master terminal board, rigid type and numbered. The master terminal board shall have a minimum of 25 percent spares. Terminal blocks shall be arranged in horizontal rows and separated into groups. (Power, AC control, DC signal, and alarm). Terminal blocks shall be barrier type with the appropriate voltage rating (600 volts minimum) and shall be the raised channel mounted type. Wire connectors shall be the hook fork type with non insulated barrel for crimp type compression connection to the wire. Wire and tube markers shall be the sleeve type with heat impressed letters and members. Direct interlock wiring between equipment will not be allowed. Only one side of a terminal block row shall be used for internal wiring. The field wiring side of the terminal shall not be within six (6) inches of the side panel or adjacent terminal.

I. All components shall be mounted in a manner that shall permit servicing, adjustment, testing and removal without disconnecting, moving or removing any other component. Components mounted on the inside panels shall be mounted on removable plates and

not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required by the manufacturer to protect equipment from vibration. Component mounting shall be oriented in accordance with the component manufacturer's and industries' standard practices. All internal components shall be identified with suitable plastic or metal engraved tags attached with drive pins adjacent to (not on) each component identifying the component in accordance with the drawing, specifications, and supplier's data.

2.02 PUSH BUTTONS

A. Push buttons shall be heavy-duty, oil tight, with momentary contacts. Switches shall be supplied with the number of poles required for the application, an escutcheon plate, and contacts rated for 10 amperes at 120 volts AC. Push buttons shall be as manufactured by Square-D, Class 9001, Type K or approved equal by City of Hallandale.

2.03 ROTARY HAND SWITCHES

A. Rotary selector switches shall be heavy duty oil tight, with the number of poles and number of positions as required. Switches shall have a pistol grip handle and be of the maintained contact type rated for 10 amps at 120 volts AC. The switches required for "electronic duty" shall have low, stable, contact resistance and gold contacts. Provide make-before-break bridging contacts where required. Rotary hand switches shall be as manufactured by Square-D, Class 9001, Type K, standard knob, or approved equal by City of Hallandale.

2.04 LED PILOT LIGHTS

A. LED indicating lights shall be provided as shown on the Drawings. Units shall be approximately 1/2 inch diameter. Bulbs shall be of the push-to-test type shall be as manufactured by Square-D, unless otherwise noted on the drawings, or approved equal by City of Hallandale.

2.05 RELAYS

A. Relays shall be double pole, double throw, octal plug-in type with a transparent dust cover. The relay shall be equipped with an indicating light to indicate when its coil is energized. The relays shall have 10 amperes 120 volt AC contacts. Relays shall be as manufactured by Square D, Class 8501, Type KP, unless otherwise noted on the drawings, or approved equal by City of Hallandale.

2.06 TIME DELAY RELAYS

A. Time delay relays shall be of the pneumatic type with time delay and instantaneous contacts. Time delay relays shall be double pole, double throw with output contacts rated at 10 amperes, 120 volt AC minimum. The time delay relays shall be set for sixty seconds except where otherwise shown on the Drawings but shall be adjustable from 0 to 180 seconds. Time delay relays shall be as manufactured by Square-D, Class 9050, Type A, unless otherwise noted on the drawings, or approved equal by City of Hallandale.

2.07 TIMERS

A. Timers shall be plug-in type with a dust and moisture resistant case. The timers shall be of the multirange/analog or digital type with selectable ranges. The output contacts shall be rated at 10 amperes 120 volt AC minimum. The timer shall have a "timing in progress" indication. Timers shall be manufactured by Square D, or approved equal by City of Hallandale.

2.08 CIRCUIT BREAKERS

A. Circuit breakers shall be thermal-magnetic, molded case, permanent trip. Voltage, current, interrupting ratings, and number of poles required shall be as shown on the Drawings. Circuit breakers used in 120/240 volt control panels shall be UL listed and have an interrupting capacity of not less than 18,000 amperes, RMS, symmetrical. Circuit breakers shall be manufactured by Square D, or approved equal by City of Hallandale.

B. Do not substitute single-pole circuit breakers with handle ties for multi-pole breakers.

2.09 SURGE PROTECTIVE DEVICE (SPD) POWER APPLICATIONS

A. Refer to specification 16050.

2.10 PHASE MONITOR

A. Phase monitor shall be a three phase solid state device with voltage sensing capabilities. Phase monitor shall have undervoltage capabilities with a UL listed relay. The monitor shall protect the motor against phase loss, phase unbalance, phase reversal, and undervoltage. Phase monitor shall be manufactured by ACT, or approved equal by City of Hallandale.

2.11 MOTOR STARTER

A. The motor starter shall be a full voltage non reversing, NEMA rated, three phase starter with thermal motor overload units. Overload units shall have manual resets. Motor starter shall be manufactured by Square D, or approved equal by City of Hallandale.

2.12 CONTROL POWER TRANSFORMER

A. If applicable, control power transformer shall be rated for 240x480V/120V A.C. and shall be rated with the appropriate kVA rating as called out in drawings. Control power transformer shall be manufactured by Square D, or approved equal by City of Hallandale.

2.13 DUPLEX RECEPTACLE

A. A 20A duplex receptacle shall be installed within the control panel. Receptacle shall be GFCI Type and shall be manufactured by Leviton Company Type 6599-I, unless otherwise noted on the drawings, or approved equal by City of Hallandale.

2.14 INTRINSICALLY SAFE RELAYS

A. Intrinsically safe control relays shall be as manufactured by Pepperl + Fuchs, unless otherwise noted on the drawings, or approved equal by City of Hallandale.

2.15 ELAPSED TIME METER

A. Elapsed time meter shall be as manufactured by Yokogawa Type 240, unless otherwise noted on the drawings, or approved equal by City of Hallandale.

2.16 TERMINAL BLOCKS

A. Terminal blocks shall be as manufactured by Square D Class 9080, unless otherwise noted on the drawings, or approved equal by City of Hallandale.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Seal all conduit entrances into control panels using sealing fittings as detailed on the drawings.

3.02 TESTS

A. The supplier shall test all equipment at the factory prior to shipment. Coordinate with pump supplier for testing and startup at the site for each lift station.

3.03 ACCEPTANCE

A. Upon successful completion of operation test and subsequent review and approval of the complete system's final documentation, the system shall be considered as acceptable.

END OF SECTION

SUBSURFACE EXPLORATION
FACTUAL REPORT
PS#8 & FORCE MAIN
SE 5 STREET & 4 AVENUE
SE 5 STREET & 1 AVENUE
CITY OF HALLANDALE, FLORIDA
FILE NO.: 04-3718
JULY 15, 2004

Ardaman & Associates, Inc.

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Orlando, 8008 S. Orange Avenue, Orlando, Florida 32809, Phone (407) 855-3860
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Fort Myers, 9970 Bavaria Road, Fort Myers, Florida 33913, Phone (941) 768-6600
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MEMBERS:
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Ardaman & Associates, Inc.

Geotechnical, Environmental and
Materials Consultants

July 15, 2004
File No.: 04-3718

Mr. Norman Woliner, P.E.
Tetratech WHS
2101 N. Andrews Avenue
Ft. Lauderdale, FL 33311

RE: **SUBSURFACE EXPLORATION FACTUAL REPORT**
PS # 8 & FORCE MAIN
SE 5 STREET & 4 AVENUE
SE 5 STREET & 1 AVENUE
CITY OF HALLANDALE, FLORIDA

As requested and authorized by you, we have completed a shallow subsurface soil exploration for your proposed force main project. The purposes of performing this exploration were to evaluate the general subsurface conditions at the above referenced areas.

SITE LOCATION AND SITE DESCRIPTION

The site for the proposed facility is located on the northeast corner of the intersection of SE 5 Street & SE 4 Avenue and west of SE 1 Avenue intersecting SE 5 Street in Hallandale, Florida (Section 27, Township 51 S, Range 42 E).

FIELD EXPLORATION PROGRAM

SPT Borings

The field exploration program consisted of performing two (2) Standard Penetration Test (SPT) borings.

2608 West 84th Street, Hialeah, Florida 33016 Phone (305) 825-2683 FAX (305) 825-2686
Offices in: Barrow, Cocoa, Fort Lauderdale, Fort Myers, Miami, Orlando, Port Charlotte, Port St. Lucie, Sarasota, Tallahassee, Tampa, W. Palm Beach

The SPT borings were performed at the approximate location shown in our boring location plan. The borings were advanced to depths ranging from 25 to 41 feet below the ground surface using the methodology outlined in ASTM D-1586. A summary of this field procedure is included in the Appendix. Split-spoon soil samples recovered during performance of the borings were visually classified in the field and representative portions of the samples were transported to our laboratory in sealed sample jars for further classification and laboratory testing.

The groundwater level at each of the boring locations was measured upon completion of drilling.

LABORATORY TESTING PROGRAM

Representative soil samples obtained during our field sampling operation were packaged and transferred to our laboratory for further visual examination and classification. The soil samples were visually classified. The resulting soil descriptions are shown on the soil boring profiles presented in the Appendix.

GENERAL SUBSURFACE CONDITIONS

General Soil Profile

The results of the field exploration and laboratory testing programs are graphically summarized on the soil boring profiles presented in the Appendix. The stratification of the boring profiles represents our interpretation of the field boring logs and the results of laboratory examinations of the recovered samples. The stratification lines represent the approximate boundary between soil types. The actual transitions may be more gradual than implied.

The results of our test borings indicate the following general soil profile:

Depth Below Ground Surface (feet)	Description
0 - 6	Sand (upper 6" of topsoil)
6 - 41	Limestone

The above soil profile is outlined in general terms only. Please refer to the boring logs for soil profile details.

Measured Groundwater Level

The groundwater level was measured in the boreholes on the day drilled after stabilization of the downhole water level. As shown on the boring logs, the measured groundwater levels were encountered at depths that ranged from 5.3 to 9.0 feet below the ground surface on the dates indicated. Fluctuations in groundwater levels should be anticipated throughout the year primarily due to seasonal variations in rainfall and other factors that may vary from the time the borings were conducted.

NORMAL SEASONAL HIGH GROUNDWATER LEVEL

The normal seasonal high groundwater level each year is the level in the August-September period at the end of the rainy season. The water table elevations associated with a 100-year flood level would be much higher than the normal seasonal high groundwater level. The normal high water levels would more approximate the normal seasonal high groundwater levels.

The seasonal high groundwater level is affected by a number of factors. The drainage characteristics of the soils, the land surface elevation, relief points such as drainage ditches, lakes, rivers, swamp areas, etc., and distance to relief points are some of the more important factors influencing the seasonal high groundwater level.

Based on our interpretation of the site conditions using our boring logs, we estimate the normal seasonal high groundwater level at the site to be approximately 1-1.5 feet above the groundwater levels measured at the time of our field exploration.

July 15, 2004
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CLOSURE

This factual report has been prepared in accordance with generally accepted local foundation engineering practice. This report may not account for all the possible variations that may exist between conditions observed in the borings and conditions at locations that were not explored. The nature and extent of any such variations may not become evident until construction is underway.

It has been a pleasure to assist you on this phase of your project. Please contact us whenever we may be os service to you and please call if you have any questions concerning this report.

Very truly yours,
ARDAMAN & ASSOCIATES, INC.

Evelio Horta 7/15/04

Barbara Valdes-Perez
Staff Engineer

Evelio Horta, Ph.D., P.E.
Branch Manager
FL Reg. No. 46625

APPENDIX

STANDARD PENETRATION TEST BORING LOGS

Our borings describe subsurface conditions only at the locations drilled and at the time drilled. They provide no information about subsurface conditions below the bottom of the boreholes. At locations not explored, surface conditions that differ from those observed in the borings may exist and should be anticipated.

The information reported on our boring logs is based on our drillers' logs and on visual examination in our laboratory of disturbed soil samples recovered from the borings. The distinction shown on the logs between soil types is approximate only. The actual transition from one soil to another may be gradual and indistinct.

The groundwater depth shown on our boring logs is the water level the driller observed in the borehole when it was drilled. These water levels may have been influenced by the drilling procedures, especially in borings made by rotary drilling with bentonitic drilling mud. An accurate determination of groundwater level requires long-term observation of suitable monitoring wells. Fluctuations in groundwater levels throughout the year should be anticipated.

The absence of a groundwater level on certain logs indicates that no groundwater data is available. It does not mean that no groundwater will be encountered at that boring location.

STANDARD PENETRATION TEST BORINGS

The Standard Penetration Test is a widely accepted method of testing foundation soils in place. The N-Value obtained from the test has been correlated empirically with various soil properties. These empirical correlations allow satisfactory estimates to be made of how the soil is likely to behave when subjected to foundation loads. Tests are usually performed in the boreholes at intervals of five feet. In addition, our Firm performs tests continuously in the interval directly below the expected foundation bearing grade where the soil will be the most highly stressed.

Boreholes where Standard Penetration Tests will be performed are drilled with a truck-mounted CME 45A drill rig. The boreholes are advanced by rotary drilling with a winged bit that makes a hole about three inches in diameter. A bentonitic drilling mud is recirculated in order to remove the cuttings and support the walls of the borehole. The drag bit is specially modified to direct the mud upward and reduce disturbance of the soil ahead of the bit.

Occasionally, running or squeezing ground is encountered that cannot be stabilized by the drilling mud alone. In addition, drilling mud may be lost into the soil or rock strata that are unusually pervious. In such cases, flush-coupled steel casing with an outside diameter of about 3.5 inches is driven as a liner for the borehole.

After the borehole has been advanced to the depth where a Standard Penetration Test will be performed, the soil sampler used to run the test is attached to the end of the drill rods and lowered to the bottom of the borehole. The testing procedure used conforms closely to the methods recommended in ASTM D-1586. The sampler used has a split-barrel 24 inches long and an outside diameter of 2.0 inches. It is driven into the ground below the bottom of the borehole using a hammer that weighs 140 pounds and falls 30 inches. The driller records the number of hammer blows needed to advance the sampler the second and third six-inch increments constitutes the test result; that is, the N-Value at the depth. The test is completed after the sampler has been driven not more than 24 inches or when refusal is encountered, whichever occurs first. Refusal occurs when 50 hammer blows advance the sampler six inches or less. After the test is completed, the sampler is removed from the borehole and opened.

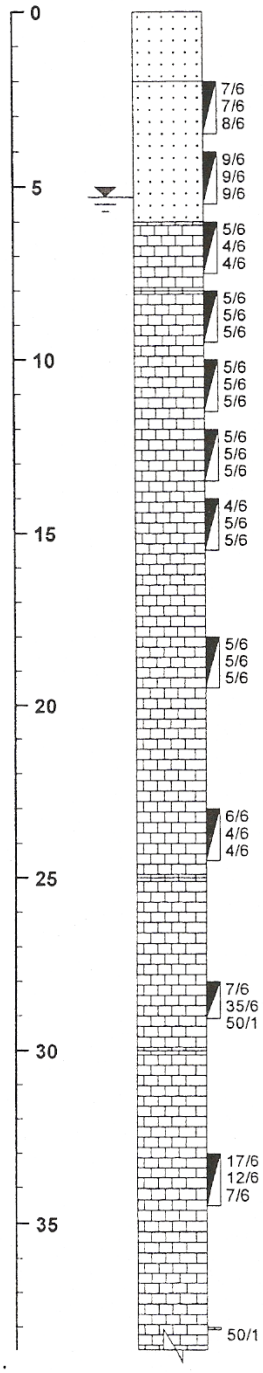
The driller examined and classifies the soil recovered by the sampler. He places representative soil specimens from each test in closed glass jars and takes them to our laboratory. In the laboratory, additional evaluations and tests are performed, if needed. The driller's classifications may be adjusted, if necessary, to conform more closely with the United Soil Classification System, ASTM D-2487. Jar samples are retained in our laboratory for sixty days, then discarded unless our clients request otherwise.

After completion of a test boring, the water level in the borehole is recorded.

SOIL TEST BORING SYMBOLIC LOGS

BORING B-1

Project: **SE 5 Street & SE 4 Avenue** File No.: **04-3718**
Date: **06/23/04** Elev.: **N/A**
Boring Location: **SEE PLAN**
Casing: **N/A**
Drill Method: **SPT/HSA** Driller: **J.J./J.C.**
Depth of Water Table ▼ : **5.3'** Date Checked: **06/23/04**



ELEVATION / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	SOIL DESCRIPTION	SAMPLE No.	SPT "N" VALUE
		SAND, dark brown, fine grained. (upper 6" of topsoil)	1	
		SAND, brown, fine grained, with rock fragments.		15
			2	18
		LIMESTONE, pale brown.		8
			3	
		LIMESTONE, very pale brown.		10
				10
				10
			4	
				10
				10
			5	
				8
		LIMESTONE, grayish brown.	6	
				85
		LIMESTONE, pale brown.	7	
				19
			8	

Notes:

Ardaman & Associates, Inc.

SOIL TEST BORING SYMBOLIC LOGS

BORING B-1

Project: **SE 5 Street & SE 4 Avenue**
File No.: **04-3718**
Date: **06/23/04**
Elev.: **N/A**
Boring Location: **SEE PLAN**
Casing: **N/A**
Drill Method: **SPT/HSA**
Driller: **J.J./J.C.**
Depth of Water Table ▼ : **5.3'**
Date Checked: **06/23/04**

ELEVATION / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	SOIL DESCRIPTION	SAMPLE No.	SPT "N" VALUE
40	65/6 50/1 50/1		9	50
45				
50				
55				
60				
65				
70				
75				

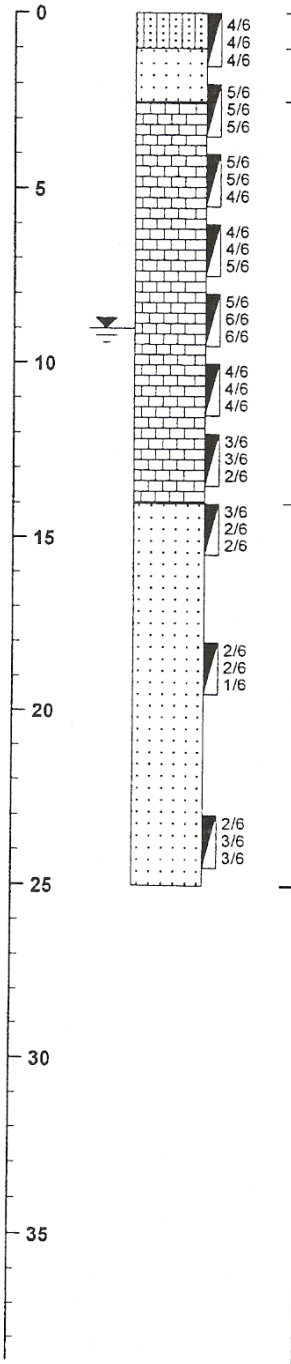
Notes:

Ardaman & Associates, Inc.

SOIL TEST BORING SYMBOLIC LOGS

BORING B-2

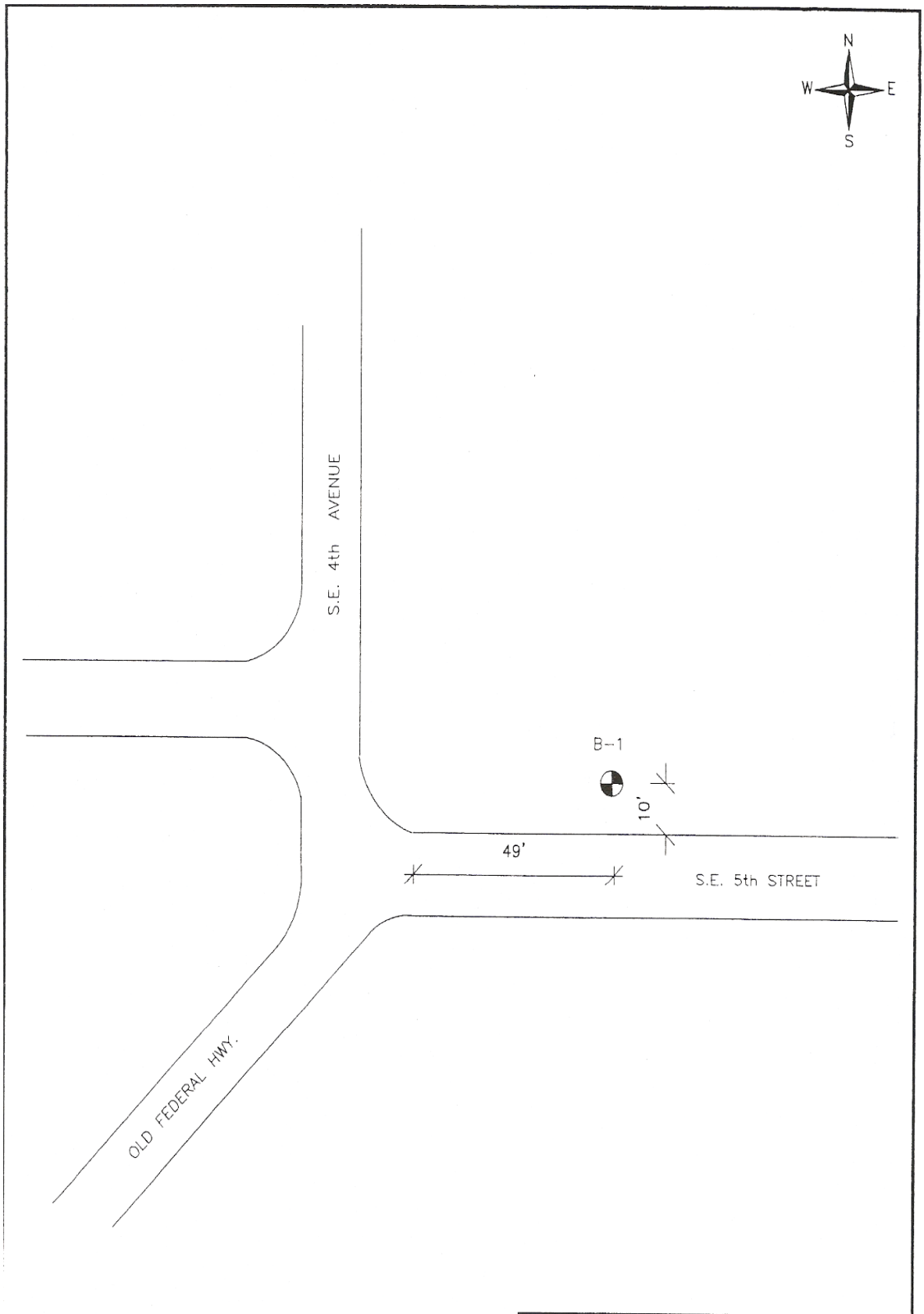
Project: **SE 5 Street & SE 4 Avenue**
File No.: **04-3718**
Date: **06/23/04**
Elev.: **N/A**
Boring Location: **SEE PLAN**
Casing: **N/A**
Drill Method: **SPT/HSA**
Driller: **J.J./J.C.**
Depth of Water Table ▼ : **9.0'**
Date Checked: **06/23/04**



ELEVATION / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	SOIL DESCRIPTION	SAMPLE No.	SPT "N" VALUE
		SILTY SAND, dark brown, fine grained.	1	8
		SAND, very pale brown, fine grained.		
		LIMESTONE, pale brown to very pale brown.	2	10
			3	9
				9
				12
			4	8
				5
		SAND, brownish yellow, fine grained, loose.		4
				3
				6
			5	

Notes:

Ardaman & Associates, Inc.



LEGEND

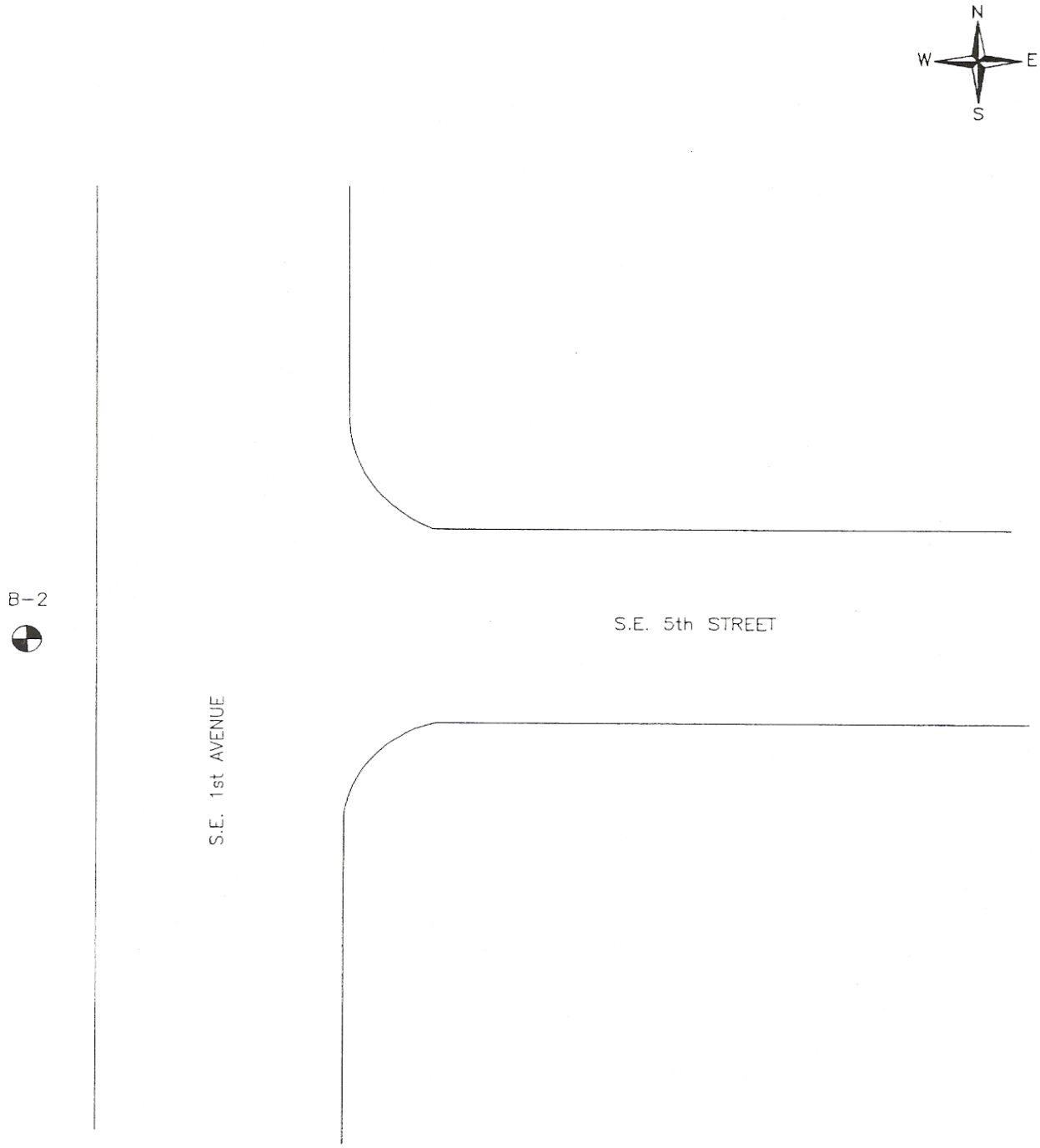
Boring location

This sketch is for illustration only.

Ardaman & Associates Inc.
Consulting Engineers in Soils, Hydrology, Foundations and Material Testing.

PS # 8 & Force Main
SE 5 Street & 4 Avenue
SE 5 Street & 1 Avenue
City of Hallandale, Fl.

DRAWN BY: B.V-P.	CHECKED BY: E.H.	DATE: 07/08/04
FILE No: 04-3718	APPROVED BY:	



LEGEND

Boring location

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PS # 8 & Force Main
SE 5 Street & 4 Avenue
SE 5 Street & 1 Avenue
City of Hallandale, Fl.

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END OF SECTION