

***TOWNSHIP OF FLORENCE
BURLINGTON COUNTY, NEW JERSEY***

***RULES, REGULATIONS
AND
TECHNICAL SPECIFICATIONS***

FOR

WATER DISTRIBUTION

AND

SANITARY SEWER SYSTEMS

OCTOBER 2006

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PREFACE TO SPECIFICATIONS

1.0 PURPOSE AND SCOPE

The purpose of this document is to set forth the rules, regulations and standards to guide Developers and Builders in the service area of Florence Township (hereinafter called the OWNER), so as to promote the public health, safety, convenience, and general welfare of the municipality. These rules and specifications shall be administered by the OWNER to insure the orderly growth, development, and construction of both the water distribution and sanitary sewer systems, in accordance with the requirements of the New Jersey Department of Environmental Protection and of the OWNER.

These specifications are addenda to the regularly adopted rules and regulations of the OWNER. They supersede and compliment all prior rules and regulations. Any alleged conflict between any of the articles or paragraphs or rules and regulations of the OWNER will be interpreted by the OWNER and the OWNER'S interpretations and ruling shall be final. These regulations, administered by the OWNER, are minimum requirements. They are intended to apply to the usual conditions encountered during design and construction. These specifications are subject to amendment for exceptional situations. The OWNER reserves the right to specify greater or less stringent requirements in any case, in their judgment, to be in the best interest of the community.

Prior to commencement of any detailed design for any water main or sanitary sewer system, it is advisable to prepare preliminary reports and plans, and in turn schedule a meeting with the OWNER and/or its ENGINEER for the purpose of review and discussion of the proposal. At this time, the OWNER will make comments and/or provide pertinent data applicable to these plans. The OWNER will provide the forms and information necessary to obtain approval for construction of the new facilities.

The OWNER recognizes the fact that questions may arise during the planning, construction and/or testing phases of water and/or sanitary sewerage development that may or may not be covered by specifications, rules or regulations. In these cases, the OWNER will take whatever action is necessary to either clarify the meaning of the specifications or provide direction or information necessary for the Developer, Builder or Contractor to understand and meet OWNER requirements.

2.0 BONDING REQUIREMENTS

Prior to the onset of any construction of water systems, sewage systems or pumping stations, the developer shall submit Performance Bonds in the full amount, as calculated by the ENGINEER, for review and acceptance. At the OWNER's discretion, letters of credits may be posted in lieu of Performance Bonds.

At no time shall any water, sewer or pump station construction take place without approved Performance Bonds or without expressed written approval from the OWNER.

Upon completion of a substantial portion of the work, the developer may request a reduction of the performance bond.

Upon completion of all of the utility work, the developer may request a release of the performance bond. A performance bond shall not be released until all final paving is complete, manholes and valve boxes are brought to grade, and as-built drawings are approved. The OWNER may release the performance bond after a two-year maintenance bond is posted in its place. Typically, the two-year maintenance bonds required will be for fifteen percent (15%) of the original performance bond amount. Before OWNER release of the maintenance bond, a walk through will be performed and punch list generated.

All items on the punch list must be completed prior to OWNER release of the maintenance bond.

3.0 WATER DISTRIBUTION SYSTEMS

Water mains are installed to provide a means for conveying water from the wells or storage tanks to some distant point where it may be used for human consumption, fire protection, watering of lawns and gardens or for many other purposes. Since this water is used for human consumption, among other things, the necessity for safe potable water is easily recognized.

In order to provide a water distribution system of high reliability, the construction of same must be inspected to insure that all rules and regulations are being met and that workmanship in general meets minimum specifications requirements. After construction has been completed, all lines must pass a chlorine residual test, a pressure test and a bacteriological test before the line is placed in service.

It shall be the responsibility of the Developer or Owner to maintain these lines after preliminary inspection has been completed and the water mains activated. The OWNER, however, reserves the right to direct the responsible party to have the water mains retested when, in the opinion of the OWNER, the water mains or appurtenances have been subjected to stresses or damage to such a degree that retesting is deemed necessary.

Once all construction has been completed but prior to the OWNER accepting the lines, an inspector from the OWNER and/or its ENGINEER will perform a final inspection of all water boxes and valves to see that they are physically sound and to proper grade. All hydrants and valves will be inspected and tested to see that they operate properly and that all valves are accessible. Should any problems be encountered during this inspection, it will be the Developer's or Builder's responsibility to make the necessary repairs and/or replacements.

Hydrant Flow Tests: All hydrant flow tests must be performed by qualified persons using a hydrant wrench. (Pipe wrenches are not acceptable.) The OWNER must be notified a minimum of forty-eight (48) hours in advance of any requested flow tests. Call the water superintendent at (609) 499-2518 to schedule flow tests. Tests shall be performed Monday to Friday from 8:00 a.m. to 4:00 p.m. The OWNER reserves the right to refuse the authorization of any flow test at any time it deems necessary. The OWNER's ENGINEER shall also be notified of all flow tests to be performed by a Developer or its representative.

Water Main Taps: All wet taps into OWNER water mains require a minimum of forty-eight (48) hour notice to the OWNER and ENGINEER. At its discretion, the OWNER may authorize a main to be taken out of service and a dry tap to be utilized. In that case, it is the responsibility of the Developer or Builder to notify all affected OWNER customers in writing a minimum of forty-eight (48) hours in advance of the temporary discontinuance of service. It shall be the responsibility of the Developer to rectify any and all disturbances or damages to the OWNER customer's systems.

4.0 SANITARY SEWER SYSTEMS

Sanitary sewer collection systems and pumping stations are installed to provide a means of conveying wastewater from its source of origin to a wastewater treatment plant. Wastewater is essentially the water supply of the community after it has been fouled by a variety of uses. Wastewater contains organic materials and numerous pathogenic or disease-causing organisms which must be immediately and safely removed from its source of origin.

In order to provide a wastewater collection system which will function properly for many years, the design must be reviewed, evaluated and approved by the OWNER and ENGINEER prior to construction. During the period of construction, the OWNER and ENGINEER will perform inspections of all approved sewer systems.

Once all construction has been completed, but prior to the OWNER accepting the lines, the lines will be air tested for infiltration and exfiltration. All lines shall be free and clear of construction debris and/or other matter. The lines shall be mandrelled prior to placement in service. Should any problem be encountered during the tests or any other facet of the installation process, it will be the Developer's or Builder's responsibility to make the necessary repairs and/or replacements.

All taps into the OWNER's existing sanitary sewer system require a minimum forty-eight (48) hour notice to the OWNER and ENGINEER.

Pumping Stations: All sewage pump stations shall be completely cleaned prior to testing and shall be tested under the direction of the OWNER and its ENGINEER. All equipment will be tested for operation during low, medium and high flow situations and for operation during a power outage. All pieces of equipment must operate in a satisfactory manner before the pump station can be placed into service. The OWNER, at its discretion, may authorize operation of a pump station prior to completion of the punch list items.

A licensed operator is required for the operation of all pumping stations at all times. If the OWNER authorizes operation of the pump station prior to the OWNER's acceptance and ownership of same, it is the responsibility of the Developer to provide a State licensed pump station operator at all times.

The OWNER will be responsible for and provide operation and maintenance of the pumping station upon release of the pumping station performance bond. At this time all utilities (electric, telephone, alarms) shall be placed in the OWNER's name. In addition, it is at this time that the developer shall deed the pumping station to the OWNER.

SECTION I

GENERAL SPECIFICATIONS

1.0 PURPOSE AND SCOPE

These specifications are intended as a guide for Developers and Builders within the Township. They are addenda to the regularly adopted rules and regulations of the OWNER, and represent the minimum acceptable requirements. The OWNER reserves the right to specify greater or less stringent requirements in any case, in their judgment, to be in the best interest of the OWNER.

The OWNER recognizes the fact that questions may arise during the planning, construction, and/or testing phases of a project that may or may not be covered by these specifications. In these cases, the OWNER will take whatever action is necessary to either clarify the meaning of the specifications or provide the necessary information for the Builder, Contractor, or Developer to understand and meet the OWNER's requirements.

Whenever and wherever the term "Standard Specifications" are used in these specifications, it shall mean the current edition of the New Jersey Department of Transportation Standard Specifications for Road and Bridge Construction.

Whenever and wherever the term "ENGINEER" is used in these specifications, it shall mean the ENGINEER duly appointed by the OWNER.

1.1 GENERAL APPROVAL REQUIREMENTS

The APPLICANT/ DEVELOPER must complete the following steps in order to receive water and/or sanitary sewer service from the OWNER:

- Complete all application forms and permits as required by the OWNER.
- Obtain NJDEP permits when required.

1.2 PERMITS

It is the responsibility of the Developer or Builder to obtain all required permits before the onset of construction. The OWNER will not permit construction of any sanitary sewer facilities and/or water distribution system without first obtaining a Treatment Works Approval and/or Bureau of Safe Drinking Water permit(s) from the NJDEP, if applicable.

2.0 PRODUCT DATA

2.1 GENERAL

- A. Submit to the ENGINEER shop drawings, product data and samples required by the specification sections.
- B. All shop drawings, product data and samples shall be reviewed and approved by the Design ENGINEER prior to submission.
- C. Schedule submission for shop drawings, product data and samples at least twenty-one (21) days before dates reviewed submittals will be needed.

2.2 SHOP DRAWINGS

- A. Original drawings, prepared by Contractor, subcontractor, supplier or distributor, which illustrate some portion of the work; showing fabrication, layout, setting or erection details.
- B. Minimum sheet size: 8-1/2" x 11".
- C. Present drawings in a clear and thorough manner: Details shall be identified by reference to sheet and detail, schedule or room numbers shown on development plans.

2.3 PRODUCT DATA

- A. Preparation:
 - 1. Clearly mark each copy to identify pertinent products or models.
 - 2. Show performance characteristics and capacities.
 - 3. Show dimensions and clearances required.
 - 4. Show wiring or piping diagrams and controls.
- B. Manufacturer's standard schematic drawings and diagrams:
 - 1. Modify drawings and diagrams to delete information not applicable to the work.
 - 2. Supplement standard information to provide information specifically applicable to the work.

- C. Manufacturer's catalog sheets, brochures, diagrams, illustrations and other standard descriptive data:
 - 1. Clearly mark each copy to identify pertinent materials, products or models.
 - 2. Show dimensions and clearances required.
 - 3. Show compliance with referenced standards.

2.4 SAMPLES

Office samples:

Of sufficient size and quantity to clearly illustrate:

- 1. Functional characteristics of product or material with integrally related parts and attachment devices.
- 2. Full range of color, texture, and pattern.
- 3. After review, samples will be retained by ENGINEER. Upon completion of the work, Contractor may submit written request for return of samples.

2.5 CONTRACTOR'S 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 requirements of the work and of the OWNER'S standard details.
- D. Contractor's responsibility for errors and omissions in submittals is not relieved by the OWNER or ENGINEER review of submittals.

- E. Contractor's responsibility for deviations in submittals from requirements of OWNER'S specifications is not relieved by the OWNER or ENGINEER review of submittals, unless the OWNER gives written acceptance of specific deviations.
- F. Notify ENGINEER, in writing at time of submission, of proposed deviations in submittals from OWNER requirements.
- G. Begin no fabrication or work that requires submittals until return of submittals with ENGINEER'S stamp and initials or signature indicating review.

2.6 SUBMISSION REQUIREMENTS

- A. Make submittals so as to cause no delay in the work or in the work of any other Contractor.
- B. Number of submittals required:

Shop drawings: Submit the number of opaque reproductions which the Contractor requires, plus eight (8) copies, two (2) of which will be retained by the ENGINEER and two (2) by the OWNER.
- C. Accompany submittals with transmittal letter, in duplicate, containing:
 - 1. Date of submission and dated of any previous submissions.
 - 2. Project title and number.
 - 3. Contractor's name and address.
 - 4. The number of each shop drawing, product data and sample submitted.
 - 5. Notification of deviations from OWNER requirements.
 - 6. Other pertinent data.
- D. Submittals shall include:
 - 1. Date and revision date.
 - 2. Project title and number.

3. The names of:
 - a. Design ENGINEER
 - b. Contractor
 - c. Subcontractor
 - d. Supplier
 - e. Manufacturer
 - f. Separate details when pertinent.
4. Identification of product or materials.
5. Field dimensions, clearly identified as such.
6. Specification section number.
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 OWNER standards.
10. Identification of revisions on resubmittals.
11. An 8" by 3" blank space for Contractor and ENGINEER stamps.
12. Contractor's stamp, initialed or signed, certifying to review of submittal, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of the OWNER'S standards.
13. Design Engineer's stamp, initialed or signed, certifying to review of submittal, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of the OWNER'S standards.

2.7 RESUBMISSION REQUIREMENTS

- A. Make any corrections or changes in the submittals required by the ENGINEER and resubmit until approved.
- B. Shop drawings and product data:
 - 1. Revise initial drawings or data, and resubmit as specified for the initial submittal.
 - 2. Indicate any changes that have been made other than those requested by the ENGINEER.
- C. Samples: Submit new samples as required for initial submittals.

2.8 DISTRIBUTION

- A. Distribute reproductions of shop drawings and copies of product data that carry the ENGINEER stamp of review to:
 - 1. Subcontractors.
 - 2. Supplier.
 - 3. Contractor's file.
- B. Distribute samples that carry the ENGINEER stamp of review as directed by ENGINEER.

2.9 ENGINEER DUTIES

- A. Review submittals with reasonable promptness.
- B. Review for:
 - 1. Design concept of project.
 - 2. Information given in approved plans.
- C. Review of separate item does not constitute review of an assembly in which item functions.
- D. Affix stamp and initials or signature certifying to review of submittal.
- E. Return submittals to Contractor for distribution or resubmission.

3.0 INSPECTIONS

Any work completed or proceeded without inspection and in an unacceptable manner will be considered done at the Developer or Builder's expense since, by proceeding without inspection they have assumed the burden of proof for acceptability.

3.1 ENGINEER

The ENGINEER'S Field Services Department shall be notified at least forty-eight (48) hours in advance that field services are required. Notification may be made either in writing or verbally, but in either instance, notification must be received by the Field Services Department prior to the said forty-eight (48) hours.

A. Written notification shall be directed to:

Richard A. Alaimo Associates
Field Services Department
200 High Street
Mount Holly, New Jersey 08060

Attention: Chief Field Representative

B. Verbal notification shall be made to the above at:

(609) 267-8310

The request for field services is the direct responsibility of the Developer or Builder and should they neglect to request same (or request same less than forty-eight (48) hours prior to need, and field services cannot be scheduled), all work accomplished without field services will automatically be considered unacceptable. Extreme care should be taken to avoid this situation, since:

1. All construction not accessible for complete visual inspection must be reestablished in such a manner as to allow for same before it will be accepted.
2. All construction which is subject to curing and hardening and/or which must be compacted (e.g. Portland cement concrete, bituminous concrete, backfill, subgrade, etc.) must be tested in such a manner as to allow for complete evaluation before it will be accepted.
3. A complete schedule of the required tests, examinations, etc., required in specific instance will be provided by this office.

3.2 OWNER

The OWNER's Plant Superintendent shall be notified at least forty-eight (48) hours in advance that inspection is required. Notification may be made either in writing or verbally, but in either instance, notification must be received prior to the said forty-eight (48) hours.

A. Written notification shall be directed to:

Township of Florence
Water and Sewer Department
1500 West Front Street
Florence, New Jersey 08518

Attention: Superintendent

B. Verbal notification shall be made to the above at:

(609) 499-2518

The request for inspection is the direct responsibility of the Developer or Builder and should they neglect to request same (or request same less than 48 hours prior to need, and inspection cannot be scheduled), all work accomplished without inspection will automatically be considered unacceptable. Extreme care should be taken to avoid this situation, since:

1. All construction not accessible for complete visual inspection must be reestablished in such a manner as to allow for same before it will be accepted.
2. All construction which is subject to curing and hardening and/or which must be compacted (e.g. Portland cement concrete, bituminous concrete, backfill, subgrade, etc.) must be inspected in such a manner as to allow for complete evaluation before it will be accepted.

4.0 SCHEDULING WORK/INSPECTIONS ON WEEKENDS, HOLIDAYS AND AFTER NORMAL WORKING HOURS

4.1 DESCRIPTIONS

- A. All non-emergency work performed after 3:30 p.m. or before 7:00 a.m. or on Saturday, Sunday or Holidays shall be scheduled with the Water and Sewer Department as in Section 3.2.
- B. If any additional staff is necessary for assistance/inspection after normal work hours, all costs will be the responsibility of the property owner. Additional staff requirements will be determined by the Water and Sewer Department.
- C. Any work performed outside normal business hours without proper scheduling with the Water and Sewer Department must be properly inspected and approved by the Water and Sewer Superintendent or a designee from his department. In order to insure a proper inspection, the Water and Sewer Department can require the removal of any materials that may be covering the lines that were worked on by the contractor or homeowner.
- D. The work site of any emergency work or work done during normal business hours shall be maintained in a safe condition and free of hazards to the public. Failure to maintain a safe environment is cause for the township to do whatever is necessary to make sure the work site is safe. All costs borne by Florence Township to insure a safe environment or work zone shall be the responsibility of the homeowner and/or contractor.

Emergency work is defined to mean repairs to a water or sewer service line to correct a leak, sewer backup, or non-functioning sewer lateral that poses a threat to the health and safety of the property owner and/or the surrounding residents. All other work will be considered non-emergency.

5.0 TRENCH EXCAVATING, BACKFILLING, AND COMPACTING

5.1 DESCRIPTIONS

A. Description of the work:

Trenching, backfilling, and compaction includes, but is not limited to:

1. Excavation for trenches and trench backfilling;
2. Rough and finish grading of the work; and
3. Furnishing and installing trench stabilization material and select backfill material.

B. Definitions:

1. Trench excavation: Removal and disposal of all material encountered when establishing required grade elevations, including pavements, concrete slabs and other obstructions.
2. Unauthorized excavation: Removal of materials beyond specified subgrade elevations without approval of the ENGINEER.

5.2 MATERIALS

A. Trench backfill material from on-site excavation:

B. All on-site backfill materials shall be subject to the approval of the ENGINEER, and to the following requirements:

1. Free from deleterious substances, stumps, brush, weeds, roots, sod, rubbish, garbage and matter that may decay.
2. Backfill to a height of two feet (2') above the top of pipes, culverts and other structures with material free from stones or rock fragments larger than two inches (2") in greatest dimension.
3. Free of large rocks or lumps that, in the opinion of the ENGINEER, may create voids or prevent proper compaction.

C. Select backfill material: Select backfill material shall be Type I-13. Soil aggregate select backfill materials, when designated, shall conform to Section 901.09 of the Standard Specifications.

D. Broken stone material:

1. Broken stone subbase material under slabs, foundations and structures shall conform to Section 901.04 of the Standard Specifications, and meeting the gradations specified in Table 901-1. Size shall be #57.
2. Trench stabilization material for bedding shall conform to the above requirements. Size shall be #57.

E. Other materials: All other materials, not specifically described but required for a complete and proper installation shall be as selected by the Contractor and approved by the ENGINEER.

5.3 METHODS OF CONSTRUCTION

A. Requirements of regulatory agencies:

1. All excavations shall be in compliance with Federal Occupational Safety and Health Act (OSHA) and Rules and Regulations of the State of New Jersey Department of Labor and Industry, Bureau of Engineering and Safety, N.J.A.C. 12:180. Failure to comply may result in a cease and desist order for that portion of work.
2. Excavation work shall be in compliance with applicable requirements of other governing authorities having jurisdiction.

B. Reference standards included in this specification section:

1. New Jersey State Highway Department Standard Specifications for Road and Bridge Construction, 1983 (Standard Specifications).
 - a. Section 901.03: Aggregate, Coarse
 - b. Section 901.04: Broken Stone
 - c. Section 901.09: Soil Aggregate
2. American Society for Testing and Materials (ASTM):
 - a. D-1556: Density of Soil in Place by the Sand-Cone Method.

- b. D-1557: Moisture Density Relations of Soils and Soil Aggregate Mixtures Using 10-lb. Rammer and 18-inch Drop.
 - c. D-2049: Relative Density of Cohesionless Soils.
 - d. D-2922: Density of Soil and Soil Aggregate In-Place by Nuclear Methods (Shallow Depth).
- C. Submittals: Pursuant to Section 2.0 of the General Specifications, Product Data.
- D. Test reports:

When directed by the ENGINEER, submit test reports on all select backfill material in accordance with the following standards:

Particle Size Analysis of Soils: ASTM D-422.
- E. Job Conditions:
 - 1. Existing utilities: Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult the utility owner immediately for directions. Cooperate with owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.
 - 2. Do not interrupt existing utilities serving facilities occupied and used by Owner or others, except when permitted in writing by the ENGINEER and then only after acceptable temporary utility services have been provided.
- F. Use of explosives: The use of explosives is not permitted unless approved by the ENGINEER.
- G. Protection of persons and property:
 - 1. Barricade open excavations occurring as part of this work and post with warning lights as required to protect persons on site. Operate warning lights as recommended by authorities having jurisdiction.
 - 2. Protect trees, shrubs, lawns and other features remaining as part of final landscaping.

3. Protect structures, utilities, sidewalks, pavements and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.
 4. In the event of damage, immediately make all repairs and replacements to the approval of the ENGINEER at no cost to the Owner.
- H. Dust control: Use all means necessary to control dust on and near the work if such dust is caused by the Contractor's operations during performance of the work or if resulting from the conditions in which the Contractor leave the site.
- I. Weather conditions: Do not place, spread, roll or fill materials during freezing, raining or otherwise unfavorable weather conditions. Do not resume work until conditions are favorable as determined by the ENGINEER.
- J. Inspection by Contractor: Examine the areas and conditions under which trenching, backfilling, compacting and grading are to be performance and notify the ENGINEER in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner.
- K. Preparation:
1. Prior to commencement of work, forty-eight (48) hour notification shall be given to the OWNER'S water and sewer department.
 2. Prior to commencement of work, establish location and extent of all utilities in the work areas. Maintain, protect as required existing utilities which pass through the work area.
 3. Prior to excavation in pavement areas, cut existing pavement vertically with sharp tool on a straight line to the limits of excavation shown on the Plans or as directed by the ENGINEER. Maintain cut straight and neat, or recut and dress as directed by the ENGINEER.

L. Lines and depth:

1. Trenches shall be excavated along the lines and at a depth necessary for laying the pipe to the grade given, as designated by the ENGINEER. Excavation shall not be carried below the required level except where unstable soil is encountered. Whenever excavation has been made below the required level, it shall be replaced with 3/4 inch crushed stone and shall be thoroughly tamped. The ENGINEER shall determine the depth of removal of unstable soil encountered.
2. Excavation for manholes and other structures shall have a twelve-inch (12") minimum clearance and twenty-four inch (24") maximum clearance on all sides. The width of trenches for pipe shall equal pipe outside diameter plus two feet (2') unless otherwise provided by the ENGINEER. Excavations shall be confined within the narrowest possible limit and made as nearly as possible in a vertical line, and any sheathing, shoring, bracing and timbering which is necessary to obtain this result shall be done as hereinafter specified.
3. Preliminary excavation shall be made only to a depth of three inches (3") above the final depth of any trench or other excavations. The remaining depth shall be carefully excavated, shaped, and formed with hand tools immediately preceding laying of pipe or placing concrete. Trench bottoms shall be accurately formed to receive and support the bottom of the barrel of the pipe. Additional excavation shall be made in pipe trenches at the pipe joints and to prevent any possibility of a pipe resting on the bell rather than the barrel.
4. In rock, the bottom shall be excavated six inches (6") below the normal support grade and refilled with compacted granular material.

M. Materials excavated:

1. The materials excavated shall be stored compactly on the side of the trench and kept trimmed to be of as little inconvenience as possible to travel and adjoining properties. All streets shall be kept open for travel unless otherwise directed by the ENGINEER. All bituminous gravel, stone surface, gravel base course and topsoil shall be kept separate from other excavated materials and shall be used as the final layer in the backfill operation where appropriate.

2. Before excavating any existing surface, topsoil shall be stripped to a minimum depth of six inches (6") and stored for reuse as final grade where planting is proposed.
3. The Contractor shall not remove from the site any sand, gravel or other soil excavated from the trench which may be suitable for backfilling until backfilling is completed.
4. Surplus material remaining after the proper backfilling of trenches shall be used to fill in low areas or where shown on the profiles. Other surplus materials shall be transported and placed by the Contractor, at his expense, at a location within the Township as determined by the ENGINEER.

N. Removal of water:

1. The Contractor shall at all times provide and maintain ample means and devices to promptly remove and disperse all water or sewage entering excavations and structures dry until all work therein is completed.
2. The Contractor shall dispose of the water from the trenches and excavations in a manner satisfactory to the Owner, Developer and/or OWNER inspector, without damage to adjacent property. In no case, shall water or sewage be allowed to enter new lines. Sewage shall not be discharged onto the ground, nor into the storm water system.
3. If groundwater and subsoil conditions along the line of the work are such that the Contractor cannot successfully remove water or provide a stable trench by ordinary trench pumping and bailing, or when necessary to protect the work, workmen, public, under or above ground utilities and structures, pavements and public and private property, the Contractor shall, where designed by the ENGINEER, furnish and provide the necessary equipment, power and labor to employ the well point method of trench dewatering. The well point system or portions thereof shall be removed by the Contractor upon the completion of backfill, and the holes remaining from the points shall be backfilled and thoroughly tamped.

O. Shoring and sheathing:

1. The Contractor shall be responsible for the installation of shoring and sheathing on all faces of the excavation where it is necessary: to insure a suitable, dry, and/or safe excavation, to eliminate settlement of, or damage to structures or items adjacent to the excavation, to preserve the bearing capacity of the soil, to keep the excavation within the narrowest possible limits, to protect work from damage, and to provide conditions acceptable to the ENGINEER and all interested agencies.
2. Bracing shall be installed so that there is no stress on or displacement of any part of the completed work until the construction thereof has proceeded far enough to provide the necessary strength, as determined by the ENGINEER.
3. Any damage to pipelines, road structures, etc., occurring through settlement, soil pressure, cave-ins, shift of sheathing, or any other causes associated with the Contractor's activities, shall be repaired or the damage items replaced by the Contractor without cost thereof to the OWNER.

P. Backfill and compaction:

1. After each joint has been made, inspected, and approved, backfill shall proceed immediately. The space between the pipe and the bottom sides of the trench shall be backfilled by hand and thoroughly tamped with a light tamper. Fill shall be placed uniformly on both sides of the pipe in six-inch (6") layers using the material obtained from on-site excavating, except use select backfill material where indicated on the Plans or as directed by the OWNER'S inspector.
2. Backfill to a height of two feet (2') above the top of the pipe with earth free from stones, rock fragments, dirt clods or frozen material greater than two inches (2") in largest diameter, and thoroughly tamped.
3. The remainder of the trench shall be backfilled in twelve-inch (12") layers, loose measure, each layer thoroughly tamped. Dampening of the material to be tamped may be required by the ENGINEER.

4. In light soils such as sand, loam, or light gravel, the trench may be backfilled carefully with a front-end loader at a maximum rate of one cubic yard per load. Each load shall be placed immediately on the previous load.
5. Backfilling prior to approvals:
 - a. Any of the work enclosed or covered up before it has been approved will be considered unacceptable.
 - b. The Contractor shall, at his own expense, uncover all such work for inspection and approval prior to backfilling.

6.0 CONCRETE ENCASEMENT

6.1 DESCRIPTION

Provide concrete encasement at locations described herein, or as directed by the ENGINEER.

6.2 MATERIALS

A. Concrete:

1. Use concrete developing a minimum compressive strength of 4,000 psi at twenty-eight (28) days.
2. Use air-entrained concrete.

B. Cement, aggregates, water and air entrainment methods and materials: Section 914 of the Standard Specifications.

6.3 METHODS OF CONSTRUCTION

A. Reference standards included in this specification section:

New Jersey State Highway Department Standard Specifications for Road and Bridge Construction, 1989 (Standard Specifications):

1. Section 914: Portland Cement, Mortar and Grout Concrete
2. Section 501: Concrete Structures

B. Submittals: Pursuant to Section 2.0 of the General Specifications, Product Data.

C. Certificates: All deliveries of concrete shall be accompanied by delivery slips, copies of which shall be provided to ENGINEER by Contractor.

D. Location:

1. Notify the ENGINEER when the following conditions are encountered. Subject to the ENGINEER'S approval, concrete encasement shall be provided at these locations. All materials, methods and equipment shall be subject to the approval of the ENGINEER.

- a. At all locations where a proposed sanitary sewer main is located closer than ten feet (10') to a water main (measured horizontally).
 - b. At all crossings of sanitary sewer lines and water lines where the vertical separation is less than eighteen inches (18").
 - c. At all crossings of sanitary sewer mains and water mains where the sanitary sewer main is located above the water main.
 - d. All other locations where the vertical or horizontal separation between proposed and existing utility pipes are less than twelve inches (12").
2. Concrete encasement shall conform to the standard engineering drawings. When a situation is encountered for which there is no detail, concrete encasement shall conform to the following requirements or as otherwise approved by the ENGINEER.
- a. Minimum thickness: Six inches (6")
 - b. Length: At utility crossings, extend concrete encasement a minimum of ten feet (10') on both sides of the centerline of the crossing. At all other locations, extend concrete encasement until the allowable vertical or horizontal separation between utility pipes is achieved.
 - c. All ductile iron pipe and fittings shall be wrapped in visquene where concrete encasement is used.

E. Performance:

The method of construction for concrete encasement shall conform to Section 501 of the Standard Specifications except as modified by the Supplemental Requirements below:

Earth cuts may be used as forms provided the horizontal and vertical earth surfaces can be shaped to the proper dimensions.

7.0 AS-BUILT DRAWINGS - MINIMUM REQUIREMENTS

7.1 GENERAL

- A. This specification defines the minimum requirements imposed on the Contractor when submitting as-built drawings of water, sewer or force mains and pumping stations.
- B. Each submittal shall be transmitted to the OWNER and the ENGINEER.
- C. Receipt of as-built drawings in accordance with this section is a requirement of the performance bond release.

7.2 SUBMITTAL REQUIREMENTS

A. MINIMUM AS-BUILT REQUIREMENTS

The applicant shall provide three (3) sets of as-built plans conforming to these "Minimum As-built Requirements".

The as-built plan should include both the proposed information (crossed out where it has changed, but remaining legible) and the as-built information shown clearly and underlined.

The applicant must also provide a disk or CD in AutoCAD format of the submitted plans. The plans must be submitted on a 24" x 36" sheet and at a scale of 1" = 100'. All text must be drawn clearly, and at a minimum size of 0.07" and a maximum size of 0.10".

The following information, where applicable, shall each be drawn on its own individual layer:

- Water mains.
- Water services/curb stops.
- Hydrants/valves/blowoffs, etc.
- Water main text.
- Sanitary sewer mains.
- Sanitary sewer laterals/cleanouts.
- Sanitary sewer manholes.

- Sanitary sewer text.

The plans must include that portion of the existing systems where the proposed system connects.

The plans must be signed and sealed by a New Jersey licensed land surveyor.

All elevations must be on the 1929 datum (a.k.a. NGVD 29, NJGCS, USGCS and USC & G datum).

As a minimum, the following survey information is required: depicting all proposed facilities and as-built information.

1. **Water Mains**

- a. Pipe lengths between bends.
- b. Pipe diameter and pipe material.
- c. All bend angles.
- d. The lid and top of nut elevation for all water valves.
- e. All hydrants and valves.
- f. All valve sizes shall be shown and valves and blowoffs shall be located using three (3) tie-down dimensions (i.e., measurement from a permanent object; catch basin, manhole, hydrant, edge of pavement, etc.).
- g. All curb stops for water service. Provide a station from the nearest downstream manhole to each curb stop and provide an offset from the curb to each curb stop. If this cannot be accomplished, then tie down similar to valve location method. Each curb stop shall be clearly identified denoting the townhouse, condominium, house, office, store, etc. that it services.
- h. All concrete cradles and encasements.
- i. Location of all easements and location of utility within that easement. The as-built pipe length between bends.

- j. All the above information shall be shown on a plan drawing.

2. **Sewer Mains**

- a. As-built manhole rim and invert elevations and invert elevation of all pipes penetrating the manhole.
- b. As-built pipe diameter, pipe material, pipe lengths (measured from manhole centerline to manhole centerline), pipe slope and flow direction arrows.
- c. All cleanouts for sewer laterals. Provide a station from the nearest downstream manhole to each lateral or cleanout. Provide an offset from the main to each cleanout.
- d. Any lateral left for a future connection shall have the pipe cover and three (3) tie-down dimensions taken at the end of the lateral (i.e., measurements from a permanent object; corner of house, catch basin, manhole, hydrant, edge of pavement, etc.).
- e. All as-built concrete encasements and concrete cradles shall be noted.
- f. Location of all easements and location of utility within that easement. Provide a minimum of two (2) tie dimensions from the utility to the easement line. A tie dimension shall be provided for all changes in direction and bens with stationing.
- g. All the above information shall be shown on a plan drawing.

3. **Force Mains**

- a. Locate the force main using tie dimensions from the face of curb/edge of paving to the force main. A tie dimension shall also be provided for all changes in direction and bends with stations from nearest manhole.

- b. Location of all easements and location of utility within that easement. Provide a minimum of two (2) tie dimensions from the utility to the easement line. A tie dimension shall be provided for all changes in direction and bends with stationing.
- c. The as-built pipe length between bends.
- d. Approximate elevations at each bend and high point.
- e. As-built pipe diameter and pipe material.
- f. Manufacturer's data on air relief valves, gauges, and all valves.
- g. Location of all easements and location of utility within that easement. Provide a minimum of two (2) tie dimensions from the utility to the easement line. A tie dimension shall be provided for all changes in direction and bends with stationing.
- h. All the above information shall be shown on plan drawing.

4. **Pumping Stations**

- a. As-built plans shall be submitted and should include both the proposed information (crossed out where changed, but remaining legible) and the as-built information shown clearly. Show all valves, curb stops, yard hydrants, underground sewer manholes, wet well, dry well elevations and water piping, gates, etc. All valves and curb stops must be tied down as described above for water valves.
- b. Ten (10) copies of manufacturer's operation and maintenance information shall be submitted for all installed equipment.
- c. All the above information shall be shown on plan drawing.

SECTION II

WATER DISTRIBUTION SYSTEMS SPECIFICATIONS

1.0 GENERAL

1.1 MISCELLANEOUS CONSTRUCTION NOTES

- A. Water mains shall be laid in straight lines except when otherwise specifically approved by drawings or directed by the OWNER's INSPECTOR. When deviation from a straight line is permitted, the deflection of each joint shall not exceed the manufacturer's recommended maximum for the type of joint and size of pipe being installed. Pipe shall be laid with at least three and one-half feet (3½') of cover over the pipe to proposed finished grade or to the future finished grade when such is lower. Along extensions of roads which are unimproved, the pipe shall be laid with at least five feet (5') of cover over the top of the pipe to the existing grade. The depth of pipe may be increased locally to pass obstructions. Grade changes shall be accomplished by fittings and/or dividing the necessary deflection among several joints as approved by the inspector.
- B. Special care shall be exercised to remove all dirt, stones and other materials from each pipe as it is laid, and to prevent any such materials from entering the pipeline. The Contractor shall see that the entire line is maintained absolutely clean on the inside and that all valves and hydrants are clean and in good working order when installed. Open ends shall be adequately protected at all times and shall be securely sealed with approved plugs whenever work is stopped for any reason whatsoever. After removing a plug, the interior of the pipeline shall be inspected and cleaned before resuming pipe-laying operations.
- C. Before placing each length of pipe, the Contractor shall carefully examine it for breaks, cracks or other defects and shall discard any section which appear in any work to be defective. All pipe and fittings shall be handled and installed with care to avoid damage.
- D. Each section of pipe shall be solidly bedded in the trench bottom and shall be supported for its full length.
- E. Before making a connection, the ends of the pipes and all joint members shall be thoroughly cleaned of loose excess coating and lumps. All mating shall be done in strict accordance with the manufacturer's recommendations and the requirements of the ENGINEER.

- F. The Contractor shall do all necessary pipe cutting and shall locate valves, fittings and fire hydrants in the exact positions indicated on approved drawings. He shall provide and use cutting tools of an approved type and in good order, so as to insure clean, square cuts to exact measurements.
- G. When and if required and/or necessary, all commercial, industrial or institutional meter pits shall be approved by the OWNER. It should be noted that the OWNER requires that all meters be installed inside a building; therefore this section shall apply for extenuating circumstances at the discretion of the OWNER. The pits, as a minimum, shall meet the following requirements:
1. Waterproof
 2. Frost proof
 3. Construct with sump
 4. Constructed with conduit in place for installation of sump pump is required by the OWNER.
 5. The minimum clearance from shutoff valves to end of pit shall be twelve inches (12").
 6. The minimum sidewall clearance shall be twenty-four inches (24").
 7. Hinged, locking access hatch shall be provided for the entire length and width of pit. The hatch shall be constructed of aluminum and withstand a loading of 500 lbs./S.F. The hatch shall be a minimum of thirty-two inch (32") diameter clear opening, as manufactured by Bilco or an approved equal. All hatches shall be provided with a ladder up.

H. WATER METERS AND CURB BOXES

1. All meters shall be placed indoors in a utility area.
2. The OWNER must have one (1) additional day notice for setting the meter. When calling in a request for service, provide the following information:
 - a. Meter location (address)
 - b. Permit number

3. The plumber will have installed the required size adapters and spuds, leaving space as required for the meters.
4. The meters are to be uniformly set. Water services will include a curb stop and box at the curb line, a valve on either side of the meter for isolating purposes and a backflow preventer.
5. The OWNER expects all lines to be protected from inclement weather. The water valve at the curb is to be shut off until OWNER personnel determine the line can become active.
6. All water meters installed inside buildings shall be located in a heated area. The meter shall be installed, with the following minimum clearances: four inches (4") free space from any wall, eight inches (8") from the floor. The meter face should be easily seen and must have eighteen inches (18") of free area above. This shall include the required isolation valves and fittings.
7. Curb box shall be placed in an area between customer's sidewalk and curb. Distance from curb shall be eighteen (18") inches. Box lid shall be above finished grade, chimney shall be in line with valve head. For those areas without curbing, curb boxes shall be placed eighteen (18") inches behind sidewalk. Valves will be buried at a minimum of three feet (3') and a maximum of five feet (5').
8. Tapping inspections shall take place during normal business hours Monday thru Friday. Forty-eight (48) hours notice shall be given.
9. No utility valves shall be installed under or in concrete.
10. Meters are to be placed only in utility areas. The OWNER shall not be responsible for damages caused by leaking meters if this requirement is not followed.

I. FIRE SERVICE METERS

1. Commercial: All commercial fire services for fire sprinklers or fire service connections require installation of a backflow preventer in accordance with N.J.A.C. 7:10, Subchapter 10.

The fire service meter shall be installed inside the building and shall be provided by the building owner.

- J. Water and sewer mains shall be separated a distance of at least ten feet (10') horizontally. If such lateral separation is not possible, the pipes shall be in separate trenches with the sewer at least eighteen inches (18") below the bottom of the water main; or such other separation as approved by the OWNER shall be made. In general, the vertical separation at a crossing of water and sewer line shall be at least eighteen inches (18"). Where this is not possible, the sewer shall be constructed of ductile iron pipe using mechanical or slip-on joints for a distance of at least ten feet (10') on either side of the crossing or other suitable protection shall be provided, such as concrete encasement of the sanitary sewer for ten feet (10') either side of the water pipe. This encasement is to be six inches (6") thick.
- K. An approved blowoff or fire hydrant shall be installed at the end(s) of all water line dead ends. Location shall be subject to approval prior to installation.

1.2 PRIOR TO CONSTRUCTION

Prior to starting construction of any water mains within the OWNER service area, the Developer or Owner must have in his possession a set of OWNER approved drawings. In addition, he must have paid all the necessary charges and fees as well as obtaining the necessary bonding. When easements are necessary, all paperwork must be in order; and if Road Opening Permits are required, these must also be obtained before work can start.

2.0 DUCTILE IRON PIPE AND FITTINGS

2.1 DESCRIPTION

- A. Provide cement lined ductile iron pipe for water main.
- B. Pipe sizes shall be eight inch (8") or larger for all areas.

2.2 MATERIALS

A. Proprietary Products:

- 1. References to specified proprietary products are used to establish minimum standards of utility and quality.

B. Manufacturers:

- 1. U. S. Pipe and Foundry Company.
- 2. Griffin Pipe Products Company.
- 3. American Ductile Iron Pipe Company.
- 4. Tyler Pipe.
- 5. Atlantic States Cast Iron Pipe Company.
- 6. McWane Cast Iron Pipe Company.
- 7. Clow Water Systems Company.
- 8. or equal.

C. Pipe:

- 1. Ductile iron conforming to AWWA C151.
- 2. Manufactured in eighteen (18) or twenty (20) foot lengths.
- 3. Thickness/Pressure Class:
 - a. Push-on, Push-on Restrained, or Mechanical Joint:
 - 4" through 12": Pressure Class 350
 - 14" through 24": Pressure Class 250
 - 30" through 64": Pressure Class 150

b. Flanged: Thickness Class 53.

4. Coatings and Linings:

a. All ductile iron pipe and fittings for water service shall be cement-lined in accordance with ANSI/AWWA C104/A21.4 and seal coated inside minimum 1/8" thick.

b. All ductile iron pipe and fittings for sanitary and other services shall not be cement lined but shall be coated inside with bituminous material at least 1 mil. thick which conforms to the requirements for seal coat in accordance with ANSI/AWWA C104/A21.4 latest revision.

c. Coatings shall be free of runs, drips, sags and excessive material.

d. External coatings:

(1) Piping to be buried or installed in valve pits shall be coated on the outside with bituminous material at least 1 mil thick conforming to the requirements for seal coat in accordance with ANSI/AWWA C104/A21.4, latest revision, unless otherwise shown.

(2) Exposed piping and other piping so designated shall be provided without the external bituminous coating specified above and shall be epoxy coated in accordance with a coating system approved by the Township's engineer.

D. Pipe Fittings:

1. Ductile iron fittings shall conform to ANSI/AWWA-C110/A21.10 or ANSI/AWWA-C153/A21.53.

E. Joints for Ductile Iron Pipe and Fittings:

1. Below Grade:

a. Mechanical joints shall be used. Mechanical joints shall conform to the requirements of ANSI/AWWA-C111/A21.11.

- b. All valve and valve connections shall be mechanical joint.
 - 2. Above ground or in vaults or valve pit joints shall be flanged conforming to the requirements of ANSI/AWWA-C115/A21.15 or grooved and shouldered conforming to the requirements of ANSI/AWWA-C606.
- F. Gaskets:
- 1. Gaskets shall conform to ANSI/AWWA-C111/A21.11 for mechanical joints and ANSI/AWWA-C110/A21.10 for flanged joints.
 - 2. Gaskets for flanged joints shall be 1/16" thick, ring gaskets, of rubber with cloth insertion.
 - 3. Gasket lubricants shall be water-soluble and not have deteriorating effects on the pipe or rubber gaskets.
 - 4. Gasket lubricants shall be supplied by pipe manufacturer.
- G. Plugs:
- 1. Flat plugs for mechanical and flanged joints.
- H. Sleeve Couplings:
- 1. Except as otherwise specified or shown on the plans, all sleeve couplings for connecting ductile iron pipe shall be Smith-Blair 441 standard sleeve straight cast couplings as manufactured by Smith-Blair, Incorporated, or equivalent. Bolts and nuts shall be stainless steel.
 - 2. Couplings shall have ductile iron sleeves and flanges. Gaskets shall be of specially compounded natural rubber, and shall have a wedge type design and large cross sectional area. Bolts and nuts shall be stainless steel.
 - 3. All necessary gaskets, followers, bolts and other appurtenances required for making up flexible joints shall be of the pattern and material recommended by the manufacturer for the conditions or service to be encountered.

- I. Joint Harness: Studs for harnessed joints shall conform to the requirements of ASTM A193, Grade B-7, or equivalent. Plate lugs shall conform to ASTM A283, Grade B, or ASTM A285, Grade C, or equivalent.

- J. Joint Restraint Devices:
 - 1. Mechanical joint restraint devices shall be Model F-1058 Ductile Iron Retainer Gland as manufactured by Clow Corporation or equivalent by Ebba Iron, Uniflange or others, and shall be installed in accordance with manufacturer's printed instructions.

- K. Thrust Blocks: Concrete for thrust blocks shall be not less than 3,000 psi, air entrained and conform to ASTM C-94.

- L. Tapping Sleeves:
 - 1. Tapping sleeves shall be of a full sleeve type capable of containing pressure within the full volume of the sleeve. Sleeve shall be mechanical joint suitable for use with Class AB or CD cast iron pipe or ductile iron pipe.
 - 2. Sleeve shall be rated at 200-psi water working pressure through twelve-inch (12") size and 150 psi for sleeves fourteen inch (14") through twenty-four inch (24").
 - 3. All cast iron shall conform to ASTM-A-126, Class B. Castings shall be cleaned and sound without defects that will impair their service. No plugging or welding of such defects will be allowed. Bolts, nuts and gaskets shall be in accordance with mechanical joint requirements of AWWA C-111.
 - 4. Tapping sleeves shall be capable of withstanding their rated working pressure without leakage past the side gaskets and end gaskets of the sleeve. Sleeves shall be supplied with split end gaskets and two-piece glands. Side flange rubber gaskets shall butt against the rubber end gaskets affecting a totally watertight seal. Side and end bolts shall be of a T-head design. The throat flange shall be so designed as to afford centering of the tapping valve to the sleeve. Tapping sleeve shall be equipped with a test plug.
 - 5. Inside and outside of all tapping sleeves shall be coated in accordance with AWWA standards.

6. Sleeves shall be marked with name of manufacturer and size (run x branch).

2.3 METHODS OF CONSTRUCTION

A. Submittals:

1. All pipe and fittings shall be inspected and tested at place of manufacture as required by the AWWA standards referenced in this specification. Provide ENGINEER with two (2) copies of certifications from each manufacturer stating the product was inspected as required, and that the test results comply with the AWWA standards.
2. Submit manufacturer's product data for pipe, fittings, and gaskets as specified in section entitled, "Product Data".
3. All manufacturers shall validate other than by certification, the ductility of each length of pipe by an underwriters Laboratory approved method. All ductile iron pipe is to have Underwriters Laboratory approval.

B. Inspection and quality of pipe:

1. Before being lowered into the trench, each pipe shall be carefully inspected by the OWNER and ENGINEER, and those not meeting the specifications shall be rejected and either destroyed or removed from the work within ten (10) hours. No pipe shall be laid except in the presence of the ENGINEER or his authorized inspector. The ENGINEER or OWNER may order the removal and relaying of any pipe not so laid.
2. In addition to the inspection made by the ENGINEER, the Contractor shall carefully examine all pipe and special castings before placing the same in the trench. Any pieces which are broken or show evidence of cracks or fractures shall be rejected by him. Such inspection shall carry with it the responsibility on the part of the Contractor for the removal at his own expense of all pipe, special castings, and appurtenances, incorporated in the work, and which under test are found to be cracked or otherwise defective.

3. Contractor shall also inspect all pipe and fittings for loose, excess seal coating (and lumps) which may dislodge during service and clog fixtures. All such loose material shall be removed from the pipe or fitting prior to placement into service without damaging the integrity of the coating.

C. Installation of pipe and fittings:

1. Excavation and backfill for pipes shall conform to the specification entitled, "Trench Excavating, Backfilling and Compacting".
2. All piping shall be installed in a neat and workmanlike manner. All piping shall be installed to accurate lines and grades and shall be supported as shown, specified, or necessary. Where temporary supports are used, they shall be sufficiently rigid to prevent shifting or distortion of the pipe. Suitable provision shall be made for expansion where necessary.
3. No defective pipe or fitting shall be laid or placed in the piping, and any piece discovered to be defective after having been laid shall be removed and replaced by a sound and satisfactory piece by the Contractor at his own expense.
4. Every pipe and fitting shall be cleared of all dirt and other debris before being installed and shall be kept clean until accepted in the completed work.
5. No pipes shall be laid in fill or other unstable material, in wet trench, or in same trench with another pipe or other utility. A minimum eighteen-inch (18") clearance shall be maintained between the outside surface of pipe and outside surface of other existing pipes and structures. When this clearance cannot be maintained, contact the ENGINEER for instructions prior to proceeding with the pipe installation.
6. No direct contact between pipes and structures at crossings will be permitted. Pipes in place shall not be worked over or walked on until covered by layers of earth well tamped in place to a depth of twelve inches (12") over the pipe.
7. Minimum cover over water mains shall be three and one-half feet (3½').

8. The interior of all pipes shall be thoroughly cleaned of all foreign material before being lowered into trench. Pipes shall be kept clean during laying operations by means of plugs or other approved methods.
- D. Piping supports: The Contractor shall furnish and install all supports necessary to hold the piping and appurtenances in firm, substantial manner at the lines and grades indicated. Where required, bends, tees, and other fittings buried in the ground shall be backed up with concrete placed against undisturbed earth where firm support can be obtained. If the soil does not provide firm support, then suitable bridle rods, clamps, and accessories to brace the fitting properly shall be provided. Such bridle rods, etc., shall be coated thoroughly with an approved bituminous paint after assembly, or, if necessary, before assembly. This work shall include bracing plugs to prevent leakage or blowout during testing.
- E. Handling and cutting pipe: Every care shall be taken in the handling and laying of pipe and fittings to avoid damage to the pipe, scratching or marring machined surfaces, and abrasion of the coating or lining. Pipe cuts shall be made using an abrasive wheel, rotary wheel cutter, guillotine pipe saw, milling wheel saw, oxyacetylene torch or other method approved by the ENGINEER. Grind cut ends and rough edges smooth. For push-on connections, bevel all cut ends.
- F. Assembling pipe:
 1. Mechanical Joints:
 - a. Clean ring groove and bell socket prior to inserting rubber gasket seal. Properly seat gasket; make sure it faces proper direction.
 - b. Clean and lubricate spigot end of pipe. Lubricate spigot end of pipe and rubber gasket.
 - c. Hold pipe securely and in proper alignment when joining.
 - d. Join pipe so that reference mark on spigot end, if provided by manufacturer, is flush with end of bell.
 - e. Join pipe in strict accordance with manufacturer's printed installation procedures.

2. Flanged Joints:

- a. Flange faces shall be clean and free of all debris and foreign material.
- b. Flange faces shall bear uniformly on gasket, and bolts shall be tightened uniformly.

G. Protection of work:

1. Great care shall be exercised in the protection of finished work. Joints once made and disturbed shall be subjected to immediate rejection. It shall therefore be the duty of the Contractor to avoid the slightest movement in completed work, while in the act of laying the pipe, in backfilling, or in the passage of workmen up and down the trench. At all times during which pipe is not laid, the end of the pipe shall be sealed with a tight fitting plug. In no case will the drainage of trench water through a completed pipe be permitted.
2. All curves, bends, tees, hydrants or ends of pipe shall be securely blocked with socket clamps or yokes to prevent movement. At the end of line or turn, where provision has been made for future extension or connection, fittings shall be furnished with lugs and anchored by means of socket clamps or yokes.

H. Adapters: When it is necessary to join pipes of different types the Contractor shall furnish and install the necessary adapters. Adapters shall have ends conforming to the above specifications for the appropriate type of joint to receive the adjoining pipe. When adapters join two classes of pipe, the bodies may be of the lighter class.

3.0 GATE VALVES AND VALVE BOXES

3.1 DESCRIPTION

- A. Provide gate valves for proposed water main. Valves shall be located so that no more than one-fifth (1/5) of a mile of water main would be affected by a single water main break
- B. No less than three (3) valves shall be provided for each T-connection, one (1) on each side of the connection. No less than four (4) valves shall be provided for each cross-connection, one on each side of the connection.

3.2 DELIVERY STORAGE AND HANDLING

- A. Prepare valves and accessories for shipment according to AWWA C500, Section 31, and:
 - 1. Seal valve ends to prevent entry of foreign matter into valve body.
 - 2. Box, crate, completely enclose, and protect valves and accessories from accumulations of foreign matter.
- B. Store valves and accessories in area protected from weather, moisture, or possible damage.
- C. Do not store materials directly on ground.
- D. Handle items to prevent damage to interior or exterior surfaces.

3.3 MATERIALS

- A. Proprietary products:
 - 1. References to specified proprietary products are used to establish minimum standards of utility and quality.
- B. Valves:
 - 1. Valves installed below the ground shall have mechanical joint end connections and shall be furnished and installed with a suitable valve box and ground level position indicator.
 - 2. Valves installed above ground shall have flanged ends conforming to the 125-lb. American Standard unless otherwise indicated and have position indicators and actuators as shown or required.

3. Contact-surface-to-contact-surface dimensions shall conform to the ANSI Standard Face-to-Face dimensions of Ferrous Flanged and Welding End Valves, ANSI B16-10.
4. Valves shall have clear waterway equal to the full nominal diameter of the valve unless otherwise specified.
5. Each valve shall have maker's name, pressure rating and year in which manufactured cast on body.
6. Prior to shipment from the factory, each valve shall be tested by hydrostatic pressure equal to 400 psi in sizes twelve inch (12") and smaller, and 300 psi in sizes fourteen inch (14") and larger.
7. Coatings:
 - a. All valves shall be coated on the interior and exterior in accordance with AWWA C550.
 - b. Products containing coal tar shall not be used.
 - c. Coatings used for potable water service shall be NSF approved.
8. All valves shall open to the left or counterclockwise. Any wrong hand valves shall be removed and replaced by the contractor at his own expense.

C. Manufacturers:

1. Clow Valve Corporation
Oskaloosa, Iowa
(515) 673-8611
2. M & H Valve Co.
Anniston, Alabama
(205) 237-3521
3. American-Darling Valve
Birmingham, Alabama
(205) 325-7856

4. Mueller Co.
Decatur, Illinois
(217) 423-4471
5. Kennedy Valve Co.
Elmira, New York
(607) 734-2211
6. Waterous Co.
South St. Paul, Minnesota
(612) 450-5000
7. U. S. Pipe & Foundry
Burlington, New Jersey
(609) 387-6147

3.4 GATE VALVE, THREE INCH (3") AND LARGER

- A. Iron body, resilient seated, NRS conforming to AWWA C509.
- B. "O"-ring stem seals field replaceable under full pressure.
- C. Gate valves sixteen inch (16") or larger shall be supplied with a three-inch (3") bypass and bypass valve.
- D. No valve shall be set under sidewalks except where so noted on the detail drawings.

3.5 VALVE BOXES

- A. Buffalo type, cast iron, two (2) piece with 5¼" shaft and cover marked "WATER". (NOTE: For fire services the cover shall be marked "FIRE SERVICE".)
- B. Two (2) "T" handle socket wrenches of 5/8" round stock and long enough to extend two feet (2') above ground surface from the deepest valve shall be provided for each size of buried valve furnished.
- C. The valve box shall not transmit shock or stress to the valve.
- D. Acceptable manufacturers:
 1. Bingham & Taylor
 2. Tyler
 3. Clow

4. or equal.

3.6 CLEANOUTS

Large diameter gate valve shall be fitted with cleanouts on one side of the valve body. Cleanouts shall be of the hand hole type and, where required for valves with the stem in the horizontal position, shall be provided on the bottom of the valve body.

3.7 POSITION INDICATORS

- A. All valves shall be equipped with position indicators.
- B. Buried valves shall be equipped with ground level position indicators.
- C. Acceptable manufacturers:
 1. Henry Pratt (Diviner)
 2. Val-Matic
 3. Clow
 4. M & H
 5. or equal.

3.8 METHODS OF INSTALLATION

- A. Submittals: Submit manufacturers' product data for valves and valve boxes as specified in General Specification Section 2.0 entitled, "Product Data".
- B. Prior to installation, inspect valves for direction of opening, freedom of operation, tightness of pressure-containing bolting, cleanliness of valve ports and especially seating surfaces, handling damage and cracks. Do not install dirty or defective valves.
- C. Valves shall be set and joined to the pipe in the manner specified in section entitled, "Ductile Iron Pipe and Fittings" for installing and joining ductile iron pipe.

4.0 FIRE HYDRANTS

4.1 DESCRIPTION

Provide fire hydrants for the purpose of fire protection. Hydrants must be placed within 600 feet of each other along road or street lines.

4.2 FIRE MARSHAL

The Florence Township Fire Marshal shall approve all fire hydrant locations and equipment as well as the OWNER. All plans shall be submitted directly to the Fire Marshal and to the OWNER for approval.

4.3 MATERIALS

Hydrants shall be Mueller Super Centurian 250 #A-423, having the following characteristics:

1. Size of hydrant: 5" minimum.
2. Direction to open: Counterclockwise.
3. Size and shape of operating nut: 1½" from point to flat - pentagon.
4. Three-way hose nozzles:

Two, 2½" ID (National Standard) with 7½ threads per inch.

One, 5-3/4" OD, 4½" ID with 4 threads per inch.
5. Internal valve opening: 5¼".
6. Color: Silver with color-coded caps based on tested flow.
7. Depth of bury: 3'-6".
8. Size and type of connection to main: 6" - mechanical joint.

4.4 METHOD OF INSTALLATION

- A. Hydrants are to be located and installed in accordance with Fire Marshal and OWNER approved drawings. The steamer connection will be turned to face the road or street to provide easy access.

- B. The elevation of the hydrant will be such that the bottom of the steamer connection will not be less than eighteen inches (18") from the finished grade or top of curb.
- C. A stone sump two feet (2') in length, width, and depth will be installed under each fire hydrant to permit hydrant to drain after each use. (Use 3/4" clean stone.)
- D. A concrete thrust block will be poured behind the "tee" and the hydrant shall be rodded.
- E. Hydrants shall not be located laterally within five (5) feet of any structure which would interfere with connection of hoses to the hydrant.
- F. Water main shall not have more than one (1) fire hydrant on a main that is not looped.
- G. For fire fighting purposes, note the following comparison of pipe capacity:

Size of Pipe Inches	Relative Capacity
=====	=====
6	1.0
8	2.1
10	3.8
12	6.2
14	9.3
16	13.2

5.0 WATER SERVICES

5.1 DESCRIPTION

Provide water service lines, corporation stops, curb valves and boxes, backflow prevention, meter isolation valves, and accessories.

5.2 MATERIALS

A. Proprietary Products:

1. References to specified proprietary products are used to establish minimum standards of utility and quality.

B. Acceptable Manufacturers:

1. Mueller Company
Decatur, Illinois
2. Ford Meter Box Company
Wabash, Indiana
3. Materials shall be the product of a single manufacturer.

C. Curb Valve: Mueller ball curb valve with copper flare fittings, Catalog No. B-25204.

D. Curb Box: Cast iron, improved extension type, arch pattern; Mueller Catalog No. H-10314.

1. Box Length: Order to meet project conditions.

E. Shutoff Rods: Steel; Mueller Catalog No. H-10322.

1. Furnish one (1) rod per curb box.
2. Length: Order to meet project conditions.

F. Corporation Stop: Ball Corporation, Mueller B-25000 with flared fittings, or approved equal.

G. Service Clamps

1. Service clamps shall be extra wide strap or double strap type with stainless steel straps. Only to be used with approval of the OWNER.
2. Approved manufacturers:
 - a. Dresser Style 194.
 - b. McDonald Model 3801.
 - c. Rockwell #313, 342, 352.
 - d. JCM #403, 404, 406.
 - e. or equal.

H. Piping:

1. Copper:
 - a. Seamless Copper Water Tube: ASTM-B88, Type K, annealed, straight or in coils.
 - b. Fittings: Cast bronze fittings for flared copper tubes: ANSI-B16.26.
2. IPS to PVC adapters: Use threaded male adapter as supplied by pipe manufacturer and approved by the ENGINEER.

I. Water Meters:

Cast bronze; Neptune T-10 with R900V3 remote read encoder.

5.3 METHODS OF CONSTRUCTION

A. Inspection:

1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Verify that the work of this section may be installed in accordance with all pertinent codes and regulations, the original design, and the referenced standards.
3. All work must be inspected by the OWNER or the OWNER's ENGINEER.
4. All taps must be inspected by the OWNER or the OWNER's ENGINEER.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the OWNER or OWNER's ENGINEER.
2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

C. Workmanship:

1. Examine pipe, fittings, curb boxes and valves before installation to assure no defective materials are incorporated.
2. Keep inside of pipe fittings, boxes and valves free of dirt and debris.

D. Placement:

1. Lay piping on firm bed for entire length of trench except where supports are otherwise provided.
2. Employ partial backfilling and cradling to hold pipe in secure position during backfilling operations.
3. Backfill evenly on both sides of pipe to maintain alignment.
4. Anchor piping laid on grade prior to embedment in concrete.

E. Bending Pipe:

1. Bend pipe by any method and to any radius within manufacturer's recommendation.
2. Only bend surface free of cracks and buckles.

F. Flared Joints:

1. Ream or file pipe to remove burrs.
2. Slip fitting over tube end to be flared.
3. Expand end of tube using flaring tool.
4. Tighten joint fitting.

G. Curb Valves and Boxes:

1. Install curb valves and boxes in accordance with the manufacturer's printed instructions and in a manner to allow proper operation of the valve. Assure that valves are installed in the proper direction and that boxes are installed plumb.

6.0 TAPPING SLEEVES AND CROSSES

6.1 DESCRIPTION

Provide tapping sleeves or crosses (and valves) for connections to existing water mains.

6.2 MATERIALS

A. Acceptable manufacturers:

1. The products of Mueller Company, Decatur, Illinois, as specified in the following paragraphs are used to establish standards of quality. Other manufacturers' materials may be used provided they are approved as an equivalent product.
2. Materials shall be the product of a single manufacturer.

B. Tapping sleeve: H-615 or 619 as indicated on the standard details.

C. Tapping cross: H-715 or 719 as indicated on the standard details.

D. Other materials: All other materials, not specifically described but required for a complete and proper installation of the work of this section, shall be new, first quality of their respective kinds, and as selected by the Contractor subject to the approval of the ENGINEER.

6.3 METHODS OF CONSTRUCTION

A. INSPECTION

1. Examine areas to receive taps for:
 - a. Defects that adversely affect execution and quality of work.
 - b. Deviations beyond allowable tolerances for correct tap seat.
2. Start work only when conditions are satisfactory.

B. INSTALLATION

1. Workmanship:

- a. Examine pipe and sleeves or crosses before installation to assure no defective materials are incorporated.
- b. Keep inside of pipe and tapping materials free of dirt and debris.
- c. All sleeves must be properly disinfected prior to tap.

2. Placement:

- a. Lay sleeves or crosses on firm bed for entire length of fitting except where supports are otherwise provided.
- b. Employ partial backfilling and cradling to hold tap in secure position during backfilling operations.
- c. Backfill evenly on both sides of new tap to maintain alignment.
- d. Provide thrust blocks with plastic barrier as required.

C. TAPPING SLEEVES AND CROSSES:

- 1. Install tapping sleeves and crosses in accordance with the manufacturer's printed instructions and in a manner to allow proper installation of the new main.
- 2. Install tapping sleeves or crosses where new mains are to be connected to existing mains.

7.0 TESTING AND DISINFECTION OF WATER SUPPLY SYSTEMS

7.1 DESCRIPTION

- A. Disinfect water supply system, and test for bacteriological quality and chlorine residual.
- B. Definitions:
 - 1. Water supply system: The water main, water service pipe, water distributing pipes and the necessary connecting pipes, fittings, control valves, pumps, and all appurtenances in or adjacent to the building or premises including wells.
 - 2. Water service pipe: The pipe from the water main or other source of potable water supply to the water distributing system of the building served.
 - 3. Water distributing pipe: A pipe within the building or on the premises which conveys water from the water service pipe to the point of usage.
- C. The existing water supply system shall not be contaminated by allowing water with a high chlorine residual to enter the existing water supply system.

7.2 MATERIALS

Chlorine: High test calcium hypochlorite conforming to AWWA B300 and AWWA C601.

7.3 METHODS OF CONSTRUCTION

- A. Quality assurance: Testing laboratories shall be certified by the State of New Jersey Department of Health.
- B. Requirements of regulatory agencies: Taking and analysis of water samples, and water bacteriologic quality shall conform to the requirements of the New Jersey State Department of Environmental Protection and Energy.
- C. Reference standards applying to this specification section:
 - 1. New Jersey State Department of Environmental Protection: PW-D10 - Potable Water Standards, as amended.

2. American Water Works Association:
 - a. AWWA B300: AWWA Standard for Hypochlorites.
 - b. AWWA C601: AWWA Standard for Disinfecting Water Mains.

D. General: All disinfection procedures to include preventive measures during construction; methods of chlorine application; preliminary and final flushing; testing and procedures to following after cutting into existing water main shall conform to AWWA C601. The method of chlorine application shall be the Tablet Method, except that if trench water or foreign material has entered the main, or if the water temperature is below 41 F, the continuous Feed Method shall be used.

1. Granular chlorine shall be installed in the new water main during installation.
2. Charging/filling of new water mains shall be performed under direct supervision of the Florence Township Water and Sewer Department. Valves and hydrants shall be operated by Florence Township employees only, or under their direct supervision.
3. Once the water main is filled with water, it shall remain undisturbed for a minimum of twenty-four (24) hours prior to flushing.
4. Florence Township employees shall supervise the necessary flushing to attain a chlorine residual <0.50 mg/L.
5. When the desired chlorine level is attained, Florence Township laboratory personnel shall take required bacteriological samples from all hydrants or blowoffs connected to the newly installed water line.
6. Florence Township is responsible for the bacteriological testing.
7. All bacteriological samples taken shall test negative for bacteria prior to performing pressure testing. If any results are positive, the new water main shall be disinfected again and the main(s) shall remain undisturbed for another twenty-four (24) hours before bacteriological retesting.

8. Once all bacteriological samples test negative, permission will be given by Florence Township Water and Sewer to perform required pressure testing.
 9. The pressure test will be performed according to Specification Section 8.0 unless otherwise approved.
 10. After the water main passes a hydro test, a final bacteriological test shall be performed by the Township of Florence as described above.
 11. Once all final bacteriological samples test negative, the water main will be approved for public use.
- E. Bacteriological standards: Samples tested shall conform to the bacteriological standards specified in Potable Water Standards, PW-D10.
- F. If the initial disinfection fails to produce satisfactory samples, disinfection and testing shall be repeated until satisfactory samples have been obtained. The Tablet Method shall not be used in these subsequent disinfections. The water main shall not be placed into service until satisfactory samples have been obtained.

8.0 TESTING WATER SUPPLY SYSTEMS

8.1 DESCRIPTION

- A. Test water supply system for exfiltration.
- B. Definitions:
 - 1. Water supply system: The water main, water service pipe, water distributing pipes and the necessary connecting pipes, fittings, control valves and all appurtenances in or adjacent to the building or premises.
 - 2. Water service pipe: The pipe from the water main or other source of potable water supply to the water distribution system of the building served.
 - 3. Water distribution pipe: A pipe within the building or on the premises that conveys water from the water service pipe to the point of usage.

8.2 MATERIALS

Furnish pumps, valves, taps, pressure gauges, water meters, and all other equipment required for testing of piping systems.

8.3 METHOD OF TESTING - EXFILTRATION TEST

- A. General requirements:
 - 1. Perform all tests in presence of the OWNER's ENGINEER.
 - 2. Conduct exfiltration test prior to backfilling trench.
 - 3. Establish test sections between valves, or as directed by the OWNER's ENGINEER.
 - 4. All requirements of this specification shall be met prior to acceptance of water facilities by the OWNER's ENGINEER.

B. Procedure for exfiltration test - on-site piping:

1. Expel air from pipe through hydrants, blow-offs, or taps required for release of air from high points. Taps for release of air and blow-offs for filling pipe and releasing air shall be provided by the Contractor.
2. Fill each pipe section slowly with water, and subject pipe to hydrostatic pressure of 150 psi for one (1) hour.
3. When test pressure is reached, measure amount of make-up water required to maintain this pressure during the one (1) hour test period.
4. Leakage shall not exceed 12 gallons per inch of diameter per mile of pipe per day. Pipelines failing to meet this requirement shall be repaired and retested as above specified.
5. Compute leakage as follows:
 - a. Gallons of make-up water x 24 =
gallons loss/day.
 - b. Gallons loss/day x
$$\frac{\text{feet of pipe testing}}{\text{gallons/loss/mile/day}} = 5,280 \text{ feet/mile}$$
 - c.
$$\frac{\text{Gallons/loss/mile/day}}{\text{Pipe dia. in inches}} =$$

Gallons loss/inch diameter/mile/day.
 - d. Allowable exfiltration rate is 12
gallons/inch/diameter/mile/day.

- C. Procedure for exfiltration test - water distributing pipe within building:
Upon completion of a section or of the entire water distributing pipe, it shall be tested and proved tight under a water pressure not less than the working pressure under which it is to be used. The water used for tests shall be obtained from a potable source of supply.

8.4 SUBMITTALS

- A. Copies of all pressure tests shall be forwarded to the OWNER and the OWNER's ENGINEER prior to placing the main in service.
- B. The test data shall include a diagram of the areas tested and the date tested.

SECTION III

SANITARY SEWER SPECIFICATIONS

1.0 GENERAL SPECIFICATIONS

1.1 SANITARY SEWER GRAVITY MAINS AND FORCE MAINS

- A. No gravity sewer conveying raw sewage shall be less than eight inches (8") in diameter.
- B. Sanitary sewer mains shall not be installed under either curbs or sidewalks. In addition, trays, cleanouts and force main valves shall not be installed under or in concrete cement.
- C. No underdrains, conduits and/or cables of any nature will be installed in the same trench with sanitary sewer.
- D. PVC or DIP gravity sewer and force mains shall be used for all sanitary sewer except the following conditions which include, but are not limited to:
 - 1. The main is installed at a depth of less than thirty-six inches (36").
 - 2. At all stream crossings.
 - 3. The main is within 100' of a water supply well or below grade reservoir.

Under these conditions ductile iron pipe will be used, or as specified by the OWNER's ENGINEER.

- E. Sewer and water mains generally should be separated a distance of at least ten feet (10') horizontally. If such lateral separations are not possible, the pipes shall be in separate trenches with the sewer at least eighteen inches (18") below the water main; or such other separation as approved by the OWNER.
- F. Concrete encasement will be required for the following conditions:
 - 1. At all locations where a proposed sanitary sewer main is located closer than ten feet (10') to a water main (measured horizontally).

2. At all crossings of sanitary sewer lines and water lines where the vertical separation is less than eighteen inches (18").
 3. At all crossings of sanitary sewer lines and water lines where the sanitary sewer is vertically above the water line.
 4. All other locations where the vertical or horizontal separation between proposed and existing utility pipes is less than eighteen inches (18").
- G. When a new sanitary line is constructed and tied into an active manhole, the new line will be plugged and remained plugged until all testing has been completed and approved by the OWNER.
- H. All sanitary sewer laterals that are scheduled for connection to a specific sewer main must be connected and extended to the curb line prior to the acceptance testing on that line.
- I. Neither repair clamps nor saddles are permitted to be used on new sanitary sewers within the jurisdiction of the OWNER. These are only to be used in cases of emergency, and then only with the prior written approval of the OWNER. If and when saddles are approved, they will be of the strap on type with stainless steel hardware; no bolt on saddles will be permitted.
- J. Force mains will not be tied directly into a gravity manhole. A collector manhole will be constructed adjacent to the gravity manhole and the force main will terminate in this collector manhole. The effluent will flow by gravity into the manhole, which is part of the gravity system.
- K. Private ejector lines shall be connected directly to the sewer main.
- L. Air relief valves will be required at the high points of any force main.
- M. Interceptors shall be provided for commercial and industrial discharges when in the opinion of the OWNER and/or ENGINEER they are necessary for the proper handling of liquid waste containing grease, oil, sand or lint to the building drainage system, the public sewer or sewage treatment plant or processes. All commercial and industrial dischargers must complete a usage questionnaire that requires submittal of plumbing plans for each facility.

1.2 MINIMUM GRADES AND VELOCITY OF FLOW

- A. All sewer shall be designed and constructed to give mean velocities, when flowing full, of not less than 2.0 feet per second, based on Kutter's Formula using an "N" value of 0.013 for ductile iron pipe or an "N" value of 0.01 for PVC pipe. The following are the minimum slopes that should be provided; however, slopes greater than these are desirable:

<u>Sewer Size</u>	<u>Minimum Slope in Feet per 100 Feet</u>	
	<u>Ductile Iron</u>	<u>PVC</u>
8 inch	0.40	0.30
10 inch	0.28	0.20
12 inch	0.22	0.15
15 inch	0.15	0.10
18 inch	0.12	0.075
21 inch	0.10	0.06
24 inch or above	0.08	0.05

Minimum slope of mains emanating from terminal manholes shall be increased where flow conditions exist. Cul-de-sac lots shall provide minimum 0.80% slope to terminal manhole.

- B. Slopes slightly less than those required for the 2.0 feet per second velocity, when flowing full, may be permitted. Such decreased slopes will only be considered where the depth of flow will be 0.3 of the diameter or greater for design average flow. Whenever such decreased slopes are selected, the design engineer must furnish with his report his computations of the anticipated flow velocities of average and daily or weekly peak flow rates. The pipe diameter and slope shall be selected to obtain the greatest practical velocities to minimize settling problems.
- C. Sewers shall be laid with uniform slope between manholes.
- D. Where velocities greater than fifteen feet (15') per second are attained, special provision shall be made to protect against displacement by erosion and shock.
- E. The use of sewers with a slope in excess of twenty percent (20%) is prohibited. Instead, drop manholes should be considered. In any event, the OWNER and its ENGINEER will review all proposed sewers with a slope in excess of twenty percent (20%) or a case-by-case basis.

1.3 ALIGNMENT

- A. All sewers twenty-four inches (24") or less shall be laid with straight alignment between manholes. The alignment shall be checked by either using a laser beam or lamping.

1.4 CHANGES IN PIPE SIZE

- A. When a smaller sewer joins a larger one, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient. An approximate method for securing these results is to place the 0.8 depth point of both sewers at the same elevation.

1.5 MANHOLES

- A. Manholes shall be installed at the end of each line; at all changes in grades, alignment or size, and at distances not greater than four hundred feet (400').
- B. A drop pipe should be provided for a sewer entering a manhole at an elevation of twenty-four inches (24") or more above the manhole. Drop manholes shall be constructed with an outside drop connection. The entire outside of the drop connection shall be encased in concrete.
- C. The minimum diameter of manholes shall be forty-eight inches (48"). A minimum access diameter of thirty inches (30") shall be provided.
- D. The flow channel through manholes should be made to conform in shape and slope to that of the sewers.
- E. "SANITARY SEWER" shall be cast in lids of all sanitary manholes.
- F. All pipe penetrations into a manhole shall be no less than ninety degrees (90°) to the centerline of the downstream main.
- G. Manhole rims shall be set at base paving elevation and adjusted at a later date prior to installing the surface course. Manholes located in grassed areas shall be raised three inches (3") above grade with fill built-up around the cover.

1.6 INVERTED SIPHONS (IF APPROVED BY THE ENGINEER)

- A. Inverted siphons should not have less than two (2) barrels, with a minimum pipe size of six inches (6") and shall be provided with the necessary appurtenances for convenient flushing and maintenance.

- B. Sufficient head shall be provided and pipe sizes selected to secure velocities of at least 3.0 feet per second for average flows.
- C. The inlet and outlet details shall be so arranged that the normal flow is diverted to one barrel, and that either barrel may be cut out of service for cleaning.

1.7 LATERALS

- A. All laterals are to be connected to the main by means of a wye connection only. The standard lateral connection will be four inches (4") or six inches (6") in the case of PVC. All service laterals will be laid with the same care prescribed in Section 2.0 of these specifications, which includes proper trench construction and backfill, and stoning of the trench bottom when necessary to obtain a stable base under the pipe.
- B. The standard sewer service lateral will be constructed of PVC, cast iron, ductile iron or a combination thereof. If the OWNER or Builder desires to use pipe of a material other than that listed above, he must obtain the prior written approval of the OWNER.
- C. Adapters to connect the service lateral to house service lateral must be approved by the OWNER.
- D. The standard gravity sewer lateral will be constructed of four-inch (4") diameter for all residential or six inch (6") diameter for commercial/ industrial. Material shall be PVC SDR 35 pipe from the sewer main to the cleanout just behind the curb line.
- E. All sanitary sewer laterals should be installed at a grade equal to one-quarter inch (1/4") per foot, but in no case will they be installed at a grade less than one eighth inch (1/8") per foot.
- F. All laterals will be installed at a constant grade and in a straight line. There will be a cleanout constructed and a plug provided just behind the curb line and at any point where it is necessary to change the direction of the lateral. Cleanouts are required every fifty feet (50') on long laterals.
- G. When the sanitary sewer mains are over eight feet (8') in depth, the construction of a deep cut lateral is required.
- H. Minimum depth for a sanitary sewer lateral is thirty-six inches (36") at the curb line.

- I. In no case shall laterals be installed under driveways. A lateral location plan shall be submitted to the OWNER.

1.8 LATERAL CONNECTION TO EXISTING LINES

A. Gravity: Connections of the saddle type installed in the main sewer line shall be made in a smooth, round hole, machine-drilled into the top quarter of the main sewer pipe. The fitting should be such to insure that no protrusion of the fitting into the main sewer pipe shall result. The fitting shall conform to the contour of the sanitary sewer and is one that is specifically designed to fit the particular size main sewer pipe into which the connection is made. The machine-drilled hole shall be of such size to provide one-eighth (1/8) space between the shoulder of the fitting and the face of the main sewer pipe when installing. All voids shall be completely filled with joint material. The joint material shall be completely waterproof and capable of withstanding the stresses normally encountered in construction or maintenance. All saddles shall be a double strapped stainless steel connection. Wrap saddle in 6 mil clean polyethylene and encase in minimum six inches (6") of concrete.

B. Sewage Ejectors:

1. Sewage ejectors discharging to an existing gravity sewer shall be provided with a check valve and shutoff valve at the location of the ejector pump. The connection to the main shall be the same as in A., "Gravity Lateral Connection to Existing Lines".
2. Sewage ejectors discharging to a force main shall be connected via a direct tap. Each connection shall be equipped with a check valve and shutoff valve in an at grade box at the property line and a second check valve and shut off valve at the location of the ejector pump.
3. All sewage ejector services shall be marked with plastic marking tape as described in Item 2.2.C. of the section entitled "PVC Gravity Sewer and Pressure Pipe".

1.9 FORCE MAIN CONNECTION TO EXISTING FORCE MAIN

A. Sewage ejectors discharging to existing force mains shall be designed to overcome the total static and dynamic head conditions in the force main when flowing full. Connections shall be done with a tapping sleeve in accordance with manufacturer's directions.

1.10 GREASE RECOVERY UNITS AND INTERCEPTORS

- A. Grease recovery units (G.R.U.) shall be installed in the waste line(s) leading from sinks, drains, or other fixtures in all food service, food processing, or other commercial establishments which produce grease/oil and which are connected into the public sewer system. Greases and oils are defined as any substance(s) with physical characteristics which enable them to be quantitatively analyzed based upon their solubility in Freon, including hydrocarbons, fatty acids, soaps, fats, waxes, oils and any other substances or materials not volatilized during solubility testing. All grease recovery units must be constructed of stainless steel or reinforced concrete. The OWNER shall approve the size, type, and location of each recovery unit. A sediment/solids removal unit must be installed before the grease removal unit. All installations must conform to the manufacturers specifications and to all applicable building codes.

For new construction, all grease interceptors shall be an exterior concrete unit.

- B. Oil, sand and lint interceptors shall be installed in the waste line(s) of all commercial establishments which produce such waste and are connected into the OWNER's sewer system.
- C. All grease recovery units or interceptors shall be so installed as to provide ready accessibility to the cover and contents thereof, for servicing and maintaining the grease recovery units or interceptors in working operating condition. All grease recovery units or interceptors shall be maintained in an efficient operating condition by regular, periodic removal of accumulated contents.
- D. The OWNER, through its authorized officers, employees and agents, shall have authority to inspect, at reasonable times, those food service, food processing or other commercial establishments which produce oil, grease, sand, lint or other harmful ingredients and which are connected into the OWNER's sewer system to ensure that said establishments have installed and are properly maintaining their grease recovery unit and/or interceptor on all waste line(s).
- E. Plumbing and floor plans shall be submitted for OWNER review and approval. Finalized plans shall be forwarded by the establishment to the OWNER for their records.

- F. Full service restaurants, pizzerias and fast food type restaurants or other commercial establishments which produce excessive quantities of grease/oily waste shall furnish both an interior G.R.U. and an exterior grease trap.
- G. Grease conveying laterals shall be separated from laterals conveying raw sewage until after interceptor connection.

1.11 PRIOR TO CONSTRUCTION

Prior to starting construction of a sewer system within the Township, the Developer or Owner must have in his possession a set of OWNER approved drawings. In addition, he must have paid all the necessary charges and fees as well as obtaining the necessary bonding. When easements are necessary, all paperwork must be in order; and if road-opening permits are required, these must also be obtained before work can begin.

2.0 PVC GRAVITY SEWER AND PRESSURE PIPE AND FITTINGS

2.1 DESCRIPTION

PVC gravity sewer and pressure pipe for proposed sanitary sewer system.

2.2 MATERIALS

A. PVC Gravity Sewer Pipe and Fittings:

1. ASTM D-3034; SDR 35; Sizes 4" through 15".
2. ASTM F-679; Sizes 18" through 27".
3. ASTM F-794; Sizes 18" through 48" ribbed.
 - a. Joint design: ASTM D-3212, Pus-On Type Joint using an elastomeric ring gasket.

Infiltration shall not exceed 50-gallons/inch diameter/mile/day.
 - b. Joint material: Elastomeric ring rubber gasket, ASTM D-3212.
 - c. Joint material Primer/Adhesive: As provided or specified by pipe manufacturer.

B. PVC Pressure Sewer Pipe and Fittings:

1. AWWA C900; Sizes four inch (4") through twelve inch (12").
 - a. Coupling shall be an integral part of pipe.
 - b. Pipe shall have slip-on joints with a rubber ring seal.
 - c. Pipe shall be PVC "Blue Brute" Pipe with "Ring-Tite" joints as manufactured by Johns-Manville, or approved equivalent.

- d. Pipe shall be of the following pressure classes having the SDR numbers indicated.
 - (1) DR-14, Pressure Class 200
 - (2) DR-18, Pressure Class 150
 - (3) DR-25, Pressure Class 100
- e. Fittings and Rubber Rings shall be as supplied by the Pipe manufacturer.

C. Locator Wire

- 1. Locator wire shall be minimum #9 AWG suitable for direct burial rated at 600 VAC.
- 2. Locator wire shall be placed on the top side of the HDPE pipe. Wire shall be attached to the pipe using nylon cable ties spaced at ten-foot (10') intervals.
- 3. Locator wire shall be continuous along entire length of pipe. Heat shrink splice kits shall be used where wire sections need to be spliced.
- 4. Locator wire ends shall be terminated at the valve box and curb stop pit using a copper set screw lug attached to the valve box and the curb stop pit.

2.3 METHODS OF CONSTRUCTION

A. Reference standard used in this specification section:

- 1. American Society for Testing and Materials (ASTM):
 - a. ASTM D-3034: Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.
 - b. ASTM F-679: PVC Large Diameter Plastic Gravity Sewer Pipe and Fittings.
 - c. ASTM F-794: PVC Large diameter Ribbed Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
 - d. ASTM D-3212: Joint for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

- e. ASTM D-2241: PVC Plastic Pipe.
 - 2. American Association of State Highway and Transportation Officials:
 - M-45: Aggregate for Masonry Mortar.
 - 3. New Jersey Department of Transportation, Standard Specifications for Road and Bridge Construction 1980 Supplement.
- B. Submittals:
- 1. Manufacturer's literature and recommendations:
 - a. Submit manufacturer's descriptive literature for all materials to be used.
 - b. Submit pipe manufacturer's recommended method of gasket installation.
 - c. Submit all test results including a diagram of sections tested.
 - d. Submit all of the above for OWNER ENGINEER'S approval.
 - 2. Certificates:
 - a. Submit manufacturer's certified letter stating that pipe or joint material ordered meets requirements of this specification. Letter shall indicate compliance with appropriate ASTM designations listed.
 - b. Submit two (2) copies prior to installing materials.
- C. Product delivery, storage and handling:
- 1. Storage of materials:
 - a. Store materials to prevent physical damage.
 - b. Store pipe and fittings off ground to prevent dirt and debris from entering.

- c. Store flexible gasket materials and joint primer or adhesive compounds, in cool dry place. Keep rubber gaskets clean, away from oil, grease, excessive heat, and out of direct rays of sun.
2. Handling of materials:
- a. Protect materials during transportation and installation to avoid physical damage.
 - b. Use extra care in cold weather when flexibility and impact resistance of PVC pipe is reduced.
 - c. Do not install out-of-round pipe.
 - d. Unload pipe to prevent abrasion.
 - e. Do not drag or push pipe when handling or distributing on project site.
- D. Inspection by Contractor:
- 1. Check pipe for following information which shall be clearly marked on each pipe section:
 - a. Pipe type and SDR number.
 - b. Nominal pipe size.
 - c. The PVC cell classification, for example 12454-B.
 - d. Name or trademark of manufacturer.
 - e. The ASTM Specification designation.
 - 2. Check fittings for the following markings:
 - a. The ASTM Specification designation.
 - b. Manufacturer's name or trademark.
 - c. Nominal size.
 - d. The material designation PVC, PSM.

3. Inspect pipe for defects prior to placement in trench. The pipe and fittings shall be free from visible cracks, holes, foreign inclusions or other injurious defects.
4. Assure that all materials are to the type specified and are not defective. Unmarked pipe; or pipe and materials not meeting specifications requirements shall be removed from the site as directed by the ENGINEER.

E. Excavation for trenches:

1. Dig trenches to the uniform width required for the particular item to be installed, sufficiently wide to provide ample working room.
 - a. Maximum trench width to a point one foot above the outside top of pipe shall be the pipe outer diameter plus sixteen inches.
 - b. Maximum trench width at ground surface shall be as required for depth of pipe.
2. Excavate trenches to the depth indicated or required. Carry the depth of trenches for piping to establish the indicated flow lines and invert elevations.
3. Trenches for pipes shall not be opened more than the number of linear feet of pipe that can be placed and backfilled in one day.
4. Grub roots and stumps within six inches of outside surface of pipe bottom and sides to minimum depth of six inches below bottom of trench.
5. Install pipe bedding of material approved for initial backfill in accordance with the standard details and as specified herein.

F. Installation:

1. Lay pipe only in presence of ENGINEER. ENGINEER may order removal and relaying of pipe not so laid.
2. Fine grade trench bottom so that pipe is supported for its full length.
3. Lay pipe to lines and grades required. Face socket end of pipe in direction of pipe laying.

4. Do not lay pipe on unsuitable material, in wet trench, or in same trench with another pipe or utility.
5. Lower pipe into trench with ropes, machinery, or other means approved by ENGINEER.
6. General procedure for joining pipe:
 - a. DO NOT USE EXCAVATING EQUIPMENT TO SHOVE PIPE SECTIONS TOGETHER.
 - b. Hold pipe securely and in proper alignment when joining.
 - c. Do not disturb previously made joints. Check completed piping to assure joints are intact. Insure placement of backfill over pipe is accomplished without disturbing pipe position.
 - d. Do not allow earth, stones, or other debris to enter pipe or fittings.
 - e. Method of installing joint materials and joining piping shall be in strict accordance with manufacturer's printed instructions as approved by the ENGINEER.

G. Backfill and compaction:

1. Initial backfill:
 - a. Initial backfill material shall be soil aggregate designation I-8 conforming to the requirements of Article 8.8.1. Table 36 of the Standard Specifications, 1980 Supplement, or stone crushing to conform with AASHTO designation M-43 (ASTM designation D448), Size No. 8, 1/8" to 3/8" (2.36 mm to 9.25 mm) clean, free flowing and shall meet all ASTM C-33 requirements for quality and soundness.
 - b. Install initial backfill material as shown on the standard details for the type of pipe being used.

- c. When required material shall be placed under the pipe haunch to provide adequate side support. Material shall be installed entire trench width and shall be tamped and rodded to insure full contact with pipe at haunch up to the spring line.
 - d. Little or no tamping of the initial backfill directly over the pipe shall be done.
2. Final backfill: See General Specification Section 4.0 entitled "Trench Excavating, Backfilling and Compacting".

H. Testing:

1. Deflection testing:
- a. For pipe conforming to the requirements of ASTM D3034 Maximum allowable pipe deflection (reduction in vertical inside diameter) shall be 7-1/2%.
 - b. For pipe conforming to the requirements of ASTM D2241 Maximum allowable pipe deflection (reduction in vertical inside diameter) shall be 5%.
 - c. Deflection tests shall be successfully performed on the complete installation by means of one of the following methods prior to the acceptance of construction.
 - (1) "Go-No-Go" mandrel properly sized.
 - (2) Calibrated television.
2. Lamping:
- a. ENGINEER will lamp all installed pipe between manholes. Sewer lines shall meet the following standards to pass the lamping inspection.
 - (1) Barrel of pipe shall have no vertical deflection (not to be confused with the deflection test), and at least seventy-five percent of barrel shall be visible in the horizontal direction.
 - (2) Pipe not meeting this specification shall be relaid and relamped until compliance is achieved at no cost to the OWNER.

3. Air testing:
 - a. Air testing shall conform to the requirements of Section 7.0 "Testing of Sanitary Sewer Systems" except as herein modified.
 - b. The minimum time duration for a low pressure exfiltration pressure drop between two consecutive manholes shall not be less than shown in Table 1.
 - c. The prescribed drop shall not exceed .5 psi from 3.5 to 3.0 psi in excess of the groundwater pressure above the top of the sewer.

TABLE 1

MINIMUM DURATION FOR AIR TEST PRESSURE DROP

Pipe Size		Time
<u>Inches</u>	<u>mm</u>	<u>Minutes</u>
4	100	2½
6	150	4
8	200	5
10	225	6½
12	305	7½
15	380	9½

- I. Appurtenance installation:
 1. Manholes:
 - a. Precast manholes with connection ports shall have elastomeric seals precast into manhole walls.
 - b. Precast manholes with connection ports shall have flexible boot or sleeve precast into manhole walls.
 2. Laterals:
 - a. All laterals shall be installed with the same construction procedure as the sewer main.

3.0 DUCTILE IRON PIPE AND FITTINGS

3.1 DESCRIPTION

Provide ductile iron pipe for sanitary sewer force main or for gravity sanitary sewer main.

3.2 MATERIALS

A. Sanitary sewer force main:

1. Ductile iron pipe:

- a. Shall conform to AWWA C151.
- b. Manufactured in eighteen or twenty foot nominal lengths.
- c. Pressure Class 150 (minimum).

2. Joints for ductile iron pipe:

Push-on-joint, conforming to AWWA C151 and AWWA C111.

3. Pipe fittings:

- a. Shall be ductile iron fittings conforming to AWWA C110, with a minimum pressure rating of 250 psi.
- b. Fitting shall have push-on type joints.

4. Plugs and clamps: Plugs shall be solid plugs conforming to the pipe sizes indicated on the plans, and shall be Plug No. F-1147 as manufactured by Clow Corporation or approved equal. Clamps for retaining plugs shall be Socket Clamp No. F-740, as manufactured by Clow Corporation or approved equal.

5. Gasket lubricant:

- a. Water-soluble and not having deteriorating effects on the pipe or rubber gaskets.
- b. Shall be as supplied by pipe manufacturer or as approved by the ENGINEER.

- B. Sanitary sewer gravity main:
1. Ductile iron pipe:
 - a. Shall conform to AWWA C151.
 - b. Manufactured in eighteen or twenty foot nominal lengths.
 - c. Pressure Class 150 (minimum).
 2. Joints for ductile iron pipe: Push-on-joint, conforming to AWWA C151 and AWWA C111.
 3. Pipe fittings:
 - a. Shall be ductile iron fittings conforming to AWWA C110, with a minimum pressure rating of 250 psi.
 - b. Fittings shall have push-on type joints.
 4. Plugs and clamps: Plugs shall be solid plugs conforming to the pipe sizes indicated on the Plans, and shall be Plug No. F-1147 as manufactured by Clow Corporation or approved equal. Clamps for retaining plugs shall be Socket Clamp No. F-740, as manufactured by Clow Corporation or approved equal.
 5. Gasket lubricant:
 - a. Water-soluble and not having deteriorating effects on the pipe or rubber gaskets.
 - b. Shall be as supplied by pipe manufacturer or as approved by the ENGINEER.

3.3 METHODS OF CONSTRUCTION

- A. Submittals:
1. All pipe and fittings shall be inspected and tested at place of manufacture as required by the AWWA standards referenced in this specification. Provide ENGINEER with two copies of certifications from each manufacturer stating the product was inspected as required, and that the test results comply with the AWWA standards.

2. Submit manufacturers' product data for pipe, fittings, and gaskets as specified in General Specification Section 2.0 entitled, "Product Data".
3. All manufacturers shall validate other than by certification, the ductility of each length of pipe by an Underwriters Laboratory approved method. All ductile iron pipe is to have Underwriters Laboratory approval.
4. Submit all test results, including a diagram of sections tested.

B. Inspection and quality of pipe:

1. Before being lowered into the trench, each pipe shall be carefully inspected, and those not meeting the specifications shall be rejected and either destroyed or removed from the work within ten (10) hours. No pipe shall be laid except in the presence of the ENGINEER or his authorized inspector. The ENGINEER may order the removal and relaying of any pipe not so laid.
2. In addition to the inspection made by the ENGINEER, the Contractor shall carefully examine all pipe and special castings before placing the same in the trench. Any pieces which are broken or show evidence of cracks or fractures shall be rejected by him. Such inspection shall carry with it the responsibility on the part of the Contractor for the removal at his own expense of all pipe, special castings, and appurtenances, incorporated in the work, and which under test are found to be cracked or otherwise defective.

C. Installation of pipe and fittings:

1. Excavation and backfill for pipes shall conform to the specification entitled, "Trench Excavating, Backfilling and Compacting".
2. All piping shall be installed in a neat and workmanlike manner. All piping shall be installed to accurate lines and grades and shall be supported as shown in the standard details, specified, or necessary. Where temporary supports are used, they shall be sufficiently rigid to prevent shifting or distortion of the pipe. Suitable provision shall be made for expansion where necessary.

3. No defective pipe or fitting shall be laid or placed in the piping, and any piece discovered to be defective after having been laid shall be removed and replaced by a sound and satisfactory piece by the Contractor.
 4. Every pipe and fitting shall be cleared of all dirt and other debris before being installed and shall be kept clean until accepted in the completed work.
 5. No pipes shall be laid in fill or other unstable material, in wet trench, or in same trench with another pipe or other utility. A minimum eighteen-inch (18") clearance shall be maintained between the outside surface of pipe and outside surface of other existing pipes and structures. When this clearance cannot be maintained, contact the ENGINEER for instructions prior to proceeding with the pipe installation.
 6. No direct contact between pipes and structures at crossings will be permitted. Pipes in place shall not be worked over or walked on until covered by layers of earth well tamped in place to a depth of twelve inches over the pipe.
 7. Minimum cover over sewer mains shall be four feet.
 8. The interior of all pipes shall be thoroughly cleaned of all foreign material before being lowered into trench. Pipes shall be kept clean during laying operations by means of plugs or other approved methods.
 9. Brace all plugs as required to prevent leakage or blowout during testing.
- D. Piping supports for ductile iron force mains: The Contractor shall furnish and install all supports necessary to hold the piping and appurtenances in firm, substantial manner at the lines and grades required. Where required, bends, tees, and other fittings buried in the ground shall be backed up with concrete placed against undisturbed earth where firm support can be obtained. If the soil does not provide firm support, then suitable bridle rods, clamps, and accessories to brace the fitting properly shall be provided. Such bridle rods, etc., shall be coated thoroughly with an approved bituminous paint after assembly, or, if necessary, before assembly. This work shall include bracing plugs to prevent leakage or blowout during testing.

- E. Handling and cutting pipe: Every care shall be taken in the handling and laying of pipe and fittings to avoid damage to the pipe, scratching or marring machined surfaces, and abrasion of the coating or lining. Pipe cuts shall be made using an abrasive wheel, rotary wheel cutter, guillotine pipe saw, milling wheel saw, oxyacetylene torch or other method approved by the ENGINEER. Ground cut ends and rough edges smooth. For push-on connections, bevel all cut ends.
- F. Assembling piping:
1. Clean ring groove and bell socket prior to inserting rubber gasket seal. Properly seat gasket; make sure it faces proper direction.
 2. Clean and lubricate spigot end of pipe. Lubricate spigot end of pipe and rubber gasket.
 3. Hold pipe securely and in proper alignment when joining.
 4. Join pipe so that reference mark on spigot end, if provided by manufacturer, is flush with end of bell.
 5. Join pipe in strict accordance with manufacturer's printed installation procedures.
- G. Protection of work:
1. Great care shall be exercised in the protection of finished work. Joints once made and disturbed shall be subjected to immediate rejection. It shall therefore be the duty of the Contractor to avoid the slightest movement in completed work, while in the act of laying the pipe, in backfilling, or in the passage of workmen up and down the trench. At all times during which pipe is not laid, the end of the pipe shall be sealed with a tight fitting plug. In no case will the drainage of trench water through a complete pipe be permitted.
 2. All curves, bends, tees, hydrants or ends of pipe shall be securely blocked with socket clamps or yokes to prevent movement. At the end of line or turn, where provision has been made for future extension or connection, fittings shall be furnished with lugs and anchored by means of socket clamps or yokes.

- H. Adapters: When it is necessary to join pipes of different types the Contractor shall furnish and install the necessary adapters. Adapters shall have ends conforming to the above specifications for the appropriate type of joint to receive the adjoining pipe. When adapters join two classes of pipe, the bodies may be of the lighter class.

- I. Pipe repairs shall be accomplished utilizing stainless steel double banded repair clamps (Rockwell 226 "Super Reach" or equal), installed in accordance with the manufacturer's printed instructions.

4.0 MANHOLES

4.1 DESCRIPTION

- A. Provide precast concrete manholes for gravity sanitary sewer system.
- B. Reconstruct existing manholes.
- C. Provide connection to existing manholes.

4.2 MATERIALS

- A. Precast concrete manholes shall conform to ASTM C 478.
- B. Rubber gasket for precast manhole sections shall conform to ASTM C 361. Concrete and rubber gasket joint shall be watertight at head pressure of up to fifty feet (50').
- C. Rubber gasket pipe to manhole seal for precast manholes: ASTM C 443.
 - 1. Gasket shall be cast integrally in manhole wall.
 - 2. Use "A-Lok" gasket as manufactured by Atlantic Concrete Products Company, Omega Concrete Products, Inc., Duncan Thecker Precast, or approved equal.
- D. Ladder rungs: Shall be aluminum alloy conforming to ASTM C478.
 - 1. Steps shall be twelve inches wide with a non-slip surface, with the ends turned up a minimum of two inches. Rungs shall be set into the wall a minimum of three inches, and extend six inches from the manhole wall.
- E. Castings for Manholes: Campbell Foundry Pattern No. 1012D with lifting handles and pick holes and "SANITARY SEWER" cast-in-lid, or approved equal.

4.3 METHODS OF CONSTRUCTION

- A. Submittals: Submit manufacturers' product data for ladder rungs and precast manholes as specified in General Specification Section 2.0 entitled "Product Data".
- B. Reference standards used in this specification:

1. New Jersey State Highway Department Standard Specifications:
Section 603: Inlets and Manholes
 2. American Society for Testing and Materials (ASTM):
 - a. ASTM C361: Reinforced Concrete Low-Head Pressure Pipe.
 - b. ASTM C443: Joints for Circular Concrete Sewer and Culvert Pipe Using Rubber Gaskets.
 - c. ASTM C478: Precast Reinforced Concrete Manhole Sections.
- C. The general method of construction and manhole reconstruction shall conform to Section 603 of the Standard Specifications. The manhole shall be constructed as shown on the standard details.
- D. Manhole walls shall be constructed of precast concrete rings and all joints between. The outside surface shall be painted with seal coats of coal tar or asphalt. Manhole walls may be constructed of poured concrete, subject to approval by the OWNER's ENGINEER. Installation of rubber gaskets for precast manholes shall be in accordance with the manufacturers' recommendations.
- E. Frames shall be well bedded in mortar, making a watertight joint. Cover and frame shall have a shop coat of asphaltic pitch and shall have a field coat of similar paint after the frame is set in final position. Steps shall be provided in the manhole as shown on the standard details.
- F. Each manhole shall be constructed absolutely watertight. Manholes that are not watertight will not be accepted. Plastering on top of defective joints to correct leaky conditions will not be permitted.
- G. The invert channels shall be smooth and semi-circular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. The invert channels shall be formed in the concrete fill above the manhole base, or shall be half tile laid in concrete, or shall be constructed by laying full section sewer pipe through the manhole and cutting out the top half after the surrounding concrete has hardened. The floor of the manhole outside the channels

shall be smooth and shall slope toward the channels not less than one inch per foot nor more than two inches per foot.

- H. Construct manholes to the lines and grades required in the system being installed.
- I. A maximum of four (4) courses of brick, up to twelve inches (12") in height, shall be used on any precast manhole. When a greater number of courses are required to attain the proper grade, another precast section shall be used.
- J. Provide all manhole top sections with minimum thirty-two inch (32") diameter clear opening.

5.0 PUMPS AND PUMPING STATIONS

5.1 DESCRIPTION

- A. Design, furnish, install, test and monitor complete sanitary sewage pumping station if required by project conditions.
- B. Sewage pumping stations shall be of the wet well type with submersible pumps.

5.2 SUBMITTALS

- A. Prior to pump station approval, the applicant shall submit eight (8) copies of the following for approval:
 - 1. Engineer's design report for the pump station including flow and head calculations for the pump station and common force main.
 - 2. Design drawings and specifications.
- B. Prior to construction, the Contractor shall submit shop drawings for the pump station in accordance with the General Specification Section 2.0, "Product Data".
- C. Before testing and startup, ten (10) copies of complete pump station O & M manuals shall be submitted to the OWNER/Engineer for review and approval.
- D. As-built plans shall be submitted to the OWNER/Engineer prior to the release of the performance bond.

5.3 PUMPS

- A. Pumping station capacity should be compatible with the ultimate capacity of the influent sewer. At least two (2) pumps, each designed to handle peak flows for ten (10) year hence, shall be provided. If more than two (2) pumps are provided, their capacities shall be such that upon failure of the largest pump, the others will handle such peak flows. Pumps shall include run hour meters on the main electrical panels.
- B. Special repair tools and accessories as well as ten (10) copies of all operation and maintenance literature required for maintenance shall be provided.

5.4 WET WELLS

- A. The capacity of a wet well should not exceed ten (10) minutes retention when flow is at the average dry weather rate.
- B. The floors of wet wells shall slope at least forty-five degrees (45) toward pump suction to prevent solids accumulation.
- C. Wet wells shall be designed and installed to comply with OSHA regulations and the requirements governing confined space entry.

5.5 ELECTRICAL EQUIPMENT

- A. All control equipment and standby generator shall be located outside of the wet well in a suitable building, approved by the OWNER.
- B. Automatic visual and audible alarm systems shall be provided for all pumping stations, operating independently of the station power. The alarm shall be activated in cases of power failure, pump failure, level control failure, or any cause of pump station malfunction. Pump station alarms shall be telemetered, including identification of the alarm condition to the sewage treatment plant or other location as designated by the OWNER.
- C. Ground fault interrupter (GFI) breakers shall be provided for all dry well and exterior fixtures.
- D. All electrical equipment and work shall comply with Fire Underwriter's regulations for the location involved, the National Electric Code, and OSHA 1910.147.3.C.2.
- E. All outdoor panels and junction boxes shall be NEMA 4X 316 stainless steel.

5.6 EMERGENCY POWER

- A. An emergency power source must be provided with automatic transfer capability in case of primary power failure. This unit must be sized so as to provide all power necessary to supply all the electrical equipment for the pumping station from the period of primary power failure.
- B. The OWNER shall be supplied with ten (10) sets of operational instructions, including emergency procedures and maintenance schedules. Any special tools and spare parts as designated by the OWNER shall also be provided.

5.7 PUMPING STATIONS - GENERAL

- A. Unless otherwise approved by the OWNER, pump stations shall be underground concrete wet well type.
- B. The OWNER shall be contacted prior to the selection of any pump and/or pump station within the OWNER's service area.
- C. Pumps and pumping stations shall be provided for transfer of raw sewage when flow by gravity is not possible or impractical, as determined by the OWNER/ENGINEER.
- D. Raw sewage shall be screened before pumping unless special pumping equipment approved by the OWNER is used. A trash basket and guide rails, constructed of either aluminum or stainless steel, must be provided in the wet well. A mechanical means, such as a winch, must be provided so this basket can be removed from the wet well for cleaning.
- E. Wet wells shall be provided with adequate light and ventilation and a means of access for pumps and trash basket.
- F. At least two (2) pumps shall be provided at each pump station. All pumps shall be designed for at least 2.5 times the expected average daily flow for ten (10) years hence. Pumps shall be designed to overcome the total static and ultimate dynamic head conditions of any common force main flowing full. At the OWNER's discretion, variable frequency drives (VFD) may be required for any new or rehabilitated pump station. VFD shall be Safetronics or equal.
 - 1. Two Pump System:
 - a. One pump shall be considered a standby for the other.
 - b. Both pumps shall be the same capacity.
 - c. The pump considered to be the lead pump shall be alternated on each lead pump start up.
 - 2. Three Pump System:
 - a. The pumps shall be of such capacity that with any one pump out of service the remaining pumps shall have the capacity to handle the expected maximum flow.

- b. Provisions shall also be included for all the pumps to operate in parallel, should the level in the wet well continue to rise above the starting level for the lead pump.
- G. Pumps shall be capacity of passing spheres of at least three inches (3") in diameter, and pump suction and discharge piping shall be at least four inches (4") in diameter.
- H. Pump stations shall be located outside the FEMA 100 year flood area and shall not be subject to flooding. Pump stations shall be accessible by motor vehicles at all times.
- I. Pump Controller

- 1. Controller

The PLC should be a Modicon Momentum series with the following devices:

Processor	171CCC76010
TOD	Option Adapter
I/O Base 1	ANR 120-90
I/O Base 2	ADM 350-10
Com. Adapter	170INT 11000

Programming for the PLC with Concept – Version 2.6 for a complete working duplex pump control.

Duplex pump control for VFD/bypass operation with all required programming to accommodate items listed in HMI control paragraph.

The level control system should have a Pressure System, Incorporated's submersible transducer, a 700 series with a 0-5V input to PLC.

Separate independent relay logic, controlled by Warrick float balls, should be selector switch enabled to provide backup automatic level control to the bypass starters during the event of PLC or HMI failure. This selector switch shall disable PLC operation.

Florence Water and Sewer Department shall be provided with complete PLC and HMI Software licenses, written programs in electronic and paper format and PC to device cables.

The HMI interface will be a Red Lion – G308 color touch screen. Operator programming for the G308 is free software, downloadable from Red Lion’s wet site (Crimson 2.0). Screens developed should include the following:

- Wet well level – graphical and digital readout.
- Set point control.
- Pump hand off auto control.
- Pump hours.
- Pump hours reset.
- Manual speed control and time out.
- Wet well pump level set point adjustment.
- Pump alternation control:
 - Manual control
 - Cycle control
 - Timed Control
- Alarm page for:
 - Wet well flooded
 - Wet well low level
 - Pump failure
- VFD/bypass control selection
- PID control function
- Alarm history

2. Automatic Pump Alternation

Upon operator selection, the controller shall select first one pump then the second pump, to run as the lead pump for a pumping cycle. Alternation of the lag pump shall occur similarly. All alternations shall occur at the end of a pumping cycle. In triplex configuration, all pumps should cycle.

3. Transducer

The transducer shall be permanently mounted in the wet well to accurately measure the liquid level in the wet well. The output signal shall be proportional to the liquid level from 0 to 100% plus or minus 1%. The sensor shall be capable of operating ranges of one (1) to twenty-five (25) feet, and shall function over an ambient temperature range of -40 degrees F. to 200 degrees F. and shall be rated FAM and CAS for Class I and Class II hazardous environment.

4. Installation

The transducer shall be installed in a stilling well constructed of three-inch (3") diameter PVC conduit that will extend through the top slab of the wet well. The cable outside the wet well shall be enclosed in seal-tite conduit and supported with a unistrut support as shown on the plan. Link seals shall be used at wet well penetrations.

5. Warranty

The manufacturer of the controller shall guarantee for one (1) year of operation, that the equipment shall be free from defects in design, workmanship or materials. In the event a component fails to perform as specified or is proven to be defective in service during the guarantee period, the manufacturer shall promptly replace the defective part at no cost to the owner.

J. Provide minimum 2,000-pound capacity winch with a 2.85 to 1 cranking ratio. Winch shall be the ratchet type with a disc brake. Winch shall be supported by a removable, swiveling type davit. Winch cable shall be minimum 3/16-inch diameter stainless steel and have sufficient length to reach the bottom of the wet well. The end of the cable shall be furnished with a spring-loaded hook.

K. An automatic alarm dialer shall be provided in the location described. The alarm dialer shall be mounted and wired within the control enclosure with the dialer's keypad and display mounted through the enclosure door. The dialer shall be a solid state component capable of storing and dialing up to sixteen (16) phone numbers, each up to thirty-two (32) digits in length. The dialer shall be a sixteen (16) channel device, wired for the following alarm inputs:

1. System failure.
2. High water level alarm.
3. Generator status.
4. Generator failure.
5. Control power failure (integral to dialer).
6. Station temperature (integral to dialer).
7. Low water level alarm.
8. Pump #1 failure (high temperature, overload, pump failure).
9. Pump #2 failure (high temperature, overload, pump failure).

The dialer shall utilize digital speech recording. The dialer shall allow the user to record and rerecord in their own voice messages for each input channel and for the Station ID. The time for each message shall be adjustable, and recordings may be made at the front panel or from any remote Touch Tone telephone. The dialer shall be Verbatim Raco Model VSS.

- L. Pump station design shall comply with all Occupational Safety and Health Standards (OSHA), including Section 1910.27 for minimum dimensions of access hatch openings.
- M. The pump station design shall include a complete analysis of buoyant forces. In addition, structural design calculations for all concrete structures and metal support system shall be submitted.
- N. Provide minimum of eight (8) copies of all shop drawings to the OWNER/ENGINEER prior to manufacture for review.
- O. The pump station operation and maintenance manual shall include at a minimum, but not be limited to, the following information:
 1. Certified pump curves from the actual pumps being furnished.
 2. Suggested maintenance schedule.

3. Complete and detailed schematics of all electrical systems and controls, including schematic and wiring diagrams for the engine alternator set, automatic transfer switch and interconnecting diagram showing connections to individual components which constitute the standby power system.
 4. Complete and detailed exploded view drawings of all equipment included with the pump station.
 5. Descriptions of, and operating instructions for, each major component of the pump control as supplied.
 6. Instructions for operation of the pump controls in all intended modes of operation.
 7. Instructions for the adjustment, calibration, and testing of selected electronic components or assemblies, normally considered replaceable by the manufacturer, whose performance is not ascertainable by visual inspection.
- P. The OWNER's engineer shall be present for on-site testing of all equipment including, but not limited to, determining pump capacity. The pump station manufacturer's representative shall perform the testing.
- Q. The Applicant shall coordinate progress of the work with utilities and local authorities which require inspection and approval of the work.
- R. The pump station and generator manufacturers shall each provide the services of a factory trained representative for a minimum period of eight (8) hours to perform initial start-up of the pump station and generator, and to instruct the OWNER's operating personnel in the operation and maintenance of the equipment. This instructions time is in addition to any required testing and equipment start-up preparation.
- S. All aluminum materials shall be suitably protected against dissimilar materials such as concrete, steel, non-ferrous metals, etc. using neoprene washers, painting or other approved method.
- T. The OWNER shall be provided with special repair tools, spare parts and accessories for each pump station.
- U. In addition to the above criteria, all pump stations shall meet the New Jersey Department of Environmental Protection Rules and Regulations for the Preparation and Submission of Plans for Sewer Systems and Wastewater Treatment Plants.

5.8 WET WELL

- A. Minimum wet well diameter shall be seven feet (7'). Top of wet well slab shall be minimum nine inches (9") above the finished grade.
- B. The concrete wet well construction shall conform to:
 - 1. ASTM C478, Precast Reinforced Concrete Manhole Sections.
 - 2. ASTM C890, Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures.
 - 3. ASTM C913, Precast Concrete Water and Wastewater Structures.
 - 4. ASTM C443, Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets (for joint design only).
 - 5. ASTM C923, Resilient Connectors between Reinforced Concrete Manhole Structures and Pipes.
- C. There shall be no joints between the base slab and first riser section, as these two sections shall be monolithically constructed.
- D. The floors of wet wells shall slope at least forty-five degrees (45°) toward pump suction to prevent solids accumulation.
- E. Provide aluminum bar screen basket with aluminum guides, constructed of aluminum alloy 6061-T6 or 6063-T6. All raw sewage shall be screened before pumping unless special pumping equipment approved by the OWNER is utilized. Provide removable bar screen basket with guide rails constructed of aluminum alloy 6061-T6 or 6063-T6. Minimum 3/16" by 1-1/4" aluminum flat bars shall be positioned on the bottom and all sides. Maximum clear space between bars shall be one inch (1"). All hardware shall be stainless steel.
- F. Provide access hatches based on the following requirements:
 - 1. One access hatch shall be provided to accommodate removal of the bar screen and for personnel access. Hatch size shall be as large as can be structurally accommodated in the wet well top slab. Minimum hatch width shall be thirty inches (30").

2. Each hatch shall be equipped with heavy duty hinges, lifting handle, spring operators, automatic hold open arm with release handle, and a snap lock with removable handle, all of stainless steel. In addition, all hardware shall be stainless steel.
3. Two (2) heavy-duty stainless steel safety chains shall be provided on each end of all double leaf doors.
4. The hatch covers shall be mill finished.
5. All metal used in fabricating the access doors shall be either aluminum or stainless steel. All aluminum shall be alloy 6061-T6 or 6063-T6 and all stainless steel shall be Type 316.
6. Each hatch shall be provided with an integral safety gate that provides fall through protection.

G. Provide an exhaust air odor control system:

1. Capacity minimum of twelve (12) air changes per hour.
2. Unit to be Carbtrol Model G Series air purification system.
3. Motor shall be 115/230 VAC single phase, 3,400 rpm, with manual starter.
4. Suction piping material to be PVC. Final connection to unit shall be hose supplied with system.
5. PVC ball valve shall be supplied on suction side of unit for flow control.
6. Provisions for manual operation only shall be provided. On/off switch shall be located in the control room.
7. Applicant's engineer to specify blower capacity and static pressure, and provide backup calculations.

H. On the entire interior concrete surface of the wet well provide an epoxy-polyamide or approved equal painting system installed in accordance with the painting system manufacturer's recommendations (see Section 5.9.X.).

- I. All materials inside the wet well shall be aluminum alloy 6061-T6, 6063-T5 or 6063-T6, Type 316 stainless steel, PVC or fiberglass. This includes the fall prevention system, expansion anchors, anchor bolts, nuts and washers.

5.09 STANDBY EMERGENCY POWER ENGINE/GENERATOR

A. General:

The Contractor shall furnish and install a complete diesel engine/generator set, complete, at the job site. The generator set shall be installed inside the control building. The complete standby system shall consist of:

- 1. A diesel engine/generator set to provide standby electric power during periods of failure of normal utility power supply. The engine/generator capacity shall be selected on the following basis:
 - a. Engine/generator set capacity shall be sized assuming raw sewage pumps operating with motors sized to drive pumps installed with largest pump impeller required for all future flows and all future total dynamic head conditions.
 - b. Starting: Unit shall be capable of simultaneously starting all raw sewage pumps required to handle the average daily flow, and a minimum accessory load of 6.5 KW due to auxiliary equipment and the wet well light and blowers. Any additional loads for items such as exterior lights shall also be included. A time delay device shall be used to sequentially start the remaining raw sewage pumps.
 - c. Operation: Unit shall be capable of continuously running all raw sewage pumps, the minimum 6.5 KW accessory load, exterior lights and any other items requiring electricity to operate at the site.
 - d. Unit shall be 3 phase, 60 hertz and capable of delivering the required power as described above at 0.80 power factor.
 - e. Frequency regulation shall not exceed 3 hertz from no load to rated load. Frequency variation shall not exceed plus or minus 0.3 hertz for constant loads from no load to rated load.

- f. Voltage regulation from no load to rated load shall be within plus or minus 2 percent of rated voltage for any size unit.
 - g. Instantaneous voltage dip for all possible sequences of load application and motor starting for loads described in conditions of service shall not exceed twenty percent (20%) of nominal voltage.
 - h. Sound attenuation: The unit shall be designed so that the maximum sound level generated shall not exceed 90 DB at a distance of fifty feet (50') from the intake or the exhaust system. Sound readings shall be taken with generator operating under a full load condition. Applicant to provide certification from manufacturer.
2. Engine generator control console mounted on the generating set.
 3. An automatic load transfer control to provide automatic starting and stopping of the plant and switching of the load.
 4. Mounted accessories and other equipment as specified.
 5. Weatherproof, heavy gauge painted steel or aluminum housing with removable side panels insulated as necessary.
 6. A rechargeable, minimum five (5) pound capacity fire extinguisher (Class ABC) mounted near the generator in a weatherproof enclosure.

B. Control Panels:

1. Engine and generator control panels may be separate panels, or a combined panel, and mounted with vibration isolators on the unit in a NEMA 4 enclosure. Control module shall be located on the generator end of the set. Instruments shall be of direct-reading type, factory mounted and factory connected. Instruments shall be accurate within three percent (3%).
2. Provide engine panel with following minimum features and instruments:
 - a. Three position run-stop-remote switch.
 - b. Manual starting switch.

- c. Full automatic starting from pilot device initiating start when normal power fails. Automatic cranking shall be interrupted cycle type not affected by ambient temperature with overall time limit. A total of three (3) cranking cycles (approximately 10 seconds each) shall automatically shut down engine.

- d. Automatic engine shutdown for the following fault conditions:
 - (1) Over crank
 - (2) Over speed
 - (3) Low lube oil pressure
 - (4) High engine temperature

- e. Indicator lamps shall be provided to signal the following functions:
 - (1) RUN - indicates start disconnect.
 - (2) OVER CRANK - indicates the starter has been locked out because cranking time was excessive.
 - (3) OVER SPEED - indicates engine has shut down because of excessive rev/min.
 - (4) HIGH ENGINE TEMPERATURE - indicates engine has shut down because of critically high temperature.
 - (5) LOW OIL PRESSURE - indicates engine has shut down because of critically low oil pressure.
 - (6) PRE-HIGH ENGINE TEMPERATURE - indicates engine temperature is marginally high.
 - (7) PRE-LOW OIL PRESSURE - indicates oil pressure is marginally low.
 - (8) LOW ENGINE TEMPERATURE - indicate engine temperature is marginally low for starting.

- (9) SWITCH OFF (FLASHING) - indicates control switch is in the "STOP" position.
 - (10) LOW FUEL - indicated fuel supply is marginally low.
 - (11) Two spare faults (red), for future OWNER use.
- f. A fault reset switch shall be provided to clear fault indications and allow restarting of the engine after shutdown faults. The control design shall be such that the fault indication shall remain until reset. The fault indicator memory shall not be dependent on the presence of either A-C or D-C voltage and shall retain the fault status memory even through complete removal and replacement of the starting batteries. The fault reset function shall operate only when the RUN-STOP REMOTE switch is in the STOP position.
 - g. A locking screwdriver type potentiometer shall be provided to adjust the voltage $\pm 5\%$ from rated value.
 - h. Manual reset exciter field circuit breaker.
 - i. AC voltmeter, 90-degree scale, 2½" (61.25mm) flange, 2% switchboard meter.
 - j. AC ammeter, 90-degree scale, 2½" (61.25mm) flange, 2% switchboard meter.
 - k. Frequency meter 45-65 Hz., 90 degree scale, 1½" (61.25mm) flange, ± 0.6 Hz. panel meter.
 - l. Four position Ac meters phase selector switch to read line current and voltage in each phase with off position.
 - m. Water temperature gauge.
 - n. Ammeter charging circuit.
 - o. Lubricating oil pressure gauge.
 - p. Running time meter.

- q. Light with on/off switch for panel illumination.

C. Appurtenances:

1. All accessories needed for the proper operation of the pump station and generator shall be furnished. These shall include, but be limited to, the following:
 - a. A painted critical type exhaust muffler, and stainless steel flexible exhaust connection. Muffler shall be factory mounted on the housing with the condensate drain located at the bottom. To prevent birds from entering the muffler a threaded exhaust piping extension shall be installed with the end of the piping cut at a 45 angle. The shortest end of the pipe shall be on the bottom.
 - b. Above ground fuel tank shall be the double walled skid type mounted directly below the generator. Tank capacity shall be either seventy-five (75) gallons or sufficient capacity to operate the generator at full load for twelve (12) consecutive hours, whichever is greater. Above ground storage tanks shall not exceed 660 gallons unless they conform to NFPA 30 and the Uniform Construction Code. Fuel system shall include fuel gauge, fuel lift pump (if recommended by generator manufacturer), and all necessary fuel piping. Fuel piping shall be Type K soft temper copper tubing, or as recommended, and installed by the manufacturer. All above ground fuel storage tanks shall be designed and installed in conformance with NJDEP requirements.
 - c. A mechanical governor capable of maintaining engine speed within five percent (5%) of synchronous speed from no load to full load shall be furnished.
 - d. Control wires running between generator and transfer switch shall have termination identification on both ends. Identification shall be provided for each device or function and shall be silk-screened white on a black background.

D. Paint:

1. Unless otherwise noted, paint for exterior surfaces of equipment (including skids) shall be two (2) coats of acceptable oil and heat-resistant paint, applied after surfaces have been thoroughly cleaned and prepared with suitable priming coat. Color for weatherproof housing and automatic transfer switch shall be green, unless otherwise approved.
2. The generator muffler shall be protected with two (2) coats of high heat aluminum paint. The paint system shall be primed in accordance with the manufacturer's recommendations.
3. All painted surfaces damaged during installation shall be restored by the applicant/developer.

E. Spare parts:

Provide spare parts as recommended by manufacturer for six (6) months of operation for each engine-generator set in addition to the following:

1. One filter for each type of service.
2. One fuse for each rating.

F. Automatic load transfer control:

1. The complete automatic load transfer control shall include the necessary relays and components parts, together with U.L. listed and tested interlocked contactor, and shall provide the following functions:
 - a. Upon normal power line outage, automatically start the pump station, and when the pump station comes up to voltage, disconnect the normal circuits from the main line and transfer them to the emergency pump station's output.
 - b. Upon power line return, transfer the load back to the line and stop the pump station.

2. Each contact pole of the main transfer device shall be double break design, with solid silver cadmium contacts, capable of handling both non-inductive and inductive loads and allow for inrush currents of twenty (20) times the continuous rating. Contact pressure shall be maintained by a coil spring, not a part of the current carrying path. The ampere rating of the transfer switch shall be sufficient to handle the capacity of the pump station and loads being transferred.
3. The control shall contain either a 12 or 24 volt, fused, battery trickle charging circuit, with a rheostat and ammeter, to maintain starting batteries fully charged.
4. The automatic transfer switch shall be provided with terminal lugs for copper wire and shall have individual, heat resistant chambers to protect against arcing. The transfer switch shall be provided with mechanical and electrical interlocks to prevent simultaneously energizing both normal and emergency service.
5. The transfer switch shall be located in a NEMA 1 enclosure which is contained in a separate NEMA 4 enclosure, if skid mounted for outdoor use.
6. Control accessories in the NEMA 1 enclosure shall mount on a dead front, swing out control accessory panel to avoid shock hazard while adjusting control functions, but will swing out exposing the wiring to facilitate servicing. Indicating lamps and meters shall be set in a front mounted panel to be visible with only opening the NEMA 4 enclosure door.
7. Solid-state voltage sensors shall simultaneously monitor all phases of the normal source and all phases of the emergency source to provide adjustable range sensors for field adjustment for specific application needs. Voltage sensors shall be temperature compensated type, for maximum deviation over the temperature range of -20 F to +175 F. Voltage sensors shall allow for adjustment to sense partial loss of voltage on any phase or normal or emergency source, even where motor feedback voltages exist.
8. Controls shall signal the emergency power system to start upon signal from normal source voltage sensors. Solid-state time delay start, adjustable from 0 to 5 seconds shall avoid nuisance start-ups on momentary voltage dips or momentary interruptions.

9. Switch shall transfer the load to the emergency power system after the generator set reaches proper voltage and frequency. Solid-state timer delay transfer, adjustable from 2 to 120 seconds shall allow the engine-generator set to stabilize before application of load.
10. The transfer switch shall control the generator set to allow generator set to start and transfer load within ten (10) seconds after normal source power failure.
11. Switch shall retransfer the load to the normal source after normal power restoration. Solid-state time delay retransfer, adjustable from 0 to 30 minutes, shall allow;
 - a. Normal power to stabilize before retransfer.
 - b. Staggered retransfer.
 - c. Engine to run unloaded for cool down before shutdown.
 - d. Cool down period shall be adjustable from 0 to 10 minutes.
12. The operating power for transfer and retransfer shall be obtained from the source to which the load is being transferred. Controls shall provide an automatic retransfer of the load from emergency source to normal source if emergency source fails when normal source is available.
13. Transfer switches shall have the "Programmed Transition" feature available by plugging the proper Program Timer into the factory installed timing receptacle. This provides the capability of either factory or field installation of this feature. This feature shall incorporate a field adjustable time delay of 1.5 to 15 seconds. The time delay shall occur during switching in both directions, during which time the load is isolated from both normal and emergency sources. This will allow residual voltage components of motors or other inductive loads (such as transformers) to decay before completing the switching cycle. The Program Timer shall be connected in a manner that will not cause the time delay in switching, where the time delay as already been established by the loss of voltage to the load during normal source power interruptions. Transfer methods that use the phase relationships between the two power sources to control initiation time are not acceptable. Provide program timer.

14. Controls shall provide built-in "control mode status indicators", consisting of LED's to indicate a sequence of functions such as the following:
 - a. Source 1 OK
 - b. 2-wire run
 - c. Source 2 OK
 - d. Timing for Transfer
 - e. Transfer Command
 - f. Timing for Retransfer
 - g. Retransfer Command
 - h. Timing for Stop

These indicators shall allow the operator to determine that the controls are properly sequencing and shall assist in determining sequence of any malfunctions that might occur.

15. Provide position indicator lamps (green "NORMAL" and red "EMERGENCY") and a key operated selector switch to provide the following positions and functions:
 - a. TEST - simulated normal power loss to control unit for testing of generator set, including transfer to load. Control system shall provide for "system test without load transfer" for use in that manner when desired.
 - b. NORMAL - this is normal operating position and it restores the load to the normal source after test and after time delays.
 - c. RETRANSFER - momentary position to override retransfer time delay and cause immediate return to normal source after test or actual outage.

16. Provide exerciser clock to set the day, time and duration of generator set period; also include "with/without load" selector switch. Clock shall have a one (1) week dial minimum. If normal power is interrupted while the generator is exercising at no load, the load is immediately transferred to the set.
17. Provide battery charger, SCR voltage regulated type, with float and taper features; 12 or 24 V.D.C. as required for generator set. Charger shall have charging ammeter and fuse protection. Charger shall not be damaged during engine cranking.
18. Transfer switch capacity shall be no smaller than the disconnect switch capacity.
19. Provide contacts to operate an alarm light in the dry well and a remote alarm indicating the generator is supplying power to the dry well. Upon automatic shutdown the signal will be deactivated.

G. Products:

1. Single manufacturer: This equipment shall be manufactured by a single source manufacturer who has been regularly engaged in the production of engine-generator sets. The emergency electric generating system described herein, including these components shall be factory built, factory tested, and shipped by one source of supply and responsibility for warranty, parts and service. This manufacturer shall have a local representative who can provide factory-trained servicemen, required stock of replacement parts, and technical assistance.
2. Safety standards: The electric generating system must meet all requirements of NFPA 110 (latest edition) including design specifications, prototype tests, one-step full-load pickup, and installation acceptance. Automatic transfer switch shall conform to U.L. 1008.
3. The responsibility for performance to this specification includes the entire system and cannot be split up among individual suppliers of components comprising the system, but must be assumed solely by the supplier of the system.

4. All controls shall be the standard of the manufacturer, who is engaged in the manufacture of engine-generator sets, transfer switches, and accessories and has then available for sale on the open market. Control parts shall be identified by part numbers of this manufacturer and shall have second source listing where applicable.

H. Field quality control:

1. Provide full load test utilizing portable test bank for four (4) hours minimum. Simulate power failure including operator of transfer switch, automatic starting cycle, automatic shutdown and return to normal. All testing procedures shall be as described in NFPA 110 under Installation Acceptance.

I. Personnel training:

1. The generator manufacturer shall provide the services of a factory-trained representative for a minimum period of eight (8) hours to perform initial start-up of the generator, and to instruct the OWNER's personnel in the operation and maintenance of the equipment. Initial start-up of generator shall conform to NFPA 110.

J. Shop drawings and O & M Manuals:

1. Applicant's engineer to specify generator capacity and shall provide OWNER with backup information justifying the capacity selection. As a minimum, backup information shall identify motor horsepower and accessory load, motor voltage, motor code letter, starting sequence, and full or reduced voltage starting requirements. Manufacturer's load calculation sheets for both the specified generator and the furnished generator shall be submitted to the OWNER.
2. Applicant shall provide eight (8) copies of manufacturer's shop drawings for approval prior to fabrication. All eight (8) copies will be utilized by the OWNER and the applicant shall furnish additional copies for his use. As a minimum shop drawings shall contain:

- a. Plan and elevation views with both overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, and electrical diagrams including schematic and interconnection diagrams.
 - b. Product data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, transfer switch, battery, battery rack, battery charger, exhaust silencer, vibration isolators and skid tank.
 - c. Warranty data.
 - d. Generator capacity with backup information justifying the capacity selection. As a minimum, backup information shall identify motor horsepower and accessory load, motor voltage, motor code letter, starting sequence, and full or reduced voltage starting requirements. Manufacturer's load calculation sheets for the furnished generator shall be submitted for approval.
3. Provide ten (10) copies of the generator operations and maintenance manual including, but not limited to:
- a. As-built plans of the concrete support pad and conduit locations.
 - b. Suggested maintenance schedule and step-by-step maintenance procedures.
 - c. Complete and detailed schematics of all electrical system and controls, including schematic and wiring diagrams for the engine alternator set, automatic transfer switch and an interconnecting diagram showing connections to individual components which constitute the standby power system.
 - d. Complete and detailed exploded view drawings of all equipment. Include description of all parts.
 - e. Copy of all approved shop drawings.
4. All operation and maintenance and warranty materials shall be submitted before testing of the generator takes place.

K. Warranty:

The complete standby electric power system, including engine-generator set and transfer switch equipped with set exerciser, and running time meter, shall be warranted for a period of five (5) years or fifteen hundred (1,500) operating hours, whichever occurs first, from the date of initial start-up. During the warranty period manufacturer shall promptly furnish the OWNER with replacement parts for all items deemed defective. Multiple warranties for individual components (engine, generator, controls, etc.) will not be acceptable. Satisfactory warranty documents must be provided. This warranty shall be detailed in available written documents. In the judgment of the OWNER, the manufacturer supplying the warranty for the complete system must have necessary financial strength and technical expertise with all components supplied to provide adequate warranty support.

5.10 PUMP STATION SITE

- A. Provide minimum seven-foot (7') high fence along the pump station area perimeter. All fence shall be located a minimum of ten feet (10') behind the present or future public right-of-way line or privately owned curbing and sidewalk. All slabs, equipment and utilities shall be located within the fenced area at least three feet (3') from the fence.
- B. Adequate light and ventilation shall be provided at all pumping stations. Where operation or maintenance duties are required in enclosed areas or pits, forced ventilation by suitable means shall be provided with sufficient capacity to induce at least thirty (30) air changes per hour. Explosion-proof equipment shall be utilized.
- C. Adequate fresh water facilities shall be provided to permit routine wash down and cleaning operations at all pumping stations. Where a domestic service connection is provided to a pumping station, the water supply shall be properly protected with an appropriate backflow prevention device. No cross connections between fresh water and sewage pumps or pipes shall be permitted.
- D. Sewage pumping station structures and electrical and mechanical equipment shall be protected from physical damage by the 100-year flood. Sewage pumping stations shall remain fully operational and accessible during the twenty-five (25) year flood.
- E. The pumping station shall be readily accessible by maintenance vehicles during all weather conditions.

- F. A paved access road shall be provided for ingress and egress to the pump station. The access drive shall include a turn-around area.
- G. The entire site shall be fenced, and all appurtenances located within minimum 50' x 50' parcel.
- H. Site area lighting shall be provided and shall be shielded as necessary to protect adjacent uses from nuisance lighting.
- I. Sheared white pine screening, or approved substitution, shall be provided around the outside perimeter of the station fence. Provide an eight-foot (8') wide stone mulch area (6" thick) with polyethylene weed barrier below starting out from the edge of the pump station pavement.
- J. Provide a source of potable water with a frost proof post hydrant and one inch (1") hose bib connection.
- K. Within the pump station fenced-in area, provide a Woodford Iowa Model Y1 or approved equal freeze-proof post hydrant with one inch (1") inlet, three-quarter (3/4") threaded brass hose nozzle, three-quarter (3/4") galvanized steel pipe outer casing, 1/8" drain hole and furnished for four foot (4') depth of bury. Provide Nidel Model 34HD vacuum breaker-backflow preventer. Provide minimum one (1) cubic yard of 3/4" washed gravel below hydrant for drainage purposes.
- L. Provide fifty feet (50') of three-quarter (3/4") heavy duty, double layer nylon reinforced rubber water hose. Provide a high-pressure adjustable brass nozzle with adjustable spray pattern and removable barrel to fit the hose. Provide a galvanized steel hose rack on a stand located adjacent to the post hydrant. Stand shall be three feet (3') high by two-inch (2") diameter Schedule 40 stainless steel pipe with pipe cap. Set pipe two feet (2') deep with twelve-inch (12") diameter by two feet (2') deep concrete footing. Bolt rack to pipe with 2-1/4-20 by three inch (3") stainless steel carriage bolts with self-locking nuts. Post hydrant, hose rack and stand shall all be painted green. Hydrant and stand to be located out of the motor vehicle traffic area. No connections between fresh water and sewage pumps or pipes shall be permitted.
- M. Pavement to extend six inches (6") beyond fence perimeter. Apply tack coat conforming to NJDOT Standard Specifications Grade RC-70 or RC-T cutback asphalt or Grade SS-1 emulsified asphalt, Section 904.02 or 904.03 over entire stabilized base course.

- N. Extending from the wet well area pavement shall have minimum 0.75% slope towards fence. Finished surfaces shall be free from all roller marks, ridges and voids. Surfaces will not be acceptable if any puddling is possible or if slope is off more than ¼ inch in ten feet (10') when tested in any direction.
- O. Provide a fifteen-foot (15') wide driveway up to the pump station gate. Cantilevered slide gate shall be minimum twelve feet (12') wide. A motor vehicle entering the site shall have the ability to drive to both the wet well and dry well. The access drive shall include a turnaround area.
- P. All bolts, nuts, and washers whether buried, embedded in concrete or exposed above grade shall be stainless steel. All nuts and rods for harnessing shall be bituminous coated.
- Q. The pump station property line shall extend to at least ten feet (10') outside the pump station fence and shall include the access road and turnaround area.
- R. Pump station shall include a bypass pumping valve pit. Valve pit shall be constructed per Township of Florence standard detail.
- S. Sump Pump Piping Sleeves and Wet Well Joint Leakage Test: Before putting the pump station into operation the contractor shall fill the wet well to the top with clean water to demonstrate both the sleeves connecting the wet well and dry well and all the wet well joints are watertight. Water level shall be maintained at top of the wet well slab for one (1) hour by the contractor without the addition of water. Before the test commences the contractor shall position a sufficient number of pumps to dewater the dry well in the event of a leak. If the test is unsuccessful, the contractor shall make repairs and retest sleeves as many times as is necessary.
- T. All tests shall be conducted in the presence of the ENGINEER.
- U. All pumping station sites must be provided with a street address on a separate parcel with a distinct lot and block number.

6.0 TESTING GRAVITY SANITARY SEWER SYSTEMS

6.1 DESCRIPTION

- A. Test gravity sanitary sewer for exfiltration and infiltration.
- B. Perform mandrel test on all gravity sanitary sewer lines.

6.2 MATERIALS

Furnish pumps, valves, plugs, taps, pressure gauges, air compressor, and all other equipment required for testing of piping system.

6.3 METHOD OF TESTING - EXFILTRATION TEST FOR GRAVITY SANITARY SEWER LINES

- A. General requirements:
 - 1. Perform all tests in presence of the ENGINEER.
 - 2. Conduct exfiltration test when all utilities (including gas, water, telephone, sewers), manholes, laterals have been installed.
 - 3. Establish test sections between consecutive manholes as directed by the ENGINEER.
 - 4. All requirements of this specification shall be met prior to acceptance of sewer facilities by the ENGINEER.
- B. Procedure for exfiltration test (low pressure air test, 3.5 lbs.):
 - 1. Plug test section of sewer line at each end. Tap one (1) plug and provide air inlet connection for filling pipe from air compressor.
 - 2. Cap or plug all service laterals, stubs and fittings connecting to sewer test section, brace same against internal pressure to prevent air leakage by slippage and blowouts.
 - 3. Connect air hose to tapped plug selected for air inlet. Connect other end of air hose to portable air control equipment used for controlling air entry rate to sewer test section and monitoring air pressure in pipeline.

4. Air control equipment shall include shut-off valve, pressure regulating valve, pressure reduction valve and monitoring pressure gauge having pressure range from 0 to 5 psi and an accuracy of +0.04 psi.
5. Connect another air hose between air compressor (or other source of compressed air) and air control equipment. This completes test equipment set up.
6. Supply air to test section slowly, filling pipeline until constant pressure of 3.5 psig is maintained. Air pressure must be regulated to prevent pressure inside the pipe from exceeding 5.0 psig.
7. When constant pressure of 3.5 psig is reached, throttle air supply to maintain internal pressure above 3.0 psig for at least five (5) minutes, permitting temperature of entering air to equalize with temperature of pipe wall. During this stabilization period, check all capped and plugged fittings with a soap solution to detect leakage at connections.
8. If leakage is detected, release pressure in line and tighten all leaky caps and plugs. Start test operation again by supplying air. When necessary to bleed off air to tighten or repair faulty connection, a new five-minute interval shall be allowed after pipeline has been refilled.
9. After stabilization period, adjust air pressure to 3.5 psig and shut off or disconnect air supply. Observe gauge until air pressure reaches 3.0 psig. At 3.0 psig commence timing with a stopwatch that is allowed to run until the line pressure drops to 2.5 psig. The time required, as shown on the stopwatch, for a pressure loss of 0.5 psig is used to compute air loss.
10. If the time, in minutes and seconds, for the air pressure to drop from 3.0 to 2.5 psig is GREATER than that shown in Table 1 for designated pipe size, the section undergoing test shall have passed.
11. If the time, in minutes and seconds, for 0.5 psig drop is LESS than shown in Table 1 for designated pipe size, the section of pipe shall have failed the test. Necessary repairs shall be made by the Contractor and the line retested.

***TABLE 1
TIME REQUIREMENTS FOR AIR TESTING
FOR SEWER LINE OF UNIFORM PIPE SIZE**

<u>PIPE SIZE (IN INCHES)</u>	<u>TIME</u>	
	<u>MINUTES</u>	<u>SECONDS</u>
** 4	2	32
** 6	3	50
** 8	5	6
10	6	22
12	7	39
14	8	56
15	9	35
16	10	12
18	11	34
20	12	45
21	13	30

* Multi Pipe Sizes: When sewer line undergoing test is 8 inch or larger diameter pipe and includes different sized laterals, the figure in Table 1 for uniform sewer main sizes WILL NOT give reliable or accurate criteria for the test. Where multi-pipe sizes are to undergo air testing, the ENGINEER will compute "average" size in inches which is multiplied by 38.2 seconds. The results give minimum time in seconds acceptable for pressure drop of 0.5 psig for "average" diameter pipe.

** For 8 inch and smaller pipe only, if during the five (5) minute stabilization period, pressure drops less than 0.5 psig after initial pressurization and air is NOT added, pipe section undergoing test shall have passed.

C. Procedure for air pressure correction due to groundwater:

1. Air pressure correction is required when prevailing groundwater is above sewer line being tested. Under this condition, air test pressure shall be increased 0.433 psi for each foot groundwater level is above invert of pipe.
2. Establish height of groundwater (in feet) above pipe invert:

- a. DURING SEWER AND MANHOLE CONSTRUCTION, install one-half inch diameter pipe nipple (threaded one or both ends, approximately ten (10") inches long) through manhole wall directly on top of one of sewer pipes entering manhole, with threaded end of nipple extending inside the manhole.
 - b. Seal pipe nipple with a threaded one-half inch cap.
 - c. Immediately before air testing, determine groundwater level by removing the threaded cap from nipple, blowing air through the pipe nipple to remove any obstructions, and connecting clear plastic tube to pipe nipple.
 - d. Hold plastic tube vertically permitting water to rise to groundwater level.
 - e. After water level has stabilized in plastic tube, measure vertical height of water, in feet, above invert of sewer pipe.
3. Determine air pressure correction, which is added to 3.0 psig normal starting pressure of test, by dividing the vertical height in feet by 2.31. The result gives air pressure correction in pounds per square inch to be added:

Example: If the vertical height of water from the sewer invert to the top of the water column measures 11.55 feet, the additional air pressure required would be

$$\frac{(11.55)}{2.31} = 5 \text{ psig}$$

Starting pressure of the test would be 3.0 plus 5 or 8.0 psig, and the one-half pound drop becomes 7.5 psig. There is not change in the allowable drop (0.5 psig) or in the time requirements established for the basic air test.

6.4 METHODS OF TESTING - INFILTRATION TEST

A. General:

1. All work relating to infiltration testing shall be performed in the presence of the ENGINEER.

2. All requirements of this specification shall be met prior to acceptance of sewer facilities by the ENGINEER.

B. Procedure for infiltration test:

1. Examine the sanitary sewer system for infiltration at the downstream end of the system after construction has been completed.
2. In the event that there is infiltration and water is flowing at the downstream end of the system, then the source and volume of flow shall be determined by an infiltration test.
3. The test shall consist of isolating the source of infiltration by plugging the first upstream manhole and observing to see if the flow stops. This procedure is repeated one manhole at a time until each source has been isolated.
4. When the infiltration has been isolated to a section or area, the volume of flow shall be determined using a 90-degree V-notch weir inserted into the pipe.
5. The actual infiltration rate will be determined by the ENGINEER based on the weir measurements. This rate will be compared with the allowable infiltration rate of 50-gallons/inch diameter/mile of pipe/per day (24 hours).
6. If the allowable infiltration rate is greater than the actual infiltration rate, the infiltration test passes. If the actual infiltration is greater than the allowable infiltration, the infiltration test fails.
7. In the event the infiltration test fails, the section of the pipe involved shall be repaired as necessary and the test repeated.

6.5 METHOD OF TESTING - MANDREL

A. General:

1. Mandrel test shall be performed on all gravity sanitary sewer lines.
2. All work related to the mandrel test shall be performed in the presence of the ENGINEER.

B. Procedure for mandrelling:

1. Pipes shall be tested for deflection by passing a mandrel through the pipe without obstruction.
2. The size of the mandrel shall be 92.5% of the base inside diameter of the pipe.

7.0 TESTING SANITARY SEWER FORCE MAINS

7.1 DESCRIPTION

Test sanitary sewer gravity and force mains for exfiltration.

7.2 MATERIALS

Furnish pumps, valves, taps, pressure gauges, meter, and all other equipment required for testing of piping systems.

7.3 METHOD OF TESTING - EXFILTRATION TEST

A. General requirements:

1. Perform all tests in presence of the ENGINEER.
2. Conduct exfiltration test prior to backfilling trench.
3. Establish test sections between valves, or as directed by the ENGINEER.
4. All requirements of this specification shall be met prior to acceptance of force main by the ENGINEER.

B. Procedure for exfiltration test:

1. Expel air from pipe through blow-offs, or taps required for release of air from high points. Taps for release of air and blow-offs for filling pipe and releasing air shall be provided by the Contractor.
2. Fill each pipe section slowly with water, and subject pipe to hydrostatic pressure of 150 psi for one (1) hour.
3. When test pressure is reached, measure amount of make-up water required to maintain this pressure during the one (1) hour test period.
4. Leakage shall not exceed 12 gallons per inch of diameter per mile of pipe per day. Pipelines failing to meet this requirement shall be repaired and retested as above specified.

5. Compute leakage as follows:
- a. Gallons of make-up water x 24 =
gallons loss/day.
 - b. Gallons loss/day x
feet of pipe testing = 5,280 feet/mile
gallons/loss/mile/day.
 - c. Gallons/loss/mile/day =
Pipe dia. in inches

Gallons loss/inch diameter/mile/day.
 - d. Allowable exfiltration rate is 12
gallons/inch/diameter/mile/day.

SECTION IV
DRAWINGS

	<u>SHEET NO.</u>
PVC Gravity Sewer Installation	1
Sanitary Sewer Precast Concrete Drop Manhole	2
Sanitary Sewer Precast Concrete 4'-0" Diameter Manhole	3
Sanitary Sewer Typical Lateral Connection	4
Sanitary Sewer Typical Deep Cut Lateral Connection	5
Force Main Air Relief Manhole	6
Force Main Blowoff Manhole	7
Force Main Discharge Manhole	8
Exterior Grease/Water Separator, 1,500 Gallon Capacity	9
Lateral Cleanout in Paved Areas	10
Concrete Cradle	11
Ejector Station Connection to Gravity Main	12
Ejector Station Connection to Proposed Force Main	13
Ejector Station Connection to Existing Force Main	14
Pump Station Bypass Valve Vault	15
Removable Bar Screen and Ladder	16
Pressure Transducer Wet Well Level Sensor	17
Wall Penetrations	18
Standardized Color Paint Schedule	19

	<u>SHEET NO.</u>
Yard Hydrant	20
Trench Construction and Water Main Pipe Installation	21
Fire Hydrant Connection	22
Thrust Block	23
Water Main Blowoff	24
Water Main Typical Service Connection	25
Wet Tap Connection	26
Concrete Encasement	27
Access Drive Within Utility Easements	28
Utility Crossing Offset	29