DEVELOPER HANDBOOK

PROCEDURES FOR EXTENSION
OF PUBLIC SEWAGE FACILITIES

APRIL 2003

HRG PROJECT NO.: 2340.000

FOX TOWNSHIP SEWER AUTHORITY
P.O. Box 186
Kersey, PA 15846

DEVELOPER HANDBOOK

TABLE OF CONTENTS

INTRODUCTION

In terms of this Handbook, a Developer is defined as any individual, partnership, or corporation constructing sewage facilities whose ownership is intended to be transferred to the Authority. This Handbook has been prepared to describe the procedures to be followed throughout the entire process; planning and design, construction and post-construction, so that the Developer can become familiar with the various requirements in order to properly design and schedule the project. **A schematic of the entire approval process can be found in the Appendix.** The Handbook also includes the technical specifications, which are the standards for the water facilities. The procedures also apply to capped sewer lines which will be connected to the Authority system at a later date.

All owners of property accessible to and whose principal building(s) are within 150 feet from the sanitary sewers, as defined by the Act 537 plan, of the Authority are required to make connection with the sewer system for the purpose of discharging all sewage from such premises. A property owner whose property and principal building(s) are located more than 150 feet from the sanitary sewer system of the Authority may connect to the system provided, however, that the connection is make entirely at the expense of the property owner and the connection is make pursuant to the provisions of Part 1 of the Fox Township Sewer Code and all rules and regulations of the Authority.

GENERAL STIPULATIONS

REGULATIONS OF THE AUTHORITY

All facilities must be designed following the guidelines included in this Handbook, the Fox Township Sewer Code, rules and regulations, and regulation set fourth by the Pennsylvania Department of Environmental Protection (DEP). All facilities must be constructed in accordance with the technical specifications adopted by the Authority, copies of which are provided in the Appendix of this Handbook. All sewer facilities must be adequately sized for the Authority's future requirements.

REGULATION OF THE DEPARTMENT OF ENVIRONMENTAL PROTECTIONS (DEP)

1. All regulations and requirements of the Pennsylvania Department of Environmental Protections pertaining to the construction of sanitary sewers are incorporated herein as if those rules and regulations were fully written in this document.

2. Any DEP rule, regulation and/or requirement which is more stringent than contained in this Handbook, Fox Township Sewer Code, and Fox Township Sewer Rules & Regulations shall have precedence.

3. The construction of sanitary sewers shall not be permitted until the proper permit(s) has been issued either by the Department of Environmental Protections to the Authority or the Authority itself has issued a permit to the developer authorizing construction of the sanitary sewers.

COST

The Developer is responsible for all costs relative to the design, review, applications, permits, rights-of-way, construction, inspection, connection, testing, and dedication of the facilities to be constructed by the Developer. The applicant shall pay all inspection, permit, connection, and tapping fees before permits will be granted. The Developer will also be responsible for any specific improvements or enlargements required in the existing facilities to accommodate the sewer demands from the proposed service area.

OWNERSHIP AND EASEMENTS

The Authority shall assume ownership and will maintain and operate sanitary sewers that have been constructed by the Developer to serve the land improved, under the following terms and conditions:

1. The Developer has provided evidence the Sewage Planning Modules, as may be required by the Department of Environmental Protections and/or the municipality, is approved.

2. The Developer will provide the Authority the proper Sewer Extension Agreement. (A sample of the Agreement is included in the Appendix. A. Specific Agreement will be drafted by the Authority's solicitor upon submission of an Application to the Authority Manager.)

3. The Developer provides to the Authority easements as may be required to maintain sewers in accordance with the rules and regulations. Easements shall be recorded in the name of respective Authority.

GENERAL SEQUENCE OF AUTHORITY APPROVAL

I. PLANNING PHASE

During the planning phase, two (2) copies of the Sketch Plan must be submitted to the Office Manager for the Authority's review of the layout of the sewage facilities.

The layout should show the approximate locations of the proposed lines and the point of connection to the Authority system. The submission should include the number and types of units proposed, and the estimated average and maximum sewer flows. Submitted sketch plans shall contain a minimum of the following information:

Plans:

i. The name of the proposed subdivision or land development.
ii. North Arrow
iii. Graphics scale
iv. Day, month, year plan prepared and/or revised.
v. Name and address of developer
vi. Name and address of individual or form preparing the plan.
vii. Key map showing location of proposed subdivision and land development.
viii. Total acreage of property.
ix. Location and widths of rights-of-way and cart ways.
x. The layout of each lot.
xi. Utility, drainage and other easements.
xii. Point of connection to existing sewer system.
xiii. Preliminary layout of proposed sewage facilities.

Additional:

i. A draft copy of the Sewage Facilities Planning Modules. (in duplicate)

Based upon the information provided, the Authority will complete an evaluation of the system capacities to determine the ability of the system to serve the proposed service area. A review fee may be assessed to compensate the Authority for the cost of the evaluation.

The evaluation will identify the existence of any potential problems with providing the service requested, both in terms of physical facilities and timing of the service. If the preliminary evaluation indicates that further study is required to determine the ability of the systems to provide the service requested or that modifications are

required, the Developer will be notified that a detailed study must be completed by the Authority. The cost of that study is the responsibility of the Developer. An estimate of the cost of the study will be provided to the Developer so that an escrow can be established to reimburse the Authority for the cost of the study.

In the event that the Developer is unable or does not desire to provide the design and Construction phase services outlined in this Handbook, a request may be made to the Authority to complete these tasks on the Developers behalf. In this instance, all costs of design, permitting and construction will be borne by the Developer. The Authority will provide the Developer with a cost estimate to complete the tasks. An escrow account will be established to reimburse the Authority for the cost of the project.

The Authority's approval of Developer's request for planning approval shall not constitute approval to serve the proposed subdivision or land development project.

II. FINAL DESIGN PHASE

Three (3) copies of the Final Plans shall be submitted to the Authority Manger for the Authority's review of the proposed sewer line construction. The plans shall include the detailed design of the proposed facilities including, plan of the sewer mains indicating the locations of all vents and cleanouts, and detailed plans of any special facilities such as grinder pumps, pumping stations, special construction such as highway, stream or railroad crossings. Plans shall meet, but not limited to, requirement set fourth under Fox Township Sewer Code, Rules & Regulations and herein. Final Plans shall also meet the following requirements:

i. Final Plans shall show all facilities, all rights of way and parcels for dedication. Plans shall be laid out and contain, as a minimum, the information listed on the FINAL PLAN CHECKLIST, which can be found in the Appendix. The scale shall be a maximum of 1" = 50', or other suitable scale for all proposed water and sewer line construction. Suitable scales shall be used for pump stations and appurtenances. Sheet size shall be 24" X 36". U.S.G.S. datum shall be used for all elevations.

ii. The plans must be prepared under the supervision of or by a Pennsylvania registered professional engineer whose seal, signature and registration number shall appear on each sheet of the plans. All designs must meet the current requirements of Pennsylvania Department of Environmental Protection (DEP), Authority, and other controlling agencies where deemed appropriate by the Authority.

iii. All designs shall conform to good engineering practice and shall meet the requirements of all applicable regulatory agencies and the Authority. The technical requirements shall be in accordance with the Authority's standard specifications that are included in the Appendix.

These specifications are standard in nature and the Authority reserves the right to alter the requirements to meet specific project conditions. The developer shall check with the Authority prior to initiating design to confirm that the current edition of the standard specifications are in his possession.

iv. The plan submission should also include information relative to rights-of way to be granted to the Authority and property to be dedicated to the Authority as a pump station. That information shall include right-of-way or property drawings and legal descriptions.

v. Provide the Authority with one (1) copy of the Department of Environmental Protection approval of the Sewage Facility Planning Module(s).

vi. The Developer shall present to the Authority for it consideration a fully executed (in triplicate) Sewer Extension Agreement as contained in the appendices.

vii. Include two (2) copies of all applications and supporting data required by the various agencies from which approval is required for the project. The submission should also include the application forms that the Developer wishes the Authority to complete for the required project approvals.

viii. In the event a Water Quality Management Permit must be issued by the DEP, the Developer shall submit three (3) copes of the appropriate application mandated by the DEP accompanied by the requisite fee as mandated by the Department. Following approval of final design, the Authority shall submit the application for Water Quality Management Permit to the DEP.

The Developer shall be solely responsible for the application for all permits for any local, state, and federal approvals required for the construction of the project. This responsibility shall include preparation of all application forms, supporting data, and payment of all filing fees and PA DOT bonds and insurances. All permits and/or approvals shall be in the name of the Authority.

The Authority will review the plans relative to the proposed sewer facilities and provide written comments. The Developer shall be required to make the revisions required by the Authority and make a resubmission of the final plans. The Authority will review the revised final plans and, if all questions have been resolved, issue approval of the proposed sewer line extension.

At the time the approval is issued, the Authority, as appropriate, will execute the application forms submitted with the final plans, provided all outstanding invoices for review fees have been paid by the Developer.

IV. CONSTRUCTION PHASE

A. REQUIRED DOCUMENTATION

After final plan approval and issuance of all required permits by the appropriate agencies, but prior to the issuance of a permit by the Authority, the Developer shall submit two (2) copies of all agreements, permits, rights-of-way, insurances and bonds required for the construction of the project. It shall also be required that all outstanding invoices for final plan review be paid. Changes to any plans or documents modified as required by any reviewing agency shall be included in this submission.

In addition to the documentation itemized above, the Developer shall also post financial security to ensure completion of the construction in accordance with approved plans and the rules and regulations of the Authority. Financial security may be Federal or Commonwealth chartered lending institution irrevocable letters of credit and restrictive or escrow accounts posted with a Federal or Commonwealth chartered lending institution chosen by the Authority, if the lending institution is authorized to conduct such business within the Commonwealth. Such security shall provide for, and secure to the Authority, the completion of the improvements.

The amount of financial security shall be equal to one hundred ten percent (110%) of the cost of the required improvements, including inspection and testing costs, and record drawings for which financial security is to be posted. The construction cost shall be established by estimate acceptable to the Authority and can be based on actual contract amounts or estimates made by the Authority. The escrow shall also include an amount to pay for inspection during construction, as well as testing and inspection as construction is completed. The Authority will establish the allowance for inspection and testing. Any unexpended balance in the escrow will be returned.

If more than one year from the date of posting such financial security is required for completion of the required improvements, the amount of financial security may be increased by an additional ten percent (10%) for each one-year period beyond the first anniversary date from the posting of financial security or to one hundred ten percent (110%) of the cost of completing the required improvements as reestablished on or about the expiration of the preceding one-year period.

B. PRECONSTRUCTION

Prior to construction, the Developer must complete the following:

1. Schedule a preconstruction meeting with the Authority to review all aspects of the proposed project and the construction schedule.

2. Provide a list of contractors, subcontractors, and material suppliers to the Authority.

3. Submit material samples and material compliance certifications if requested by the Authority.

4. Provide documentation satisfactory to the Authority, indemnifying and holding harmless the Authority, their consultants and employees, for any and all claims for injury, death or damages, arising or alleged to arise from the construction of the project.

Construction shall not begin until the Developer has received a letter from the Authority that all preconstruction requirements have been satisfactorily completed. At that time, a Permit will be issued, provided the Developer has paid all costs of review.

C. DURING CONSTRUCTION

All construction must be completed in accordance with the specifications of the Authority relative to sewer line construction and the approved plans. The type of inspection, either full-time or periodic, shall be at the discretion of the Authority. The inspector shall have the authority to halt construction if, in his/her opinion, construction is not being completed according to the approved plans and specifications. The cost for the Authority inspection will be paid from the escrow established. The Developer shall be responsible for the inspection costs of permitting agencies such as PennDOT, Conrail, Townships, etc.

The Contractor for the Developer shall maintain detailed field notes regarding any agreed-upon changes to the design plans. Copies of these notes will be turned over to the Authority at the completion of installation for comparison of the record drawings with the design drawings.

As the construction proceeds, the Developer may request the Authority to authorize the release, from time to time, of portions of the financial security as long as the progress of work remains satisfactory to the Authority. Any such request, and basis therefore, shall be in writing to the Authority. If the Authority approves the request, the Authority will, within thirty (30) days of its approval of a request for partial release of escrow funds, authorize a release to the Developer on the basis of the approved partial release. The Authority will not authorize release of more than ninety percent (90%) of the amount due the Developer on account of the partial estimates.

The retainage will be held until the Authority, as appropriate, formally accepts the construction.

Following installation, all facilities will be inspected and tested in accordance with the Authority specifications. All inspection and testing and subsequent re-inspection and retesting shall be at the cost of the Developer.

D. POST CONSTRUCTION

Following completion of the installation and satisfactory passage of the inspections and tests required by the Authority, the Developer may request that the Authority accept dedication of the competed facilities. That request shall be made in writing and include the following:

1. Two (2) copies of the Contractor's field notes regarding agreed-upon changes to the design plans made during the installation of the facilities.

2. Two (2) sets of plans and one (1) set of reproducible mylars showing the sewer facilities installed. The plans shall incorporate all changes to the design plans made during construction and shall constitute record plans of the facilities. In addition, the record plans shall include the location, length and depth of all sewer services.

3. Two (2) sets of right-of-way drawings, descriptions, and agreements revised to include any changes in location made during construction. If no changes were made from the documents previously submitted, no new submission is required. In that instance, the Developer shall indicate in writing to the Authority that no changes have been made from the location shown and described on the previously submitted right-of-way documents.

4. Financial security in the amount of 10% of the actual installation cost of the facilities to secure integrity of the facilities for a period of 12 months (24 months in the case of State road work) from the date of acceptance by the Authority.

The Developer shall grant permission to the Authority to utilize portions of the facilities installed prior to acceptance if the Authority deems such use advisable.

The Developer shall provide a warranty for one (1) year following the date of acceptance of the facilities by the Authority. This warranty shall include all equipment, materials or appurtenances installed by the Developer. It shall be the sole responsibility of the Developer to repair or replace any equipment, materials or appurtenances deemed defective by the Authority during that period. The warranty shall include restoration and/or settlement of excavated areas either in public or private rights-of-way. The Developer shall be solely responsible for refilling excavations and restoring surfaces damaged due to settlement during that period.

The Developer shall provide financial security in a form satisfactory to the Authority in an amount of ten percent (10%) of the installed cost of the facilities as non interest-bearing security for any repairs required to the facilities within such warranty period. If, within that warranty period, any work installed by the Developer is determined to be defective by the Authority, the Developer shall promptly make repairs to such defective work.

If repairs to the defective work are not made within a reasonable period, such period to be at the sole discretion of the Authority, the Developer agrees that the Authority shall use the security provided by the Developer to make such repairs. The Developer shall provide additional funds to maintain the security at the 10% level and/or to complete the repairs should the security be insufficient, and to reestablish the security at the 10% level. At the end of the warranty period, the security shall be returned to the Developer.

FOX TOWNSHIP SEWER AUTHORITY

APPLICATION TO CONSTRUCT PUBLIC SEWER FACILITIES

DATE_____

APPLICANT NAME_____

ADDRESS_____TELEPHONE_____

_____ZIP_____

PROJECT NAME_____

LOCATION_____

(Attach sketch plan and location map on USGS quadrangle or other suitable mapping)

Number of units to be connected:

	NUMBER	FLOW
First Year	_____	_____
Second Year	_____	_____
Third Year	_____	_____
Fourth Year	_____	_____
Fifth Year	_____	_____
Ultimate	_____	_____

Type of units and number of each to be served:

Single Residence _____
Multi-Family Residential _____
Commercial _____
Industrial _____
Other (specify) _____

Proposed point of connection: _____
(Street Intersection)

_____
APPLICANT SIGNATURE

APPENDICES

FINAL PLAN CHECKLIST

1. Cover Sheet
    a. Key/Location Map
    b. Name of Project
    c. DEP Permit #
    d. Authority Permit #
    e. Name of Permittee
    f. Name of Engineer
    g. Name of Township, County & State
    h. Date of Preparation
    i. ACT 172 Information
    j. Engineers Seal (Signed)
    k. Engineers Certificate (Signed)
    l. Change Notations (If Any)
    m. List of Plans
    n. Sheet Reference
2. Second Sheet
    a. General Plan of Project
    b. Lots Located & Numbered
    c. Street & ROW Locations
    d. Sanitary Sewer Location
    e. Scale to use Majority of Sheet
3. Subsequent Sheets (Plan and Profile sheets)
    a. Plan
        i. Sheet Size: 24” x 36”
        ii. Scale: 1” = 50’
        iii. Title Block

FINAL PLAN CHECKLIST

Check List Continued

iv. Benchmark (1 per sheet)

v. Structures in Plan

vi. Utilities and Drainage in Plan

1. Mains

2. Laterals

a. Wyes Stationed

b. Profile Over Sewer

i. Horizontal Scale: 1" = 50'

ii. Vertical Scale: 1" = 5'

iii. Existing and Proposed Grade

iv. Pipe Sizes, Grades and Material

v. Sewer Inverts at Manholes (Entering & Exiting)

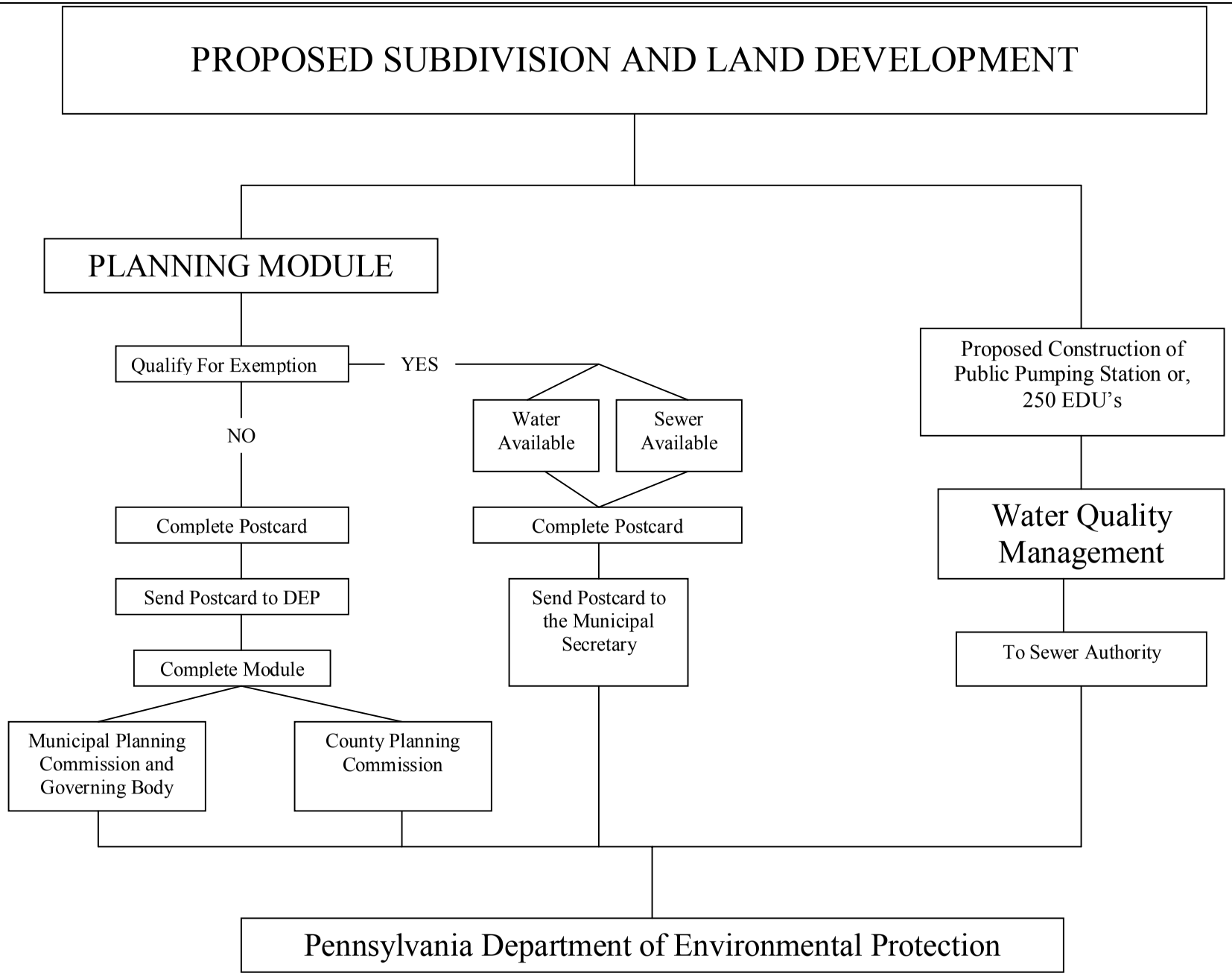
vi. Tope of Casting Elevations

vii. Structure including Basement Elevations

viii. Utilities and Drainage in Profile

1. Crossing

2. Closely Parallel


PROPOSED SUBDIVISION AND LAND DEVELOPMENT
PLANNING MODULE
Qualify For Exemption
YES
NO
Water Available
Sewer Available
Complete Postcard
Complete Postcard
Send Postcard to DEP
Send Postcard to the Municipal Secretary
Complete Module
Municipal Planning Commission and Governing Body
County Planning Commission
Proposed Construction of Public Pumping Station or, 250 EDU's
Water Quality Management
To Sewer Authority
Pennsylvania Department of Environmental Protection

DIVISION 2 - SITE WORK
SECTION 02221 - TRENCHING, BACKFILLING AND COMPACTING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Excavating trenches for utilities.

B. Backfilling and compaction of utility trenches.

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO T 99, Moisture-Density Relations of Soils, Using a 5.5-lb Rammer and a 12-inch Drop.

2. AASHTO T 191, Standard Method of Test for Density of Soil In-Place by the Sand Cone Method.

B. American Society for Testing and Materials:

1. ASTM D698 - Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort.

2. ASTM D1556 - Test method for Density and Unit Weight of Soil in Place by Sand Cone Method.

3. ASTM D 2216 - Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock

4. ASTM D2321 - Practice for Underground Installation of Flexible Thermosplastic Sewer Pipe.

5. ASTM D2977 - Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

6. ASTM D3017 - Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

7. ASTM D4643 - Test Method for Determination of Water Moisture Content of Soil by the Microwave Oven Method

C. Pennsylvania Department of Transportation:

1. PADOT Publication 408, 1994 edition

   a. PADOT Section 703.2, Coarse Aggregate
   b. PADOT Section 703.3, Select Granular Material

2. PADOT Chapter 459, Occupancy of Highways by Utilities, latest edition

3. PADOT Chapter 203, Work Zone Traffic Control, latest edition

1.03 DEFINITIONS

A. Definitions:

1. Rock Excavation: Removal of consolidated hard mineral material mass exceeding one-half cubic yard in volume which, cannot be excavated except by drilling and blasting or drilling and wedging. Structure foundations of concrete or of masonry or stone laid in cement-mortar is classified as rock if the volume requiring removal at a single location exceeds one-half cubic yard. No soft or disintegrated rock which can be removed with a pick, or material which can be broken down by sledge hammers, or a ledge or single boulder less than one-half cubic yard in volume, or loose, shaken, or broken stone in rock filling or elsewhere, or rock exterior to the line of measurement as hereinafter specified, will be allowed as rock**. For purposes of bidding this contract, rock excavation is unclassified.**

2. Miscellaneous Unclassified Excavation: Unclassified Excavation required by the Engineer and not included in other items for payment.

3. Miscellaneous Aggregate Backfill: Aggregate backfill required by the Engineer and not included in other items of payment.

4. Miscellaneous Earth Backfill: Earth backfill required by the Engineer and not included in other items of payment.

5. Subgrade: Trench bottom prepared as specified to receive first class bedding, concrete cradle or concrete encasement or the bottom of excavations prepared to receive pipe line structures.

6. Utility: Any buried pipe, duct, conduit or cable.

7. Final Surfacing Elevation: Elevation of bottom of final surfacing operation such as bottom of topsoil depth or paving subgrade.

1.04 SUBMITTALS

A. Submit under provisions of 01300.

B. Samples: Submit aggregate samples when requested by Engineer and other required submissions to the Engineer's field office.

C. Test Reports:

1. Submit testing laboratory aggregate test reports based on requirements stated in Source Quality Control.

2. Compaction density test reports based on method of density determination as specified in Reference Standards and the method as approved by the Engineer.

D. Certificates: Submit certificate from aggregate supplier based on requirements stated in Source Quality Control, when requested by Engineer.

E. Bonds and Licenses: Submit evidence of bonds, licenses, and experience prior to commencement of any blasting operations.

1.05 QUALITY ASSURANCE

A. Source Quality Control:

1. Laboratory Tests: In accordance with Section 01400, aggregate materials specified herein under Products require advance examination or testing according to methods referenced, or as required by the Engineer.

a. Testing laboratory shall furnish both Engineer and Contractor two copies of test result reports. Same reports will be considered as sufficient evidence of acceptance or rejection of materials represented.
b. Conduct aggregate quality tests in accordance with requirements of appropriate Referenced Standard for such materials.
c. The Engineer reserves the right to accept aggregate materials based on certification from supplier that the aggregate originates from a source approved by PADOT and that the aggregate complies with specified PADOT requirements.

B. Regulatory Requirements

1. Work performed within Spring and Benner Township rights-of-ways shall be completed according to all requirements of the appropriate Township.

1.06 PROJECT CONDITIONS

A. Classification of Excavated Materials: No consideration will be given to the nature of the materials encountered in trenching operations or for difficulties encountered during excavating or handling of materials. Therefore, if rock, as defined, is encountered in trenching operations, no additional payments will be made for difficulties occurring in excavating and handling of materials.

B. Removal of Obstructions:

1. Remove, realign or change the direction of above or below ground utilities and their appurtenant supports, if such is required in the opinion of the Engineer. Perform such work as extra work unless such work is done by the Owner of the obstruction without cost to the Contractor. However, Contractor shall uncover and sustain the obstruction at own expense prior to the final disposition of obstruction. The Contractor is not entitled to claims for damage or extra compensation due to the presence of such obstruction or delay in the removal or rearrangement of same. Additional precautions concerning obstructions as follows:

a. Do not interfere with persons, firms, corporations or utilities employing protective measures, removing, changing or replacing their property or structures, but allow said persons, firms, corporations or utilities to take such measures as they may consider necessary or advisable under the circumstances; which shall not relieve the responsibilities of the Contract.

b. Without extra compensation, break through and reconstruct if necessary, the invert or arch of a sewer, culvert or conduit that may be encountered if the said structure is in such a position, in the judgment of the Engineer, as not to require its removal, realignment or complete reconstruction.

C. Environmental Requirements:

1. Do not perform trenching, backfilling or compacting when weather conditions or the satisfactorily.

2. Do not use frozen materials as backfill nor wet materials containing moisture in excess of the amount necessary for satisfactory compaction.

3. Prior to use, moisten dry backfill material not having sufficient moisture to obtain satisfactory placement or compaction.

4. Plan work so as to provide adequate protection during storms with provisions available for preventing flood damage. Protect installed piping and other work against damage from uplift due to high ground water levels.

5. Accommodation of Drainage: Keep gutters, sewers, drains and ditches open for surface drainage. No damming or ponding or water in gutters or other waterways will be permitted, except where stream crossings are necessary and then only to an extent which the Engineer shall consider necessary. Do not direct water flows across or over pavements except through approved pipes or properly constructed troughs. When so required, provide pipes or troughs of such sizes and lengths as required, and place the same as required at no expense to the Owner. Perform grading in the vicinity of trenches so that the ground surface is properly pitched to prevent water running into the trenches.

6. Pumping: Keep excavations free from water during the performance of the work under this Contract at no expense to the Owner. Build dams and other devices necessary for this purpose, and provide and operate pumps of sufficient capacity for dewatering the excavations. Provide for the disposal of the water removed from excavations in such manner as not to cause injury to the public health, to public or private property, to the work of others, to the portion of the work completed or in progress or produce an impediment to the use of streets, roads and highways.

7. When it is necessary to haul soft or wet soil material over roadways, use suitably tight vehicles to prevent spillage. Clear away spillage of materials caused by hauling on roadways.

8. Provide effective dust and mud control.

9. Do not dispose of water in trenches by draining through completed portions of sewer piping.

D. Protection: Assume the risks attending and presence or proximity of overhead or underground public utility and private lines, pipes, conduits and support work for same, existing structures and property of whatever nature. Damages and expenses for direct or indirect injury to such structures or to any person or property by reason of them or by reason of injury to them; whether such structures are or are not shown on the Drawings, by work of this Contract, rests solely with the Contractor.

1. Outside Rights-of-Way: Take necessary precautions to protect trees, shrubs, lawns and such other landscaping from damage. Complete restitution work for damages at no additional cost to Owner.

2. Pipe Supports: Adequately support underground pipes or conduits exposed as a result of excavations. Provide adequate support along their entire exposed length. Install such supports in such manner that backfilling may be performed without dislodging such pipes or conduits. Place and carefully compact Aggregate Backfill around the supports and leave such supports in place as a guard against breakage due to backfill settlement. No additional payment will be due the Contractor for support material left in place or for the labor of installing and maintaining supports.

3. Temporary Protective Construction:

a. Temporary Fence Barricade: Erect and maintain substantial temporary fences surrounding excavation to prevent unauthorized persons from entering such areas.

b. Barricades: Furnish and erect substantial barricades at crossings of trenches, or along trenches, to protect the traveling public.

c. Excavation Covers: Cover open excavation when work therein is suspended or left unattended, including the end of a work day. For such covers, use materials of sufficient strength and weight to prevent their removal by unauthorized persons.

d. Remove temporary protective construction at the completion of work on the Project.

e. Comply with Spring and/or Benner Township and PA DOT requirements.

E. Structure Supports: Where passing buildings or any structure which by their construction or position might bring a great pressure upon the trenches, the right is reserved by the Engineer to require that such buildings or structures be underpinned or supported and protected, or special sheeting be driven or that short lengths of trench be opened at one time. Failure of Engineer to recommend said protection shall not relieve Contractor of his responsibility to protect structures near the construction.

F. Accommodation of Traffic: (Comply with the requirements of Section 01500.) DO NOT OBSTRUCT FIRE HYDRANTS. Employ traffic control measures in accordance with PADOT, Title 67, Chapter 203.

G. Explosives and Blasting:

1. Blasting will be permitted except in areas where the proximity of structures, underground facilities or public safety precludes the use of explosives or unless otherwise noted on the Drawings.

2. The use of explosives shall be governed by the "Regulations for the Storage, Handling and the Use of Explosives" of the Pennsylvania department of Labor and Industry and any other applicable federal, state, local codes that may have jurisdiction, or utility company requirements.

3. All blasts shall be properly matted and securely covered. The Contractor shall be solely responsible for injury to persons or property located within or beyond the area or scope of the project that may result from his use of explosives.

4. Blasting work shall be supervised by personnel licensed and experienced in this type of work.

5. Explosives shall be stored in state-approved magazine off the job site and shall be delivered to the site in vehicles clearly marked to indicate cargo.

6. Blasting will be permitted in the Township rights-of-way. Township permits for blasting may be required. The Contractor shall be solely responsible for damage to streets located within or beyond the area or scope of the project that may result from the use of explosives at no additional cost to the Owner.

H. Removal of Rock by Means Other Than Blasting: Where removal of rock by means other than blasting is required, in accordance with the requirements of State and local laws, rules and regulations, and utility owner requirements, remove by the use of mechanical surface impact equipment, or by drilling and hydraulic rock splitting equipment, or by other methods.

I. Responsibility for Condition of Excavation: Condition and results of excavation are solely the responsibility of the Contractor. Remove slides and cave-ins at whatever time and under whatever circumstance they occur.

J. Excess Materials: No right of property in materials is granted to the Contractor of excavated materials prior to backfilling. This provision does not relieve the Contractor of his responsibility to remove and dispose of surplus excavated materials.

K. Borrow Material: When the required quantity of backfill material exceeds the quantity of suitable on site material, provide borrow material. If borrow material is needed, notify the Engineer sufficiently in advance to permit the Engineer to verify such need and to view the proposed borrow pit to determine the material suitability. Borrow excavation will be subject to the Engineer's approval whose written consent shall be obtained prior to its use. Contractor shall be responsible for all sampling and testing required by Engineer to determine suitability.

L. Change of Trench Location or Depth:

1. Should the Engineer require a change in location of a trench from that indicated on the Drawings due to the presence of an obstruction, or from other cause and such change is made before the excavation is begun, the Contractor shall not be entitled to extra compensation or to a claim for damages.

2. If a change in trench location made at the request of the Engineer involves the abandonment of excavation already made, such abandoned excavation, together with the necessary backfill will be classified as Miscellaneous Unclassified Excavation and Miscellaneous Earth or Aggregate Backfill, (whichever applies).

3. The Contractor shall have no claim for additional compensation as a result of changes in trench depths other than the unit price bid for trenches of the revised depth. However, if the change results in abandonment of excavation already made, such abandoned excavation together with the necessary backfill will be classified as Miscellaneous Unclassified Excavation and Miscellaneous Earth or Aggregate Backfill (whichever applies).

4. If a changed location of a trench is authorized by the Engineer upon the Contractor's request, the Contractor shall not be entitled to extra compensation or to a claim for damage. If such change of trench location involves the abandonment of excavation already made, the abandoned excavation and backfill shall be at the Contractor's expense.

M. Advance Trenching: Where existing Utilities or other suspected underground obstructions as indicated on the Drawings are within close proximity of proposed pipelines, uncover and verify the exact location of Utilities and other underground obstructions far enough in advance of pipe laying to allow any changes in pipe alignment or grade required to bypass the obstructions to avoid removing sections of pipe already installed. If any sections of installed pipe must be removed and reinstalled as a result of not verifying Utilities or other underground obstructions far enough in advance, the Contractor shall remove and reinstall the pipe at no additional cost to Owner.

1.07 COORDINATION

A. Coordinate work under provisions of Section 01010.

B. Verify work associated with lower elevation Utilities is complete before placing higher elevation Utilities.

PART 2 - PRODUCTS

2.01 FILL MATERIAL

A. Backfill

1. Suitable Trench Backfill Material: On site excavated soil or soil-rock mixed materials free of topsoil, vegetation, lumber, metal and refuse; and free of rock or similar hard objects larger than six inches in greatest dimension. Rock to soil ratio shall not exceed one part rock to three parts soil.

2. Clean Organic Material Backfill: One site excavated material free of vegetation, lumber, metal and refuse, and free of rocks or similar hard objects larger than one inch in greatest dimension. Rock to soil ratio shall not exceed one part rock to three parts soil.

3. Aggregate Backfill: PADOT 2A Coarse Aggregate conforming to PADOT Publication 408, Section 703.

B. Pipe Bedding

1. First Class Bedding: Coarse Aggregate conforming to PADOT Publication 408, Section 703.2

a. For piping having a diameter of 24 inches and less use AASHTO No. 8 Coarse Aggregate.
b. For pipes having a diameter greater than 24-inches use AASHTO No. 57 Coarse Aggregate.

2. Initial Backfill: Coarse Aggregate conforming to PADOT Publication 408, Section 703.2

a. For piping having a diameter of 24 inches and less, use AASHTO No. 8 Coarse Aggregate.
b. For pipes having a diameter greater than 24-inches use AASHTO No. 57 Coarse Aggregate.
c. For ductile iron piping, use clean earth backfill or, if aggregate backfill is required, use aggregate backfill.

C. Concrete Cradle and Encasement: Conforming to Section 03301 - Cast-in-Place Concrete with a 28-day compressive strength of 3,000 psi.

D. Unsuitable Bearing Material: AASHTO No. 3 Coarse Aggregate conforming to PADOT Publication 408, Section 703.2.

E. Underground Warning Tape: Required for nonmagnetic force main and curvelinear gravity pipe.

1. Printed polyethylene tape, three inches minimum width, color coded, one inch minimum lettering, printed with name of utility buried below, and suitable for installation in all soil types.

2. Magnetic.

3. Provide for:

a. Sewer pipe, green.

PART 3 - EXECUTION

3.01 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. Protect plant life, lawns, rock outcropping and other features remaining as a portion of final landscaping.

C. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

D. Maintain and protect above and below grade utilities which are to remain.

3.02 EXCAVATING

A. Perform soil erosion and sedimentation control work in accordance with the approved Erosion and Sedimentation Control Plan.

B. General:

1. Excavation shall be performed to the lines and grades indicated on the Drawings or as directed by the Engineer.

2. Perform excavation and backfilling using machinery except where hand excavation and backfilling is required or is necessary to protect existing structures, utilities, or other private or public properties.

3. Begin excavation in trenches at the control point having the lower invert and proceed upward.

4. Remove pavement according to requirements of Section 02500 - Paving.

5. Remove rock to subgrade at least twenty-five (25) feet in advance of pipe laying.

6. Do not interfere with 45 degree bearing splay of foundations.

C. Subgrade Preparation:

1. Do not excavate below depths indicated or specified except where unsuitable material is encountered at subgrade.

2. Remove unsuitable material found below subgrade to a depth determined by Engineer and backfill with Unsuitable Bearing Replacement material or as directed by Engineer to required Subgrade.

3. Remove rocks or other hard matter protruding through trench bottom at Subgrade which could damage pipe or impede consistent backfilling or compaction. Backfill with first class bedding to required Subgrade. Compact in four (4) inch lifts.

4. Remove rock below subgrade if shattered due to excessive drilling impact or splitting operations and in the opinion of the Engineer it is unfit for foundations. Backfill to Subgrade with Concrete or other material acceptable to the Engineer. No separate or additional payment will be made for such removal and backfill.

E. Excavated Material Storage:

1. Separate and stockpile in designated area, excavated materials suitable for use as backfill. Remove from the site, excess materials and excavated materials not suitable for backfill.

2. In no case shall excavated materials be stockpiled outside of the construction easements or the permanent right-of-way if construction easements are not in place.

F. Trench Width:

1. From subgrade elevation to an elevation at least twelve inches above the top of the outside barrel of the pipe, excavate trench banks to vertical lines and not less than the minimum nor more than the maximum widths specified in Table A. If shoring is required, the following Table A dimensions apply to the inside face of sheeting.

TABLE A

Diameter of Pipe	**Minimum Trench Width (Outside Diameter of Pipe at the Barrel Plus)**	**Maximum Trench Width (Outside Diameter of Pipe at the Barrel Plus)**
through 24 inches	**12 inches**	**16 inches**
27 through 36 inches	**20 inches**	**24 inches**
42 through 72 inches	**26 inches**	**30 inches**
Larger than 72 inches	**30 inches**	**36 inches**

2. From a point twelve inches above the top of the outside barrel of the pipe, maintain trench banks as follows:

a. Vertical as possible for trenches in paved or unpaved roadways.

b. In open areas, trenches may be sloped at angles required to make trench stand, however, in no case shall angle exceed one-half horizontal to one vertical.

c. Top of trench shall not exceed limits of right of way or construction easement if such is in place.

d. Maintain trenches such that there is no conflict with State or OSHA regulations.

G. Length of Open Trench:

1. Complete trench excavation at least twenty-five (25) feet but not more than one hundred (100) feet in advance of pipe laying and keep trenches free from obstructions, except that at the end of a work day or at the discontinuance of work, the pipe laying may be completed to within five feet of the end of the open trench.

2. The Contractor shall limit all trench openings to a distance commensurate with all rules of safety.

3. If the work is stopped either totally or partially, the Contractor shall refill the trench and temporarily repave over the same at his expense. The trench shall not be opened until he is ready to proceed with the construction of the pipeline.

4. Engineer reserves the right to request trench refilling over completed pipe if in his judgement, such action is necessary. No claim for extra compensation will be allowed for such refilling even though work may be stopped elsewhere as a result.

3.03 PIPE BEDDING

A. Place Pipe Bedding and Initial Backfill as specified herein unless indicated otherwise on Drawings. Place material in trench for full width. Place on each side of pipe and fittings simultaneously.

B. First Class Bedding: Carefully place on undisturbed subgrade or compacted subgrade as pipe springline. Work pipe bedding material by hand under pipe haunching to provide adequate side support. Place in three (3) inch layers.

C. Initial Backfill: From pipe springline to twelve (12) inches above outside of pipe barrel carefully place initial backfill in four (4) inch layers. Place carefully so as not to disturb pipe.

3.04 BACKFILL

A. Backfill trenches to contours and elevations indicated on Drawings.

B. Maintain optimum moisture content of fill materials to attain required compaction density.

C. Do not use frozen backfill materials or place backfill on frozen subgrades or trench subgrades.

D. Preform backfilling by methods which will result in thorough compaction of backfill material.

E. Backfill to Final Restoration Elevation: Backfill from one (1) foot above the top of pipe to Final Restoration Elevation using backfill materials specified in Schedule at end of this Section. Consolidate backfill materials evenly from center to side of trench to prevent arching.

F. If there is a deficiency of backfill material, provide borrow material as required at no additional cost to Owner

3.05 COMPACTION

A. Solidly tamp each layer of bedding around the pipeline and above pipeline using proper tamping tools made specially for this purpose. Compact each layer to the densities specified in the Schedule contained at the end of this Section using ASTM D698 Standard Proctor Test Methods determined at maximum density at optimum moisture content as determined by AASHTO T 99.

B. Do not use rolling equipment or heavy tampers to consolidate backfill until at least two (2) feet of backfill is placed over the top of the pipe.

C. The use of HYDRA-HAMMER for compacting backfill in trenches is prohibited.
D. The use of puddling or jetting for compacting backfill in trenches is prohibited.

E. Compaction Tests: During the coarse of backfilling and compacting, the Owenr/Engineer will at various locations and depths of trenches request that the Contractor make field tests to verify that specified compactions are being achieved. Perform field density tests according to AASHTO T 191 or ASTM D2977 and ASTM D3017. At a minimum, the following will apply:

1. One compaction test shall be performed at every two vertical feet of backfill every 200 linear feet in roadways, paved areas, and driveways, etc.

2. One compaction test shall be performed at every four vertical feet of backfill every 500 linear feet in all other areas.

F. If compaction tests indicate that Work does not meet specified requirements, remove Work, replace, compact and retest at no additional cost to the Owner.

3.06 CLEAN-UP AND MAINTENANCE

A. General: During construction, the surfaces of all areas including, but not limited to, roads, streets, and driveways shall be maintained on a daily basis to produce a safe, desirable, and convenient condition. Streets shall be swept and flushed after backfilling, and recleaned as dust, mud, stones and debris caused by the work, or related to the work again accumulates.

B. Remove surplus excavated materials, rubbish and other construction debris from the site after backfilling is completed.

C. Construction site shall be left clean at end of each working day to satisfaction of Engineer.

3.07 Clay dikes to be installed at mid-point of manhole run. If pipe grade exceeds 10%, the clay dikes will be installed at one-third and two-thirds of manhole run, or where directed by Engineer.

END OF SECTION

DIVISION 2 - SITE WORK
SECTION 02605 - MANHOLES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Sanitary sewer manholes and related appurtenances.

1.02 REFERENCES

A. American Society for Testing and Materials.

1. ASTM A 48 - Gray Iron Castings.
2. ASTM A 276 - Stainless and Heat-Resisting Steel Bars and Shapes
3. ASTM A 307 - Carbon Steel Externally Threaded Standard Fasteners
4. ASTM A 615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
5. ASTM C 270 - Mortar for Unit Masonry
6. ASTM C 361 - Reinforced Concrete Low-Head Pressure Pipe
7. ASTM C 443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
8. ASTM C 478 - Precast Reinforced Concrete Manhole Sections
9. ASTM C 923 - Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes
10. ASTM D 2146 - Propylene Plastic Injection and Extrusion Materials
11. ASTM D 2240 - Test Method for Rubber Property-Durometer Hardness

B. American Association of State Highway and Transportation Officials (AASHTO) Standards as referenced throughout these Specifications.

C. American Water Works Association:

1. AWWA C 302, AWWA Standard for Reinforced Concrete Water Pipe-Noncylinder Type, Not Prestressed.

D. Federal Specifications:

1. Fed. Spec. SS-SS-210A, Sealing Compound, Preformed Plastic, for Expansion joints and Pipe Joints (Type 1 Rope Form).

1.03 SUBMITTALS

A. Shop Drawings and Product Data:

1. Manufacturer's published detail drawings, modified to suit design conditions if required, and Contractor prepared drawings as applicable.

2. Manufacturer's sworn certification that components and products will be manufactured in accordance with specified reference standards for components and products.

3. Manufacturer's sworn certification that manhole frame and cover tensile test bars were poured from the same iron as castings they represent.

B. Certificates:

1. Certified records or reports of results of shop tests, such records or reports to contain a sworn statement that shop tests have been made as specified.

2. Manufacturer’s sworn certification that components and products will be manufactured in accordance with referenced standards for components and products as specified in source quality control.

1.04 QUALITY ASSURANCE

A. Initial Manhole: Construct first manhole in the Project to demonstrate the following, and serve as the minimum acceptable conditions of construction throughout the Project. No additional compensation allowed for initial manhole requirement.

1. Demonstrate manhole base construction methods.

2. Demonstrate manhole component sealing in the case of precast reinforced concrete manholes.

3. Demonstrate manhole step alignment.

4. Demonstrate pipe opening sealing.

5. Demonstrate method of adjustment of manhole frame and cover to grade and manhole frame and cover attachment.

6. Demonstrate successful manhole acceptance test.

B. Shop Inspection:

1. All materials furnished by the Contractor shall be certified by the supplier for compliance with the pertinent specifications. Shop inspections and testing may be required. The cost of shop testing shall be borne by the Contractor.

C. Field Inspection

1. All materials furnished shall be tested for defects in material and/or workmanship in the manner specified and in the presence and as approved by the Engineer.

D. Source Quality Control:

1. Maintain uniform quality of products and component compatibility by using the products of one manufacturer for precast reinforced concrete manholes.

2. Obtain certificate of construction compliance with ASTM C 478 from the precast reinforced concrete manhole manufacturer. Submit same certificate as part of required submittals.

3. Obtain certificate of approval from PA DOT for manhole frame and cover manufacturer, and precast reinforced manhole manufacturer. Submit same as part of required submittals.

4. Obtain certificate of material compliance with ASTM A 48, Class 30 tensile strength from the manhole frame and cover manufacturer. Furnish certification that tensile test bars were from same pour as castings. Submit same certificates as part of required submittals.

5. Obtain certification from manufacturer that manhole covers complies with AASHTO HS-20 loading requirements.

1.05 DELIVERY, STORAGE AND HANDLING

A. Transport and handle precast reinforced concrete manhole components and other Products specified herein in a manner recommended by the respective manufacturers of such to prevent damage and defects. Through-wall lifting holes not permitted in manhole component construction.

B. Store precast reinforced concrete manhole components in accordance with manufacturer's recommendations to prevent joint damage and contamination. Exercise such care in storage of other specified Products as recommended by the respective manufacturers.

1.06 PROJECT CONDITIONS

A. Environmental Requirements:

1. Do not set or construct manhole bases on subgrade containing frost.

2. To improve workability of Preformed Plastic Sealing Compound during cold weather, store such at temperature above 70 degrees F or artificially warm compound in a manner satisfactory to the Engineer.

PART 2 - PRODUCTS

2.01 BASIC MATERIALS

A. Cast-in-Place Concrete Products: Formwork, and Cast-in-Place Concrete conforming to requirements of Division 3 - Concrete. Type II Portland cement shall be used.

B. Waterproofed Mortar: Material composition meeting requirements of ASTM C 270, Type M with waterproofing admixture included.

1. Medusa Cement Company; Medusa Waterproofing Paste or Powder.

2. Grace Construction Materials; Hydratite.

3. Chem-Master Corporation; Hydrolox.

4. Or Equal.

C. Epoxy Bonding Compound: Use product such as A. C. Horn EPOXTITE BINDER; Sika Chemical SIKADUR-HI-MOD or equal.

D. Manhole Steps: Design as indicated on Drawings.

1. Reinforced Plastic Step: Composed of a 1/2-inch Grade 60, ASTM A 615 deformed steel reinforcing bar completely encapsulated in Grade 49108, ASTM D 2146 polypropylene copolymer compound, Type II; M. A. Industries, Inc., Type PS1-PF or equal.

2. Manhole step dimensions shall meet requirements of OSHA standard 1910.27 for fixed ladders.

E. Manhole Frame and Cover: Gray iron castings conforming to ASTM A 48, Class No. 30, designed for AASHTO Highway Loading Class HS-20. Provide castings of uniform quality, free from blowholes, porosity, hard spots, shrinkage distortion or other defects. Frame and cover design and dimensions as indicated on Drawings.

1. Finish: Bearing surfaces machined to prevent rocking and rattling under traffic. Casting surfaces shotblast cleaned and coated with asphalt paint, non-tacky drying.

2. Identification: Cast the word SANITARY integrally on cover in two inch size raised letters.

3. Frame Hold-down Bolts: ASTM A 307. Each frame shall have four one-inch bolt holes equally spaced to match the manhole inserts for fastening.

4. Cover Gasket: One piece O-ring gasket factory installed in a machined rectangular or dovetail groove in the cover bearing surface.

   a. Gasket material of neoprene composition having good abrasion resistance, low compression set, Type D 40 durometer hardness determined in accordance with ASTM D 2240 and suited for use in sanitary sewer manholes.
   b. Gluing of gasket is not permitted.

5. Tensile Test Bar: Size B, cast separately, but poured from same iron as castings they represent.

6. All manhole covers shall contain two non-penetrating pick holes.

H. Watertight Manhole Frame: Gray iron castings conforming to previously specified requirements for Manhole Frame and Cover with the addition of cover hold-down bolts.

1. Cover Hold-Down Bolts: Type 316 stainless steel, ASTM A 276, bolts and washers; or manufacturer's standard bronze bolts and washers.

I. Preformed Plastic Sealing Compound: Fed. Spec. SS-S-210A, Type 1, Rope Form, of either bitumastic base compound or butyl rubber base compound, and shipped protected in a removable two-piece wrapper. Size cross-section of rope form, (7/8" x 1-3/8" minimum) to provide squeeze-out of material around entire interior and exterior circumference when joint is completed.

1. K. T. Snyder Company, Inc.; RAM-NEK

2. K. T. Snyder Company, Inc.; RUB'R-NEK

3. Hamilton Kent Manufacturing Company; KENT-SEAL NO. 2

4. Or Equal.

J. PVC Waterstop: Gasket type waterstop composed of virgin polyvinyl chloride (PVC) such as manufactured by Fernco Joint Sealer Co.; CMA Concrete Manhole Adapter. (CMA Waterstop distributed by The General Engineering Company, Frederick, Maryland).

K. Pipe Opening Seals: Shall be cast integrally with manhole section, sized to fit pipe specified, and set at correct elevation and location. Shall meet requirements of ASTM C-923.

1. Dura Tech, Inc. – DUAL SEAL II-III

2. Press Seal Gasket Corp. – PRES SEAL

3. A-Lok Products – A-Lok Manhole Pipe Seal

4. Scales Manuf. – RES SEAL

2.02 PRECAST REINFORCED CONCRETE MANHOLE COMPONENTS

A. Materials and Construction: Conforming to requirements specified in ASTM C 478 except as follows:

1. Concrete: Composition and compressive strength conforming to ASTM C 478 except use Type II or Type III cement in manhole components and increase compressive strength to 4500 psi (at 28 days) in precast bases.

2. Casting and Curing: Wet cast and steam curing process in accordance with Section 3.6.11 and 3.7.2 of AWWA C 302.

3. Manhole Steps: Factory installed in manhole components, prealigned vertically, spaced on equal centers, and located the minimum distance from ends of risers and top sections as indicated on Drawings.

4. Manhole Component Seals: Manhole component joints factory formed for self-centering concrete to concrete bearing employing either a rubber compression gasket or preformed plastic sealing compound.

   a. Rubber Compression Gasket: Composition conforming to ASTM C 361 or ASTM C 443.
   b. Preformed Plastic Sealing Compound: As specified previously.

5. Manhole Component Design: Base, tapered and straight riser section, and top section dimensions and diameters, not consistent with ASTM C 478, are as indicated on Drawings.

6. Lifting Holes and Lugs: Through-wall lifting holes not permitted in manhole component construction. Factory-install lifting keys or lugs integrally in manhole components.

B. Precast Bases and Riser Sections: Design, materials and construction as specified previously.

C. Pipe Openings: Custom preformed during manufacturing in each base and riser section requiring such, to accommodate type of pipe and pipe opening seal provided.

1. Manufacturers: A Lok Products (A Lok MH Pipe Seal) or Dual Seal Gaskets Inc. (Dual Seal II).

D. Precast Top Sections: Designs as required by Drawings, of materials and construction as specified previously except additional and differing requirements as follows:

1. Hold Down Bolt Inserts: Factory cast in top section no less than four 3/4-inch threaded inserts or slotted inserts to accommodate manhole frame hold down bolts. Threaded inserts of three inches depth. Both insert types designed for an ultimate load in tension of 12,500 pounds. Inserts factory plugged for shipping. Coordinate insert location with manhole component manufacturer to assure proper location in top sections.

2. Eccentric Cone Tops: Manufacture to same minimum wall thickness and with same area of circumferential steel reinforcement as riser sections.

E. Precast Grade Rings: Leveling and adjusting units of three inches or four inches thickness of materials and constructions as specified previously. Factory cast grade rings with hold down bolt holes matching location of same in manhole frame. Design must provide for full bearing of manhole frame.

F. Bitumastic Coating: two (2) coats of a bitumastic coating by Koppers 300M Epoxy, Pennsbury 32-B-4 Epoxy, or approved equal.

PART 3 - EXECUTION

3.01 INSPECTION

A. Inspect precast reinforced concrete manhole components in accordance with requirements of ASTM C 478 regarding repairable defects and defects subject to rejection by the Engineer.

3.02 PREPARATION

A. Keep pipe and manhole interiors cleared of debris as construction progresses.

B. Earthwork: Perform earthwork for manhole installation as previously specified in Trenching, Backfilling and Compacting: Section 02221.

3.03 MANHOLE CONSTRUCTION METHODS

A. Cast-in-Place Concrete Manhole Base: Construct in accordance with design and dimensions indicated on Drawings. When necessary to construct wider or deeper manhole bases than indicated or specified, build such bases as required by the Engineer.

1. Form and pour concrete in accordance with requirements of Division 3 - Concrete. Additional requirements as follows:

a. Vibrate poured concrete using mechanical vibrator of a type and design approved by Engineer. Use vibrators of type capable of transmitting vibration to concrete in frequencies of not less than five thousand impulses per minute.

b. Form and pour joint monolithically in manhole base top to match joint of adjoining precast riser section. Use template as obtained from precast concrete manhole component manufacturer of manhole components used in the Project.

2. Install sewer piping in cast-in-place manhole bases prior to pouring the concrete.

a. Apply Epoxy Bonding Compound in accordance with manufacturers instructions to pipe at base connection prior to pouring the concrete.

b. Install PVC Waterstop on pipes entering and leaving manhole base prior to pouring concrete. Install PVC Waterstop in accordance with manufacturer's written instructions.

3. Use 4000 psi concrete, unless indicated otherwise on Drawings.

B. Precast Concrete Bases: Install bases on a 6-inch deep compacted layer of AASHTO No. 57.

1. When using prefabricated pipe opening seals (i.e., A-LOK, RES-SEAL, PRES-WEDGE II, etc.) for connecting pipes into manholes, and such seals create an annular space on interior and exterior of manhole wall pipe openings after pipe connection is made, fill such annular spaces with preformed plastic sealing compound.

    a. Tightly caulk sealing compound into annular spaces in a manner to completely fill the spaces and render the installation watertight.
    b. Following sealing compound installation, trowel compound surface smooth and flush with interior face of manhole.

C. Length of Pipe Connections into Manholes:

1. Use pipes no longer than five feet in length when connecting into manholes through resilient gasket type pipe opening seals (i.e., A-LOK, RES-SEAL, PRES-WEDGE II, etc.).

2. For all other pipe connections into manholes, use pipes of such length that a pipe joint is provided at the outside edge of manhole base or wall as applicable. Also use pipes no longer than 6 feet in length for first pipe joined thereto.

D. Concrete Channel Fill: Field pour concrete channel fill for each manhole base.

1. Form inverts directly in concrete channel fill.

2. Accurately shape invert o a semi-circular bottom conforming to inside of connecting pipes, and steel trowel finish to a smooth dense surface.

3. Make changes in size and grade gradually.

4. Make changes in direction of entering sewer and branches to a true curve of as large a radius as manhole size will permit.

5. Make slopes gradual outside the invert channels.

6. Use 4000 PSI concrete unless indicated otherwise on Drawings.

E. Manhole Wall Erection: Provide precast reinforced concrete straight riser, tapered riser and top sections necessary to construct complete manholes. Fit the different manhole components together to permit watertight jointing and true vertical alignment of manhole steps.

1. If rubber compression gaskets are used between sections, install gaskets and join sections in accordance with written instructions of manhole component manufacturer.

2. If preformed plastic sealing compound is used between sections, install sealing compound in accordance with manufacturer's recommendations, and join sections also in accordance with written instructions of manhole component manufacturer.

   a. Prime joint surfaces if required by preformed sealing compound manufacturer.
   b. If sealing compound is installed in advance of section joining leave exposed half of two piece protective wrapper in place until just prior to section joining.
   c. Use preformed sealing compound as the sole element utilized in sealing section joints from internal and external hydrostatic pressure.

   d. Arrange and pay for the preformed sealing compound manufacturer's representative to be present for first installation of manhole sections to instruct workmen on proper installation methods of sealing compound and to be present while manhole sections are being installed.
   e. Following manhole section installation, trowel sealing compound surface smooth and flush with interior face of manhole.
   f. Make pipe connections into manhole walls as specified previously for pipes connecting into manhole bases.

F. Lifting Recess Sealing: Seal with properly designed tapered rubber plugs. Drive plugs into recesses in such manner to render them completely water and air tight. Sealing of lifting recesses with grout not permitted.

G. Frame and Cover Installation: Where required, make final adjustment of frame to elevation using materials selected in Contractor's options.

1. Set precast grade rings in non-shrink grout. Cement thickness not to exceed 3/4-inch maximum and 3/8-inch minimum. Wet, but do not saturate precast grade rings immediately before laying.

2. Precast grade ring: Pre-set to proper plane and elevation using wedges or blocks of cementitious material not exceeding one square inch wide on all sides. No more than four wedges or blocks per grade ring permitted. Incorporate wedges or blocks in fresh grout to product squeeze-out between grade rings. Tool exposed joints with appropriately shaped tool and compact mortar edge into joints. Clean off excess grout prior to initial grout set.

3. Parge the outside of precast grade ring with a minimum of 1/2-inch thick waterproof nonshrink grout.

4. Bolt manhole frames in place on manhole top section, or on leveling units if required, after installing 1/2-inch thick preformed plastic sealing compound on bearing surface of manhole frame. Remove excess sealing compound squeeze-out after manhole frame is bolted in place.

5. Use bolts of sufficient length to properly pass through leveling units, if any engage full depth of manhole top section inserts and allowing enough threaded end to pass through manhole frame to properly tighten nut and washer. Tighten manhole frame bolts after grout has cured.

H. Waterproofing: The entire outer surface of all manhole components including parged grade rings shall receive two coats of bitumastic.

I. Drop Manholes: Construct in accordance with Type indicated in Details on Drawings. Use same type pipe and fittings in drop connection as used in sewer line from which drop connection is made.

J. Connections to Existing Manholes or Structures: Core drill required opening or openings to prevent cracking and spalling concrete. Make openings of sufficient size to accommodate pipe with PVC Waterstop installed and one inch of annular grout space. Grout annular space using Non-Shrink and Non-Metallic Grout as specified in Section 03600 - Grout. Make connection watertight. Form a new invert channel in the existing manhole base to properly conduct the flow through the existing manhole. Do not permit ground water, surface water or debris to enter the existing facilities through the new connection.

1. Plugging Existing Facilities: Plug pipe opening where noted on the Drawing. Provide watertight seal using Class B Concrete.

3.04 FIELD QUALITY CONTROL

A. General: Test each manhole constructed in the Project by one of the methods specified herein. If the manhole is constructed on an existing sewer where sewage flow must be maintained, the test will be waived.

1. Conduct tests in presence of and to complete satisfaction of the Engineer.

2. Should a manhole not satisfactorily pass testing, discontinue manhole construction in the Project until such manhole does test satisfactorily.

3. Provide tools, materials (including water), equipment and instruments necessary to conduct manhole testing specified herein.

a. Vacuum Testing Equipment:

1) Use vacuum apparatus equipped with necessary piping, control valves and gauges to control air removal rate from manhole and to monitor vacuum.
2) Provide an extra vacuum gauge of known accuracy to frequently check test equipment and apparatus.
3) Vacuum testing equipment and associated testing apparatus subject to Engineer's approval.
4) Provide seal plate with vacuum piping connections for inserting in manhole frame.

4. Prior to testing clean manholes thoroughly and seal openings, both to the complete satisfaction of the Engineer. Seal openings using properly sized plugs.

5. Perform testing with frames installed. Include the joint between the manhole and manhole frame in the test.

6. The Contractor may elect to make a test for his own purposes prior to backfilling. However, conduct tests of the manholes for acceptance, only after the backfilling has been completed.

B. Vacuum Test Procedure:

1. Perform vacuum testing in accordance with the testing equipment manufacturer's written instructions.

2. Draw a vacuum of ten inches of mercury and close the valves.

3. Consider manhole acceptable when vacuum does not drop below nine inches of mercury for the following manhole sizes and times:

a. Four foot diameter - 60 seconds
b. Five foot diameter - 75 seconds
c. Six foot diameter - 90 seconds

C. Repair and Retest: Determine source or sources of leaks in manholes failing acceptable limits.

1. Repair or replace defective materials and workmanship, as is the case, before conducting such additional Manhole Acceptance Tests and such subsequent repairs and retesting as required until manholes meet test requirements.

2. Materials and methods used to make manhole repairs must meet with Engineer's approval prior to use.

3. Make repairs, replacements and retests at no additional expense to Owner.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02722 - PIPED WASTEWATER SEWER

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Sanitary sewer pipe, force mains, fittings and related appurtenances.

1.02 REFERENCES

A. American National Standards Institute:

1. ANSI A 21.4, Cement-Mortar Lining for Cast Iron and Ductile-Iron Pipe and Fittings for Water.

2. ANSI A 21.10, Gray-Iron and Ductile-Iron Fittings, 2 through 48 inches, for Water and Other Liquids.

3. ANSI A 21.11, Rubber Gasket Joints for Cast Iron and Ductile Pressure Pipe and Fittings.

4. ANSI A 21.50, Thickness Design of Ductile-Iron Pipe.

5. ANSI A 21.51, Ductile-Iron Pipe, Centrifugally Cast, in Metal Molds or Sand-Lined Molds for Water or Other Liquids.

B. American Society for Testing and Materials.

1. ASTM D 1784, Rigid Poly (Vinyl Chloride) Compounds and Chlorinated Poly (Vinyl Chloride) Compounds.

2. ASTM D 1785, Poly (Vinyl Chloride) (PVC) Plastic Pipe Schedules 40, 80 and 120.

3. ASTM D 2467, Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

4. ASTM D 2564, Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

5. ASTM D 3034, Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

6. ASTM D 3212, Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

7. ASTM F 477, Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

8. ASTM F 789, Type PS-46 Poly (Vinyl Chloride) (PVC) Plastic Gravity Flow Sewer Pipe and Fittings.

9. ASTM D 2321, Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.

10. ASTM D2837, High Density Polyethylene Sewer Pipe

C. American Water Works Association:

1. AWWA C 600, Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Shop Drawings and Product Data: Furnish completely dimensioned shop drawings, catalog cut or other data as required to provide a complete description of piping, fittings and appurtenances specified herein.

C. Certificates:

1. Certified records of reports of results of shop tests, such records or reports to contain a sworn statement that shop tests have been performed as specified.

2. Manufacturer's sworn certification that pipe will be manufactured in accordance with specified reference standards for each pipe type.

1.04 QUALITY ASSURANCE

A. Design Criteria:

1. Use one type and class of pipe in continuous line of sewer between structures, unless otherwise indicated on the Drawings.

2. Use pipe and fittings designed to withstand imposed trench loadings and conditions at the various locations.

B. Source Quality Control:

1. Shop Tests: Each pipe manufacturer must have facilities to perform listed tests. The Engineer reserves the right to require the manufacturer to perform such additional number of tests as the Engineer may deem necessary to establish the quality of the material offered for use.

	Material	Test Method	Number of Tests
a.	Ductile Iron Pipe	ANSI A 21.51	As specified in ASNI A 21.51
b.	Polyvinyl Chloride Pipe	ASTM D 3034	As specified in ASTM D 3034, ASTM 2241

2. Laboratory Tests: The Engineer reserves the right to require that laboratory tests also be conducted on materials that are shop tested. Furnish without compensation, labor, materials, and equipment necessary for collecting, packaging, and identifying representative samples of materials to be tested and the shipping of such samples to the Testing Laboratory. These laboratory tests will be paid for by the Contractor.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Transport, handle and store pipe materials and other Products specified herein in a manner recommended by the respective manufacturers to prevent damage and defects.

1.06 SITE CONDITIONS

A. Environmental Requirements:

1. Keep trenches dewatered until pipe joints have been made and concrete cradle and encasement (as required) have cured.

2. Do not lay pipe in water or on bedding containing frost.

3. Do not lay pipe when weather conditions are unsuitable, as determined by the Engineer, for pipe laying work.

PART 2 - PRODUCTS

2.01 SEWER PIPE AND FITTINGS

A. For pipe joints, use rubber gaskets suitable for conveying domestic sewage.

B. Ductile Iron (DIP):

1. Pipe: ANSI A21.50 and ANSI A 21.51, ASTM A377 and ASTM A716.

2. Wall Thickness Class (Buried): Class 52.

3. Fittings: Gray iron or ductile iron ANSI A21.10.

4. Joints:

a. Rubber-Gasket Joints (Buried): ANSI A 21.1

1) For buried pipe installation, provide mechanical joints except where other types of joints are indicated on the Drawings or required by the Specifications.

5. Cement Lining: Ductile Iron pipe and fittings shall be coated inside with double thickness cement mortar lining (1/8") and seal coated, all in conformance with ANSI A21.4 and AWWA C104.

6. Pipe and Fittings Coating: Factory coated inside and out with bituminous material; minimum 1 mil dry thickness. Bituminous material and finished coat conforming to seal coat requirements in ANSI A21.4.

C. Polyvinyl Chloride Pipe (PVC): Use PVC pipe except as noted otherwise on Drawings.

1. Gravity Sewer Pipe: Type PSM SDR-35, ASTM D 3034.

2. Force Main: SDR-21 (200 PSI), ASTM D 2241.

3. Fittings: Conforming to same applicable ASTM Specification requirements for pipe.

4. Joints: Push-on with elastomeric gasket, ASTM D 3212; and ASTM F 477 for gasket specifications.

a. Pipe bell design shall incorporate a gasket locked in a groove so as to prevent displacement when pipes are joined.

PART 3 - EXECUTION

A. Inspect each section of pipe and each pipe fitting before laying in conformance with the inspection requirements of the appropriate referenced standard.

B. Remove rejected pipe from the Project.

3.02 PREPARATION

A. Clean piping interior and mating surfaces of bell, spigot, and gasket prior to laying pipe and following pipe laying. Maintain clean until completed work is accepted.

B. Perform trenching for sewer installation as specified in Section 02221.

C. Coating Touch-Up: Touch-up chipped, cracked, or abraded surfaces and finished joints with two coats of the particular coating material.

3.03 SEWER CONSTRUCTION METHODS

A. General Requirements:

1. Lay pipe proceeding upgrade true to line and grades given. Lay bell and spigot pipe with bell end upgrade unless shown otherwise on the drawings or directed by the Engineer.

2. Exercise care to insure that each length abuts against the next in such manner that no shoulder or unevenness of any kind occurs along inside bottom half of pipe line.

3. Center spigot end in bell or socket end of previously laid pipe, shove tight and secure.

4. No wedging or blocking permitted in laying pipe unless by written order of Engineer.

5. Before joints are made, bed each section of pipe full length of barrel with recesses excavated so pipe invert forms continuous grade with invert of pipe previously laid. Do not bring succeeding pipe into position until the preceding length is embedded and securely in place.

6. Walking or working on completed pipe line, except as necessary in tamping and backfilling, not permitted until trench is backfilled one-foot deep over top of pipes.

7. Take up and relay pipe that is out of alignment or grade, or pipe having disturbed joints after laying.

8. Take up and replace with new, such in-place pipe sections found to be defective. Replace at Contractor's expense.

9. Take necessary precautions to prevent newly laid pipe from floating as a result water accumulation in the trench; or the collapse of the pipe line from any cause. Restore or replace pipe as necessary at Contractor's expense.

10. Bed pipe using materials specified in Section 02221 - Trenching, Backfilling and Compacting.

11. At the close of each day's work, and at such other times when pipe is not being laid, protect open end of pipe with a close fitting stopper.

12. Cut pipe using only equipment specifically designed for that purpose such as an abrasive wheel, rotary wheel cutter, a guillotine pipe saw or a milling wheel saw. The use of chisels or hand saws will not be permitted. Grind smooth cut ends and rough edges. Bevel slightly, cut end for push-on connections.

13. Where cutting of pipe is necessary, minimum laying length shall be five (5) feet.

B. Joints: Make joints in joining of pipe materials specified under PART 2 and not specifically covered for installation under PART 3 of this Specification, in strict accordance with manufacturer's installation instructions and such included reference standards.

1. Arrange and pay for pipe manufacturer's representative to be present for first installation of pipe to instruct workmen on proper installation methods.

2. Make joints absolutely watertight and immediately repair detected leaks and defects. Methods of repair subject to Engineer's approval.

C. Laying Ductile Iron Pipe: Installation and joint assembly according to AWWA C 600, and as follows:

1. Where necessary to field cut pipe use approved pipe cutter, milling cutter or abrasive wheel saw.

2. Make joints as specified previously under Joints.

3. Pipe sections must have a minimum laying length of 5 feet.

D. Laying Specified Types of Plastic Pipe: Installation and joint assembly according to ASTM D 2321 for Class I bedding material.

E. Drop Connections: Make drop connections where indicated on the Drawings, where drop in invert is two feet or more or as required by the Engineer. Use same pipe material used to construct the main from which the drop connection is made. Construct drop connection in accordance with design shown on Detail Drawing.

F. Wye, Lateral Service Connections: Use wye fittings for connection to the sewer main. Use pipe if required as specified previously. Make connection to existing piping with flexible pipe couplings.

1. Use commercially manufactured wye or tee fittings and one-eighth bends.

2. Set wye or tee branches at proper vertical angles as required to bring service connections to the proper depth.

3. Fitting locations determined by the Engineer with respect to existing service connection location.

3.04 FIELD QUALITY CONTROL

A. General Requirements: Conduct tests specified herein so that each pipe line installed in the Project is tested to the Engineer's satisfaction.

1. Provide tools, materials (including water), apparatus and instruments necessary for pipe line testing.

2. Conduct tests in the presence of and to the satisfaction of the Engineer.

B. Alignment: After the mains have been laid and backfilled, a light will be flashed between manholes or manhole locations to determine whether the alignment of the sewer is true and whether any pipe has been displaced, broken or otherwise damaged subsequent to laying. This test will again be conducted before final acceptance of the sewer. Each section (manhole to manhole) of sewer shall show a good light circle throughout its length and any and all defects shall be corrected by the Contractor, to the satisfaction of the Engineer, before the work shall proceed and before acceptance of and/or payment therefore shall be made.

C. Initial Section Test:

To demonstrate acceptability of installed pipe materials and workmanship, construct and air test one sewer section from manhole to manhole using the pipe provided in the Contract. Pretesting such section prior to actual Initial Section Test not permitted.

1. Conduct Initial Section Test in same manner as Line Acceptance Test specified in a following paragraph.
2. Conduct said Initial Section Test for each size and type pipe material used in the Project prior to continued installation of same pipe.

3. Provide pipe manufacturer’s representation during laying, backfilling and testing of Initial Sections Tests.

4. Failure of an Initial Section Test will be sufficient cause for the Engineer to reject manufacturer and supplier of pipe regardless of cause of failure.

5. Sewer sections successfully tested as Initial Section Test will be retested under Line Acceptance Test.

6. Include costs for above stated tests in unit or lump sum price or prices bid for the Work as no separate payment will be allowed for Initial Section Test.

D. Line Acceptance Test for Gravity Lines: (Leakage tests)

1. After a section of sewer is constructed between adjacent manholes, backfilled and successfully cleaned, perform a low pressure air Line Acceptance Test in accordance with ASTM C 828 and the following:

a. Seal and brace sewer piping at upstream and downstream manholes and at all laterals. Test plug seal before actual use by testing plugs outside the trench in one length of pipe pressurized to maximum anticipated testing pressure. Plugs shall hold without bracing and show no movement. After plug is placed in pipe and sealed, brace or protect as insurance against blow out. Protect workers from potential of plug blow out.

b. Introduce low pressure air slowly into sealed sewer section until the internal air pressure is four psig greater than the average ground water pressure acting on the pipe, but in no case higher than 10 psig.

c. To determine the internal air pressure for the test, add 3.5 psig to the height in feet of the ground water above the invert of the pipe divided by 2.3. However, the test pressure should not exceed 10 psig.

For example,
if ground water height is 6.9': 3.5+(6.9/2.3) = 6.5 psig.

d. Allow no less than 3 minutes for air temperature and pressure to stabilize. Add air only to maintain required test pressure.

e. After the stabilization period, adjust the test pressure to the required test pressure, and disconnect the air supply. Then measure the time that is required to achieve a 1.0 psig pressure drop.

f. The line passes if the time required for a 1 psig pressure drop exceeds the value listed in the following table. Interpolate values for intermediate distances from those shown. If the time for 1 psig pressure loss is less than that reported in the table, then the line fails and shall be repaired prior to re-test.

g. For conditions not reflected in the Table, utilize the following equation:

$$T=0.085 * \frac{(D*K)}{Q}$$

Where: T=shortest time, in seconds, allowed for the air pressure to drop 1.0 psig.
K=0.000419D*L, but not less than 1.0
Q=0.0015 cubic feet/minute/square feet of internal surface
D=nominal pipe diameter in inches

L=Length of pipe being tested in feet

2. After laterals are installed, re-test line in accordance with the above procedure if line is initially tested before the installation of laterals.

3. Where lines are live and carry flow, perform Joint Acceptance Test by testing one joint at a time as described in paragraph 4, below.

4. Joint Acceptance Test shall test one joint at a time using test apparatus such as CHERNE Joint Tester, CHERNE Industrial, Inc., or equal. Test pressure shall be as determined in paragraph 3.04 E.1.c. above. Consider joint acceptable when the pressure loss is less than one psig in one minute. Perform test after one minute stabilization period.

E. Deflection Test

1. 25% of the total manhole runs will be tested. If lines fail, the test will be increased until assurance of Contract compliance. Any additional test will be at no cost to the Owner.

2. In addition to air test, conduct deflection tests on PVC pipe. Test all PVC sewer main installed not less than 30 days following backfill.

3. Mandrel shall be cylindrical in shape, 95 percent of nominal pipe diameter and 4' long. Mandrel diameter achieved with no less than 8" arms evenly spaced at each end and in the middle of the mandrel.

4. Pull mandrel through pipe section manually. Powered pulling devices not allowed.

5. Pipe fails test if mandrel cannot be pulled through pipe. Note location of failure, excavate, replace pipe section that failed, and re-test.

F. Hydrostatic Testing for Pressure Lines:

1. Leakage Test Requirements:

a. After the pipe has been installed as specified, all newly laid pipe, or any valved section thereof, shall be subjected to a pressure of 150 pounds per square inch, or 50% in excess of the normal working pressure.
b. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.
c. No pipe installation will be accepted until the leakage is less than the number of gallons per hour as determined by the formula,

$$L = \frac{ND \quad P}{7400}$$

in which "L" equals the allowable leakage in gallons per hour; "N" is the number of joints in the length of pipelines tested; "D" is the nominal diameter of the pipe, in inches, and "P" is the average test pressure during the leakage test, in pounds per square inch gauge. (The allowable leakage according to the formula is equivalent to 11.6 gallons per 24 hours per mile of pipe per inch nominal diameter, for pipe in 18' lengths evaluated on a pressure basis of 150 psi.)

2. Duration of Test: The duration of the test under pressure shall be two hours.

3. Procedure: Each valved section shall be slowly filled with water and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to Engineer. The pump, pipe connections, and all necessary apparatus, including gauges, shall be furnished by Contractor and approved by Engineer. Contractor will make all taps into the pipe, and furnish all necessary assistance for conducting the tests.

4. Expelling Air Before Test: Before applying the specified test pressure, all air shall be expelled from the pipe. If hydrants or blowoffs are not available at high places, Contractor shall make the necessary taps at points of highest elevation before the test is made and insert the plugs after the test has been completed, at no additional cost to Owner.

5. Variation from Permissible Leakage: Should any test of pipe laid disclose leakage greater than that specified above, Contractor shall, at his own expense, locate, repair and replace the defective joints, pipe or fittings until the leakage is within the specified allowance.

6. Time for Making Test:

   a. Where any section of a main is provided with concrete reaction backing, the hydrostatic pressure test shall not be made until at least five days have elapsed after the concrete reaction backing was installed. If high early strength cement is used in the concrete reaction backing, the hydrostatic pressure test shall not be made until at least two days have elapsed.
   b. Engineer shall be present during the operating of valves required to fill mains for pressure and leakage test.
   c. Contractor shall advise Engineer of any pressure test and leakage test at least 48 hours in advance. No testing will be authorized unless ambient air temperature is 35 or higher.
   d. The pressure and leakage tests shall be witnessed by Engineer.
   e. Contractor shall furnish laboratory calibrated test gauges and measuring devices for the leakage test.
   f. The section under test shall be brought back to test pressure at one-half hour intervals during the testing. Engineer will record both the makeup water amount and pressure at each one-half hour repressurization.

G. Alignment Test for Pressure Lines:

1. Prior to backfilling of pressure lines, the joint alignment shall be inspected to assure the maximum deflection present in each joint does not exceed the manufacturer's recommendations.

2. Pressure lines which are a portion of a pump discharge system shall be inspected to assure the line is installed at a constant or increasing grade so as to eliminate the possibility for air accumulation at an intermediate high point.

3. Any and all defects shall be corrected by Contractor at no additional cost to Owner and to the satisfaction of Engineer prior to backfilling. This shall be completed before the work shall proceed and before acceptance of and/or payment shall be made.

H. Acceptance: Observation of successful testing of manholes, sewers or force mains by the Engineer does not constitute acceptance of the system or any portion thereof. Upon completion of any determined portion of a total system, and successful testing thereof, the Engineer may recommend final acceptance to the Owner. Only upon final inspection by the Owner or Engineer, and upon written acceptance for same will the system or portion thereof be considered substantially completed. Upon such acceptance, the warranty period as specified for the manholes, sewers or force main will commence.

1. If, during this final inspection, any irregularities are observed, the condition must be corrected at the Contractor's expense prior to acceptance.

3.05 PIPE SCHEDULE

Description	Pipe Material	Joint Type
Gravity Sewers	PVC, SDR 35 DIP	Push-on Mechanical Joint
Pressure Sewers (Force Main)	PVC, SDR 21	Push-on
Pressure Sewers (Pump Station)	DIP	Flanged

MINIMUM SPECIFIED TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015

1 Pipe Diameter (in.)	2 Minimum Time (min: sec)	3 Length for Minimum Time (ft)	4 Time For Longer Length (sec)	SPECIFICATION TIME FOR LENGTH (L) SHOWN (MIN:SEC)							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	597	.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3.46	3:46
6	5:40	398	.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3:418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768 I	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

END OF SECTION