

**STANDARD CONSTRUCTION
AND MATERIAL SPECIFICATIONS**

FOR

**SANITARY SEWER
SYSTEM EXTENSIONS**

2003

**WEST HANOVER TOWNSHIP
WATER AND SEWER AUTHORITY
DAUPHIN COUNTY
PENNSYLVANIA**

GANNETT FLEMING, INC.



HARRISBURG, PENNSYLVANIA

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AND MATERIAL SPECIFICATIONS

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SECTION 1 - GENERAL INSTRUCTIONS

1.01 DEFINITIONS. Wherever in these Specifications the following words, terms and expressions, or pronouns in place of them are used, the intent and meaning shall be interpreted as follows:

Approved, etc. The words "approved", "acceptable", "satisfactory", or words of like import, shall mean approved by, or acceptable, or satisfactory, to the Engineer, unless another meaning is plainly intended or otherwise specifically stated.

Completion Certificate: The certificate of the Engineer approved by the Owner indicating the completion and acceptance of all work specified and performed under the Contract.

Contract: The written agreement executed by and between the Developer and the Contractor, covering the performance of the work and the furnishing of labor, materials and service in the construction of sewer extensions to the West Hanover Township Water and Sewer Authority Wastewater Collection System.

Contractor: Party of the Second Part or Second Party to the Contract, acting directly or through his authorized lawful agents, legal representatives, superintendents, or employees, appointed to act for said party in the performance of the work under contract.

Developer: Party of the First Part or First Party to the Contract; the corporation, partnership, or individual intending to develop for residential or other purposes a certain tract of land situated within the sewer franchise area of the Owner, acting directly or through any authorized lawful agents, legal representatives or employees appointed to act for said party in the execution of the work of the Contract.

Drawings or Plans: Collectively, all of the drawings or plans (or reproductions of them) pertaining to the construction of the project and attached to the Contract or otherwise made a part thereof; and also such supplementary drawings as may be issued from time to time in order to elucidate or clarify said Contract Drawings, or for showing details which are not shown thereon.

Engineer: The person or organization duly employed by the Owner as consultant and authorized to inspect the results of the performance of the work under Contract by the Contractor, acting directly or through properly authorized agents, engineers, assistants, inspectors, or other representatives acting severally within the scope of the particular duties entrusted to them. The word "Engineer", shall include the officers, agents and employees of the Engineer. In cases where the Owner does not employ a consultant, the word "Owner" is substituted for "Engineer" throughout these Specifications.

Inspection: The examination of the work performed by the Contractor to ascertain its conformity with the Specifications.

Owner: WEST HANOVER TOWNSHIP WATER AND SEWER AUTHORITY, acting directly or through any agent, officer or employee duly authorized to act for the said party in the execution of the work required by the Contract.

Payment Bond: The approved and executed form of security furnished by the Developer and his Surety as a guaranty of good faith to promptly pay or cause to be paid in full such sums as may be due for material furnished, labor supplied or performed, services rendered and reasonable rentals of equipment for certain periods.

Performance Bond: The approved and executed form of security furnished by the Developer and his Surety as a guaranty of good faith to execute and complete the work in accordance with the terms of the Agreement.

Project: All the necessary performance, services and materials required for the satisfactory completion of the work under Contract as described in the Specifications and indicated on the Drawings.

Sewer Extension Agreement: The written agreement executed by and between the Owner and the Developer covering the performance of the work and the furnishing of labor, materials and service in the construction of the Project, also any and all supplemental agreements which could reasonably be required to complete the construction contemplated.

Specifications: Collectively, all of the definitions, descriptions, directions, provisions, requirements, terms and stipulations contained in these Standard Specifications; and all written supplements thereto, made or to be made, pertaining to the Contract, and the materials and workmanship to be furnished under the Contract.

Subcontractor: A person, firm or corporation having a direct contact with the Contractor to perform part of the latter's contract; such as one who installs or furnishes and installs equipment forming a permanent part of the Contract work, or who furnishes labor for work required by the Contract in accordance with the Plans and Specifications. This term does not include individual workmen furnishing labor only, nor one who merely furnished material not worked to a special design.

1.02 DRAWINGS AND SPECIFICATIONS. The Drawings and Specifications are complementary, and the requirements of any one shall be considered as the requirements of all.

(a) The Specifications in this document are written as if they were included in the Contract Documents executed by and between the Developer and the Contractor. Whether they are so used is at the discretion of the Developer; however, the Owner will not accept the sanitary sewer extensions provided by the Developer unless and until they conform to the requirements of these Standard Specifications.

(b) All drawings or plans pertaining to the Project (the Contract Drawings) shall be submitted by the Developer to the Owner for review. After review of these Contract Drawings by

the Owner, the Developer shall make any corrections required, and submit corrected copies thereof to the Owner. The Owner's approval of the Contract Drawings shall not relieve the Developer from responsibility for errors or discrepancies in such drawings. All Contract Drawings shall be prepared and submitted in conformance with the requirements set forth in Section 01300.

(c) Deviations from the Drawings or Specifications required by the exigencies of construction will be determined by the Engineer only, and authorized in writing.

(d) At all times the Contractor shall keep on the Project, available to the Engineer and his representatives, one (1) copy of the Drawings, and Specifications.

1.03 PRELIMINARY INSPECTION. Unless the requirement is waived by the Engineer prior to the start of actual construction operations, the Contractor, or his authorized representative, shall go over the Project accompanied by the Engineer, or his designated representative, and shall observe for himself, with the approved Drawings before him, all pertinent conditions relative to the Contract, including the status of rights-of-way and structures, obstructions, or other objects to be removed, altered and changed.

1.04 COMPETENT WORKMEN. The Contractor shall employ only competent and efficient superintendents, foreman, clerks, timekeepers, equipment operators, laborers, and mechanics or artisans, for every kind of work. These requirements shall not operate against the employment of physically handicapped persons otherwise employable, where such persons may be safely assigned to work which they can ably perform. No person under the age of sixteen (16) years, and no person currently serving sentence in a penal or correctional institution, shall be employed to perform any work under the Contract.

The Contractor shall provide a competent and reliable person, who is delegated to be readily available and have full authority to act in the behalf of the Contractor, in case it is necessary to deal with any emergency situations, which may arise in connection with the project during off working hours, evenings, weekends or holidays.

1.05 WORKING CONDITIONS.

(a) No night, Sunday, or legal holiday work, requiring the presence of the Engineer or his representative, will be permitted, except in cases of emergency, and then only with the written consent of the Engineer, and to such an extent as he may judge necessary.

(b) No work shall be done when, in the opinion of the Engineer, the weather is unsuitable for good and careful work to be performed. Should the severity of the weather continue, such that the work cannot be prosecuted successfully, the Contractor, upon order of the Engineer, shall cease all such work until directed to resume the same.

(c) The Contractor shall arrange for, and be responsible for, a sufficient amount of illumination at all times subject to the approval of the Engineer, to carry on all phases of the work.

(d) The Engineer shall be given at least three (3) working days notification prior to construction to schedule inspection.

1.06 MATERIALS.

(a) The Contractor shall furnish the Engineer, promptly after the award or execution of the Contract, with a complete statement of the origin, composition, and manufacture of all materials to be used in the construction of the Project. Only materials conforming to the requirements of these Specifications and approved by the Engineer shall be used in the work.

(b) Representative preliminary samples of the materials, of the character and quality prescribed in the Contract shall be submitted when indicated or directed, for advance examination or test. Written approval of the quality of such samples shall be received by the Contractor prior to obtaining materials from the respective sources of supply.

(c) Samples of all materials requiring laboratory tests shall be taken under the direction or supervision of, or in the manner prescribed by the Engineer. Such materials shall not be used until accepted as the result of such tests. Materials will be used only so long as the quality of the material remains equal to that of the accepted sample. The acceptance at any time of any material shall not be a bar to its future rejection, if it is subsequently found to be defective or inferior in quality to the material specified.

(d) Required laboratory tests of materials shall be made by a testing laboratory or agency selected or approved by the Engineer and in accordance with the methods indicated herein. When standard Specifications and serial numbers of technical societies and associations are stipulated, the reference shall be construed to be the latest of such Specifications and serial numbers.

(e) The Contractor shall furnish all labor, materials, and equipment necessary for collecting, packaging and identifying, representative samples of materials, and the shipping of such samples to the testing laboratory.

(f) For tests or inspections conducted by, and at the options of, the Engineer, at sites other than the testing laboratory and not under the jurisdiction thereof, the Contractor shall furnish or arrange with the producer to furnish all material, labor, tools, and equipment, and every facility for the verification of the accuracy of all scales, measures and testing equipment, necessary for such tests or inspections.

(g) The Contractor shall permit or arrange with the producer to permit the Engineer or any agent of the testing laboratory to inspect or test any and all material being used or to be used, at any time before, during or after its preparation, or while being used during the progress of the work or after the work has been completed.

(h) Materials shall be stored so as to insure preservation of their specified quality and fitness for the work. When considered necessary they shall be placed on wooden platforms or other hard and clean surfaces, and not on the ground, and shall be placed under cover when

directed. Stored materials shall be located so as to facilitate prompt inspection. Private property shall not be used for storage purposes without permission of the owner or lessee of the property.

(i) If any material intended for use in the construction of the Project has been inspected and rejected after such material has been delivered to the Site, all such rejected material shall be immediately removed from the property by the Contractor.

1.07 REFERENCED STANDARDS.

AASHTO: American Association of State Highway and Transportation Officials

ACI: American Concrete Institute.

AISC: American Institute of Steel Construction.

ANSI: American National Standards Institute.

ASTM: American Society for Testing Materials.

Fed. Spec: Federal Specifications, United States Government.

1.08 ASSIGNED WARRANTIES. Manufacturer's warranties on materials and equipment, including internal components, exceeding the guarantee time period as stated in the Agreement, shall be assigned directly to the Owner. Assigned warranties shall be submitted to the Owner with the appropriate information required therein written and executed before final payment.

1.09 ADVERTISING. No advertising will be permitted on any part of buildings, scaffolding, fences, materials, obstructions, barricades or work.

1.10 PERMITS AND LICENSES. The Contractor or Developer shall, unless otherwise specified, procure all necessary permits and licenses, pay all charges and fees therefore, and shall give all notices necessary and incident to the proper and lawful prosecution of the work. The Owner requires the Developer to complete all necessary permit applications.

Certain permits required in connection with a sewer extension must be obtained in the Owner's name. The permit applications shall be submitted to the Owner for review and submission to permitting agencies. the following permits, as applicable, must be acquired in the Owner's name:

(a) DEP Bureau of Water Quality Management Sewerage Permit. Complete the single-page application form (DEP form ER-BWQ-265) for any sewer extension. If a pumping station is included in the project, DEP Module No. 7 must also be completed. Construction plans, soil erosion and sediment pollution control plan and narrative, and DEP filing fee must also be included.

(b) PennDOT Highway Occupancy Permit. If the sewer extension is to be located in State highway, obtain and complete the Highway Occupancy Permit application form (PennDOT form M945A) and submit five copies to the Owner.

(c) Any pavement cut excavation permits required by the West Hanover Township Water and Sewer Authority.

(d) After review of the applications by the Owner, the Developer shall make any corrections, if required, and submit corrected copies to the Owner. The Owner will forward the applications and fees to the applicable agency.

The Developer shall be responsible for compliance with and payment of costs (fees, inspectors, etc.) in connection with all permits, licenses, and regulations applicable to sanitary sewer extension construction.

Information on the permit forms specific to the Owner as applicant may be obtained from the Owner's Engineer.

1.11 CARE OF PUBLIC AND PRIVATE PROPERTY. The Contractor shall take all necessary precaution to prevent damage to all overhead and underground structures and to protect and preserve property within or adjacent to the Project and shall be responsible for damage thereto. Special care must be used by the Contractor in the prosecution of the work in order to avoid interference or damage to any operating utilities or plants; however, where there is any possibility of such interference or damage, the Contractor shall make satisfactory arrangements with responsible officers or with the owners of the utilities or plants, covering the necessary precautions to be used as safeguards during the performance of the work by the Contractor. Such arrangement shall be made before the work is started and shall be subject to the approval of the Engineer, which approval will not be considered as releasing the Contractor from any responsibility for the acts of himself or his employees or representatives.

The Contractor shall protect all land monuments and property markers which will be affected by the construction until they have been correctly referenced. Monuments and markers which are disturbed by the Contractor during the construction of the Project or otherwise, shall be satisfactorily reset by him when directed.

(a) One Call: If public or privately owned utility pipelines, cables or structures exist below the surface within the construction area, no sub-surface work shall be done in the area without the presence or approval of an authorized representative of the utility company or agency having jurisdiction.

Attention is directed to the provisions of the Underground Utility Line Protection Law Act No. 287 (1974), as amended, and full compliance therewith is required of the Contractor.

The Contractor shall not proceed with construction operations in any work area where subsurface utility pipelines, cables or structures may exist until he has:

- (1) Notified the facility owners through the One Call System (1-800-242-1776) not less than 3 nor more than 10 working days prior to excavation.
- (2) Determined from the owners of such and by use of other prudent techniques the precise locations of such pipelines, cables or structures;
- (3) Made necessary arrangements with said owners for, and has had the locations of the existing pipelines, cables or structures shown on the surfaces by painted markings (or with wood stakes in earth surfaces) and also the kind of utility pipeline, cable or structure shown by painted markings (or markings on wood stakes in earth surfaces).
- (4) Maintained such painted markings and stakes until such time as the work in the area has been completed, and renewed such markings whenever deemed necessary by the Engineer during the maintenance period.
- (5) Otherwise complied with the requirements of Act No. 287 (1974) as amended.

1.12 SAFETY REQUIREMENTS.

(a) The Contractor is solely responsible for implementing any and all safety requirements.

(b) The Contractor shall furnish, erect and maintain at closures, intersections and throughout the Project, all necessary approved barricades, suitable and sufficient red lights, approved reflectors, danger signals, warning, and closure signs, provide a sufficient number of watchmen and take all necessary and legal precautions for the protection of the work and safety of the public. All barricades, danger signals, warning signs and obstructions shall be illuminated at night and all lights shall be kept operational from sunset until sunrise. All materials and safety devices (i.e., barricades, flashing warning lights, torches, reflectors and signs) which the Contractor provides for the purpose of protecting the work and the safety of the public and for maintaining and protecting traffic must conform to the requirements specified in Section 901 of the current edition of the Commonwealth of Pennsylvania Department of Transportation Specifications Publication 408, as supplemented and to the requirements specified in the current edition of PA Code Title 67, Transportation Chapter 203 - Work Zone Traffic Control which complements Section 901.

(c) If, and when the use of explosives is necessary for the prosecution of the work, the Contractor shall observe the utmost care, so as not to endanger life or property. All explosives shall be stored in a secure and safe manner in strict conformity to all State and local regulations, and all such storage shall be clearly marked "DANGEROUS EXPLOSIVES", and shall be in care of a competent watchman at all times.

(d) The safety provisions or applicable laws, and regulations of the Pennsylvania Department of Labor and Industry, and building and construction codes shall be observed. Machinery, equipment, and other hazards shall be guarded in accordance with the safety provisions of the "Manual of Accident Prevention in Construction", published by the Associated

General Contractors of America, to the extent that such provisions are not in contradiction of applicable state and local laws.

Observance of, and compliance with, said regulations shall be solely and without qualification, the responsibility of the Contractor, without any responsibility whatsoever on the part of the Owner or Engineer. The duty of enforcing such laws and regulations lies with the said Department, not with the Owner or Engineer.

(e) The provisions of the "OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970" of the U.S. Department of Labor shall be complied with in the performance of all work. Observance of, and compliance with, said Act shall be solely and without qualification the responsibility of the Contractor, without reliance on superintendence of, or direction by, the Owner or Engineer. The duty of enforcement of the provisions of the Act lies with the U.S. Department of Labor, not with the Owner or Engineer.

(f) Confined Spaces: The Contractor is hereby advised that confined space entry may be required in the performance of this work. No confined spaces shall be entered by Contractor personnel until Contractor written confined space entry procedures are developed for the Project in accordance with the provisions contained within 29 CFR 1910.146 Permit Required Confined Spaces - effective April 15, 1993. These procedures require the identification of potential hazards, safety precautions, protective equipment requirements and rescue procedures [29 CFR 1926.21 (b) (6)]. If respiratory protection is required for entry, the Contractor shall have a written respiratory protection program in effect and which defines attendant responsibilities, communication procedures and safety equipment utilization [29 CFR 1910.134 (e) (3)].

1.13 REGULATIONS OF THE DEPARTMENT OF LABOR AND INDUSTRY. The regulations of the Pennsylvania Department of Labor and Industry relating to wage scales, trenches and excavations, tunnel construction, equipment, materials, labor, safety, sanitation, and other regulations on which the Contractor shall be fully informed and with which he shall fully comply. Observance of and compliance with said regulations shall be solely and without qualification, the responsibility of the Contractor, without reliance or superintendence of, or direction by, the Owner or Engineer. The duty of enforcing such laws and regulations lies with the said Department.

1.14 REGULATIONS AND REQUIREMENTS OF THE DEPARTMENT OF ENVIRONMENTAL PROTECTION (DEP). The Contractor and the Developer are advised that they will be required to design and conduct their work in compliance with the rules, regulations and requirements of the Pennsylvania Department of Environmental Protection.

1.15 OBSERVANCE OF LAWS. The Contractor at all times shall observe and comply with all Federal and State laws and regulations, and local bylaws, ordinances and regulations in any manner affecting the conduct of the work or applying to employees on the Project, as well as all safety precautions and orders or decrees which have been promulgated or enacted, or which may be promulgated or enacted, by any legal bodies or tribunals having authority or jurisdiction over the work, materials, equipment, employees or the Contract; such observance and compliance shall be solely and without reliance on superintendence or direction by the Owner or Engineer. The

duty of enforcement of all of said laws, ordinances, regulations, orders or decrees lies with the body or agency promulgating them, not with Owner or Engineer.

1.16 CLEANING SITE. The Contractor shall at all times keep the Project Site free from accumulations of waste material or rubbish caused by the work. Before the work will be considered as having been completed, the Contractor shall clean and remove from the Project and adjacent property, all surplus and discarded materials, equipment and temporary structures. The Contractor shall also restore all cultivated lawns and shrubbery which he may have damaged in the course of construction.

1.17 ENGINEER'S DUTIES, EXAMINATION AND INSPECTION. The work shall at all times be subject to the examination and inspection of the Engineer and his authorized assistants, who shall have free access to the work, and be furnished by the Contractor with every reasonable facility for examination of the work, to the extent of uncovering, testing or removing finished portions thereof. The Contractor shall provide all labor and equipment necessary for such examinations. The Engineer may require the Contractor to uncover for examination, or to remove any work done or placed in violation or disregard of instructions issued to the Contractor by the Engineer or his representative.

The Engineer will not perform or be responsible for any hiring, firing, supervision, superintendence, direction of personnel, use of equipment, construction site safety, safety programs or the direction of the manner of methods of construction employed by the contractors, their subcontractors, agents, servants or employees.

All inspections and tests shall be performed without unnecessarily delaying the work. All material and workmanship, if not otherwise designated by the Specifications shall be subject to inspection, examination and test by the Engineer or his duly authorized representatives. The Engineer shall have the right to reject defective material or workmanship, or require its correction. Rejected workmanship shall be satisfactorily replaced with proper material and the Contractor shall promptly segregate and remove rejected material from the premises. If the Specifications, the Engineer's instructions, laws, ordinances, or any public authority require the work to be specially tested or approved, the Contractor shall give the Engineer timely notice of its readiness for inspection.

The Engineer shall, within a reasonable time after presentation to him, determine all questions in relation to the construction of the Project, and in all cases decide every question which may arise relative to the performance of the work covered by the Contract.

The Engineer shall have full authority to decide all questions which may arise under the Contract relative to the quality and acceptability of materials furnished and the manner, rate of progress, quality and acceptability of work performed, and the interpretation of any or all Plans and Specifications.

Any verbal opinion or suggestion which the Engineer may give the Contractor shall in no wise be construed as binding the Owner in any way.

In case of any dispute relative to the quality of materials or work, the Engineer shall have authority to reject materials and to advise the Owner to suspend the work. He shall not be authorized to revoke, alter, enlarge, relax or release any requirements of the Specifications, nor to approve or accept any portion of the work, or issue instructions contrary to the Specifications.

Within ten (10) working days after the Developer notifies the Owner in writing that the collection system has been completed and is ready for final inspection, the Owner, or the Owner's agent, shall begin to inspect the collection system in order to verify that the system has been completed in accordance with the approved plans and Specifications. The costs incurred in performing the inspection and testing will be the responsibility of the Developer. The Developer agrees that all defects, problems, damages, or items of poor workmanship that may be found as a result of the inspection, field testing or by any other manner or means, shall be repaired by the Developer in proper manner under the direction and inspection of the Owner's representative prior to acceptance by the Owner. After the acceptance of the sewers, the Owner will notify the Township that connection permits may be issued.

1.18 DEFECTIVE WORK. When any material not conforming to the requirements of the Specifications and Drawings, has been delivered upon the Site of the Project, or incorporated in the work, or when any work performed is of inferior quality, such material or work shall be considered as defective and shall be immediately removed and renewed or made satisfactory as directed by the Engineer. Failure or neglect on the part of the Engineer to condemn or reject any bad or inferior work or materials, shall not be construed as to imply an acceptance of such work or materials, if such bad or inferior material or work becomes evident at any time prior to the delivery of the Completion Certificate by the Owner to the Developer.

The Contractor shall remove any work or material condemned, and shall rebuild and replace the same.

The Contractor shall promptly move from the premises all materials condemned by the Engineer as failing to conform to the Specifications, whether incorporated in the structure or not, and the Contractor shall promptly replace his own work in accordance with the Contract.

1.19 NOTICE. The service of any notice, by the Owner or Engineer to the Developer or Contractor, shall be considered accomplished upon completion of any one of the following procedures.

(a) When delivered, in writing, to the person in charge of the office used by the addressee to conduct business;

(b) When delivered, in writing, to the addressee or any of his authorized agents in person;

(c) When delivered, in writing, to the addressee or any of his agents at the office used by the addressee to conduct the business of the Contractor at or near the Site of the work;

(d) When deposited in the United States Mail, postpaid, and addressed to the party intended for such service at his office used for conducting the business of the Contract at the Site of the work, or his last known place of business; or

(e) When filed at any company operated office of the Western Union Telegraph Company and addressed to the party intended for such service at his last known place of business or for conducting the business of the Contract at the Site of the work.

1.20 ENGINEERING STAKES. The Contractor shall furnish, set and maintain without cost to the Owner, suitable stakes, grade boards, temporary structures, templates, and other materials for establishing and maintaining points, marks, and lines. The Contractor shall be held responsible for the preservation of all stakes and marks. Provide a level and rod for use by the Owner to verify accuracy of installation.

1.21 INSURANCE AND INDEMNITY REQUIREMENTS. The Developer shall not commence work until all protections required under this section are in full effect and verified to the satisfaction of the Owner.

(a) Duties of The Developer. Four (4) copies of the original certificates must be prepared as indicated in the following subparagraphs and forwarded to the Engineer. In addition, the Owner or its representative, shall have the right to reject any form of security which does not meet nationally recognized standards for financial strength as indicated below. Contractors and subcontractors must satisfy all conditions to the same extent unless otherwise specified herein. Protections as described shall be maintained until work in connection with the Project has been accepted by the Owner. In the case of wrap up policies or claims made policies, coverages shall be maintained for a minimum of two years after the project has been completed.

(b) Coverages to be Maintained by the Developer. The insurance types to be provided are General Liability, Automobile Liability, and Workers' Compensation, and Railroad Protective Liability when Contract includes work on, under or adjacent to Railroad rights-of-way or properties. The minimum specific insurance coverages, and minimum limits of liability carried by the Developer and/or his Contractors and Subcontractors, shall be as follows:

<u>TYPE OF INSURANCE</u>		<u>LIMITS OF LIABILITY</u>	
(1)	COMMERCIAL GENERAL LIABILITY	<u>Each</u>	<u>Aggregate</u>
	<u>Occurrence</u>		
	Insured: Contractor or Developer		
	Additional Insureds: West Hanover Township		
	Water and Sewer Authority and Gannett Fleming, Inc.		
	Required Submission: Certificate, 4 copies		
	Premises-Operations	<u>*General Aggregate</u>	\$2,000,000
	Explosion and Collapse Hazard	Product-Completed	
	Underground Hazard	<u>Operations Aggregate</u>	\$1,000,000
	Contractual Insurance	Bodily Injury and Property	
	Broad Form Property Damage	<u>Damage - Combined</u>	\$1,000,000
	Independent Contractors	Personal and	
	Personal and Advertising Injury	Advertising Injury	\$1,000,000
	*General Liability "General Aggregate" limit with a minimum \$2,000,000 amended by Endorsement (CG2503) to apply on a "Per Project" Basis.		

<u>TYPE OF INSURANCE</u>		<u>LIMITS OF LIABILITY</u>	
(2) AUTOMOBILE LIABILITY		<u>Each</u>	<u>Each</u>
		<u>Person</u>	<u>Accident</u>
Insured: Contractor or Developer			
Additional Insureds: West Hanover Township			
Water and Sewer Authority and Gannett Fleming, Inc.			
Required Submission: Certificate, 4 copies			
Any Auto	Bodily Injury	\$ 750,000	\$1,000,000
	Property Damage		\$1,000,000
	OR		
	Bodily Injury and Property Damage	\$3,000,000	
		<u>Combined Single Limit</u>	
(3) EXCESS LIABILITY			
Insured: Contractor or Developer			
Additional Insureds: West Hanover Township			
Water and Sewer Authority and Gannett Fleming, Inc.			
Required Submission: Certificate, 4 copies			
Umbrella, Following Form -	Excess liability forms may be used to satisfy "Limit Requirements" shown under General Liability, Automobile Liability and Workers' Compensation coverages as long as it meets all requirements of this Article 1.22 paragraphs (a), (b), (d) and (f).		
(4) WORKER'S COMPENSATION			
Insured: Contractor or Developer			
Required Submission: Certificate, 4 copies			
Coverage A (Statutory) - Sufficient limits and endorsements to discharge obligations under all applicable WC Laws, USL&H Act, the Jones Act and Admiralty or Maritime Law.			
Coverage B (Employers' Liability) -	\$500,000 (Each Accident)		
	\$500,000 (Disease - Policy Limit)		
	\$500,000 (Disease - Each Employee)		

(c) Certificate Preparation. The Contractor's Insurance provider shall prepare Insurance Certificates for the coverages listed previously, provide the quantity of copies as stated previously, show the following the Certificates:

OWNER: WEST HANOVER TOWNSHIP
WATER AND SEWER AUTHORITY
7901 Jonestown Road
Harrisburg, PA 17112

ENGINEER: _____(Engineer's Name)_____
_____(Address)_____

PROJECT NAME: _____(Enter Project Name here)_____

(d) Coverage Modifications Which Must be Obtained: Owner and Engineer and each of their Officers, Agents and Employees shall be named as additional insureds with respect to all work performed in connection with this Project. This applies to General Liability, Automobile Liability and Railroad Protective Liability coverages.

Owner shall be notified by Registered United States Mail thirty (30) days in advance of any cancellation or any material change resulting in the elimination or reduction of any protection.

Waiver of Subrogation in favor of the Owner and Engineer and each of their Officers, Agents, and Employees applying to all Workers' Compensation coverages must be provided by the Developer unless not permitted by laws of the state in which this Agreement applies.

(e) Indemnification of Owner and Engineer by Developer: Developer is responsible for all liabilities and duties assumed by Developer including but not limited to the indemnity liability in the Agreement between Owner and Developer and the provisions of this subparagraph (d) and shall provide such protections for the Owner and Engineer whether or not such claims, losses, liabilities or expenses are covered by insurance.

The Developer shall at all times, indemnify and save harmless and Owner and Engineer, of and from all claims of whatsoever nature, including without limitation claims which may be made by any of the employees of the Developer or by any employees of any Contractor or Subcontractor to whom the Developer may have let the performance of any part of the work and the Developer will appear for and defend the Owner and Engineer against any and all such claims.

The status of the Developer in the work to be performed by him is that of an Independent Contractor and as such he shall properly safeguard against any and all personal injury including death, or damage to the public, to public and private property, materials and things; and as such, he alone shall be responsible for any and all damage, loss or injury to persons or property that may arise, or be incurred, in or during the conduct or progress of said work without regard to whether or not the Developer, Contractor, his Subcontractors, Agents, or Employees have been negligent; and the Developer shall keep the Owner and Engineer indemnified from and discharged of, and from any and

all responsibility and liability for risks and casualties of every description, as provided in the Agreement between the Owner and Developer.

The Developer shall assume and be liable for all blame and loss of whatsoever nature by reason of neglect or violation of any federal, state, county, or local laws, regulations or ordinances.

(f) Minimum Standards of Financial Strength and Policyholder Service Required of Insurance Carriers Providing Coverage for the Work: Insurance Companies used must be admitted carriers authorized to transact business in the Commonwealth of Pennsylvania unless Owner is notified and waives this requirement.

Insurance Companies used shall be rated (A 10) or better by Best's Rating Service unless Owner is notified and waives this requirement.

1.22 FEE REQUIREMENTS. The Developer shall be required to pay the following fees applicable to the sewer extension.

(a) Owner Review Fee. An initial fee of \$1,000.00 made payable to the West Hanover Water and Sewer Authority (Owner) shall be remitted with the first submission of documents to the Owner for review. Additional fees in \$1,000.00 increments shall be remitted to the Owner when requested as the review continues. Any balance remaining after the review is complete will be deposited in the escrow account described below.

(b) DEP Filing Fee. A fee of \$100.00 (or such other fee as required by DEP) shall accompany the permit application to DEP. The check shall be made payable to Pennsylvania Department of Environmental Protection.

(c) Escrow Account. When the sewer extension is approved for construction, the Owner will estimate the anticipated cost of inspection and administrative costs by the Owner. The Developer will then be required to put that amount of money into an escrow account from which the actual costs of inspection and project administrative costs can be drawn.

(d) Any other fees, inspection costs and bonds associated with other permits or licenses that are applicable to the extension.

1.23 ITEMS REQUIRED PRIOR TO BEGINNING CONSTRUCTION

(a) Execution of a "Sewer Extension Agreement" with Owner.

(b) An escrow account in the Owner's name for payment of the Owner's costs associated with inspection, legal counsel, and administration must be established.

(c) Evidence that the final subdivision plan has been filed by the Township at the county courthouse, Recorder of Deeds office, if applicable.

(d) Performance and Payment Bonds or other financial security to assure completion of the sewer extension and to cover the warranty period.

Should the Surety of any Bond or the issuer of other financial security be deemed unsatisfactory or become unacceptable to the Owner at any time, the Developer shall, upon written notice of the Owner, promptly furnish acceptable or substitute security as may be required to protect the interests of the Owner or of persons supplying services (including rental of equipment), labor, or materials in the prosecution of the work under the "Sewer Extension Agreement."

(e) Receipt of a letter from the Developer stating the name of the Contractor who will be installing the sanitary sewer extension.

(f) Certificates of public liability and property damage, auto liability and worker's compensation insurance. The Owner and Engineer shall be certificate holders and shall be named by endorsement as additional insureds.

(g) Receipt from the Owner of a copy of the Water quality Management Permit issued by DEP, if applicable.

(h) A list of suppliers for the materials to be used in the sanitary sewer construction.

(i) Shop drawings of manhole bases, manhole risers, manhole frames and covers, pipe and other necessary construction materials approved by the Owner.

(j) Certification from the pipe manufacturer that the pipe meets or exceeds the requirements of the Owner's standard specifications.

(k) Written approval by the Owner to proceed with construction.

(l) Receipt by the Owner of the executed deeds of easements for all lots and properties that contain a sanitary sewer right-of-way.

1.24 DEDICATION OF SANITARY SEWER EXTENSION TO THE OWNER. The Developer shall deliver a Deed of Dedication transferring ownership of the sanitary sewer extension to the Owner. Upon receipt of the executed Deed of Dedication from the Developer, the Owner will release the Developer from all obligations to the Owner with respect to the extension, except that the Developer shall guarantee the extension installation including materials and workmanship for a period of 18 months from the date of the deed, or in the case of work on PennDOT right-of-way, for a period of five years from the date of the deed.

1.25 STEEL PRODUCTS PROCUREMENT ACT. Special attention is drawn to the provisions of the Commonwealth of Pennsylvania "Steel Products Procurement Act" - Act No. 3 of 1978, as amended by Act No. 1982-161 and Act No. 1984-144 and subsequent amendments (73 P.S. 1881 et seq). The Owner affirms its compliance with the Act. The Developer is advised that only steel

products as defined in said Act (which includes cast iron in the definition of steel products) shall be used or supplied in the performance of the contract for public works or any subcontracts thereunder.

END OF SECTION

SECTION 01010

SUMMARY OF WORK

PART 1 GENERAL

1.01 SITE LOCATION

- A. Project locations will be in West Hanover Township, Dauphin County, Pennsylvania.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

- A. Without intending to limit or restrict the extent of the Developer/Contractor work required under these Specifications, the work generally comprises construction of extensions to the existing wastewater collection system in accordance with these Specifications and the Sewer Detail Drawings bound herein.
- B. The Standard Construction and Material Specifications for Sanitary Sewer System Extensions manual may be purchased at the cost of \$30.00 from:
West Hanover Township Water and Sewer Authority
7901 Jonestown Road
Harrisburg, Pennsylvania 17112
Telephone No.: (717) 540-0124
(Make payment payable to West Hanover Township Water and Sewer Authority)
- C. Drawings: The following listed Sewer Detail Drawings represent the standards of construction of the Owner and are bound in the back of the Specifications.
1. On the Sewer Detail Drawings, the words "Project Manual" are to be defined as these Standard Specifications.

<u>Detail No.</u>	<u>Drawing No.</u>	<u>Title</u>
1	A-35876	Simplex Grinder Pump
2	A-35877	Duplex Grinder Pump
3	A-35878	In-Line Valve, Pressure Wastewater
Sewer		
4	A-35879	Terminal Cleanout, Pressure Wastewater Sewer
5	A-35880	In-Line Cleanout, Pressure Wastewater Sewer
6	A-35881	Air Release Junction Chamber, Junction Cleanout, Pressure Wastewater Sewer

<u>Detail No.</u>	<u>Drawing No.</u>	<u>Title</u>
7	A-35882	Air Release Chamber, Pressure Wastewater Sewer
8	A-35957	Air Release Chamber, Pressure Wastewater Sewer
9	A-36174	Pressure Lateral
10	A-36175	Low Pressure Drop Connection
17	A-31731	Cleanout Chamber
18	A-28778	Concrete Anchor
26	A-27016	Concrete Thrust Blocks
33	A-28777	Earth Dam
34	A-23528	Embankment
35	A-23526	Encasing Conduit
36	A-29977	Encasing Conduit
M-2		Drop Manhole - Type "A" (Interior Drop)
63	A-27065	Precast Reinforced Concrete Manhole Bases
64	A-27080	Standard Manhole - Type "A"
65	A-27081	Standard Manhole - Type "B"
67A	A-27056A	Manhole Frame and Cover
70	A-27057	Manhole Steps
73	A-27017	Concrete Cradle
74	A-27019	Concrete Encasement
75	A-27038	Pipe Zone Bedding and Initial Backfill Inspection Riser and Building Sewer Cap Protection Casting Detail for Areas Exposed to Vehicular Traffic, Snowplowing, and in Sidewalks
92	A-26074	Service Connection Shallow Sewer
93	A-31498	Service Connection Deep Sewer
121	A-34280	Air Release Chamber
133	A-36181	Tunnel Work Pit & Tunnel Liner Plate

1.03 PRELIMINARY REQUIREMENTS

- A. Consultant: Before any work is started, the Developer shall ascertain from the Owner whether or not the latter intends to employ a consultant as Engineer for the Project. If the Owner indicates that no Engineer will be employed, the word "Owner" is substituted for the word "Engineer" throughout these Specifications, and the Developer and Contractor shall be guided accordingly.

- B. Street Regulatory Requirements: Where sewers are to be installed within the limits of

existing streets, all removal and protection of street paving, backfilling of trenches, temporary and permanent replacement of street paving, restoration of shoulders and the maintenance and protection of traffic will be performed in strict conformance with the requirements of West Hanover Township, other governing municipality in the immediate vicinity, or the Commonwealth of Pennsylvania Department of Transportation, as applicable.

1. The cost of inspection by personnel of the Commonwealth of Pennsylvania Department of Transportation shall be paid by the Developer.
2. Perform work within the right-of-way of State Highways in accordance with the requirements of the latest edition of the Commonwealth of Pennsylvania, Pennsylvania Code, Title 67, Transportation, Department of Transportation, Chapter 459, Occupancy of Highways by Utilities. The Regulations are made a part of these Specifications.

- C. DEP Regulations and Requirements: The Contractor and Developer are advised that they will be required to conduct their work in complete compliance with all of the rules, regulations and requirements of the Pennsylvania Department of Environmental Protection (DEP). The DEP Water Quality Management Sewerage Manual is available at:

Pennsylvania Department of Environmental Protection
909 Elmerton Avenue
Harrisburg, Pennsylvania 17110-8200
Telephone No.: (717) 705-4707

- D. House or Building Sewer Requirements: If as part of the work of this project, house or building sewers are constructed from the test tee to the house or building, use materials required by the OWNER.

1. Construct the inspection riser and connect the house or building in accordance with the Inspection Riser and Building Sewer Detail. All house or building sewers with inspection riser shall be constructed in accordance with Inspection Riser and Building Sewer Detail.

- E. Sewer Locations: New sewers shall be located in streets and paved areas to the maximum extent possible, where feasible, to facilitate access for maintenance purposes. If sewers must be located on private property, a right-of-way at least 30 feet wide centered on the sewer shall be dedicated from the Developer to the Owner.

1. The Owner will not grant final approval of the sewers for the project and will not grant approval to proceed with sanitary sewer construction until the Owner is in receipt of executed deeds of easement for the rights-of-way by the property owners.

- F. Unauthorized Connections To Sewers: In general, stormwater or groundwater drainage connections to any sewer extension of the Owner's system are unauthorized connections.

1. No rain water leaders, roof drainage, area or yard drainage, basement, surface or water from fire hydrants, ground water or water from underground drainage fields shall be permitted to drain into or be admitted into the sanitary sewer system; nor shall any of these be admitted to the sanitary sewer system by the use of pumps of any type.
2. The sanitary sewer system, and all extensions, are intended to convey sanitary sewage only and all sewer extensions will be strictly sanitary sewers..

G. Test Tee Requirement: when a house or building sewer is repaired or replaced and reconnected to a lateral that does not contain a test tee, make the new connection to the lateral in accordance with the Inspection Riser and Building Sewer Detail.

1. Construct the inspection riser in accordance with Inspection Riser and Building Sewer Detail.

1.04 PROJECT CONDITIONS

A. Design Criteria: In addition to the design requirements of the Pennsylvania Department of Environmental Protection (DEP), comply with the following:

1. Grade of Proposed Sewers: Minimum 0.40 percent on 8-inch mains and 1.0 percent on terminal manhole sewer runs.
2. Minimum Cover: Provide a minimum cover of five feet over the sanitary sewers measured from finished grade elevation.
3. Underground Utility Clearances:
 - a. Provide a minimum of 18-inches vertical clearance between sanitary sewers and domestic water supply lines. Provide a minimum clearance of 12-inches between sanitary sewers and other underground utilities.
 - b. Provide a minimum horizontal clearance of ten feet between sanitary sewers and other underground utilities. Provide a minimum horizontal clearance of five feet between the sanitary sewers and existing and proposed utility structures such as manholes, inlets, curbs, etc.

B. DIP and Concrete Encasement Requirement: Wherever the required clearances between the sanitary sewer and domestic water supply lines, or the minimum cover over the sanitary sewer cannot be provided, the sanitary sewer shall be run in cement-lined ductile iron pipe (DIP).

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.01 SUBMISSIONS REQUIRED

- A. General Requirements: Developer shall make the various submissions as stated under the SUBMITTALS Article in each Specifications Section. In addition, submit copies of Developer's plans and a construction progress schedule.
 - 1. Make each submissions to the office of the Owner unless otherwise directed by the Owner.
- B. Definition: The term shop drawing used throughout this Section includes manufacturer's product data in the forms of descriptive literature, specifications and published detail drawings, and also Contractor prepared drawings, certified test records or reports and such other certificates required by the Specifications.

1.02 PROCEDURES FOR SUBMISSIONS

- A. Preliminary Submissions: At the time of submission of preliminary plans for the subdivision to the Owner, complete the necessary documents and submit them to the Owner for review. Any documents requiring corrections will be returned to the Developer for correction and re-submission. Each time a submission is made to the Owner, two copies shall be provided. The required documents are as follows:
 - 1. Contract Drawings and Owner review fee. If the sanitary sewer extension is part of a larger project, those sections of the project specifications dealing with the sanitary sewer extensions shall be submitted.
 - 2. Copies of the Pennsylvania Department of Environmental Protection (DEP) Planning Modules, Components II and IV, and a copy of DEP's approval of Components II and IV.
 - 3. DEP Sewerage Permit Application form (Bureau of Water Quality Management), Erosion and Sediment Pollution Control Plan and Narrative, and filing fee.
 - 4. Any other permit or license applications required to be in the Owner's name, including associated documents and fees.
 - 5. If the above documents meet the approval of the Owner, the Developer will be so notified. The Developer will then be required to furnish the DEP filing fee and additional copies of documents as may be required for submission to the permitting agency. (With current DEP procedures, four additional copies of all documents will be required in connection with DEP permit approval submissions.)
- B. The Developer may elect to submit the Contract Drawings (with Owner review fee) for preliminary review and approval prior to completion of the required permit applications.

1.03 CONTRACT DRAWINGS - DEVELOPER SUBMISSION

- A. General Requirements: Submit two copies of drawings for review. After review of these drawings, make any corrections required and submit six corrected copies.
1. Sheet Size: 24-inches by 36-inches.
 2. Base elevations on the datum of the existing sewers.
 3. Include the following notes on the drawings:
 - a. Sanitary sewer construction methods and materials shall conform to the latest standards of the West Hanover Township Water and Sewer Authority (Owner), Pennsylvania and shall be subject to approval by the Owner's Engineer.
 - b. The Permittee for this sewer extension is the West Hanover Township Water and Sewer Authority.
 4. For details of manholes, bedding, encasement, service connections, etc., make reference to the appropriate "Sewer Detail Drawing" bound herein.
 5. Bind drawings in sets and number them consecutively.
 6. Include on the drawings a list of Act 287 (as amended) users. The list of Act 287 users may be obtained from the Dauphin County Recorder of Deeds, and shall include the name, address, phone number, and person to contact of each utility maintaining facilities in the area of the proposed extension.
- B. Indicate on the drawings the following general items:
1. Name of the Design Engineer.
 2. Seal of the Design Engineer.
 3. Signature of the Design Engineer.
 4. Name of the development and the owners.
 5. Date.
 6. Indicate by note on the Index Map(s) or Plan and Profile sheet(s) the Water Quality Management Permit Number of the existing facility that the proposed sewers are connecting into.
- C. Include the following drawings:
1. Location Plan: Showing approximate area of the municipality in which the project is located. No particular scale is required.
 2. Index Map(s): Drawn to a scale of 1-inch equals 400-feet and having the following items included thereon:
 - a. Sewer sizes other than 8-inch sewers.
 - b. Name of each street.
 - c. Number designation of each manhole. (Contact Owner's Engineer to coordinate manhole numbering system.)
 3. Detail Sheets (Plan and Profile): Plan View drawn to a scale of 1-inch equals 50-feet and Profile View drawn to a horizontal scale of 1-inch equals 50-feet and a vertical scale of 1-inch equals 10-feet, or 1-inch equals 5-feet, and having the following items included thereon:

- a. Location of each existing or proposed building with elevation of the existing or proposed basement (Plan View). If proposed basement elevations are not known, the drawings shall include a note stating which lots are not intended to be provided with gravity basement drainage.
- b. Sewer ties to existing permanent and semi-permanent features (Plan View).
- c. Top elevations of manholes (Profile View).
- d. Invert elevations of manholes (Profile View).
- e. Manhole numbers corresponding to those on Index Map (Plan View and Profile View).
- f. Distance between manholes (Profile View).
- g. Grade of proposed sewer (Profile View).
- h. Size of proposed sewer (Profile View).
- i. Location, size and elevation of all existing and proposed underground utilities (Plan View and Profile View).
- j. The permit number and permittee of the existing receiving sewer (Plan View).
- k. The lots which will not be provided with gravity basement drainage (Plan View).
- l. Right-of-way limits (Plan View).
- m. Service Connection Ties:
 - 1) The measurement to locate the wye or tee branch is the horizontal distance measured along the centerline of the main sewer from the downstream manhole to the centerline of wye or tee branch.
 - 2) The ties and measurements necessary to locate the upper free end of the service connections are:
 - a) The horizontal distance measured to the closest tenth of a foot from the downstream and upstream property markers or house corners to the end of the service connection.
 - b) The horizontal distance from the center line of the main sewer to the end of the service connection.
 - c) The depth from the ground surface or the top surface of curb to the invert of the service connection.

- D. Submit the following information as a supplement to the construction drawings:
 - 1. Number of persons to be served initially.
 - 2. Number of persons to be served in the future.
 - 3. Number of acres to be served initially.
 - 4. Number of acres to be served in the future.
 - 5. Initial and future sanitary sewer flows if the development is other than residential.
- E. Record Drawings: Before the work will be accepted by the Owner, submit the record drawings on computer disk and one (1) set of Diazo Mylar reproducibles of all working drawings, modified as necessary to show the facilities as constructed.

1. Submit a certificate from the Developer's engineer with the record reproduces attesting to the correctness of all information shown on the Drawings. The Owner intends to use prints of the reproduces to provide information to designers and contractors as required by the Commonwealth of Pennsylvania Act 287 (as amended).

1.04 RIGHT-OF-WAY DRAWINGS

- A. Provide six (6) copies of the required plats and descriptions for rights-of-way on 8-1/2-inch by 11-inch paper.
- B. Owner will prepare Right of Way Agreements transferring the rights-of-way to Owner using plats and legal descriptions prepared by Developer-Applicant and approved by Owner.
- C. Provide a deed of conveyance transferring ownership of the sanitary sewer extension to the Owner.

1.05 CONSTRUCTION PROGRESS SCHEDULE - CONTRACTOR SUBMISSION

- A. At least seven days before work is commenced, submit three copies of a practicable and feasible progress schedule showing the order in which the Work is to be carried on, the dates on which salient features will start (including procurement of materials and equipment), and the contemplated dates for completing same.
- B. Prepare the schedule in chart form and of a suitable scale so as to appropriately indicate the percentage of Work completed at any time.
- C. At the end of each month, update the Construction Progress Schedule by entering the actual progress of the Work on the schedule. Deliver three copies of the updated Construction Progress Schedule immediately after its completion.

1.06 SHOP DRAWINGS - CONTRACTOR SUBMISSION

- A. Submit five copies of each shop drawing with such promptness as to avoid delay in the work.
- B. Each submission of shop drawings shall be accompanied by a letter of transmittal listing the items in the submission. Each shop drawing shall be marked with the name of the Project and the name of the Contractor and be numbered consecutively.
- C. When making a submission for approval, the Contractor shall do so with the understanding that he is considered to have checked the items in the shop drawing before submitting them and that he is satisfied that, in their present state, they not only meet the requirements of the Specifications, but will present no difficulties in erection and completing his Contract. The Contractor shall clearly note his approval on all shop drawings prior to their submission to the Engineer. Failure of the Contractor to note his

approval will be reason for the Engineer to return such submission to the Contractor unchecked.

1. If it appears that shop drawings submitted by the Contractor to the Engineer have not been properly checked, even though the Contractor's approval has been noted thereon, it will also be considered reason for the Engineer to return such submission to the Contractor unchecked.
 2. Markings, written or otherwise, made by the Contractor or by his suppliers or manufacturers shall be made on the Submittal in a color other than red. RED is reserved for the exclusive use of the Engineer in marking Submittals.
- D. If shop drawings show variations from the Specifications requirements because of standard shop practice or other reasons, the Contractor shall make specific mention of such variations in his letter of submission in order that (if accepted) suitable action may be taken for proper adjustment in the Contract; otherwise the Contractor will not be relieved of the responsibility for executing the Work in accordance with the Specifications even though the shop drawings have been approved.
- E. The approval of shop drawings will be general and shall not relieve the Contractor from the responsibility for proper fitting and construction of the Work nor from furnishing materials and work required by the Specifications which may not be indicated on the shop drawings when approved.
- F. After review by the Engineer, shop drawings will be returned marked as follows:
Approved, Approved With Changes Noted, Returned for Correction or Not Approved.
1. Approved: When shop drawings are returned "Approved", that means the shop drawings have been found to be in conformance with the Specifications. The Engineer's approval of the shop drawings does not relieve the Contractor from responsibility for errors or discrepancies in such shop drawings.
 2. Approved with Changes Noted: When shop drawings are returned "Approved With Changes Noted" that means the shop drawings have been found to be in conformance with the Specifications, provided the changes noted by the Engineer are incorporated in the shop drawings. Shop drawings returned "Approved With Changes Noted" will not require re-submission.
 3. Returned For Correction: When shop drawings are returned noted "Returned For Correction" that means the Contractor shall make the required corrections and resubmit five copies of corrected shop drawings to the Engineer.
 4. Not Approved: When shop drawings are returned "Not Approved" that means the Contractor shall make completely new shop drawings and submit five copies to the Engineer for review.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01500

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 TEMPORARY SERVICES

- A. General Requirements: Provide for the following temporary services at the site of the work throughout the entire period of construction and until the work is completed and the new facilities are placed in operation of the Owner's personnel.
- B. Temporary Stormwater Control: The Contractor is responsible for maintaining temporary stormwater control as specified hereinafter. The means and methods the Contractor employs to meet the following requirements are at his discretion.
 - 1. At all times during the construction of work, maintain the flow of stormwater and naturally occurring water in existing facilities and channels affected by the Work.
 - 2. The Contractor assumes risk from flooding and any damages done to the work in progress or to completed work.
 - 3. Contractor assumes responsibility for damages to property caused by flooding of property due to blocking or restriction of stormwater passages, natural waterways and stormwater facilities capacity.
 - 4. Do not pump or otherwise permit groundwater to flow into existing wastewater pipelines during the construction.
- C. Temporary Wastewater Flow Control: During the connection into existing wastewater collection system, the Contractor is responsible for maintaining continued wastewater service and flow. The means and methods the Contractor employs to meet the following requirements are at his discretion.
 - 1. Bypassing: Maintain continued wastewater flow by bypass pumping or other suitable means of wastewater bypassing. In either case, the bypassing shall be through a properly sized and fail-safe means.
 - 2. Unlawful Sewage Discharges: The Contractor is hereby made aware that it is unlawful to permit wastewater (sewage) flow from existing sewers to discharge into nearby waterways or to flow on surface areas. Furthermore, should an accidental discharge occur, notify the Department of Environmental Protection immediately at (717) 787-4343.
 - a. Fines and related costs resulting from failure to provide adequate protection against wastewater overflow are the obligation of the Contractor.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 REMOVAL

- A. Contractor shall dismantle (if required) and remove such temporary facilities as required during construction of the project.

END OF SECTION

SECTION 01570

TRAFFIC REGULATION

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: This Section includes general guidelines for the control of traffic when work is being performed within existing street right-of-ways. The goal is to help ensure safe and efficient traffic movement through work areas and provide safety for the Contractor's work force.

1.02 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies: State Highways, and Roadways other than State Highways (Township Streets), shall not be unnecessarily obstructed, and the Contractor shall take such measures to keep the highways open and safe for at least one lane of traffic at all times.
 - 1. The specific requirements for traffic control provided herein are for the convenience of the Contractor and shall in no way be construed as a release from the PennDOT requirements referenced herein.
 - 2. After working hours cover trenches with steel plate or wood planking, both of adequate strength to permit safe and unrestricted traffic movement.
 - 3. Provide and maintain at closures, intersections, and throughout the Project, necessary approved barricades, required quantity of approved lights, approved reflectors, danger signals, warning, detour and closure signs.
 - 4. Provide a sufficient number of watchmen (when required) and take necessary and lawful precautions for protection of work and safety of the public.
 - 5. Barricades, danger signals, signs and obstructions shall be illuminated from sunset until sunrise.
 - 6. Fines and related costs resulting from the Contractor's failure to provide adequate traffic control shall be borne solely by the Contractor.
- B. Traffic Control on State Highways: Provide traffic control in complete compliance with the rules and regulations of the Pennsylvania Department of Transportation (PennDOT), including but not necessarily limited to the following:
 - 1. PA Code Title 67, Transportation: Chapter 203 - Work Zone Traffic Control.
 - 2. PA Code Title 67, Transportation: Chapter 441 - Access to and Occupancy of Highways by Driveways and Local Roads.
 - 3. PA Code Title 67, Transportation: Chapter 459 - Occupancy of Highways by Utilities.

4. Section 901 Maintenance and Protection of Traffic During Construction of the Commonwealth of Pennsylvania Department of Transportation Specifications Publication 408, as supplemented, and such other sections therein which complement this Section.
- C. Traffic Control Figures: Traffic control requirements of the construction site within state highway right-of-way shall be illustrated on the Drawings by way of figures taken from Chapter 203 of the PennDOT regulations.
 1. The traffic control figures are to be used in conjunction with the Specifications to establish the minimum requirements for the Project and in no way preclude the installation of additional control measures.
- D. Police Traffic Control: When required by local traffic regulation provide traffic control in the form of police physically directing traffic. The costs for such police activity shall be the local police force direct charges, without Contractor's mark-up, passed on to the Owner for payment directly to the local police force.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Materials and safety devices such as barricades, flashing warning lights, reflectors and signs, provided for the purpose of protecting the work and the safety of the public, and for maintaining and protecting traffic, shall conform to the requirements specified in Section 901 of the current edition of the Commonwealth of Pennsylvania Department of Transportation Specifications Publication 408, as supplemented.
 1. Safety devices shall also conform to the requirements specified in the current edition of PA Code Title 67, Transportation, Chapter 203 - Work Zone Traffic Control which complements Section 901.
 2. Provide danger signals and warning signs in the approved orange color.

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 02010

SUBSURFACE EXPLORATION

PART 1 GENERAL

1.01 SUMMARY

- A. Digging Test Pits: In locations where new underground utilities are to be connected to existing underground utilities, the Contractor will not be permitted to proceed with the new construction until he has dug test pits and determined the exact location and elevation of the existing underground utilities.
 - 1. The Contractor is advised that no excavation is permitted in the underground utility location without the presence or written approval of an authorized representative of the owner of the subsurface utility.
 - 2. Dig such test pits only at the locations agreed to by the owner of the subsurface utility and the Engineer.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 02151

SHORING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: This Section includes the provision for shoring which conforms to Federal, State and local laws, rules, regulations, requirements, precautions, orders and decrees.
- B. Related Sections: Division 2 Sections involving excavations.

1.02 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies: Shoring materials and installation work shall conform to Federal, State and local laws, rules, regulations, requirements, precautions, orders and decrees.
 - 1. The duty or responsibility for inspection, determination, compliance and enforcement of Federal, State, local laws, rules, regulations, requirements, precautions, orders and decrees rests with such department or agency and not with the Owner or Engineer.
- B. Shoring Design: The design and the adequacy of the shoring installed is the responsibility of the Contractor.

1.03 SITE CONDITIONS

- A. Responsibility for Condition of Excavation: The Contractor is solely responsible for the condition of his excavations.
 - 1. The failure or refusal of the Engineer to suggest the use of Shoring, or a better quality, grade, or section, or larger sizes of Shoring materials, or to suggest Shoring to be left in place; shall not in any way or to any extent relieve the Contractor of any responsibility concerning the condition of excavation or of any of his obligations under the Contract, nor impose any liability on the Engineer or the Owner.
 - 2. No delay, whether caused by any action or want of action on the part of the Contractor, or by any act of the Engineer, Owner, or their agents, or employees, resulting in the keeping of any excavation open longer than would otherwise have been necessary, relieve the Contractor from the necessity of properly and adequately protecting the excavation from caving or slipping, nor from any of his obligations under the Contract relating to injury to persons or property.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Shoring materials shall conform to Federal, State and local laws, rules, regulations, requirements, precautions, orders and decrees.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Shoring installation shall conform to Federal, State and local laws, rules, regulations, requirements, precautions, orders and decrees.

END OF SECTION

SECTION 02221

TRENCHING, BACKFILLING AND COMPACTING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: This Section specifies trench and structure excavation, backfilling and compacting as well as associated site restoration work.
- B. Related Sections:
 - 1. Subsurface Exploration: Section 02010.
 - 2. Shoring: Section 02151.
 - 3. Erosion and Sediment Pollution Control: Section 02270.
 - 4. Cast-In-Place Concrete: Section 03300.

1.02 REFERENCES

- A. American Society for Testing and Materials:
 - 1. ASTM D 698; Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-lb (2.49-kg) Rammer and 12-in. (304.8 mm) Drop.
 - 2. ASTM D 1556; Test Method for Density of Soil in Place by the Sand-Cone Method.
 - 3. ASTM D 2321, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 - 4. ASTM D 2774, Standard Recommended Practice for Underground Installation of Thermoplastic Pressure Pipe.
 - 5. ASTM D 2922; Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- B. Commonwealth of Pennsylvania Department of Transportation (PDT), Specifications Publication 408, as supplemented.
 - 1. PDT Section 703.1 Fine Aggregate.
 - 2. PDT Section 703.2 Coarse Aggregate.
 - 3. PDT Section 703.3 Select Granular Material (2RC).

1.03 DEFINITIONS

- A. Unclassified Excavation: Removal of materials of whatsoever nature in the excavation, including both earth and rock formations, and other consolidated mineral masses, as well as existing structure foundations as may be encountered in the excavations.
- B. Unclassified Excavation Below Subgrade: Same as unclassified excavation except such excavation is performed below elevations given as subgrade.

- C. 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.
- D. Pipe Zone: The area within the trench which extends from subgrade elevation to an elevation at least twelve inches above the top of the outside barrel of the pipe. Also, the trench dimensions within this pipe zone area shall be carefully controlled in order to comply with pipe manufacturer's warranty requirements.

1.04 SUBMITTALS

- A. Samples: Submit aggregate samples to the Engineer's Field Office. Make such other required submissions to the Engineer's Business Office street address.
 - 1. Aggregates: Submit a ten pound sample, packaged in container of suitable strength, for Engineer's verification and certification for submission to testing laboratory.
- B. Test Reports:
 - 1. Aggregate Material Tests: Submit testing laboratory aggregate test reports based on requirements stated in Source Quality Control.
 - 2. Compaction Density Tests: Submit compaction density test reports based on method of density determination as specified in Reference Standards and the method as approved by the Engineer.
- C. Aggregate Certificates: When requested by the Engineer, submit certificate from aggregate supplier certifying conformity to the requirements stated in the Source Quality Control Article.

1.05 QUALITY ASSURANCE

- A. Laboratory Tests: In accordance with Article 1.06 of the General Instructions, the specified aggregate materials shall require advance examination or testing according to methods referenced, or as required by the Engineer.
 - 1. Arrange for the testing laboratory shall furnish both Engineer and Contractor two copies of test result reports. The same reports will be considered as sufficient evidence to serve as the basis for acceptance or rejection of materials represented.
- B. On-Site Backfill Tests: Obtain samples of on-site backfill for testing in the presence of an inspector as provided by the Authority. Obtain samples from test pits dug at intervals of not less than 500 feet along the proposed alignment, or 250 feet if varying soils are encountered, as determined by the inspector.
 - 1. The Contractor shall reimburse the Authority for inspection services provided by the Authority.

- C. Aggregate Material Tests: Conduct aggregate quality tests in accordance with the requirements of appropriate Referenced Standard for such materials.
 - 1. The Engineer reserves the right to accept aggregate materials based on certification from supplier that the aggregate originates from a source approved by Penn DOT and that the aggregate complies with specified Penn DOT requirements.

1.06 SITE CONDITIONS

- A. Classification of Excavated Materials: No consideration will be given to the nature of materials encountered in trenching operations. Therefore, as unclassified excavation, no additional payment will be made for difficulties occurring in excavating and handling of materials.
- A. Borrow Material: When the required quantity of On-Site Backfill material or On-Site Select Earth Backfill material is insufficient to complete the backfilling of excavations, provide Borrow Material.
 - 1. 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.
 - 2. Borrow Material will be subject to the Engineer's approval whose written consent shall be obtained prior to its use.
 - 3. Borrow Material shall meet the requirements for On-Site Backfill material or On-Site Select Earth Backfill material.
- B. Excess Materials: No right of property in materials is granted 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 or excavated materials not suitable for use in backfilling.
- C. Removal of Obstructions: 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 unless such work is done by the Owner of the obstruction. However, uncover and sustain the obstruction prior to the final disposition of obstruction. Additional precautions concerning obstructions as follows:
 - 1. Do not obstruct fire hydrants.
 - 2. Do not interfere with persons, firms, corporations or utilities employing protective measures, removing, changing or replacing their property or structures, but allow these 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 Contractor.
 - 3. If necessary, break through and reconstruct the invert or arch of an existing sewer, storm drain, or conduit that may be encountered, when such existing obstruction is in such a position (in the judgment of the Engineer) as not to require its removal, realignment or complete reconstruction.

- D. State Highway Pipe Foundation Underdrain: Replace underdrain which is damaged or removed during construction.
1. Use same type and quality of pipe, and coarse and fine aggregate backfill material as existing.
 2. Salvage and reuse of the piping will be permitted to reconstruct the pipe foundation underdrain; however, the Engineer will inspect this pipe after its removal and pipe determined unsuitable for reuse shall be replaced by the Contractor with new pipe.
 3. Use new coarse and fine aggregate backfill material.
 4. Work shall be performed to the requirements and satisfaction of the Pennsylvania Department of Transportation.
- E. Environmental Requirements: 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.
1. Do not perform trenching, backfilling or compacting when weather conditions or the condition of materials are such, in the opinion of the Engineer, that work cannot be performed 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. Provide effective dust control by sprinkling water, spreading calcium chloride or other method approved by Engineer. Employ dust control when, where and in a manner required by Engineer.
 5. When it is necessary to haul wet soil material over roadways, use suitably tight vehicles to prevent spillage. Clear away spilled materials, as caused by hauling, from roadways.
- F. Accommodation of Drainage: Keep both piped and open drainage facilities unobstructed for proper surface drainage. No damming or ponding of 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.
1. Do not direct water flows across or over pavements except through approved pipes or properly constructed troughs of proper sizes and lengths.
 2. Perform grading in the vicinity of trenches so that the ground surface is properly pitched to prevent water running into the trenches.
- G. Dewatering: Keep excavations free from water during the performance of the work. Provide and operate dewatering equipment of sufficient capacity for dewatering the excavations.
1. 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, nor to cause an impediment to the use of streets, roads and highways.

2. Do not dispose of water in trenches by draining through completed portions of sewer piping.
- H. Protection: Assume the risks attending the presence or proximity of overhead or underground public utility (if any) and private lines, pipes, conduits and their attending support work, existing structures and property of whatever nature. Responsibility for damages and expenses arising out of the Work, 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, rests solely with the Contractor.
1. Excavation Condition: The Contractor is solely responsible for the conditions and results of his excavation work. Remove slides and cave-ins at whatever time and under whatever circumstance they occur.
 2. Protection Outside Rights-Of-Way: Take necessary precautions to protect trees, shrubs, lawns and such other landscaping from damage. Restitution work for damages rests solely with the Contractor.
 3. Support Of Existing Utility Lines: Adequately support underground utilities not requiring removal and exposed as a result of excavations. Provide adequate support along their entire exposed length by timber or planking. Install these supports in such manner that backfilling may be performed without dislodging such utilities.
 - a. Place and carefully compact On-Site Select Earth Backfill or Aggregate Backfill around the supports, and leave such supports in place as a guard against breakage due to backfill settlement.
 4. Temporary Protective Construction: Erect and maintain substantial temporary barricades and fences surrounding excavation to prevent unauthorized access.
 - a. Temporary Barrier: Where necessary, to keep one side of streets or roadway free from obstruction or to keep material piled along side of the trench from falling on private property outside the right-of-way, erect and maintain a safe and substantial barrier fence.
 - b. Excavation Covers: Cover open excavation when work therein is suspended or left unattended, such as at the end of a work day. For such covers, use materials of sufficient strength and weight to prevent their removal by unauthorized persons.
 - c. Remove temporary protective construction at the completion of work on the Project.
 5. Structure Supports: Where excavations are in the vicinity of buildings or structures, which by their construction or position might exert detrimental pressure on the excavation, provide suitable structure supports for such buildings or structures. Structure supports may be in the form of underpinning or special driven sheeting, or other suitable support systems of the Contractor's choosing. The option is allowed for short lengths of trench be opened at one time.
- I. Explosives and Blasting: Use and store explosives in accordance with requirements of Federal, State and local laws, rules, regulations, precautions, orders and decrees.

Additionally comply with the following:

1. Notifications: Notify utility owners having structures or other installations above or below ground in proximity to the trenching work prior to use of explosives.
 - a. Such notice shall be given sufficiently in advance to enable the utility owners to take such steps as they may deem necessary to protect their property from injury.
 - b. Such notice shall not relieve the Contractor of responsibility of damage resulting from his use of explosives.
 2. General Requirements: The Contractor is solely responsible for injury to persons or property as a result of his use of explosives, and shall provide competent licensed blasting person to supervise blasting operations.
 - a. Do not use methods of blasting which will result in breakage beyond trenching areas or which is dangerous to the public or destructive to property.
 - b. Schedule blasting in the proximity of proposed new concrete work prior to placement of concrete.
 - c. Stop blasting operations when street paving adjacent to trench is being damaged by blasting. Repair damaged street paving.
 3. Rock Removal by Means Other Than Blasting: Where explosives and blasting are not permitted in performance of trenching work, remove rock by such mechanical means and methods as developed specifically for rock removal without blasting. Additionally, perform rock removal in accordance with the requirements of State and local laws, rules and regulations, and utility owner requirements.
 - a. The Engineer reserves the right to direct that rock within five feet of pipe, conduit or other structures encountered in the trench be removed by methods other than blasting.
- J. Trench Work for Electrical: The requirements specified herein for excavating, backfilling and compacting pipeline trench work shall also apply to such work required for electrical conduit installations.
1. Exceptions to pipe line trench work requirements are as specified herein.

PART 2 PRODUCTS

2.01 MATERIALS

- A. On-Site Backfill: 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.
- B. On-Site Select Earth Backfill: On 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.

- C. Aggregate Backfill: Slag aggregates are not allowed.
 - 1. PDT No.2A Coarse Aggregate conforming to PDT Section 703.2.
 - 2. Select Granular Material (2RC) conforming to PDT Section 703.3.
- D. Pipe Zone Materials: Slag aggregates are not allowed.
 - 1. Pipe Zone Bedding: Coarse Aggregate conforming to PDT Section 703.2.
 - a. For piping having a diameter of 21 inches and less use AASHTO No. 8 Coarse Aggregate.
 - b. For piping having a diameter of 24 inches and larger use AASHTO No. 57 Coarse Aggregate.
 - 2. Initial Backfill: Coarse Aggregate conforming to PDT Section 703.2.
 - a. For piping having a diameter of 21 inches and less use AASHTO No. 8 Coarse Aggregate.
 - b. For piping having a diameter of 24 inches and larger use AASHTO No. 57 Coarse Aggregate.
- E. Fine Aggregate (Sand): Conforming to PDT Section 703.1, for Type A sand. Sand made for slag aggregates is not allowed.
- F. Concrete Cradle and Encasement: Conforming to requirements of Section 03300 for Class A (4,000 psi.) Concrete.
 - 1. Provide Class B (3,000 psi.) Concrete for all other applications in trench excavation and backfilling work.
- G. Foundation Backfill: AASHTO No. 3 Coarse Aggregate conforming to PDT Section 703.2. Slag aggregates are not allowed.
- H. Underground Warning Tape: Printed polyethylene metallic detection tape, six inches minimum width, color coded, one inch minimum lettering, printed with name of utility buried below, and suitable for installation in all soil types.
 - 1. Provide detection tape for the following pipe lines and utilities as installed or encountered in the work:
 - a. Sanitary Sewers and Service Connections - Green.
 - b. Sewage Force Main - Green.
 - c. Pressure Wastewater Sewer - Green.
 - d. Electrical Conduit - Red.
 - e. Water Line - Blue.
 - f. Gas Line - Yellow.
 - g. Telephone Conduit - Orange.
 - h. CATV Conduit - Orange.
 - i. Petroleum Line - Yellow.

PART 3 EXECUTION

3.01 PREPARATION

- A. Trench Line and Grade: Maintain trench line and grade for sewers and pipe lines as follows:
1. DEP Requirements: Sewer grades shall conform to the requirements of the Pennsylvania Department of Environmental Protection (DEP). The minimum grade of terminal sewer runs shall be 0.60 percent. Where practical, however, a grade of at least 1.00 percent is preferred for terminal sewer runs.
 2. Control Points: Prior to excavation for a run of piping, set control points for line and grade as given on the Drawings. Compute the depth of cut to sewer invert from top of grade stakes or other control points. Use the computed depths of cut as guides for rough excavation allowing for excavating to accommodate the required bedding and concrete encasement or cradles.
 - a. Set control points sufficiently offset from the trench centerline to prevent loss of the points during the work. Set control points 25-feet apart maximum.
 - b. In unpaved areas, mark control points on the top portion of stakes and in paved areas, drive spikes or cut crosses into the paving, both encircled with paint.
 3. Batter Boards and Grade Stakes: As rough excavation is completed set grade stakes or batter boards of rough lumber across the trench opposite the control points. Securely set up and support each batter board to prevent accidental displacement and to ensure each board being leveled equidistant above the pipeline invert.
 - a. Run a taut string-line between the batter boards directly over the proposed pipeline centerline. Use the string-line as a control for maintaining pipeline grade and horizontal alignment.
 - b. To check the vertical distance from string-line to pipe invert, use a grade stake or pole, with a true right-angled offset designed to rest on the pipe invert.
 - c. Use a plumb line from the string-line to the center of pipe to maintain horizontal alignment.
 4. Optional Methods for Maintaining Line and Grade: Other methods such as are customarily used to maintain line and grade in the utility construction industry, other than those specified previously, will be allowed subject to the approval of the Engineer.
 - a. Laser: If use of laser beam instrument is approved for use by the Engineer, perform field checks of the beam position every fifty feet of installed pipe line. Use survey or other approved method to perform the beam position check.
- B. Soil Erosion Control: Perform soil erosion control work in accordance with requirements of Section 02270.

- C. Preparation of Surfaces: In sewer rights-of-way do not remove trees and other permanent plantings except by authorization of the Engineer. No additional compensation will be paid for hand excavation or tunneling in the vicinity of trees and other permanent plantings that are not being removed.
1. When tree and other permanent plantings removal is authorized, remove both the above ground and below ground portions by methods meeting Engineer's approval.
 2. Trim merchantable timber of limbs and tops, and unless otherwise ordered by the Engineer, saw timber into eight foot lengths. Stock-pile timber at locations designated on the site by the Engineer. Merchantable timber is timber larger than six inches in smallest diameter from which saw logs, pulpwood, posts, poles, ties or cordwood can be produced.
 3. Dispose of removed tree and permanent plantings debris in a lawful manner off site.
 4. Where embankment is to be placed, clear and grub the area to a depth of not less than six inches below existing ground.

3.02 EMBANKMENT CONSTRUCTION

- A. Construction Requirements: Construct embankments in accordance with the following paragraphs:
1. Embankment Foundation: Remove existing embankment foundation material when determined unsatisfactory by the Engineer. Refill such areas to original elevation in the same manner specified for formation of embankment.
 - a. Scarify embankment foundation surface where embankment three feet or more in height is to be placed. Scarify or otherwise loosen embankment foundation surface to a depth of six inches where embankment less than three feet in height is to be placed.
 - b. Existing embankment foundations having a slope steeper than four to one shall be plowed to provide embankment binding when required by the Engineer. On steeper slopes the Engineer may require the foundation to be cut into steps or berms.
 - c. Fill existing natural depressions or such other depressions resulting from the site work to the level of adjacent ground elevation in the same manner specified for formation of embankment prior to starting initial embankment layer.
 2. Formation of Embankment: Use On-Site Backfill material placed in nine inch layers and each compacted separately using equipment meeting with Engineer's approval. Carry the whole embankment up evenly the required elevation without breaks or irregularities in material distribution or in the formation of layers. Trim embankment slopes and leave in a neat and acceptable condition.
 - a. Add water to On-Site Backfill material which does not contain a sufficient amount of moisture to obtain the required compaction. On-Site Backfill material containing moisture in excess of the amount required to obtain the necessary compaction density may not, without written approval, be incorporated in the embankment until allowed to dry to a moisture content

not greater than two percentage points above optimum for that particular material.

- b. When pipe is to be laid in fill, bring embankment height to at least four feet above the top of the pipe before the trench is excavated.
- c. Compact embankment material to a minimum final density of not less than 90 percent of the maximum dry weight density at its optimum moisture content.

B. Borrow Material Requirements: Borrow materials required for embankment shall meet the specified requirements of On-Site Backfill material.

- 1. During the excavation operation, keep the borrow area graded to insure free water drainage. Following completion of work in the borrow area, grade the area to present a uniformly trim appearance merging into the surrounding terrain and to prevent serious erosion.

3.03 EXCAVATING

A. Trench Shoring: Perform shoring in accordance with requirements of Section 02151. Follow OSHA requirements for trench shoring as applicable to prevent trench wall collapse.

B. Salvaged Topsoil: In open areas of rights-of-way (not in streets) strip turf and topsoil to the depth of suitable topsoil material and stock pile for subsequent topsoil placement operations.

C. General Requirements: Perform excavation using machinery, except that hand excavation and backfilling may be required where necessary to protect existing structures, utilities or private or public properties; and except that backfilling by hand shall be done to the extent specified herein:

- 1. Begin excavation in trenches at the control point having the lower invert and proceed upgrade.
- 2. Remove surface materials of whatever nature over the line of trenches and other excavations, and properly separate and store removed materials as suitable for use in backfilling or other purposes.
- 3. Remove subsurface materials of whatever nature down to subgrade elevation. Properly separate and store removed subsurface materials as suitable for use in backfilling.
- 4. Cut paving with a mechanical saw and to neat lines equidistant from the centerline of the trench. Comply with the Borough pavement cut back limits.

D. Rock Removal: Where rock removal is required below subgrade, and in the opinion of the Engineer the resultant subgrade is unfit for foundations, backfill to subgrade with Class B Concrete, or backfill with other material as allowed by the Engineer.

- 1. Remove rock to subgrade at least 25 feet in advance of pipe laying.
- 2. Excavate rock in miscellaneous excavations to the extent required by the Engineer.

3. Where rock is encountered in excavations for manholes in which blank connections are to be left for future extensions of sewers, remove rock for a distance of not less than ten feet from the center of the manhole in the direction of future extension. Excavate trench to specified width, depth and length.
4. Remove and lawfully dispose of excavated materials not suitable for use as backfill, or not required for backfill.

E. Excavated Material Storage:

1. In State Highway rights-of-way remove the excavated materials as soon as such is excavated. Store and return this same excavated materials for backfilling when required. In no case will the Contractor be allowed to place excavated material beyond the curb or right-of-way lines or on sidewalks or lawns.
2. In existing and proposed streets other than State Highways where more material is excavated from trenches than can be backfilled or stored on the street or within rights-of-way limits, leaving space for traffic and drainage, remove and store such excess material. Return this same excavated material for backfilling when required.

F. Trench Width and Depth:

1. Pipe Zone Area: In the pipe zone area, which extends 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.

TABLE A

<u>Diameter of Pipe</u>	<u>Minimum Trench Width (Outside Diameter of Pipe at the Barrel Plus)</u>	<u>Maximum Trench Width (Outside Diameter of Pipe at the Barrel Plus)</u>
4 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. Remainder of Trench: Beginning at a point at least twelve inches above the top of the outside barrel of the pipe, keep trench banks as nearly vertical as possible for trenches made in paved or unpaved roadways and in no case shall trench width at the top exceed the outside diameter of the pipe at the barrel plus the dimensions in Table B.

TABLE B

<u>Diameter of Pipe</u>	<u>Maximum Trench Width at Top of Trench (Outside Diameter of Pipe at the Barrel Plus)</u>
4 through 24 inches	40 inches
27 through 36 inches	48 inches
42 through 72 inches	54 inches
Larger than 72 inches	60 inches

- G. Right-of-way or Easement Restrictions: Where pipe lines are constructed in rights-of-way or easements, the work shall be performed in compliance with OSHA, however the maximum trench width shall be kept entirely within the limits of rights-of-way or easements as can be carried on without damage to adjoining property.
- H. Excavation Width and Depth for Manholes and In-Line Structures: Make excavations for manholes to a nearly vertical plane beginning at bottom of excavation one-foot beyond manhole base outside diameter (six inches each side) to two-feet beyond manhole base outside diameter for top of excavation limit (one-foot each side).
1. If surface pavement of any type is encountered (vehicle or pedestrian ways), cut such pavement to a rectangular shape as opposed to circular shape of manhole. Make limits of cut not to exceed one-foot beyond top of excavation limit as specified.
 2. Should bottom of excavation limit be exceeded, provide concrete cradle or encasement for pipes entering or leaving manhole.
 3. Excavate rock for manhole installation one foot outside the exterior lines of the manhole walls and to a depth of the outside bottom.
- I. Trench Width and Depth for Electrical Work: Excavate trenches for both single and banked conduit runs to not more than a maximum width required to accommodate the conduit or conduits with concrete encasement, and to a depth so as to provide a minimum of two feet of cover.
1. Subgrade Preparation, Conduit Trenches: Prepare the bottom of trenches to provide uniform and continuous bearing and support for the conduit, unless concrete encasement or other type of bedding is shown on the Drawings or required by the Engineer.
 2. Conduit Trench Grades: Grade trenches a minimum of four inches per 100 feet. Grade trenches so conduit lines drain away from buildings except for conduit lines from one building to another, in which case grade conduit trenches level. Where conduit lines run to underground structures, grade trenches so conduits to drain to such.
 3. Direct Burial Cable Trenches: Excavate trenches, in both earth and rock, to accommodate both the cable and the Fine Aggregate bedding and cover as indicated on the Drawings.

- J. Excavation Below Subgrade: Do not excavate below depths indicated or specified except where unstable or unsuitable material is encountered at subgrade. Excavate such material to the increased depth as may be required by the Engineer and refill to the proposed subgrade with thoroughly compacted Foundation Backfill material or construct timber foundation as required by the Engineer.
1. If excavations are carried below indicated or specified subgrades without written permission, refill excavations to proper subgrade with thoroughly compacted Foundation Backfill material.
- K. Length of Open Trench: The Engineer shall have the right to limit the amount of trench opened in advance of pipe laying and the amount of pipe laid in advance of backfilling, but in no case shall these amounts exceed 300 feet and 100 feet respectively. Additional open trench limitations as follows:
1. Complete trench excavation at least twenty-five 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 Engineer is empowered to require trench refilling over completed pipe lines if in his judgment such action is necessary.
 3. If Work is stopped on a trench, except as required by the Engineer, and the excavation is left open for an unreasonable period in advance of construction in the opinion of the Engineer, the Engineer may order trench refilling at the Contractor's expense and not allow trench reopening until ready for actual use.
- L. Tunneling and Jacking: The tunneling and jacking of this paragraph is not to be considered the same as the work of tunneling and jacking under a highway or railroad. The work described in this paragraph is intended to be an optional method for installing the pipe to clear certain features in close proximity to the pipeline route.
1. Make tunnels for laying pipe lines of sufficient size to allow the proper joining of pipes and the proper compacting of refill around them. Methods of tunneling or jacking used as may affect the workmanship or quality of completed work or product shall be changed as work progresses, in the judgment of the Engineer, conditions so require. Methods of tunneling and jacking with respect to responsibility and liability for safety to persons and property rests solely with the Contractor.
 2. Where rock is encountered in tunnel work, take rock out fully to the lines prescribed by the Engineer.
 3. Timber tunnels to such extent as may be necessary. Where ordinary timber lining is used, completely fill the space between such timber and the outer surface of the pipeline with On-Site Select Earth Backfill or other approved material, rammed solidly between the pipeline and the timber lining, or fill same space with Concrete Encasement material if ordered by the Engineer.

3.04 BACKFILLING

A. Backfill Restrictions:

1. Do not use in backfilling work materials such as house ashes, putrescible refuse and such other materials considered unsatisfactory by the Engineer. Do not permit excavations to be used as dumping areas for refuse.
2. Do not use frozen backfill materials or place backfill materials on frozen subgrade or trench surfaces.
3. Should there be a deficiency of proper backfill material, provide acceptable borrow material.
4. Except for temporary use in backfilling, no permanent bulkheads or retaining walls will be allowed in the trenches over piping.

B. Subgrade Preparation (Pipe Zone): Provide Pipe Zone Bedding as pipe foundations in trenches made in both earth and rock substrates.

1. Provide Concrete Encasement or Concrete Cradle, or other type of bedding, where and as shown on the Drawings, or required by the Engineer to be used instead of Pipe Zone Bedding.
2. If maximum trench widths specified in Table A (shown previously) are exceeded, provide Concrete Cradle or Concrete Encasement in such locations.
3. Construct Pipe Zone Bedding, Concrete Encasement and Concrete Cradle as specified and in accordance with Detail Drawings.

C. Backfilling Trenches: Perform trench backfilling, and backfilling excavations for in-line structures, by methods which will result in thorough compaction of backfill material without displacement of the grade and alignment of the pipeline and its appurtenances and minimum settlement of backfilled material. Displacement of the pipeline and settlement of backfill shall be considered evidence of improper workmanship or inclusion of unsuitable backfill materials, or both, and will require regrading and realigning the pipeline and removing and recompacting settled material. Exercise care to carry backfill up evenly within the trenches.

1. Initial Backfill: Following pipe bedding and piping and inline structure installation, backfill trenches to a height at least one foot above the top of the pipe barrel with Initial Backfill material placed in four inch compacted layers. This backfill shall be carefully placed in trenches in such manner as not to damage or disturb the pipe.
2. Remainder of Backfill In Other Than Roadways: On-Site Backfill placed and compacted in six inch layers. Exercise care to carry backfill up evenly on opposite sides of the piping. Replace topsoil to approximate depth of existing as final backfilling operation and crown to such height as required by the Engineer. Maintain crowned surface to the satisfaction of the Engineer, during the Guarantee Period.
3. Remainder of Backfilling in Roadways: Backfill remainder of the trench using backfill materials specified below. Exercise care to carry backfill up evenly on opposite sides of the piping.

- a. Within the Right-of-Way Limits of State Highways:
 - 1) Paved Areas: Conforming to the requirements of the Pennsylvania Department of Transportation Highway Occupancy Permit.
 - 2) Unpaved Areas: Aggregate Backfill compacted in four inch layers to bottom of topsoil. Replace topsoil to approximate depth of existing as final backfilling operation and crown to such height as required by the Engineer. Maintain crowned surface to the satisfaction of Engineer, during the guarantee period.
- b. Paved Roadways of Proposed and Existing Streets Other Than State Highways: Conforming to the requirements of West Hanover Township.
- c. Unpaved Shoulders of Proposed and Existing Streets Other Than State Highways: Conforming to the requirements of West Hanover Township..
- d. Bituminous Driveways: On-Site Backfill compacted in six inch layers to a point eight inches below the adjacent existing surface. Backfill the remaining eight inches with compacted Aggregate Backfill and specified replacement pavement.
- e. Stone Driveways and Parking Areas: On-Site Backfill compacted in six inch layers to a point six inches below the adjacent existing topsoil surface. Backfill the remaining six inches with stone surface replacement pavement.
- f. Sidewalks: On-Site Backfill compacted in six inch layers to a point eight inches below the adjacent existing surface. Backfill the remaining eight inches with compacted Aggregate Backfill and specified replacement pavement.
- g. Unimproved Streets: Conforming to the requirements of West Hanover Township.
- 4. Additional Requirements for PVC Gravity Pipe Bedding and Backfill: Install First Class Bedding in accordance with the requirements of ASTM D 2321 using Class 1 material.
 - a. Assure that sufficient First Class Bedding material is worked under the haunching of the pipe to provide adequate side support.
 - b. Prevent movement of pipe during placing of material under the pipe haunch. Walking or standing on pipe will not be permitted.
 - c. Excessive tamping of Initial Backfill material over the top of the pipe will not be permitted.
 - d. Do not use rolling equipment or heavy tampers to consolidate backfill until at least two feet of backfill is placed over the top of the pipe.
- 5. Additional Requirements for PVC Pressure Pipe Bedding and Backfill: Install First Class Bedding in accordance with the requirements of ASTM D 2774.
- D. Compacting: During the course of backfilling and compacting work, the Engineer reserves the right to make tests at various locations or depths of trenches, to determine whether the Contractor's compaction operations are meeting specified requirements. Compact trench backfill as follows:
 - 1. Solidly tamp each layer of Initial Backfill around the pipeline with proper tamping tools made specially for this purpose.

2. Thoroughly compact Aggregate Backfill with a vibratory compactor of a type and size satisfactory to the Engineer (and the Pennsylvania Department of Transportation). Compacting of Aggregate Backfill by puddling or jetting will not be permitted.
 3. Use mechanical tampers to compact backfill materials in trench refill operations to produce a density of backfill at the bottom of each layer of not less than 90 percent of maximum density obtained at plus or minus two percentage points of the optimum moisture content as determined by the ASTM D 698 method. Perform field determinations of density, when requested by the Engineer, according to ASTM D 1556 or D 2922.
 4. Where approved On-Site Backfill material is used under existing and proposed streets other than State Highways, compact the materials to produce a density of not less than 902 percent of maximum density up to the bottom of paving or proposed grade.
 - a. Perform two to five field determinations of density for every 200 linear feet of trench backfilled at locations and depths determined by the inspector. The Contractor shall reimburse the Authority for inspection services provided by the Authority's inspector.
 - b. Field determinations of density shall be performed by an independent testing agency provided by the Contractor, subject to the approval of the Engineer, or performed by the Engineer. The testing agency shall furnish test results verbally to the Contractor and the Authority's inspector immediately upon completion of each test, and furnish two copies of each test result report to both the Contractor and the Engineer within 48 hours of the completion of each test.
 5. The use of puddling or jetting for compacting backfill in trenches is prohibited.
- E. Compacting Backfill In State Highways: Trench excavation and backfill within State Highway right-of-way will be subject to inspection by representatives of the Commonwealth of Pennsylvania, Department of Transportation, and the work shall be performed in accordance with the requirements of that department even though such requirements may entail more labor or services than the methods herein described.

3.05 ANCILLARY WORK

- A. Earth Dams: In Pipe Zone Bedding installations, construct earth dams composed of Select Earth Backfill material. Construct earth dams in accordance with Detail Drawing. Place earth dam material by hand and compact with proper tools designed especially for such purpose.
1. Locations For Earth Dams:
 - a. Construct Earth Dams in main sewer trenches at 100 foot intervals.
 - b. Construct Earth Dams at a point not less than three feet upstream from inline structures.
 - c. Construct Earth Dams in trenches for service connections at a point not less than three feet from the main sewer trench.

- d. Construct additional Earth Dams in trenches at such other locations required by the Engineer.
- B. Service Connections: Excavate depth of cut to invert predetermined by Engineer. Where required by Engineer, excavate entire length of service connection trench before laying pipe.
1. Rock Excavation: If rock is encountered within ten feet of buildings, remove by drilling and wedging or some other method other than blasting. Remove rock to one foot beyond end of service connection.
 2. Curb and Sidewalk Restoration: If curbs and sidewalks are disturbed during service connection work, restore such curbs and sidewalks to as new condition.
 3. Markers: Do not backfill upper free end of service connection until elevation and location points are inspected and approved by Engineer. Install a two by four-inch lumber marker set plumb and flush with invert of upper free end of service connection. Cut top of marker flush with existing grade.
 4. Backfilling and compacting as specified previously.
- C. Backfilling Trenches for Electrical Work: Perform trench backfilling for conduits by methods which will result in thorough compaction of backfill material without displacement of the conduit and minimum settlement of backfilled material. Settlement of backfill shall be considered evidence of improper workmanship or inclusion of unsuitable backfill materials, or both, and will require removing and recompacting settled material with no additional compensation paid.
1. Backfill single and banded conduits, not encased in concrete, using Select Earth Backfill placed to six-inches minimum compacted depth to a point six inches above the conduit. Backfill remainder of trench to the level of planned subgrade using On-Site Backfill materials placed in layers not exceeding six-inches in thickness after compaction.
 2. Backfill concrete encased conduits using On-Site Backfill materials placed in layers not exceeding six-inches in thickness after compaction.
 - a. In trenches under paved areas, use Aggregate Backfill placed in layers not exceeding four-inches in thickness after compaction to the bottom of the temporary or permanent paving.
 3. Backfill direct bury cable encased in Fine Aggregate placed to minimum compacted depth indicated. Backfill remainder of trench to the level of planned subgrade using Select Earth Backfill materials placed in layers not exceeding six-inches in thickness after compaction.
- D. Stream Crossings: Excavate trenches in stream crossings to provide a minimum cover of one foot in rock and three feet in other material or otherwise required by the Engineer.
1. Material excavated may be used as backfill unless specifically prohibited by the state agency having jurisdiction.
 2. Make the necessary provisions for cofferdamming, dewatering and removal of excess excavated material.
 3. Maintain the flow in the stream.

- E. Underground Warning Tape: For the purposes of early warning and identification of buried pipes during future trenching or other excavation, provide continuous identification tapes in trenches. Install in accordance with printed recommendations of the tape manufacturer, and as specified herein:
1. Bury tape at a depth of 12-inches below grade. In pavements measure 12-inches from subgrade of pavement.
 2. Provide warning tape in trenches for utilities specified previously.
- F. Cleanup: After trenches and other excavations are refilled and the work completed, remove surplus excavated materials, rubbish or such other materials from the work in such manner as the Contractor may elect or provide, subject to the Engineer's approval. Dispose of such materials off the site in a lawful manner.
1. Remove surplus excavated material, rubbish and other construction debris and keep such removed to a point not more than two hundred feet from the head of the open trench, unless otherwise authorized by the Engineer.
 2. Where surplus excavated material is lawfully disposed of on public property, spread the material evenly and leave the area in a neat, smooth, compacted condition.
 3. Furnish and place topsoil, fertilize and seed grassed areas, both within and outside rights-of-way as affected by construction. Reseed and re-fertilize areas that fail to show a uniform stand of grass. Water, mow, rake, weed and otherwise maintain grass until final acceptance of Contract.
 4. Restore the area covered by both temporary and permanent rights-of-way over private property to as near the original conditions as is practical. Bring area up to original grade, place topsoil, seed, replant or replace damaged or removed shrubbery, repair or replace walks, driveways, fences and other improvements.
 5. Place topsoil, lime, fertilizing and seed in a manner consistent with acceptable trade practices for the area involved.
 6. When the repaving over trenches and other excavations has been completed, sweep paved surfaces having been affected by the work using hand or power sweepers, and if required by the Engineer, flush with water to remove dust and small particles.
- G. Maintenance: The Contractor is solely responsible for injury or damage resulting from lack of trench maintenance during the guarantee period.

END OF SECTION

SECTION 02270

EROSION AND SEDIMENT POLLUTION CONTROL

PART 1 GENERAL

1.01 REQUIREMENTS OF REGULATORY AGENCIES

- A. Contractor Prepared Erosion and Sediment Pollution Control Plan:
 - 1. Prior to earth moving activities, prepare a soil erosion and sediment pollution control plan in accordance with rules and regulations adopted by the Pennsylvania Department of Environmental Protection (DEP).
 - 2. Detail requirements for the control plan are described in an Erosion and Sediment Pollution Control Program Manual that may be obtained from the Bureau of Soil and Water Conservation, Division of Soil Resources and Erosion Control, Harrisburg, Pennsylvania.
- B. Site Review: When required, arrange and conduct an on-site review of potential soil erosion problems with personnel of the Bureau of Soil and Water Conservation or with the County Soil conservation District.
 - 1. Select proper methods of soil erosion and sedimentation control acceptable to review agency.
 - 2. Describe selected methods on maps and in narrative report of Soil Erosion and Sedimentation Control Plan.
- C. Penalties: Fines and related costs resulting from failure to provide adequate protection against soil erosion and sedimentation are the obligation of the Contractor.
 - 1. Silt, sedimentation and mud leaving the site will be construed as damage to neighboring property and evidence of negligence on the part of the Contractor.
 - 2. Damages to neighboring property shall be rectified and restitution shall be paid by the Contractor.

1.02 SUBMITTALS

- A. Erosion and Sediment Pollution Control Plan: Prior to earth moving activities furnish two copies of plan approved by regulatory agency having jurisdiction.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Materials for erosion control work are as described in the approved plan prepared by the Contractor.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Conduct work in compliance with rules, regulations and requirements of the Pennsylvania DEP. Erosion and Sediment Pollution Control measures employed will be subject to approval and inspection by the Pennsylvania DEP.
- B. The Contractor shall keep on the Project one copy of the approved Erosion and Sedimentation Control Plan.

END OF SECTION

SECTION 02300

TUNNELING, BORING AND JACKING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: This Section includes the tunneling, boring and jacking work to pass pipe lines under public transportation rights-of-way.
- B. Related Sections:
 - 1. Shoring: Section 02151.
 - 2. Trenching, Backfilling and Compacting: Section 02221.
 - 3. Piped Wastewater Sewers: Section 02722.
 - 4. Force Mains: Section 02724.
 - 5. Cast-In-Place Concrete: Section 03300.

1.02 REFERENCES

- A. American Association of State Highway and Transportation Officials (H-20): (AASHTO) Loading for Conduits Installed Under Streets, Road, or Highways.
- B. American Society for Testing and Materials:
 - 1. ASTM A 53, Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless.
 - 2. ASTM A 123, Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strip.
 - 3. ASTM A 139, Electric-Fusion (Arc) Welded Steel Pipe (NPS 4 in. and over).
 - 4. ASTM A 307, Carbon Steel Externally and Internally Threaded Standard Fasteners.
 - 5. ASTM A 569, Steel, Carbon (0.15 Maximum Percent), Hot-Rolled Sheet and Strip, Commercial Quality.
 - 6. ASTM A 615, (S1), Deformed and Plain Billet-Steel Bars for Concrete Reinforcement, including Supplementary Requirement.
 - 7. ASTM C 32, Sewer and Manhole Brick (Made from Clay or Shale), Spec. for.
 - 8. ASTM C 33, Concrete Aggregates.
 - 9. ASTM C 144, Aggregate for Masonry Mortar.
 - 10. ASTM C 150, Portland Cement.
 - 11. ASTM C 207, Hydrated Lime for Masonry Purposes.
 - 12. ASTM C 270, Mortar for Unit Masonry.
 - 13. ASTM F 467, Nonferrous Nuts for General Use.
 - 14. ASTM F 468, Nonferrous Bolts, Hex Cap Screws and Studs for General Use.
- C. American Welding Society: AWS D1.1 Structural Welding Code.

- D. Commonwealth of Pennsylvania Department of Transportation (PDT), Specifications Publication 408, as supplemented.
 - 1. PDT Section 703.3 Select Granular Material.
 - 2. PDT Section 703.2 Coarse Aggregate.

1.03 SUBMITTALS

- A. Shop Drawings and Product Data: Furnish completely dimensioned shop drawings, cuts or other data as required to provide a complete description of Products to be installed.
 - 1. The shop drawings shall show the cross section dimensions, diameter and thickness gauge of the liner plate.
- B. Furnish PennDOT for approval, detail drawings, accompanied by design calculations, for the tunneling shield, tunneling pits, including sheeting and bracing therefor, tunnel liner plate and tunneling procedure and grouting method and all such drawings and computations shall bear the seal of a Registered Professional Engineer.
- C. Certificates: Certified records or reports of results of laboratory tests, such records or reports to contain a sworn statement that laboratory tests have been made as specified.

1.04 QUALITY ASSURANCE

- A. Workmen Qualifications: Use only personnel thoroughly trained and experienced in the skills required.
 - 1. Welds shall be made only by welders, tackers and welding operators who have been previously qualified by tests as prescribed in the Structural Welding Code AWS D1.1 of the American Welding Society to perform the type of work required.
- B. Design Criteria:
 - 1. Encasing conduit under highways shall be of sufficient strength to support all superimposed loads, including an American Association of State Highway and Transportation Officials H-20 Loading with 50 percent added for impact.
- C. Requirements of Regulatory Agencies:
 - 1. State Highways: Work of this Section within State Highway right-of-way will be subject to inspection by representatives of the Commonwealth of Pennsylvania Department of Transportation, and the work shall be performed in accordance with the requirements of the latest edition of the Commonwealth of Pennsylvania, Pennsylvania Code, Title 67, Transportation, Department of Transportation, Chapter 459, Occupancy of Highways by Utilities.
 - a. Inspection, insurance or other charges demanded by the Commonwealth of Pennsylvania Department of Transportation, or other authority having jurisdiction shall be paid for by the Owner.

D. Source Quality Control:

1. Laboratory Tests: The Engineer reserves the right to require that laboratory tests be conducted on materials. 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 as provided in the Bid Form from the fund stipulated for the purpose.
2. Shop Tests: In accordance with Article 1.06 of the General Instructions, factory test pipe materials listed in the following. 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.

<u>MATERIAL</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
Steel Pipe	ASTM A 139 or ASTM A 53	As specified in ASTM A 139 or ASTM A 53, as applicable

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

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

1.06 SITE CONDITIONS

- A. Classification of Materials: No consideration will be given to the nature of materials encountered in tunneling. Remove rock encountered during the tunneling operation, no separate or additional payment will be made for tunneling through rock.
- B. Scheduling:
1. Perform tunneling operations continuously on a 24-hour basis if required by PennDOT.
- C. Environmental Requirements:
1. As specified in Sections 02221 and 02722.
- D. Protection: As specified in Section 02221 and such added requirements included herein.
1. Adequately support and protect utilities and facilities that are encountered in, or may be affected by, the work.
 2. Structure Supports: As specified in Section 02221.
 3. Accommodation of Traffic: As specified in Section 02221.
 4. Explosives and Blasting: Not permitted in performance of work of this Section.
 5. Excavation Conditions: As specified in Section 02221.
 6. Excess Materials: As specified in Section 02221.
 7. Borrow Material: As specified in Section 02221.

PART 2 PRODUCTS

2.01 ENCASING CONDUIT

- A. Steel Tunnel Liner Plate: Cold formed, steel, four flanged liner plates of minimum inside neutral axis diameter as indicated on the Drawings, or as indicated by the Engineer.
 - 1. Material: Structural quality hot rolled carbon steel conforming to ASTM A 569, and hot-dipped galvanized conforming to ASTM A 123.
 - a. Minimum Thickness: U.S. Standard Gauge 8, marked on each liner plate by manufacturer.
 - 2. Grout Holes: Provide tapped grout holes and plugs, minimum 1 ½-inch diameter, in every third plate.
 - 3. Nuts and Bolts: Minimum ½-inch diameter, coarse thread, conforming to ASTM A 307, Grade A.
 - 4. Coating: Factory coated inside and outside with asphaltic material to a minimum thickness of 0.05 inch.
 - 5. Acceptable Manufacturers:
 - a. Armco Drainage and Metal Products, Inc.
 - b. Republic Steel Corp.
 - c. Commercial Shearing and Stamping Company.
 - d. Or equal.
- B. Steel Pipe: Conforming to ASTM A 139, Grade B or ASTM A 53, Grade B, and of minimum diameter as indicated on the Drawings.
 - 1. Minimum Wall Thickness: As required by the individual site design criteria.

2.02 SEWER PIPE AND FITTINGS

- A. Ductile Iron Pipe (DIP): As specified in Section 02722.
 - 1. Use mechanical joint pipe.

2.03 MISCELLANEOUS MATERIAL

- A. Concrete: Class B (3000 psi.), as specified in Section 03300.
- B. Lean Concrete: Plant mixed concrete of 2000 psi compressive strength at 28 days with minimum cement content per cubic yard in accordance with current ready-mix plant standard practice.
 - 1. Reduced Aggregate: Lean concrete shall contain aggregate with particle size not less than 1/8-inch or more than ½-inch in any dimension and a maximum of five percent of particles passing a No. 8 sieve.
- C. Aggregate Backfill: Aggregate material conforming to the following and the choice of material being as required according to the Engineer's direction in the field.
 - 1. AASHTO No. 8 Coarse Aggregate conforming to PDT Section 703.2.

2. Select Granular Material conforming to PDT Section 703.3.
- D. Brick: Commercially manufactured brick made from clay or shale and burned, meeting requirements of ASTM C 32, Grade MS.
- E. Waterproofed Mortar: Conforming to requirements of ASTM C 270 for Type M, 2500 psi (Parts by volume include: One part cement, 1/4 part lime, and sand at not less than 2-1/4 nor more than three times the sum of the volumes of cement and lime used and of the following materials:
1. Waterproofing Agent: Medusa Waterproofing Powder by Medusa Portland Cement Co.; Hydratite by Grace Construction Materials; or Hydrolox by Chem-Master Corp. Add the Medusa product in the ratio of two pounds per bag of cement; add the other products per manufacturer's recommendations.
 2. Portland Cement: Conforming to ASTM C 150, Type I.
 3. Hydrated Lime: Conforming to ASTM C 207, Type S.
 4. Sand: Conforming to ASTM C 144.
 5. Water: Clean and free from deleterious amounts of acids, alkalis, and organic materials.
- F. Grout: Sand/Cement grout composed of the following materials:
1. Portland Cement: Conforming to ASTM C 150 Type II.
 2. Sand: Conforming to ASTM C 33, fine aggregate.
 3. Water: Potable.
 4. Grout Mixture: Mixture of one part Portland Cement, three parts fine aggregate and water.
- G. Sand: Conforming to ASTM C 33, fine aggregate.
- H. Hold Down Rod: Reinforcement bar conforming to ASTM A 615, Grade 60, deformed.
1. Field coat hold down rods with a coal tar product such as No. 46-465 H.B. Tnemecol as manufactured by Tnemec Company, Inc., or equal.
- I. Pipe Support System (Casing spacers for pipe support in Encasing Conduit): Provide casing spacers to prevent direct contact between the carrier pipe and steel encasing conduit. Casing spacers may be either of the following types except that a mixture of the two types is not acceptable.
1. Banded Wood Skid/Blocking (Pipe Support in Conduit): Composed of stainless steel band strapping and preservative treated wood blocking. Material composition as follows:
 - a. Wood Skid/Blocks: Wood species of the allowable types under recognized grading rules and stamped to indicate product compliance with U.S. Dept. of Commerce Product Standard PS-20-70.
 - 1) Preservative treatment shall conform to American Wood Preserves Association Standard P-5 (0.60 pounds per cu. ft. of wood) for soil contact service; Wolman CCA Type C, or equal.
 - b. Steel Bands: Use one inch wide (minimum) stainless steel strapping to

make the treated wood blocking attachment bands. Secure the bands in place with stainless steel compression style band clamps. Provide a minimum of two bands on each set of treated wood blocking.

2. Casing Spacer System (Pipe Support in Conduit): Composed of coated steel band with plastic block/runners or skids. Material composition as follows:
 - a. Plastic Skid/Blocks: Glass reinforced molded plastic runner blocks having a compression strength of 18,000 psi according to ASTM D 695, and a tensile strength of 17,600 psi according to ASTM D 638.
 - b. Steel Band: 14 gauge steel, hot rolled and pickled. Two piece design through 36-inch carrier pipe size. Bands shall have deep embossed flanges and corner cut a angles greater than 90 degrees.
 - 1) Bands shall contain an integral polyvinyl chloride (PVC) isolation liner of 0.90-inch thickness and Durometer hardness of A85-90.
 - 2) Bands provided with installation connection hardware consisting of cadmium plated 5/16-inch studs with hex nuts and washers; minimum of six studs on an 8-inch wide band.
 - 3) Bands factory finished in 10 to 16 mils thick fusion bonded PVC coating.
 - c. Acceptable Manufacturers:
 - 1) PSI Pipeline Seal and Insulator, Inc.
 - 2) Cascade Waterworks Mfg. Co.
 - 3) APS Advance Products and Systems, Inc.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Field Inspection: Inspect the specified Products before installation in conformance with the inspection requirements of the appropriate referenced standard.
- B. Rejected Products: Remove rejected Products from the Project site and replace with new Products at no increase in Contract Price.

3.02 PREPARATION

- A. As specified in Sections 02221 and 02722.
- B. Access Pit Excavation: Perform in accordance with Section 02221 and such added requirements as specified herein:
 1. Over Excavation: Should the Contractor in constructing an Access Pit excavate below the subgrade for the proposed crossing, he will be required to backfill the

area excavated below the subgrade with Aggregate Backfill or with Class B concrete as required by the Engineer and at no increase in Contract Price.
 2. Tunneling Pit: Construct tunneling pits as illustrated on the Sewer Detail Drawing entitled: Tunnel Work Pit and Tunnel Liner Plate.
 3. Jacking Pit: Preliminary work shall consist of excavating and shoring an

acceptable shaft on the downstream side of the crossing and the installation of a backstop and guide timbers.

- a. Bracing and Backstop Design: The bracing and backstops shall be so designed, and jacks of sufficient rating shall be used, so that the jacking can be progressed without stoppage except for adding lengths of pipe.
 - b. Accurately place guide timbers on line and grade.
4. Shoring: As specified in Section 02151. Follow OSHA requirements for excavation shoring as applicable to prevent excavation wall collapse.

3.03 CONSTRUCTION

- A. Tunneling: Tunneling shall conform to the applicable requirements of Section 02221 and the applicable requirements of the appropriate referenced regulatory agencies.
1. Liner Plate Installation: Install the Steel Tunnel Liner Plate to the limits indicated on the Drawings or required by the Engineer or the regulatory agencies.
 - a. Exercise care in trimming the surface of the excavated section in order that the steel liner plates fit snugly against undisturbed material wherever possible.
 - b. Do not advance excavation ahead of the previous installed liner plates any more than is necessary for the installation of the succeeding liner plate.
 - c. Support the vertical face of the excavation as necessary to prevent sloughing. Completely bulkhead the heading at any interruption of the tunneling operation.
 2. Painting: Field paint the bolt heads and nuts of the installed tunnel liner plate.
 3. Grouting: Completely fill the voids behind the liner plate or encasing conduit (as applicable) by placing a uniform mixture of grout under pressure.
 - a. Provide grout holes tapped for no smaller than 1 ½-inch pipe, spaced at approximately three feet around the circumference of the tunnel liner plates in every third ring.
 - b. Start grouting at the lowest hole in each grout panel and proceed upwards simultaneously on both sides of the tunnel.
 - c. Install threaded plug in each grout hole as the grouting is completed at that hole.
 - d. Proceed with grouting as required by the Engineer, but in no event shall more than six linear feet of tunnel be progressed beyond the grouting.
- B. Boring Operations: Boring shall conform to the applicable requirements of the appropriate referenced regulatory agency and additional requirements specified herein:
1. Install the encasing conduit by the boring method to the limits indicated on the Drawings or such additional limits required by the Engineer or regulatory agency.
 2. Provide devices at the front of the pipe to prevent auger and cutting heads from leading the encasing conduit. Unsupported excavation ahead of pipe is prohibited.
 3. Over-cut by the cutting head shall not exceed the outside diameter of the encasing conduit by more than one-half inch.
 4. The use of water or other liquids to facilitate casing placement and spoil removal is prohibited.

5. If voids develop, or if bored hole diameter is more than one inch greater than the outside diameter of the encasing conduit, place Grout to fill the voids.
 6. Check conduit alignment in a manner and at times required by Engineer. Check alignment and grade at least once each working shift as the work progresses.
 7. Completely bulkhead the heading at interruptions in boring operation.
 8. Completely weld joints around the circumference between sections of steel pipe encasing conduit.
- C. Jacking Operations: Jacking shall conform to the applicable requirements of the regulatory agencies and additional requirements specified herein. This operation shall be conducted without handmining ahead of the pipe and without the use of any type of boring, augering, or drilling equipment.
1. Install the encasing conduit by the jacking method to the limits indicated on the Drawings or such additional limits required by the Engineer or the regulatory agencies.
 2. Support the vertical face of the excavation as necessary to prevent sloughing.
 3. Use poling boards and bulkheads as required if subgrade conditions in the heading are unstable.
 4. Jacking and excavation within the pipe shall proceed simultaneously with the ground being cut no more than two inches outside the pipe at the top and sides and not less than two inches above subgrade at the bottom.
 5. The use of water or other liquids to facilitate casing placement and spoil removal is prohibited.
 6. If voids develop, or if jacked hole diameter is more than one inch greater than the outside diameter of the encasing conduit, place grout to fill voids in manner approved by the regulatory agencies.
 7. Check conduit alignment in a manner and at times required by Engineer. Check alignment and grade at least once per shift as the work progresses.
 8. Completely bulkhead heading at interruptions in jacking operation.
 9. Completely weld joints around the circumference between sections of steel pipe encasing conduit.
- D. Laying Pipe: Lay pipe in encasing conduit as specified in Section 02722 and such added requirements included herein:
1. Support and maintain the alignment and grade of the pipe sewer piping until the concrete cradle is poured and the hold down rods are set.
 2. Paint exposed portion of hold down rods.
 3. After the sewer piping has been installed in the encasing conduit and has been tested, close the ends of the encasing conduit with brick and mortar in such manner so as to prevent the entrance of foreign material. However, provision should be made to allow leakage to drain out of the encasing conduit in the event of a break in the sewer piping.
- E. Encasing Conduit Filling and Closing: After the pipe sewer has been installed in the encasing conduit and has been tested, fill the encasing conduit with Sand or Lean Concrete as required by the applicable Regulatory Agency.
1. Close one end of encasing conduit with brick and mortar before filling encasing

conduit. Close other end of encasing conduit with Brick and Waterproofed Mortar after filling encasing conduit or as the filling operation dictates.

- F. Cleanup: As specified in Section 02221.

3.04 FIELD QUALITY CONTROL

- A. Testing: After laying pipe in encasing conduit is completed, and before filling the encasing conduit, perform pipe line acceptance testing as specified in Section 02722 and Section 02724 as applicable.

END OF SECTION

SECTION 02500

PAVING AND SURFACING

PART 1 GENERAL

1.01 REQUIREMENTS OF REGULATORY AGENCIES

- A. State Highways: Perform paving and surfacing work in accordance with the Highway Occupancy Permit as issued by the Pennsylvania Department of Transportation.
- B. Township Streets: Perform paving and surfacing work in accordance with the Street Cut Permit as issued to the Contractor.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Use paving and surfacing materials as required by the particular regulatory agency having jurisdiction.

PART 3 EXECUTION

3.01 CONSTRUCTION

- A. Perform the paving and surfacing construction work in accordance with the requirements of the particular regulatory agency having jurisdiction.

END OF SECTION

SECTION 02601

MANHOLES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: This Section specifies construction of the various types and sizes of manholes required.
- B. Related Sections:
 - 1. Trenching, Backfilling and Compacting: Section 02221
 - 2. Cast-In-Place Concrete: Section 03300.
 - 3. Grout: Section 03600.

1.02 REFERENCES

- A. American Society for Testing and Materials.
 - 1. ASTM A 48, Specification for Gray Iron Castings.
 - 2. ASTM A 276, Specification for Stainless and Heat-Resisting Steel Bars and Shapes.
 - 3. ASTM A 307, Specification for Carbon Steel Externally Threaded Standard Fasteners.
 - 4. ASTM A 615, Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 5. ASTM C 144, Specification for Aggregate for Masonry Mortar.
 - 6. ASTM C 150, Specification for Portland Cement.
 - 7. ASTM C 207, specification for Hydrated Lime for Masonry Purposes.
 - 8. ASTM C 270, Specification for Mortar for Unit Masonry.
 - 9. ASTM C 361, Specification for Reinforced Concrete Low-Head Pressure Pipe.
 - 10. ASTM C 443, Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
 - 11. ASTM C 478, Specification for Precast Reinforced Concrete Manhole Sections.
 - 12. ASTM C 497, Standard Methods of Testing Concrete Pipe, Manhole Sections, or Tile.
 - 13. ASTM C 923, Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.
 - 14. ASTM D 412; Standard Test Methods for Rubber Properties in Tension
 - 15. ASTM D 518; Standard Test Method for Rubber Deterioration - Surface Cracking
 - 16. ASTM D 573; Standard Test Method for Rubber - Deterioration in an Air Oven.
 - 17. ASTM D 624; Standard Test Method for Rubber Property - Tear Resistance
 - 18. ASTM D 695, Test Method for Compressive Properties of Rigid Plastics.
 - 19. ASTM D 2137; Standard Test Method for Rubber Property - Brittleness Point of Flexible Polymers and Coated Fabrics.
 - 20. ASTM D 2146, Specification for Propylene Plastic Molding and Extrusion

Materials.

21. ASTM D 2240, Test Method for Rubber Property-Durometer Hardness.
22. ASTM D 3676; Standard Specification for Rubber Cellular Cushion Used for Carpet or Rug Underlay.
23. ASTM D 4101, Specification for Propylene Plastic Injection and Extrusion Materials.

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

1.03 SUBMITTALS

A. Shop Drawings and Product Data: Submit manufacturer's published detail drawings, modified to suit design conditions if required, catalog cuts, Contractor prepared drawings as applicable, and such other data as required to provide complete descriptive information for the following:

1. Basic Materials.
2. Precast Reinforced Concrete Manhole Components.

B. Certificates: Submit 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.

1. Manufacturer's sworn certification that components and products will be manufactured in accordance with specified reference standards for components and products.
2. Manufacturer's sworn certification that manhole frame and cover tensile test bars were poured from the same iron as castings they represent.

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:

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. Source Quality Control: Maintain uniform quality of products and component compatibility by using the products of one manufacturer for precast reinforced concrete manholes.
1. Obtain certificate of construction compliance with ASTM C 478 from the precast reinforced concrete manhole manufacturer. Submit this certificate as part of required submittals.
 2. 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 the certificate as part of required submittals.
 3. Shop and Laboratory Tests: As a condition of the Contract, the materials stated herein require periodic testing according to methods referenced, or as required by the Engineer.
 - a. Laboratory Tests: Submit three manhole frame and cover tensile test bars for each 50 manhole frames and covers, or less if the total required is less than 50. Submit one machined test bar ready for testing. Engineer will verify certifications, release one bar for the Machined Bar Tensile Test, and retain two remaining bars.
 - 1) Testing Laboratory shall furnish both Engineer and Contractor two copies of test result reports. These reports will be considered as sufficient evidence of acceptance or rejection of materials represented.
 - b. Shop Tests: The manhole component manufacturers shall have the capability to perform the number of tests that the Engineer may require to establish the quality of the proposed manhole components. Manufacturers shall furnish to the Engineer certified test records or reports with sworn statement of tests made as specified.
 - 1) Precast Reinforced Concrete Manholes: Conduct tests as specified in ASTM C 478.
 - 2) Manhole Frames and Covers: Test for AASHTO H-20 highway loading. Test one manhole cover of each design submitted for approval.
 4. The Engineer reserves the right to accept certified test records or reports of previously conducted tests.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Delivery and Handling: Transport and handle precast reinforced concrete manhole components, and other products specified herein, in a manner recommended by their respective manufacturers to prevent damage and defects.
1. Through-wall lifting holes are not permitted in manhole component construction.
- B. Storage: Store precast reinforced concrete manhole components in accordance with their manufacturer's recommendations to prevent joint damage and contamination.
1. Exercise such particular care in storage of the specified appurtenant products as

recommended by their respective manufacturers.

1.06 SITE 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 as recommended by the compound manufacturer.
3. During warm weather stiffen Preformed Plastic Sealing Compound by placing under cold water or by other means as recommended by the compound manufacturer.

B. Manhole Size Parameters: The typical diameter of manholes is set at four feet. Larger diameter manholes shall be required where the following conditions prevail:

1. The angle of pipes entering the manhole is such that the wall space between the pipe openings is less than one foot.
2. The manhole is scheduled to contain flow measuring instrumentation or other flow measuring devices.
3. Where the depth of the manhole is greater than 15 feet.

PART 2 PRODUCTS

2.01 BASIC MATERIALS

A. Cast-In-Place Concrete Products: As specified in Section 03300.

B. Waterproofed Mortar: Conforming to requirements of ASTM C 270 for Type M, 2500 psi (Parts by volume include: One part cement, 1/4 part lime, and sand at not less than 2-1/4 nor more than three times the sum of the volumes of cement and lime used and of the following materials:

1. Waterproofing Agent: Medusa Waterproofing Powder by Medusa Portland Cement Co.; Hydratite by Grace Construction Materials; or Hydrolox by Chem-Master Corp. Add the Medusa product in the ratio of two pounds per bag of cement; add the other products per manufacturer's recommendations.
2. Portland Cement: Conforming to ASTM C 150, Type I.
3. Hydrated Lime: Conforming to ASTM C 207, Type S.
4. Sand: Conforming to ASTM C 144.
5. Water: Clean and free from deleterious amounts of acids, alkalis, and organic materials.

C. Epoxy Bonding Compound: Provide a high-modulus, low viscosity, moisture insensitive epoxy adhesive having the following characteristics.

1. Mix Ratio: 100 percent solids, two-component; mixed one part by volume component B to two parts by volume component A.

2. Ultimate Compressive Strength: 13,000 psi after cure at 73 degrees F. and 50 percent relative humidity determined in accordance with ASTM D 695.
3. Acceptable Manufacturers:
 - a. Sika Corporation: Sikadur Hi-Mod.
 - b. Euclid Chemical Company; No. 452 Epoxy System.
 - c. A. C. Horn, Inc.; Epoxitite Binder.
 - d. Or equal.

2.02 MANHOLE MATERIALS

- A. Manhole Steps: Manhole step designs are as indicated on Drawings. A mixture of step types in any one manhole is not allowed.
 1. Aluminum Step: Aluminum Alloy AA Designation 6061-T6. Coat that portion of aluminum step being embedded in concrete with heavy bodied bituminous paint.
 2. Reinforced Plastic Step: Composed of a ½-inch size, Grade 60, ASTM A 615 deformed steel reinforcing bar completely encapsulated in Grade 49108, ASTM D 4101 polypropylene copolymer compound, Type II; M. A. Industries, Inc., Type PS4, or equal.
- B. Manhole Frames and Covers: Gray iron castings conforming to ASTM A 48, Class No. 30, designed for AASHTO Highway Loading Class H-20. Provide castings of uniform quality, free from blowholes, porosity, hard spots, shrinkage distortion or other defects. Frame and cover design and dimensions are as indicated on Drawings.
 1. Finish: Bearing surfaces machined to prevent rocking and rattling under traffic. Casting finished to meet AASHTO Specification M 306, 4.3.3 Painting, Welding, Plugging - Not Allowed.
 2. Identification: Cast the word SEWER integrally on cover in two inch size, raised letters.
 3. Frame Hold-down Bolts: Conforming to ASTM A 307.
 4. O-ring Cover Gasket: One piece O-ring gasket factory installed in a machined rectangular or dovetail groove in the bearing surface of the cover.
 - 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. Glueing of gasket is not permitted.
 5. Tensile Test Bar: Size B, cast separately, but poured from same iron as castings they represent.
- C. Watertight Manhole Frame and Cover: Conforming to above specified General Requirements with the following additional requirements:
 1. Cover Hold-down Bolts: AISI Type 316 stainless steel conforming to ASTM A 276 for bolts and washers, or manufacturer's standard bronze bolts and washers.

- D. Manhole Component Seals: The option is permitted to provide either type manhole component seal as specified herein; however, only one type is permitted in the project.
1. Preformed Plastic Sealing Compound: Conforming to 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.
 - a. Dimensions: Size the cross-section of rope form to provide squeeze-out of material around entire interior and exterior circumference of each manhole section joint when joint is completed.
 - b. Acceptable Manufacturers:
 - 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.
 2. Rubber Compression Gasket: Provide gasket of material composition conforming to ASTM C 361 or ASTM C 443
- E. PVC Waterstop: Provide PVC waterstop for use on sewer pipe entering manhole base where the manhole base is of cast-in-place construction.
1. Material Composition: Gasket type waterstop composed of virgin polyvinyl chloride (PVC) material which meets the performance requirements of U.S. Commercial Standard Specification CS 226-59.
 2. Acceptable Manufacturers:
 - a. FERNCO Inc., CMA Concrete Manhole Adapter, Distributed by the General Engineering Company.
 - b. Or equal.

2.03 PRECAST REINFORCED CONCRETE MANHOLE COMPONENTS

- A. Materials and Fabrication: 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: Of material composition conforming to ASTM C 361 or ASTM C 443.
 - b. Preformed Plastic Sealing Compound: As specified under Manhole Materials.
 5. Manhole Component Design: Designs shall conform to ASTM C 478. 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 under Materials and Fabrication..
 - C. Pipe Openings: Custom preformed during manufacturing in each base and riser section requiring a pipe opening. Preform the opening to accommodate the type of pipe and pipe opening seal required.
 1. Prefabricated Pipe Opening Seals: Resilient gasket type, conforming to requirements specified in ASTM C 923.
 - D. Precast Top Sections: Designs as required by the Drawings, and of materials and construction as specified herein, except additional and differing requirements as follows:
 1. Hold Down Bolt Inserts: Factory cast the inserts in the top section with no fewer than two 3/4-inch threaded inserts or slotted inserts to accommodate manhole frame hold down bolts. Provide threaded inserts of three inches depth and designed for an ultimate load in tension of 12,500 pounds. Inserts factory plugged for shipping. Coordinate insert locations in the top sections to match the bolt hole locations in the manhole cover frames.
 2. Flat Slab Tops: Thickness versus diameter is as indicated on the Drawings. Tops factory formed to properly accept and support required manhole cover frame and properly formed underside to join the top section to the riser section in a matching joint.
 3. Eccentric Cone Tops: Provide precast tops of the 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 and of materials and construction as specified. Provide precast grade rings with hold down bolt holes matching location of bolt holes in manhole cover frame. The design shall provide for full bearing of manhole cover frame.
 - F. Rubber Grade Rings: The Contractor shall have the option to provide rubber grade rings instead of the precast concrete grade rings, or shall be required to provide the rubber grade rings exclusively as the Owner may require.
 1. Materials and Construction: Manufactured as compressed molded rubber meeting specific ASTM material and testing requirements. The molded design shall limit lateral movement after installation by an integral interlocking system of matching ribs and grooves. The finished units shall have the following minimum physical properties:

Physical Properties

Test Requirements

Test Number

Hardness, Shore A	82 plus/minus 5	ASTM D 2240
Specific Gravity	1.1 to 1.2	ASTM D 3676
Tensile PSI	754 PSI Min. with Grain 363 PSI Min. cross Grain	ASTM D 412, Die C
Elongation, Percent	15 Percent with Grain 40 Percent cross Grain	ASTM D 412, Die C
Tear, kN/m (pi)	150 Min. with Grain 300 Min. cross Grain	ASTM D 624, Die B
Heat Resistance 70H at 70C		ASTM D 573
Hardness, Shore A	Plus/minus 10 percent	
Tensile PSI	Plus/minus 25 percent	
Elongation, Percent	Plus/minus 25 percent	
Low Temperature Brittleness Not Brittle at minus 40 Deg. C	Pass	ASTM D 2137
Ozone Resistance kN/m (pi) Minimum Cross Grain Tear strength after exposure to 50 pphm for 50 hours at 38 Deg. C	150	ASTM D 518

2. Acceptable Manufacturer: Ladtech Inc., 244 Woodridge Lane Lino Lakes MN 55013. Phone Number (612) 415-1252. Fax Number (612) 415-1090.

G. Waterproof Coating: Provide asphalt compound coating of either the solvent type or the emulsion type. However, mixtures of the two types in the Project is not permitted.

1. Solvent Type: Brush or spray-on asphalt compound, cold-applied and conforming to Federal Specification SS-A-701 B.
2. Emulsion-Type: Brush or spray-on asphalt-base, clay emulsion with fibers, cold-applied and conforming to Federal Specification SS-R-1781.
3. Acceptable Manufacturers:
 - a. W. R. Meadows, Inc.; SEALMASTIC.
 - b. Cooper Creek.
 - c. Or equal.
4. Application: The coating may be either shop or field applied. Apply coating to the exterior of manhole components.
 - a. Apply coating in two coats at the rate of 75 to 100 square feet per gallon per coat. Allow 24 hours drying between coats.

H. Corrosion Protection Coating: Prior to application of coatings, prepare manhole surfaces for coating in accordance with the written instructions of the coating manufacturer, including mechanical cleaning, blast cleaning or acid etching as required.

1. Coat precast components at the factory.
2. Manhole Exterior Surface Coating; Use one of the following:

- a. Tnemec Company, Inc., 46H-413, 20 dry mils minimum thickness.
 - b. Roskote Mastic A-51 as manufactured by Royston Laboratories, Inc., Pittsburgh, Pennsylvania. Apply two coats, each coat to have a dry film thickness of 12 mils.
- 3. Manhole Interior Surface Coating; Use one of the following:
 - a. Tnemec Company, Inc.; 104 H. S. Epoxy, 12 to 16 mils minimum thickness.
 - b. Roypex as manufactured by Royston Laboratories, Inc., Pittsburgh, Pennsylvania. Apply two coats, each coat to have a dry film thickness of 7 to 9 mils.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Field Inspection: 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. Earthwork: Perform earthwork for manhole installation as specified in Section 02221.
 - 1. Keep pipe and manhole interiors cleared of debris as construction progresses.
- B. Waterproof Coating Touch-Up: Touch-up chipped, cracked, or abraded surfaces and finished joints with two coats of the factory applied waterproof coating material.
 - 1. Bring coating materials for touch up and field coating to the job site in the original sealed and labeled containers of the manufacturer.
- C. Corrosion Protection Coating Touch-Up: Touch-up chipped, cracked, or abraded surfaces and any other surface damage using the same material as the factory applied protection coating.

3.03 MANHOLE CONSTRUCTION METHODS

- A. Construction Options: The option is permitted to construct either cast-in-place concrete manhole bases or to provide precast concrete manhole bases; except where only cast-in-place bases are required.
- B. 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 Class A (4000 psi) concrete as specified in Section 03300, unless indicated otherwise on Drawings.
- C. Precast Concrete Manhole Bases: Install bases on a 6-inch deep compacted layer of aggregate meeting requirements of First Class Bedding as specified in Section 02221.
 - 1. When using Prefabricated Pipe Opening Seals 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.
- D. Length of Pipe Connections into Manholes: Use pipes no longer than five feet in length when connecting into manholes through Prefabricated Pipe Opening Seals.
 - 1. 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.
- E. Concrete Channel Fill: Field pour and form concrete channel fill for each manhole base except in the case where precast bases are used, factory preformed channels may be provided.
 - 1. Form inverts directly in concrete channel fill.
 - 2. Accurately shape invert to 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. In terminal manholes, install concrete channel fill with formed channel extending from down stream pipe opening directly across the base to future pipe opening on upstream side of the base.
 - 6. Make slopes gradual outside the invert channels.
 - 7. Use Class B (3000 psi) concrete as specified in Section 03300, unless indicated

- otherwise on Drawings.
8. When precast bases with preformed channels are used, fill the annular space at the pipe connections, on both sides of the wall, with non-shrink non-metallic grout as specified in Section 03600.
- F. 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 in accordance with written instructions of manhole component manufacturer.
 - a. Prime joint surfaces if required by 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 sealing compound as the sole element utilized in sealing section joints from internal and external hydrostatic pressure.
 - d. Arrange and pay for the 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 for pipes connecting into manhole bases.
- G. 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.
- H. Frame and Cover Installation: Where required, make final adjustment of frame to elevation using Precast Grade Rings set in Waterproofed Mortar. Mortar thickness not to exceed 3/4-inch maximum and 3/8-inch minimum. Set manhole frame and cover to conform to roadway grade and crown. Set top of manhole frame and cover 1/2-inch below finished paving elevation.
1. Precast Grade Ring: Wet, but do not saturate the grade rings immediately before laying. Pre-set grade rings to proper plane and elevation using wedges or blocks of cementitious material not exceeding the joint thickness. No more than four wedges or blocks per grade ring permitted. Incorporate wedges or blocks in fresh mortar in a manner to completely encase each. Crown fresh mortar to produce squeeze-out between grade rings. Tool exposed joints with appropriately shaped tool and compact mortar edge into joints. Clean off excess mortar prior to initial

- mortar set.
2. Frame and Cover: 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.
 - a. 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 mortar has cured.
- I. Plugging Pipe Openings: Plug pipe openings in manholes where such openings are required for future pipe connections.
1. Use concrete knock-out plugs designed to fit the opening size and allow a minimum 3/8-inch mortar joint. Set plugs in waterproofed mortar.
 2. Install such materials to meet exfiltration limits and to allow future removal without damage to manhole.
- J. Drop Manholes: Construct in accordance with Type indicated in Details on the Drawings, or bound in Project Manual. Use the same type pipe and fittings in drop connection as used in the sewer line from which drop connection is made.

3.04 INTERFACING EXISTING CONSTRUCTION

- A. Bypassing Provisions: As work of this Section, maintain flow in the existing sewer both during construction operations and until concrete is cured, both in the case of cast-in-place work and newly formed invert channels.
1. Provide a fail-safe (and properly sized) temporary means and methods of continued wastewater system service. The means and methods are at the Contractor's discretion.
 2. Do not permit ground or surface water to enter the existing wastewater sewer facilities during the construction or the bypass work.
 3. Do not flush, drain or deposit water or debris from the new manhole construction into the existing sanitary sewer facilities.
- B. Constructing Manholes on Existing Sewers: Where new manholes are constructed on existing sewers, the Contractor shall have the option to use the specified cast-in-place manhole bases or precast bases.
1. When existing pipe is broken or damaged as a result of work of this Section, replace such pipe in new material matching existing. Use compatible joint materials or flexible pipe coupling.
 2. Connect new pipe to the specified new manhole bases, or new in-line structures.
 3. If precast manhole bases are used, replace existing sewer pipe with new to first joint outside the manhole base.
 4. Saw-cut piping to be removed. Chipping or breaking pipe as a cutting method is not acceptable.
 5. Install a watertight plug in the new sewer piping entering the new manhole.

Maintain the plug until all debris and accumulated water have been removed from the new sewer facilities and the new sewer facilities have passed all specified acceptance tests.

3.05 FIELD QUALITY CONTROL

- A. General Requirements: 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 that manhole does test satisfactorily.
 - 3. Provide tools, materials (including water), equipment and instruments necessary to conduct the manhole testing specified herein.
 - a. Vacuum Testing Equipment: Use vacuum apparatus equipped with necessary piping, control valves and gauges to control air removal rate from the manhole and to monitor vacuum.
 - 1) Provide an extra vacuum gauge of known accuracy to frequently check test equipment and apparatus.
 - 2) Vacuum testing equipment and associated testing apparatus are subject to Engineer's approval.
 - 3) 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: Perform vacuum testing in accordance with the testing equipment manufacturer's written instructions and the following:
 - 1. Draw a vacuum of ten inches of mercury and close the valves.
 - 2. 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, and conduct 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 shall meet with Engineer's approval prior to use.

END OF SECTION

SECTION 02720

LATERAL INSTALLATION

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Installation of laterals and cleanouts.

1.02 QUALITY ASSURANCE

- A. Piping and specials specified herein shall be essentially the standard products of manufacturers who have been regularly engaged in the successful production of high quality materials of this type for at least ten years, have supplied such materials for at least five years of the ten year period, and have at least five installations in successful operation for at least five years.
- B. Repair or replace defective piping or specials.
- C. Lateral Acceptance Tests.
 - 1. General:
 - a. Laterals will be tested for leakage between test tees after lateral installation has been completed. The allowable leakage rate will be zero.
 - b. All laterals be inspected prior to air testing, and all visible or detectable leaks shall be repaired before testing begins. The line acceptance tests shall be made after backfilling has been completed.
 - c. The DEVELOPER shall repair all visible or detectable leaks or defects of any nature to the satisfaction of the ENGINEER, even if the allowable leakage rates are not exceeded.
 - 2. Testing Equipment:
 - a. Air Testing:
 - 1. Air testing shall be performed utilizing testing equipment consisting of an air-compressor and storage tank of adequate capacity; an air control panel equipped with all necessary piping, valves and pressure gages to control the rate at which the air flows to the test section and to monitor the air pressure inside the test section; and all required plugs. In order to prevent overloading the test section with the full pressure of the compressor, the test equipment must be provided with an approved pressure relief device set to blow out at 10 psi. An extra pressure gage of known accuracy shall also be provided so that the gages of the test equipment can be frequently checked. The air testing equipment and all accessories shall be subject to the approval of the ENGINEER.
 - 3. Cleaning

- a. No debris, silt, or other material shall enter the lateral. It shall be the responsibility of DEVELOPER to have the pipe clean at the time of air testing. If required, the pipe shall be cleaned by hydro-flushing with water or be passing through the pipe a full gauge squeegee in a manner approved by ENGINEER.
- 4. Air Testing Procedure:
 - a. Immediately following the pipe cleaning, the pipe installation between the test tees shall be tested with low pressure air at 3.5 psi in excess of the groundwater pressure above the top of the sewer. At least two minutes shall be allowed for temperature stabilization, adding only the amount of air required to maintain pressure.
 - b. The pipe shall hold the required test pressure for the duration prescribed in the air test table in Section 02722.
 - c. Repair and retest sections of lateral not meeting test requirements.
- D. Minimum Testing Requirements.
 - 1. DEVELOPER shall take care to securely fasten and brace all line plugs in the pipe section being tested so that none of the plugs is suddenly released when the compressed air is applied to the pipe section. DEVELOPER shall limit the internal pressure in the sewer line to 5 psi greater than the average back pressure of any ground water that may submerge the pipe.
 - 2. DEVELOPER shall be responsible for any damages caused by the internal pressurizing of the sewer line.
 - 3. All gages, air piping manifolds and valves of the air testing equipment shall be located above ground at the top of the trench.
 - 4. Special care shall be exercised during removal of plugs; and the pressure in the piping of the test section shall be completely relieved before any plug shall be removed.

1.03 SUBMITTALS

- A. Submit shop drawings or catalogue cuts, as appropriate, for materials listed under Article 2.01 of this Section. Submit only those materials that are actually to be used in the work. These will usually be as follows:
 - 1. Pipe.
 - 2. Fittings.
 - 3. Gaskets, Couplings, Adapters, and Other Appurtenances.
- B. Make submittals prior to start of construction. Make submittals to ENGINEER.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and handle the piping, manholes, manhole frames and covers and appurtenances in accordance with the manufacturer's recommendations, and in such manner as to protect the materials from damage.
- B. Pipe and related materials shall be loaded and unloaded by lifting with hoists or

skidding so as to avoid shock or damage. Under no circumstances shall such material be dropped or skidded against pipe already on the ground.

- C. Pipe and related materials shall at all times be handled with care to avoid damage. The interior shall be kept free from dirt and foreign matter. All pipe, manholes, manhole frames and covers and appurtenances shall be carefully lowered or raised into place with suitable equipment in a manner that will prevent damage to the material. Under no circumstances shall pipe or accessories be dropped or dumped.
- D. All lumps, blisters, and excess coating shall be removed from the ends of each pipe. The joints shall be wire brushed and wiped clean, dry and free from oil and grease before the pipe is installed.

PART 2 PRODUCTS

2.01 MATERIALS

- A. PVC Pipe - 4" and 6" Diameter.
 - 1. Pipe and Fittings.
 - e. Unplasticized polyvinyl chloride (PVC) gravity sewer pipe and fittings with integral wall bell and spigot joints meeting ASTM D-3034 specification for Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings, Standard Dimension Ratio (SDR) 35, ASTM F789; or ASTM D-1785 Schedule 40 (Type 1, Grade 1) with socket joints and fittings suitable for solvent welding.
 - f. The SDR 35 pipe shall be joined with an integral bell, bell-and-spigot type rubber gasketed joint. Rubber gasket shall conform to ASTM F 477. The rubber gasket shall be compressed radially on the pipe spigot to form a watertight seal in accordance with ASTM D 3212. Schedule 40 pipe and fittings shall be joined by solvent welded socket joints in accordance with ASTM D-2855.
 - g. Fittings shall be made of PVC having a cell classification of 12454B or 12454C, as defined in ASTM D 1784.
 - h. As applicable for SDR 35, pipe stiffness at 5% deflection shall be 46 psi for all pipe diameters when tested in accordance with ASTM D 2412.
 - 2. PVC Saddles: Provide tee saddles with skirts correctly contoured for outside diameter of pipe, and incorporating ring gasket bell outlet and gasketed skirt. Saddles to be commercially manufactured molded units conforming to design requirements of ASTM D 3034 Type SDR-35, made from PVC compounds having a cell classification of 112454-B, 12454-C, or 13343-C as defined in ASTM D 1784.
 - a. Outlet Joint: Push-on style with elastomeric gasket, conforming to ASTM D 3212 for outlet joint design.
 - b. Gaskets: Both pipe outlet gasket and saddle skirt gasket shall conform to

ASTM F 477 requirements for material specifications, providing a watertight seal.

- c. Skirt Bands: Saddle skirts provided with two pre-assembled type 305 stainless steel band and clamp assemblies.

B. Cast Iron Pipe - 4" and 6" Diameters.

- 1. Pipe and Fittings.
 - i. Cast iron gravity sewer pipe and fittings of either "Service Weight" or "Extra Heavy" with integral wall bell and spigot joints meeting ASTM A-74 specification for cast iron gravity sewer pipe and fittings.
 - j. Pipe shall be joined with an integral bell, bell and spigot type rubber gasket joint conforming to ASTM C-564. Rubber gasket shall be compressed radially on the pipe spigot to form a water tight seal.
 - k. Fittings shall be made of either Service Weight or Extra Heavy cast iron and shall be of the bell and spigot type having a rubber gasket which meets ASTM A-74 and create a water tight seal.

C. Compression-Fit PVC Hub: Provide Compression-Fit PVC Hubs (Inserta Tee) only for service connections into Closed Profile PVC Pipe. Materials and construction as follows:

- 1. PVC Hub: Manufactured from polyvinyl chloride (PVC) pipe, Type PSM SDR-35, conforming to ASTM D 3034 requirements. The hub shall conform to ASTM D 3212 requirements for push-on style pipe joint with elastomeric gasket; gasket conforming to ASTM F 477 requirements for material specifications, providing a watertight seal.
- 2. Band-Screw Assembly: Stainless steel band and housing fabricated from type 301 stainless steel; tightening screw of type 305 stainless steel.
- 3. Rubber Sleeve: A molded component of materials composition meeting the requirements of ASTM C 443.
- 4. Acceptable Manufacturers:
 - a. Fowler Manufacturing Company; Inserta Tee.
 - b. Or equal.

D. Rigid Pipe Couplings

- 1. SDR 35 PVC in-line rigid pipe couplings, with rubber gaskets; or Schedule 40 (ASTM D-1785).
- 2. Fittings manufactured in accordance with ASTM number D-3034 and D-1784 or ASTM D-1785 and D-1784.
- 3. Rubber gaskets for fittings shall conform to ASTM designation F477.
- 4. Approved manufacturers.
 - a. GPK Products, Inc., Fargo, ND.
 - b. Approved equals.

E. Flexible Pipe Adaptors.

- 1. Flexible rubber with stainless steel band clamps.

2. Constructed from materials which will pass the strength and chemical requirements of ASTM C-954.
 3. All banded adaptors shall bear the manufacturer's identifying mark and size.
 4. Approved manufacturers.
 - a. Fernco, Davidson, MI.
 - b. Mission, Corona, CA.
 - c. Calder, Gardner, CA.
- F. Pipe Plugs: Designed for permanent installation and removable. Obtain plugs for various types of pipe used from the respective pipe manufacturer.
- G. Cleanouts
1. Construction will be as directed by the ENGINEER.
 2. Test tees will be installed at the direction of the Authority's personnel
 3. Cleanouts to be installed at all changes in vertical and horizontal directions.

PART 3 EXECUTION

3.01 LAYING PIPE

- A. Following trench excavation, pipe laying shall proceed upgrade with pipe laid carefully, hubs upgrade, spigot ends fully centered into adjacent hubs, and true to lines and grades given. Provide test tees as indicated on Detail No. 92 Service Connection Shallow Sewer or Detail No. 93 Service Connection Deep Sewer.
1. Tees: Make connections to sewer using tee fittings of same material and joint configuration as the sewer at planned point of branch connection.
 - a. Use commercially manufactured wye or tee fittings and one-eighth bends.
 - b. Set tee branches at proper vertical angles as required to bring service connections to the proper depth.
- B. Each section of pipe shall rest upon the pipe bed for the full length of its barrel, with recesses excavated to accommodate bells and joints. Each pipe shall be firmly held in position so that the invert forms a continuous grade with the invert of the pipe previously placed.
1. Lateral pipe having an inside diameter of 4" shall be laid at a grade not less than $\frac{1}{4}$ " per ft.
 2. Lateral pipe having an inside diameter of 6" shall be laid at a grade not less than $\frac{1}{8}$ " per ft.
- C. Under no conditions shall pipe be laid in water, on subgrade containing frost, and/or when trench conditions are unsuitable for such work. In all cases, water shall be kept out of the trench until concrete cradles, supports, encasement, or saddles, where used, and materials in the joints have hardened.
- D. Any pipe that has its grade or joint disturbed after laying shall be taken up and relaid. Any section of pipe already laid and found to be defective shall be taken up and

replaced with new pipe.

- E. Walking or working on top of the completed pipeline, except as may be necessary in backfilling or tamping, shall not be permitted until the trench has been backfilled to a height of at least 2 feet over the top of the pipeline when using a mechanical tamper and at least 4 feet using a hydrohammer.
- F. Maintain pipelines free and clear of debris during the progress of the work.
- G. At times when pipelaying is not in progress, the open ends of the pipe shall be closed by watertight plug.
- H. Inspect pipe and fittings for defects or damage prior to lowering into the trench.
- I. Install PVC pipe and fittings in accordance with manufacturer's written instructions.
- J. Use of hydrohammer for compaction will not be permitted within a minimum of four (4) feet of the top of the pipe.
- K. Install pipe couplings and adapters in accordance with the manufacturer's written instructions.

3.02 CONNECTION OF NEW LATERAL TO EXISTING SEWER MAIN

- A. Connection of the lateral to the mainline sewer shall be made by removing a section of the mainline sewer and replacing it with an SDR 35 PVC wye branch connection or sanitary tee and then reconnecting this to the mainline with rigid PVC gasketed couplings. In the event a rigid coupling is not available for the pipe sizes and materials being joined, flexible rubber adaptors with stainless steel bands may be used. Any other type of connection to the sanitary sewer (i.e. saddles) must have prior approval from the Authority or Authority Engineer, and be installed in accordance with and Authority approved procedure.
- B. Test tees for air testing the building sewer shall be installed adjacent to the connection between the building sewer and the service lateral or the right-of-way line, whichever is appropriate.
- C. All sanitary sewer laterals shall pass an air test before they may be accepted by the Authority.

3.03 CLEANOUTS

- A. Building sewers.
 - 1. All building sewers shall have cleanouts located not more than 100 feet apart.
- B. Changes in direction.
 - 1. Cleanouts shall be installed at each change of direction of the building drain or of

horizontal waste or soil line, which is greater than 45 degrees. Where more than one change of direction occurs in a run of piping, only one cleanout shall be required for each 40 feet of developed length of the drainage piping. Access shall be provided to all cleanouts.

3.04 CLEANING

- A. No debris, silt, or other material shall be allowed in the lateral. If required, the pipe shall be cleaned by hydro-flushing with water or by passing through the pipe a full gauge squeegee in a manner approved by the Authority.

3.05 AIR TESTING

- A. Air testing shall be performed utilizing testing equipment consisting of an air-compressor and storage tank of adequate capacity; an air control panel equipped with all necessary piping, valves and pressure gages to control the rate at which the air flows to the test section and to monitor the air pressure inside the test section; and all required plugs. The pressure gauge for measuring internal pipe pressure must be an oil filled gauge measuring from zero to twenty psi, in one pound increments. In order to prevent overloading the test section with the full pressure of the compressor, the test equipment must be provided with an approved pressure relief device set to blow out at 10 psi. An extra pressure gage of known accuracy shall also be provided so that the gages of the test equipment can be frequently checked. The air testing equipment and all accessories shall be subject to the approval of ENGINEER.
- B. Immediately following the pipe cleaning, the pipe installation between the test tees shall be tested with low pressure air at 3.5 psi in excess of the groundwater pressure above the top of the lateral. (Pressure should not exceed 5 psi above the groundwater pressure.) At

least two minutes shall be allowed for temperature stabilization, adding only the amount of air required to maintain pressure.

- C. The pipe shall hold the required test pressure for 1 minute 53 seconds for 4" pipe (lengths less than 597') and 2 minutes 50 seconds (lengths less than 398').
- D. Repair and retest sections of lateral not meeting test requirements.

END OF SECTION

SECTION 02722

PIPED WASTEWATER SEWER

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: This Section specifies construction of the various types and sizes of piped wastewater sewers and appurtenances.
- B. Related Sections:
 - 1. Trenching Backfilling and Compacting: Section 02221.
 - 2. Manholes: Section 02601.
 - 3. Lateral Installation: Section 02720.
 - 3. Grout: Section 03600.

1.02 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI A 21.10, Gray-Iron and Ductile-Iron Fittings, 2 through 48 inches, for Water and Other Liquids.
 - 2. ANSI A 21.11, Rubber Gasket Joints for Cast Iron and Ductile Pressure Pipe and Fittings.
 - 3. ANSI A 21.50, Thickness Design of Ductile-Iron Pipe.
 - 4. 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 A 48, Specification for Gray Iron Castings.
 - 2. ASTM C 144, Specification for Aggregate for Masonry Mortar.
 - 3. ASTM C 150, Specification for Portland Cement.
 - 4. ASTM C 923, Specification for Resilient Concrete Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.
 - 5. ASTM C 924, Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method.
 - 6. ASTM D 1784, Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
 - 7. ASTM D 2000, Standard Classification System for Rubber Products in Automotive Applications (SAE Recommended Practice J200).
 - 8. ASTM D 2321, Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
 - 9. ASTM D 3034, Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - 10. ASTM D 3212, Specification for Joints for Drain and Sewer Plastic Pipes Using

Flexible Elastomeric Seals.

11. ASTM F 477, Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
12. ASTM F 679, Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
13. ASTM F 789, Specification for Type PS-46 Poly (Vinyl Chloride) (PVC) Plastic Gravity Flow Sewer Pipe and Fittings.
14. ASTM F 794, Specification for Poly (Vinyl Chloride) (PVC) Ribbed Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

C. American Water Works Association:

1. AWWA C 100, Cast-Iron Pressure Fittings.
2. AWWA C 104, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
3. AWWA C 151, Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
4. AWWA C 600, Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances.

D. Uni-Bell Plastic Pipe Association:

1. UNI-B-6, Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe.
2. UNI-B-9, Recommended Performance Specification for Polyvinyl Chloride (PVC) Profile Wall Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

1.03 SUBMITTALS

- A. Shop Drawings and Product Data: Submit completely dimensioned shop drawings, catalog cuts and such other data as required to provide complete descriptive information for the following:
1. Sewer Pipe and Fittings
 2. Piping Specialties
 3. Service Connection Pipe and Fittings
- B. Certificates: Submit certified records or reports of results of shop tests, with such records or reports containing a sworn statement that shop tests have been performed as specified.
1. 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: In addition to the design requirements of the Pennsylvania Department of Environmental Protection (DEP), comply with the following:
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 prevailing site conditions at the various locations.
3. Provide a minimum depth of cover of five feet for pipe sewers. Where less cover is provided, protect the pipe with concrete encasement or by some other means acceptable to the Engineer.

B. Source Quality Control:

1. Shop Tests: In accordance with Article 1.06 of the General Instructions, factory tests of pipe materials listed in the following, shall have been performed. Each pipe manufacturer shall have facilities to perform the 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.

<u>MATERIAL</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
a. Ductile Iron Pipe	ANSI A 21.51	As specified in ANSI A 21.51.
b. Polyvinyl Chloride Pipe	ASTM D 3034 or ASTM F 789 (ASTM F 679) (ASTM F 794) as applicable.	As specified in ASTM D 3034 or ASTM F 789 (ASTM F 679) (ASTM F 794) as applicable.

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.
3. The Engineer reserves the right to accept certified test records or reports of previously conducted tests covering the above stated tests.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Transport, handle and store pipe materials and the associated materials specified herein, in the manner recommended by the respective materials manufacturers so as to prevent damage and defects to their respective materials.

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 for pipe laying work, as determined by the Engineer.

PART 2 PRODUCTS

2.01 SEWER PIPE AND FITTINGS

- A. Elastomeric Gaskets: For pipe joint gasket material, provide elastomeric gaskets that have been tested as suitable for continuous contact with domestic sewage.
- B. Solid Wall Polyvinyl Chloride (PVC) Pipe: Provide pipe which is permanently marked with manufacturer's trademark, size and ASTM conformance designation.
 - 1. Pipe, Solid Wall, Size 6 through 15 Inch Diameters: Type PSM SDR-35 conforming to ASTM D 3034 requirements, or Type PS-46 conforming to ASTM F 789 requirements for pipe sizes above 15 inch to 18 inch diameter.
 - 2. Pipe, Solid Wall, Size 18 through 27 Inch Diameters: Type PS-46 conforming to ASTM F 679 requirements.
 - 3. Fittings: Commercially manufactured molded fittings made from PVC compounds having a cell classification of 12454-B, 12454-C, or 13343-C as defined in ASTM Specification D 1784.
 - 4. Joints: Push-on style joint, with elastomeric gasket, conforming to ASTM D 3212 requirements for joint design; gasket conforming to ASTM F 477 requirements for material specifications, providing a watertight seal.
 - a. Pipe bell design shall incorporate the gasket locked in a groove so as to prevent gasket displacement when pipes are joined.
- C. Closed Profile Polyvinyl Chloride (PVC) Pipe: Provide pipe which is permanently marked with manufacturer's trademark, size and ASTM conformance designation.
 - 1. Pipe, 21 through 48 Inch Diameters: Manufactured to a controlled inside diameter, with integral bell and elastomeric seal joints, and conforming to ASTM F 794 requirements.
 - 2. PVC Compounds: Complying with the requirements for a minimum cell classification of 12364A as defined by ASTM D 1784.
 - 3. Fittings: Fabrications made by the pipe manufacturer, using closed profile pipe meeting ASTM F 794 requirements, and formed by fusion heat welded mitered joints. Molded fittings and fabricated fittings made up by solvent cement mitered joints are not acceptable.
 - 4. Joints: Push-on style joint, with elastomeric gasket, conforming to ASTM D 3212 requirements for joint design; gasket conforming to ASTM F 477 requirements for material specifications, providing a watertight seal. Gaskets factory installed and chemically bonded to the pipe to prevent gasket displacement when pipes are joined.
- D. Ribbed Wall Polyvinyl Chloride (PVC) Pipe: Provide pipe which is permanently marked with manufacturer's trademark, size and ASTM conformance designation.
 - 1. Pipe, 18 through 48 Inch Diameters: Manufactured to have a smooth interior with a solid cross-sectional ribbed exterior with the ribs perpendicular to the axis of the

- pipe, and conforming to ASTM F 794 requirements.
 - 2. PVC Compounds: Complying with the requirements for a cell classification of 12454-B, 12454-C, or 13364-B as defined by ASTM D 1784.
 - 3. Fittings: Commercially manufactured molded fittings made from PVC compounds having a cell classification of 12454-B, 12454-C, or 13343-C as defined in ASTM Specification D 1784.
 - 4. Joints: Push-on style joint, with elastomeric gasket, conforming to ASTM D 3212 requirements for joint design; gasket conforming to ASTM F 477 requirements for material specifications, providing a watertight seal.
 - a. Pipe bell design shall incorporate the gasket locked in a grove so as to prevent gasket displacement when pipes are joined.
- E. Ductile Iron Pipe (DIP): Conforming to ANSI A21.50 and ANSI A 21.51 requirements and the following:
- 1. Wall Thickness Class, Buried Pipe: As indicated on Drawings or as determined by the Engineer.
 - 2. Fittings: Gray iron or ductile iron conforming to ANSI A21.10 requirements. Fittings larger than 48 inches shall conform to AWWA C100 Class B requirements.
 - 3. Rubber-Gasket Joints, Buried Pipe: Conforming to ANSI A21.11 requirements. For buried pipe installation, provide push-on or mechanical joints except where other types of joints are indicated on the Drawings or required by the Specifications or regulatory agency.
 - 4. Pipe and Fitting Coating: Manufacturer's standard asphaltic coating, approximately one mil thick in accordance with AWWA C151, applied to the outside of pipe and fittings.

2.02 PIPING SPECIALTIES

- A. PVC Waterstop: PVC waterstop used for grouted connection of piping to existing manholes. Gasket type waterstop composed of virgin polyvinyl chloride (PVC) material which meets the performance requirements of U.S. Commercial Standard Specification CS 226-59.
 - 1. Acceptable Manufacturers:
 - a. FERNCO Inc., CMA Concrete Manhole Adapter, Distributed by the General Engineering Company.
 - b. Or equal.
- B. Sleeve Type Pipe Seal: Sleeve type pipe seal used for core-drilled connection of piping to existing manholes. In general, the pipe seal shall conform to the requirements of ASTM C 923 and shall incorporate a positive compression fit of the gasket to both the manhole and the pipe.
 - 1. Acceptable Manufacturers:
 - a. Press-Seal Gasket Corp., Concrete Products Supply Co.; PSX Seal.
 - b. Or equal.
- C. Modular, Mechanical Type Pipe Seal: Modular, mechanical type pipe seal used for

core-drilled connection of piping to existing manholes. Seal component construction as follows:

1. The seal shall consist of inter-locking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening.
2. The elastomeric element of the seal shall be sized and selected in accordance with the seal manufacturer's recommendations. Elastomeric element shall conform to ASTM D 2000 requirements for EPDM material.
3. The hardware provided in the seal shall be as recommended by the seal manufacturer for buried service such as will exist at the project site.
4. Acceptable Manufacturers:
 - a. Thunderline Corporation; Link-Seal.
 - b. Or equal.

D. Flexible Pipe Couplings: Provide flexible pipe couplings designed for differing pipe material connection; and for transition/reducing conditions of differing pipe material connections.

1. Coupling Construction: Composed virgin polyvinyl chloride (PVC) material which meets the performance requirements of Commercial Standard Specification CS 226-59. Couplings designed for pipe outside diameter coupling shall incorporate recesses to contain two stainless steel bands. Couplings provided with two pre-assembled type 305 stainless steel bands.
2. Acceptable Manufacturers:
 - a. FERNCO Inc., Distributed by the General Engineering Company.
 - b. Or equal.

2.03 CONTRACTOR OPTIONS IN PRODUCTS

A. Sewer Pipe and Fitting Options: Unless indicated otherwise on the Drawings, provide one type of pipe in the Project for a particular pipe size range listed herein. However, use only the one type of pipe, as selected, to construct the pipe sewer mains for which pipe material options are allowed.

1. Six Through 15-inch Diameter Sewer:
 - a. Polyvinyl Chloride pipe (PVC), SDR-35 or PS-46.
 - b. Ductile Iron pipe (DIP). 16-inch diameter allowed where 15-inch diameter is indicated on Drawings.
2. 18 Through 27-inch Diameter Sewer:
 - a. Polyvinyl Chloride pipe (PVC): Solid Wall, PS-46 or Ribbed Wall.
 - b. Ductile Iron pipe (DIP) 20-inch diameter DIP allowed where 21-inch diameter pipe is indicated on Drawings.
3. 21 Through 48-inch Diameter Sewer:
 - a. Polyvinyl Chloride pipe (PVC): Solid Wall, PS-46 or Closed Profile or Ribbed Wall.
 - b. Ductile Iron pipe (DIP) 20-inch diameter DIP allowed where 21-inch diameter pipe is indicated on Drawings.
4. Required Pipe Material Exception: Where DIP is indicated on the Drawings no

option is permitted because of prevailing site conditions, or DIP is required by utility companies or local governmental bodies, or where the sewer main is laid in fill material.

- B. Pipe Connections to Existing Manholes or Structures Options: The option is allowed to construct one type of connection in the Project of the types listed herein, except where required otherwise on the Drawings.
 - 1. Cut-in opening utilizing PVC Waterstop and Grout.
 - 2. Core-drilled opening utilizing Sleeve Type Pipe Seal.
 - 3. Core-drilled opening utilizing Modular, Mechanical Type Pipe Seal.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Field Inspection: Inspect each section of pipe and each pipe fitting before laying in conformance with the inspection requirements of the appropriate referenced standard.
- B. Rejected Products: Remove rejected Products from the Project site and replace with new Products.

3.02 PREPARATION

- A. General Requirements: Clean piping interior prior to laying pipe and following pipe laying and keep open ends of piping and pipe attachment openings capped or plugged until actual connection or actual pipe testing.
 - 1. Provide the protective means to prevent water and debris from washing into the pipe.
- B. Earthwork: Perform earthwork for gravity sewer installation as specified in Section 02221.
 - 1. Bedding materials and concrete work for pipe bedding as specified in Section 02221.
 - 2. Excavate trenches in rock at least 25-feet in advance of pipe laying. Protect pipe ends from blasting, if blasting is allowed in the Project.

3.03 SEWER CONSTRUCTION

- A. General Requirements: Use proper and suitable tools and appliances for the proper and safe handling, lowering into trench and laying of pipes.
 - 1. Lay pipe proceeding upgrade true to line and grades given. Lay bell and spigot pipe with bell end upgrade. Lay tongue and groove pipe with groove end upgrade.

- No wedging or blocking permitted in laying pipe unless by written order of 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. 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. Dig bell holes sufficiently large to permit proper joint making and to insure pipe is firmly bedded full length of its barrel.
 4. Walking or working on the installed pipe line, except as necessary in tamping and backfilling, is not permitted until trench is backfilled one-foot deep over top of pipes.
 5. Take up and relay pipe that is out of alignment or grade, or pipe having disturbed joints after laying.
 6. Take up and replace with new, such in-place pipe sections found to be defective.
- B. Pipe Laying and Joining: Perform pipe laying and joining in strict accordance with manufacturer's installation instructions, reference standards as included, and such additional requirements as specified herein.
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.
 3. Laying/Joining Ductile Iron Pipe: Installation and joint assembly according to AWWA C 600, and as follows:
 - a. Pipe Cutting: Where necessary to field cut pipe use approved pipe cutter, milling cutter or abrasive wheel saw.
 4. Laying/Joining Specified Types of Plastic Pipe: Installation and joint assembly according to ASTM D 2321 requirements and for Class I bedding material as included therein.
- C. 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.
- D. Connections to Existing Manholes or Structures: Make pipe connections to existing manholes or structures by the previously selected option and in accordance with the appropriate requirements as follows:
1. Cut-In Opening Utilizing PVC Waterstop and Grout: Cut required opening or openings by such methods so as to prevent cracking and spalling concrete. Make openings of sufficient size to accommodate the pipe with PVC Waterstop installed and one inch of annular grout space. Grout annular space using Non-Shrink Non-Metallic Grout as specified in Section 03600. Make connection watertight.
 2. Core-Drilled Opening Utilizing Pipe Seal: Core-drill the required opening or openings using the proper equipment for the work. Make openings of sufficient

size to accommodate the pipe and the Sleeve Type Pipe Seal or Mechanical Type Pipe Seal.

3. New Invert Channel: Regardless of the connection to existing manhole option selected, 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.
- E. Reconnection of Existing Service Connections: Use tee fittings or PVC tee saddles for connection to the sewer main. Use pipe if required as specified previously. Make connection to existing piping with flexible pipe couplings.
1. Service connection fittings as specified previously.
 2. Use commercially manufactured tee fittings and one-eighth bends.
 3. Set wye or tee branches at proper vertical angles as required to bring service connections to the proper depth.
 4. Fittings locations determined by the Engineer with respect to existing service connection location.
 5. PVC Saddles: Place saddle in position on pipe and mark guide for hole cut-in, using saddle as a template. Remove saddle from pipe and using hole guide mark, cut hole through pipe wall 1/2-inch outside the hole guide mark.
 - a. Install saddle in accordance with manufacturer's installation instructions.
 6. Pipe Outlet: Connect service connection piping to outlet in manner specified for joining pipe.
 7. Plugs: Close free ends of branches and service connections with a carefully fitted plug. Type of plug used and method of installation to Engineer's approval. Installed plugs shall successfully pass Line Acceptance Tests.
- F. Storm Sewer Obstructions: When it is necessary to construct a pipe sewer beneath an existing or proposed storm sewer in a location where the vertical separation between the top of the pipe sewer piping and the bottom of the storm sewer piping is 18 inches or less, the pipe sewer piping shall be DIP.
- G. Stream Crossing: Construct stream crossing in accordance with the requirements of Section 02221 and the following:
1. Pipe: Construct stream crossing using only Ductile Iron Pipe.

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. Testing Equipment: Use air compressing apparatus equipped with a control panel with necessary piping, control valves and gauges to control air flow rate to piping test section, and to monitor air pressure within piping test section and air pressure within test section seal plugs.
1. To prevent accidental overloading of piping test section, provide air compressing apparatus with an approved pressure relief device set to relieve at ten psi.
 2. Provide an extra pressure gauge of known accuracy to frequently check test equipment and apparatus.
 3. Air testing equipment and associated testing apparatus subject to Engineer's approval.
 4. Provide GO-NO-GO Mandrel and incidental equipment for Deflection Test. Mandrel to conform to following requirements:
 - a. Cylindrical in shape with not less than nine arms spaced evenly around the mandrel.
 - b. Minimum contact length of mandrel arms with pipe wall not less than the nominal diameter of the pipe being tested.
 - c. Mandrel diameter 95 percent of inside pipe diameter.
- C. Cleaning Prior to Tests: Before tests are conducted, flush piping including sewers, branches and service connections until free of all forms of dirt and construction debris.
1. The water for the flush cleaning operation shall be from the Contractor's source.
- D. 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 the 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. The Engineer has the option to order the same Initial Section Test for a section of sewer in each 3,000 lineal feet of sewer line of a particular size and material.
 5. Conduct same Initial Section Test for one manhole to manhole sewer section of each 3,000 lineal feet of sewer.
 6. 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.
 7. Sewer sections successfully tested as Initial Section Test will be retested under Line Acceptance Test.
- E. Line Acceptance Test: After a section of sewer and its service connections is constructed between adjacent manholes, backfilled and successfully cleaned, perform a low pressure air Line Acceptance Test in accordance with the following and the Standards listed therein:
1. Plug free ends of branches and service connections.
 2. Seal Sewer piping at upstream and downstream manholes with pneumatic type

plugs. 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.

3. Introduce low pressure air slowly into sealed sewer section until internal air pressure is four psig greater than the average ground water pressure acting on the pipe.
4. Allow two minutes minimum for air temperature to stabilize, adding only required air to maintain pressure.
5. After stabilization period (3.5 psig minimum in pipe) disconnect air supply and determine rate of air loss by measuring time interval required for 3.5 psig to decrease to 2.5 psig greater than the average groundwater pressure acting on the pipe.
6. To determine the groundwater pressure acting on the pipe being tested, divide the height in feet of the groundwater above the invert of the pipe by 2.3. Add the result to the previously specified test pressures (i.e., If maximum groundwater height is 11.5 feet above the pipe invert, the groundwater pressure is five psig. This increases the 3.5 psig and 2.5 psig to 8.5 psig and 7.5 psig, respectively.) Test pressure not to exceed ten psig regardless of height of groundwater over the pipe.
7. Consider sewer line Acceptable when a 1.0 psig pressure drop does not occur within the test time specified in the AIR TEST TABLES immediately following this Section.
8. Test Standards:
 - a. DIP, RCP, PCCP: Test according to ASTM C 924.
 - b. PVC Pipe, Solid Wall: Test according to UNI-B-6.
 - c. PVC Pipe, Profile Wall: Test according to UNI-B-9.
9. For sections of sewer containing service connections which service existing buildings, perform Line Acceptance Test by testing one joint at a time.
 - a. Equipment: Use joint testing apparatus such as the Cherne Joint Tester, Cherne Industrial, Inc., Edina, Minnesota or equal.
 - b. Consider joint acceptable when the pressure loss is less than one pound in one minute immediately following air stabilization.
 - c. Use air pressure for testing joint as previously specified.

F. Deflection Test: In addition to air tests and infiltration test, conduct deflection tests on PVC pipe. Test each PVC pipe sewer main installed.

1. Conduct deflection testing not less than 30 days after section of pipe sewer main and service connection between adjacent manholes is backfilled.
2. Pull mandrel through pipe section manually; powered pulling devices not permitted.
3. Consider sewer line section which mandrel cannot pass through, to have more than maximum allowable deflection of five percent.

G. Infiltration Test: In addition to air tests and deflection test specified previously, conduct

infiltration tests at such time and manner required by Engineer.

1. Infiltration rate of groundwater or other water into the sewer line, including manhole bases and walls, exceeding 200 gallons per inch diameter per mile of sewer per day during periods of high groundwater levels will be considered evidence of defective material or improper workmanship.
 2. Make repairs and replacements as required, if rate of infiltration exceeds allowable maximum rate.
 3. Regardless of whether the rate of leakage exceeds or is below the allowable maximum rate, repair leaks in pipe sewer lines.
- H. Repair and Retest: When section or sections of sewer fails to meet test requirements specified previously, determine source or sources of leakage, repair or replace defective material, and if as result of improper workmanship, correct such.
1. Take up and relay pipe sewer line section that has more than the maximum allowable deflection.
 2. Conduct additional tests required to demonstrate that sewer line meets specified tests requirements.
- I. The Owner reserves the right to retest any piping throughout the duration of the Construction Period.
1. Make repairs as Work of this Section to piping found defective by such Owner conducted tests.

END OF SECTION

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

PIPE DIAMETER (IN.)	MINIMUM TIME (MIN:SEC)	LENGTH FOR MINIMUM TIME (FT.)	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	0.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	0.854 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 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46
42	39:48	57	41.883 L	69:48	104:42	139:37	174:30	209:24	244:19	279:13	314:07
48	45:34	50	54.705 L	91:10	136:45	182:21	227:55	273:31	319:06	364:42	410:17
54	51:02	44	69.236 L	115:24	173:05	230:47	288:29	346:11	403:53	461:34	519:16
60	56:40	40	85.746 L	142:28	213:41	284:55	356:09	427:23	498:37	569:50	641:04

NOTE: If there has been no leakage (zero psig drop) after one hour of testing, the test section shall be accepted and the test complete.

SECTION 02725

PRESSURE WASTEWATER SEWER

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: The work specified in this Section consists of constructing the piped low pressure wastewater sewers and appurtenance.
- B. Related Sections:
 - 1. Trenching, Backfilling and Compacting: Section 02221.
 - 2. Manholes: Section 02601.
 - 3. Cast-In-Place Concrete: Section 03300.

1.02 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI A21.10, Gray-Iron and Ductile-Iron Fittings, 2 through 48 inches, for Water and Other Liquids.
 - 2. ANSI A21.11, Rubber Gasket Joints for Cast Iron and Ductile Pressure Pipe and Fittings.
 - 3. ANSI A21.15, Flanged Cast-Iron and Ductile-Iron pipe with Threaded Flanges.
 - 4. ANSI A21.50, Thickness Design of Ductile-Iron Pipe.
 - 5. ANSI A21.51, Ductile-Iron Pipe, Centrifugally Cast, in Metal Molds or Sand-Lined Molds for Water or Other Liquids.
 - 6. ANSI A21.53, Ductile-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
 - 7. ANSI B 1.1, Unified Inch Screw Threads.
 - 8. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
 - 9. ANSI B16.21, Nonmetallic Gaskets for Pipe Flanges.
 - 10. ANSI B18.2.1, Square and Hex Bolts and Screws, Including Askew head Bolts, Hex Cap Screws, and Lag Screws.
 - 11. ANSI B18.2.2, Square and Hex Nuts.
- B. American Society for Testing and Materials.
 - 1. ASTM 1804-97 "Pipeline Design for Installation by Horizontal Directional Drilling: Asce Manual of Practice".
 - 2. ASTM A 36, Specification for Structural Steel.
 - 3. ASTM A 47, Specification for Ferritic Malleable Iron Castings.
 - 4. ASTM A 48, Specification for Gray Iron Castings.
 - 5. ASTM A 123, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 6. ASTM A 167, Specification for Stainless and Heat-Resisting Chromium-Nickel

- Steel Plate, Sheet and Strip.
7. ASTM A 183, Specification for Carbon Steel Track Bolts and Nuts.
 8. ASTM A 240, Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.
 9. ASTM A 283, Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
 10. ASTM A 307; Specification for Carbon Steel Externally Threaded Standard Fasteners.
 11. ASTM A 320, Specification for Alloy Steel Bolting Materials for Low-Temperature Service.
 12. ASTM A 536, Specification for Ductile Iron Castings.
 13. ASTM B 62, Specification for Composition Bronze or Ounce Metal Castings.
 14. ASTM B 140 Specification for Copper-Zinc-Lead (Leaded Red Brass or Hardware Bronze) Rod, Bar, and Shapes.
 15. ASTM B 371, Specification for Copper-Zinc-Silicon Alloy Rod.
 16. ASTM B 584, Specification for Copper Alloy Sand Castings for General Applications.
 17. ASTM C 534, Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 18. ASTM D 1599, Standard Test Method for Short-Term Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings.
 19. ASTM D 1784, Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 20. ASTM D 1785, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Schedules 40, 80 and 120.
 21. ASTM D 2000, Standard Classification System for Rubber Products in Automotive Applications.
 22. ASTM D2239 "Standard Specification for Polyethylene Plastic Pipe based on Controlled Inside Diameter".
 23. ASTM D 2241, Specification for Poly (Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR-Series).
 24. ASTM D 2466, Specification for Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 25. ASTM D 2564, Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
 26. ASTM D2737 "Standard Specifications for Polyethylene Plastic Tubing.
 27. ASTM D 2774, Recommended Practice for Underground Installation of Thermoplastic Pressure Piping..
 28. ASTM D2774 "Standard Practice for Underground Installation of Thermoplastic Pressure Piping".
 29. ASTM D2837 "Standard Specification for Polyethylene Plastic Pipe based on Controlled Outside Diameter".
 30. ASTM D 3139, Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
 31. ASTM D3350 "Standard Specification for Polyethylene Plastic Pipe and Fittings Material".
 32. ASTM E 84, Test Method for Surface Burning Characteristics of Building

Materials.

33. ASTM F 477, Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
34. ASTM F714 'Standard Specification for Polyethylene Plastic Pipe based on Controlled Outside Diameter'.
35. ASTM F 1962 "Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings".

C. American Water Works Association:

1. AWWA C 151, Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
2. AWWA C 600, Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances.
3. AWWA C 800, Threads for Underground Service Line Fittings (with Appendix on Collected Standards for Service Line Materials).

D. Federal Specifications:

1. Fed. Spec. FF-S-325, Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry) Group II (Shield, Expansion Bolt Anchor) Type 4 (Wedge Expansion Anchors) Class 1 (One-Piece Steel Expander with Cone Taper Integral with Stud).

1.03 SUBMITTALS

A. Shop Drawings and Product Data: Submit completely dimensioned shop drawings, catalog cuts or other data as required to provide a complete descriptive information for the following:

1. Pipe and Fittings.
2. Piping Specialties.
3. Sewage Valve.
4. Gate Valves.
5. Precast Concrete Chambers

B. Certificates: Submit certified records or reports of results of shop tests, with such records or reports containing a sworn statement that shop tests have been made as specified. Sworn certifications shall bear the seal of a Registered Professional Engineer.

1. Provide 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: In addition to the design requirements of the Pennsylvania Department of Environmental Protection (DEP), comply with the following:

1. Use only one type of class of pipe in any continuous sewer between structures.
2. Use pipe and fittings designed to withstand imposed trench loadings and prevailing site conditions at the various locations.

B. Source Quality Control:

1. Shop Tests: In accordance with Article 1.06 of the General Instructions, factory test pipe materials listed in the following. 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.

	<u>MATERIAL</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
a.	Ductile Iron Pipe	ANSI A 21.51	As specified in ANSI A 21.51.
b.	Polyvinyl Chloride Pipe	ASTM D 2241	As specified in ASTM D 2241.
c.	Polyvinyl Chloride Pipe	ASTM D 1785	As specified in ASTM D 1785.

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.

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, if any, have cured.
 2. Under no circumstances 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 PIPE AND PIPE FITTINGS

- A. Elastomeric Gaskets: For pipe joint gasket material, provide elastomeric gaskets that have been tested as suitable for continuous contact with domestic sewage.
- B. Polyvinyl Chloride (PVC) SDR Pipe, 1 1/2 Through 3 Inch Diameter, Buried Pipe: Provide pipe which is permanently marked with manufacturer's trademark, size and ASTM conformance designation. Pipe design and material requirements shall conform to ASTM D 2241, SDR-21 for 200 psi pressure. PVC material shall conform to ASTM D 1784 requirements for Cell Classification 12454B.

1. Pipe Joints: Push-on or compression type, rubber gasket, conforming to ASTM D 3139 and F 477 requirements; rubber gasket that have been tested as suitable for continuous contact with domestic sewage.
2. Pipe Fittings: Manufactured in one piece of injection molded PVC compound meeting ASTM D 1784 requirements.
 - a. Fittings shall be Class 200 and conform to requirements of DR 21.
 - b. Fittings shall withstand a minimum of 630 psi quick burst pressure at 73 degrees F. when tested in accordance with ASTM D 1599 requirements.
 - c. Bells shall be gasketed joint conforming to ASTM D 3139 with gaskets conforming to ASTM F 477 requirements.
 - d. Acceptable Manufacturer: The Harrington Corporation or equal.
3. Retainers for PVC Pipe: Manufactured from 60-42-10 ductile iron conforming to ASTM A 536 requirements, including the glands and tie bolts. The retainers shall have a sufficient number of tie bolts to restrain the working and test pressures established by the retainer manufacturer.
 - a. The glands shall have serrations on the inside diameter sufficient to hold against both the working and test pressures.
 - b. Acceptable Manufacturer: EBAA Iron Sales, Inc. or equal.
4. Restraints for PVC fittings: Manufactured from 60-42-10 ductile iron conforming to ASTM A 536 requirements, including the bell ring, restraint ring and tie bolts.
 - a. A split ring shall be utilized behind the bell of the fitting outlets. A serrated ring shall be used to grip the pipe and a sufficient number of bolts shall connect the bell ring and the serrated gripping ring. The combination shall restrain continuously against a working pressure rating of 150 psi.
 - b. Acceptable Manufacturer:
 - 1) EBAA Iron Sales, Inc.
 - 2) Or equal.

- C. Polyvinyl Chloride (PVC) SCH-40 Pipe and Fittings, Exposed Pipe: Provide pipe which is permanently marked with manufacturer's trademark, size and ASTM conformance designation. Pipe design and material requirements shall conform to ASTM D 1785 Schedule 40, pressure Class 160, and manufactured from Class 1245-B Rigid PVC Compounds with a hydrostatic design stress of 13.8 MPa (2000 psi) designated as PVC 1120.
1. Socket-Type Joints: Socket-Type conforming to ASTM D 2564. Solvent cement for joint making shall conform ASTM D 2564.
 2. Flanges: PVC Schedule 40 150-lb. flanges manufactured from Rigid PVC Compounds conforming to ASTM D 1784.
 - a. Gaskets: Soft rubber full face flat type.
 - b. Bolts: Steel conforming to ASTM A 307.
 3. Socket Type Fittings: ASTM D 2466 manufactured from Class 1245-B Rigid PVC Compound.
 4. Provide adaptors, nipples, caps, etc., as required.
- D. Ductile Iron Pipe (DIP), Exposed and Buried Pipe: Conforming to ANSI A21.50 and ANSI A21.51 requirements.
1. Wall Thickness Class, Buried Pipe: As indicated on Drawings or as determined by the Engineer.
 2. Wall Thickness Class, Exposed Pipe: Class 53 except as noted otherwise on Drawings.
 3. Fittings: Gray iron or ductile iron conforming to ANSI A21.10 requirements, rated for 250 psi working pressure.
 4. Rubber-Gasket Joints, Buried Pipe: Conforming to ANSI A21.11 requirements. For buried pipe installation, provide either push-on or mechanical joints except where other types of joints are indicated on the Drawings or required by the Specifications.
 5. Restrained Joints: Conforming to requirements of ANSI A21.11 and designed for a working pressure equal to connected pipe rating. Provide joints for pipe and fittings similar to the following:
 - a. American Cast Iron Pipe Company; Lok-Fast or Lok-Set.
 - b. Clow Corporation; Super-Lock.
 - c. United States Pipe and Foundry Company; TRFLEX.
 - d. Or equal.
 6. Flanged Joints, Exposed Pipe: Conforming to ANSI A21.15 requirements. Unless indicated otherwise on the Drawings, use flanged joints for pipe and fittings installed inside of structures.
 - a. Gaskets: 1/16 in. thick cloth insertion rubber full face type conforming to ANSI B16.21 requirements.
 - b. Bolts: Conforming to ANSI B18.2.1 requirements.
 - c. Nuts: Conforming to ANSI B18.2.2 requirements.

7. Retainer Glands: Designed for pipe joint retaining through the use of a follower gland and set screw anchoring devices which impart multiple wedging action against the pipe. The mechanical joint restraint device shall have a working pressure of at least 250 psi with a minimum safety factor of two to one. Material components as follows:
 - a. Gland: Manufactured of ductile iron conforming to ASTM A 536. Gland dimensions shall match ANSI A21.11 and A21.53.
 - b. Restraining Devices: Manufactured of ductile iron heat treated to a minimum hardness of 370 BHN. Restraining devices shall incorporate a set screw/twist off nut bolt to insure the proper actuating of the restraining device. The twist off nut shall be designed to come off at the torque limit desired to anchor the restraining device in place on the pipe.
 - c. Joint Deflection: Retainer Gland joint deflection shall be limited to a two degree maximum. Joint deflection shall be applied before the set screws are torqued.
 - d. Acceptable Manufacturers:
 - 1) EBAA Iron, Inc.; Megalug 1100 Series.
 - 2) Or equal.
 8. Pipe and Fitting Coating: Manufacturer's standard asphaltic coating, approximately one mil thick in accordance with AWWA C151, applied to the outside of pipe and fittings.
- E. Flanged Adapters: Fabricated from high strength steel (Style 128), or cast iron (Style 127), and designed for joining DIP plain-end pipe to flanged fittings, valves, and flanged end equipment.
1. The compression-end of the adapter shall have the Dresser-Coupling type pack utilizing a Grade 27 wedge gasket for positive, watertight sealing. The flanged-end shall match the flange of the proposed fitting, valve or equipment connection.
 2. Acceptable Manufacturers:
 - a. Dresser Manufacturing Division of Dresser Industries, Inc.; Dresser Style 128 and 127.
 - b. Rockwell-International.
 - c. R. H. Baker & Co., Inc.
 - d. Or equal.
- AE. High Density Polyethylene (HDPE) Pipe, 1 ¼ inches to 4 inches. Provide pipe which is permanently marked with manufacture's trademark, size, and ASTM conformance designation. Pipe design and material shall conform to ASTM D3350 cell classification. ASTM 1962 and ASTM 1807-97 for Directional Drilling.
1. General
 - a. Fittings: All fittings shall be installed using butt-fused fittings, thermo-fused fittings/coupling, or flanged adapters and must be installed by a certified installer or as approved by the engineer. No size on size wet taps or compression connection shall be permitted.

- b. Handling: HDPE piping shall not be subject to dragging, dropping from excessive heights, pressure due to excessive weight, pushed or rolled off a truck. Any section kinked or buckled shall be cut out and removed. Any scratches to a depth of greater than 10% of the wall thickness shall be cut out and removed.
- 2. Short Sections:
 - a. Wall Thickness: To allow for surge allowance a HDPE Standard Dimension Ratio (SDR) of 17 as minimum strength for pressures of 50 psi. SDR of 11 as a minimum strength if pressure is 80 PSI. For working pressures greater than 80 PSI, approval required by Engineer. If temperatures are expected to exceed 80°F on a continuous time, see approval by Engineer.
 - b. Installation: Trench bottoms should be smooth, continuous and free of rocks of other debris. The bottom should be padded with sand or other fine grained fill materials of less than ½ inch particle size if ledge rock or hardpan is encountered. Compaction shall be hand compaction for first foot over top of pipe. Installation may not occur when ambient or pipe temperatures are below 45° F.
 - c. Pipe Pressure Testing: conform to ASTM F2164 "Standard Practice for Field Leak Testing of Polyethylene Pressure Piping Systems using Hydrostatic Pressure."
- 3. Direction Drilling Sections:
 - a. Wall Thickness: The minimum rated SDR shall be 11.
 - b. Pullback Fitting: A weak link should be used during pullback to avoid oversteering of the pipe.
 - c. Air Release: The HDPE pipe should be installed at a constant raising elevation so an elevated section is not created.
 - d. Reaming Hole: Hold reaming diameter to 1.2 times to 1.5 times the outside diameter of HDPE pipe being installed.
 - e. Utility Location: All utilities within 10 feet of the bore path must be located and identified.
 - f. A drilling and pullback log must be maintained which documents at least the following; drilling mud rates, axial forces, and pullback speed. Copy of drilling and pullback log shall be submitted to the Engineer upon completion of force main.

2.02 PIPING SPECIALTIES

- A. Valve Boxes: Cast iron extension roadway type, three-piece construction, and of screw adjustment design.
 - 1. Boxes shall have 4 1/4-inch minimum shaft diameter and lock cover marked SEWER.
 - 2. Boxes hot coated inside and out with a tar or asphalt compound.
 - 3. Provide box compatible with valve for operating clearances.

- B. Flexible Insulation For Piping: Insulation manufactured by closed cell, 5 to 6 pounds cubic feet density foamed plastic with thermal conductivity of 0.26 BTUH per sq. ft. per degree per inch at 70 degrees F. mean temperature, water vapor transmission rating of less than 0.1 perms. per inch, and a self-extinguishing fire-rating; ASTM E 84. Insulation manufactured to meet requirements of ASTM C 534. Use insulation manufacturer's companion joint making/sealing adhesive to make permanent insulation joints.
1. Flexible Insulation For Fittings: Insulate fittings and valve bodies with sleeves of same insulation thickness used on adjacent piping and having an inside diameter large enough to fit over the insulation on adjacent piping.
 2. Acceptable Manufacturers:
 - a. Manville Products Corp.; Aerotube II, 1/2-inch thickness.
 - b. Owens-Corning Fiberglas.
 - c. Armstrong Industry Products Division.
 - d. Or equal.
- C. Curb Stop and Box: Designed to conform to AWWA Standard C800.
1. All bronze construction, inverted key stop.
 2. Extension type arch pattern base of two-piece cast iron construction coated inside and out with tar base enamel and topped with cast iron lid secured by bronze bolt. Provide box compatible with T-wrench and stop. Provide cover marked SEWER.
- D. Flexible Pipe Coupling: Coupling shall consist of a steel middle ring or sleeve, two steel or malleable iron flange or follower rings, two wedge shaped resilient gaskets and sufficient number of track-head bolts and nuts.
1. Middle Ring or Sleeve: Steel construction conforming to ASTM A 283, (Grade A) requirements, fabricated in a true circular section and free of surface defect.
 2. Follower Rings or Flanges: Steel construction conforming to ASTM A 47 (Grade 32510) requirements, fabricated in a true circular section and free of surface defect, and tested and sized after welding by cold expanding a minimum of one percent.
 3. Bolts and Nuts: Steel bolt conforming to ASTM A 183 requirements, double radius head or buttonhead track type with rolled threads, conforming to ANSI B1.1 requirements; and steel nuts conforming to ANSI B 18.2.2 requirements, American Standard Heavy Dimension Series.
 4. Gaskets: Resilient wedge-shaped of synthetic base compound designed for raw sewage and sludge service.
 5. Shop Paint: Middle and follower rings shop painted with primer compatible with specified field coat for piping where coupling is located.
 6. Acceptable Manufacturers:
 - a. Dresser Manufacturing Division of Dresser Industries, Inc.; Dresser Style 38 or 138.
 - b. Rockwell-International.
 - c. R. H. Baker & Co., Inc.
 - d. Or equal.

- E. Stainless Steel Pipe Supports: Fabricate pipe supports and pipe straps for exposed piping using Type 304 stainless steel conforming to ASTM A 167. Individual pipe support and pipe strap designs are as indicated on the Drawings.
1. Anchors and Fasteners: Provide drilled-in type expansion anchors incorporating a one-piece stud (bolt) with integral expansion wedges, nut and washer as a UL Listed assembly and meeting physical requirements of Federal Specification FF-S-325, Group II, Type 4, Class 1. Stud of Type 303 or 304 stainless and nut and washer of Type 316 stainless.
 2. Standard Bolts, Nuts and Washers: Type 304 stainless steel conforming to ASTM A 320.
- F. Concrete: As specified in Section 03300 for Class B (3,000 psi.) Concrete.
- G. Modular, Mechanical Type Pipe Seal (LINK-SEAL): Modular, mechanical type pipe seal used for core-drilled connection of piping to existing manholes. Seal component construction as follows:
1. The seal shall consist of inter-locking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening.
 2. The elastomeric element of the seal shall be sized and selected in accordance with the seal manufacturer's recommendations. Elastomeric element shall conform to ASTM D 2000 requirements for EPDM material.
 3. The hardware provided in the seal shall be as recommended by the seal manufacturer for buried service such as will exist at the project site.
 4. Acceptable Manufacturers:
 - a. Thunderline Corporation; Link-Seal.
 - b. Or equal.

2.03 SEWAGE VALVE

- A. Sewage Air Release Valve: Valve design shall automatically release air, gas or vapor under pressure during system operation. Valve design shall feature long body and float stem components so that the operating mechanism is kept free from contact with sewage during operation. Valve construction as follows:
1. Valve Body and Cover: Cast iron, conforming to ASTM A 48, Class 35 requirements.
 2. Inlet Size: 2-inches, NPT.
 3. Outlet Size: 1/2-inch, NPT.
 4. Maximum Working Pressure: 75 psi.
 5. Vent Orifice: 5/16-inch.
 6. Discharge Orifice Seat, Mechanism and Valve Stem: Stainless Steel.
 7. Orifice Button: Stainless steel and Buna-N, Nitrile Rubber conforming to ASTM SB 800 requirements.
 8. Mechanism Lever Pins and Float: High strength stainless steel, conforming to ASTM A 240 requirements.
 9. Backflushing and Cleaning Accessories: Factory assembled to the valve and consisting of a 2-inch shut-off valve at bottom inlet, a 1-inch blow-off valve near

the bottom of the valve body, quick disconnect couplings and 1/2-inch shut-off valve at top of valve, and a section of rubber hose with quick disconnect coupling.

10. Acceptable Manufacturers:

- a. Val-Matic Valve And Manufacturing Corp.; Model No. 48 Series.
- b. Or equal.

B. Sewage Air and Vacuum Valve: Valve design shall automatically exhaust large quantities of air during the filling of a system and shall allow air to re-enter the system during draining or when a vacuum occurs. Valve design shall feature long body and float stem components so that the operating mechanism is kept free from contact with sewage during operation. Valve construction as follows:

1. Valve Body and Cover: Cast iron, conforming to ASTM A 48, Class 35 requirements.
2. Inlet Size: 2-inches.
3. Discharge Orifice: 2-inches.
4. Float Stem and Guide: Bronze, conforming to ASTM B 584 requirements.
5. Floats: Stainless Steel, conforming to ASTM A 240 requirements.
6. Orifice Seat: Buna-N, Nitrile Rubber, conforming to ASTM SB 800 requirements.
7. Backflushing and Cleaning Accessories: Factory assembled to the valve and consisting of an inlet shut-off valve, a 1-inch blow-off valve near the bottom of the

valve body, quick disconnect couplings and a 1/2-inch shut-off valve at the top of valve, and a section of rubber hose with quick disconnect coupling.

8. Acceptable Manufacturers:

- a. Val-Matic Valve And Manufacturing Corp.; Model No. 300 Series.
- b. Or equal.

C. Sewage Combination Air Valves: Consisting of an air release valve and an air and vacuum valve factory piped into a compact assembly. The combination assembly shall automatically release air, gas or vapor under system operating pressure and shall also allow air to re-enter the system during draining or when a vacuum occurs. Combination valve designs shall feature long bodies and float stem components so that the operating mechanisms are kept free from contact with sewage during operation. Valve construction as follows:

1. Valve Bodies and Covers: Cast iron, conforming to ASTM A 48, Class 35 requirements.
2. Inlet Sizes: 2-inches.
3. Air Release Outlet Size: 1/2-inch, NPT.
4. Vacuum Discharge/Outlet Size: 2-inches.
5. Air Release Valve Maximum Working Pressure: 75 psi.
6. Air Release Valve Vent Orifice: 5/16-inch.
7. Air Release Valve Discharge Orifice Seat, Mechanism and Valve Stem: Stainless steel.
8. Air Release Valve Orifice Button: Stainless Steel and Buna-N, Nitrile Rubber conforming to ASTM SB 800 requirements.

9. Air Release Valve Mechanism Lever Pins and Float: High strength stainless steel, conforming to ASTM A 240 requirements.
 10. Air and Vacuum Valve Float Stem and Guide: Bronze, conforming to ASTM B 584 requirements.
 11. Air and Vacuum Valve Floats: Stainless Steel, conforming to ASTM A 240 requirements.
 12. Air and Vacuum Valve Orifice Seat: Buna-N, Nitrile Rubber, conforming to ASTM SB 800 requirements.
 13. Backflushing and Cleaning Accessories: Factory assembled to the combination valves and consisting of two inlet shut-off valves, two blow-off valves, two clear water inlet valves, section of rubber hose and quick disconnect couplings.
 14. Acceptable Manufacturers:
 - a. Val-Matic Valve And Manufacturing Corp.; Model No. 48 or 49/300 Series.
 - b. Or equal.
- D. Valve Support work: Provide steel support as indicated on the Standard Details.
1. Miscellaneous Metals: Steel conforming to requirements of ASTM A 36 and galvanize finished according to ASTM A 123.
 2. Drilled-In Expansion Anchors and Fasteners: UL Listed stainless steel anchor and fastener incorporating a one-piece stud (bolt) with integral expansion wedges, nut and washer, and meeting physical requirements of Federal Specification FF-S-325,

Group II, Type 4, Class 1. Stud of Type 303 or 304 stainless and nut and washer of Type 316 stainless.
 3. Standard Bolts, Nuts and Washers: Type 304 stainless steel conforming to ASTM A 320.

2.04 VALVES

- A. General Requirements: Provide valves of the same type by same manufacturer; suitable for the intended service. Markings shall be cast on the bonnet or body of the valve indicating manufacturer's name or mark, the year the valve casting was made, the size of the valve, directional flow arrow and designation of working water pressure.
1. Valve pressure-temperature ratings of valve shall be not less than the design criteria applicable to the system components.
 2. Valves shall open to the left (counterclockwise). Valve shall be operated by handwheel or operating nut as indicated on the Drawings. Operating wheel shall have cast thereon an arrow indicating the direction of opening.
 3. Provide extension stems with bronze bushed stem guides where required.
 4. Valve ends as indicated on the Drawings and unless indicated otherwise shall conform to the following:
 - a. Flanged: Conforming to ANSI B16.1.
 - b. Screw End: Threaded in accordance with ANSI B2.1.
- B. Gate Valves: Provide valves designed for working water pressure of 200 psi., and having rising stem operation except when installed underground, or where indicated

otherwise on Drawings. Valves shall contain stuffing box of such design that allow repacking under pressure when valve is in fully open position.

1. Valves Smaller Than 3-inches In Diameter: Provide valves of solid bronze construction with tapered split wedge disc.
 - b. Physical properties of brass pressure containing parts shall conform to ASTM B 62.
 - c. Stems fabricated of Alloy A (rolled silicon brass) conforming to ASTM B 371, or Copper Alloy No. 876 (silicon bronze + silicon brass) conforming to ASTM B 584, or other material equally resistant to dezincification.
2. Hose End Type: Bronze construction, tapered solid wedge disc, nonrising stem, female inlet and outlet having American Standard Taper Pipe thread. (Provide quick disconnect couplings in polypropylene material as manufactured by Plastic Piping Systems.)
 - a. Acceptable Manufacturers:
 - 1) Crane Company; No. 451 with cap and chain.
 - 2) Wm. Powell Company.
 - 3) Or equal.

C. Plug Valves (Straightway Type): Provide valves designed for a minimum working water pressure of 175 psi for valves through 12 in.

1. Provide non-lubricated eccentric type plug valve with valve bodies of cast iron conforming to ASTM A 126 Grade B, or valve bodies of semi-steel with coated plug suitable for wastewater and corrosion resistant seats.
2. Provide valves with port areas sized at least 80 percent of full pipe area.
3. Provide T-wrench for operation.
4. Acceptable Manufacturers:
 - a. DeZurik; Series 100 Eccentric Valves.
 - b. Henry Pratt Company.
 - c. Homestead Industries, Inc.
 - d. Dresser Industries, Inc.
 - e. Or equal.

- D. Bronze Ball Valves: Valve body of solid bronze material conforming to ASTM B 584, and having a straight-through flow passage.
 - 1. Seats and O-rings of Buna-N.
 - 2. Valves of quarter-turn operation with a T-handle or round handle suitable for use in confined spaces, and which will allow sufficient clearance whether valve is in open or closed position.
 - 3. Threaded end valves available in sized 1/4 inch through 2 inch shall be rated 200 psi.
 - 4. Ball and Stem: Brass chrome finish conforming to ASTM B 140.
 - 5. Acceptable Manufacturers:
 - a. Crane Co.
 - b. Or equal.
- E. PVC Ball Check Valve: Provide ball check valve designed for a minimum water working pressure of 150 pounds per square inch and factory tested to double that pressure prior to shipment.
 - 1. Construction: Double union type with the valve body shaped to provide excess area through the valve to assure full delivery of the pipe line size capacity.
 - 2. Materials: Polyvinyl chloride PVC 12454-B conforming to ASTM D 1784 with sealing O-rings of Viton.
 - 3. Acceptable Manufacturers:
 - a. NIBCO Inc.; True-Union Ball Check.
 - b. Or equal.

2.05 PRECAST CONCRETE CHAMBERS

- A. General Requirements: Terminal cleanout chambers, in-line cleanout chambers, junction cleanout chambers, and air release chambers shall be of materials and construction conforming to precast concrete manhole requirements specified in Section 02601, with the following additional requirements:
 - 1. Manhole covers (lids) do not require cover hold-down bolts on air release chambers.
 - 2. Sump Frame and Grate: Cast iron conforming to ASTM A 48.
- B. Piping In Chambers: Provide ductile iron pipe and ductile iron or cast iron fittings within the chambers except where other type of pipe is indicated on the drawing detail.

PART 3 EXECUTION

3.01 INSPECTION

- 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 site and replace with new Products.

3.02 PREPARATION

- A. General Requirements: Clean piping interior prior to laying pipe, and following pipe laying, keep open ends of piping and pipe attachment openings capped or plugged until actual connection or actual pipe testing.
 - 1. Provide the protective means to prevent water and debris from washing into the pipe.
- B. Earthwork: Perform earthwork for sewer installation as specified in Section 02221.
 - 1. Bedding materials and concrete work for pipe bedding as specified in Section 02221.
 - 2. Excavate trenches in rock at least 25-feet in advance of pipe laying. Protect pipe ends from blasting, if blasting is allowed in the Project.

3.03 PRESSURE WASTEWATER SEWER CONSTRUCTION METHODS

- A. General Requirements: Use proper and suitable tools and appliances for the proper and safe handling, lowering into trench and laying of pipes.
 - 1. Lay pipe proceeding upgrade true to line and grades given. Lay bell and spigot pipe with bell end upgrade. No wedging or blocking permitted in laying pipe unless by written order of Engineer.
 - 2. Unless indicated otherwise, install piping with not less than four feet of cover.
 - 3. 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.
 - 4. 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. Dig bell holes sufficiently large to permit proper joint making and to insure pipe is firmly bedded full length of its barrel.
 - 5. Walking or working on the installed pipe line, except as necessary in tamping and backfilling, not permitted until trench is backfilled one-foot deep over top of pipes.
 - 6. Take up and relay pipe that is out of alignment or grade, or pipe having disturbed joints after laying.
 - 7. Take up and replace with new, such in-place pipe sections found to be defective.
- B. Pipe Laying and Joining: Perform pipe laying and joining in strict accordance with manufacturer's installation instructions, reference standards as included, and such additional requirements as specified herein.
 - 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.
 - 3. Threaded Joints: Cut pipe ends square, deburr and ream to size of original bore. Cut threads to American Standard tapered pipe threads, free of oil and cuttings. Use an approved joint tape or joint paste to aid in joint lubrication and sealing. After fabrication, paint exposed threads with red lead paint.
 - 4. Laying/Joining Specified Types of Plastic Pipe: Perform installation and joint

assembly according to ASTM D 2774 for Class I bedding material.

- a. Push-on Joints. To make PVC pipe push-on joints, properly seat sealing gasket, evenly and sufficiently lubricate the spigot end of pipe, and fully enter joint until joint line is visible.
 - b. Solvent-Weld Joints: Use chemical solvent welding components to join PVC pipe. Use the type of solvents specified in manufacturer's printed recommendations.
5. Laying/Joining Ductile Iron Pipe: Installation and joint assembly according to AWWA C 600, and as follows:
- a. Pipe Cutting: Where necessary to field cut pipe use approved pipe cutter, milling cutter or abrasive wheel saw.
 - b. Push-on Joints. To make ductile cast iron pipe push-on joints, properly seat sealing gasket, evenly and sufficiently lubricate the spigot end of pipe, and fully enter joint until joint line is visible . Make deflection, if required, only after the joint has been assembled properly.
 - c. Mechanical Joints: To make ductile iron pipe mechanical joint, position sealing gasket and gland for bolting and then enter the spigot into pipe bell end until joint line is visible. Tighten bolts evenly maintaining approximate distance between gland and face of flange at all points around the socket. Do not exceed pipe manufacturer's specifications for maximum torque applied to bolts.
 - d. Flanged Joints: To make ductile iron pipe flanged joint, face flanges true and fit with gaskets, and draw flanges up square and tight to insure full gasket flow and satisfactory seal.
 - e. Concrete Thrust Blocks: Provide concrete thrust blocks for each fitting, and at those locations where horizontal and vertical deflections are made in the joints of the force mains. Use Class B concrete. Provide thrust blocks of the design indicated on the Detail Drawing.
 - f. Joint Restraints: Install on buried DIP at changes in direction of pipe runs, and at terminal ends of pipe runs in accordance with the following table:

DUCTILE IRON PIPE RESTRAINED JOINT DIMENSIONS
(In feet of straight pipe for each leg)

Fitting Type	6 Inch Dia. Pipe	8 Inch Dia. Pipe
Plug	25	25
Tee	25	25
Lateral	25	25
90 Deg.	25	25
45 Deg.	15	15
22 1/2 Deg.	15	15
11 1/4 Deg.	15	15

- C. Pipe Connections to Existing Manholes: Make pipe connections to existing manholes in accordance with the appropriate requirements as follows:
1. Core-drill the required opening or openings using the proper equipment for the work. Make openings of sufficient size to accommodate the pipe and the Pipe Seal (LINK-SEAL). Install the Pipe Seal in accordance with the manufacturer's installation instructions. Do not permit ground water, surface water or debris to enter the existing facilities through the new connection.
 2. Run the exposed pipe (Drop Connection) within the manhole using SCH-40 PVC Pipe with Solvent Weld Socket Type joints. Run piping within the manhole as indicated on the Drawings.
 3. Anchor the exposed pipe in place within the manhole as indicated on the Drawings using Exposed Pipe Support Work. Embed the Drilled-In Expansion Anchors to four and one-half bolt diameters.

3.04 PRECAST CONCRETE CHAMBER INSTALLATIONS

- A. As specified in Section 02601 for precast manholes and as shown on the Drawings.
- B. Insulation Installation: Install flexible insulation on piping within chambers. Install insulation on clean, dry pipe surfaces. Perform cleaning required for removal of construction debris and dirt from the piping.
1. Installation: Install flexible insulation on piping according to manufacturer's instructions, using specific adhesive to seal both longitudinal and butt joints. Insulate in-line appurtenances to the same thickness as adjoining insulation. Install insulation in 1/2-inch thickness.
 2. Weatherizing Installation: Weatherize flexible insulation using those protective and moisture impervious materials as recommended by the insulation manufacturer.

3.05 FIELD QUALITY CONTROL

- A. General Requirements: Conduct tests specified herein so that each pressure wastewater sewer installed in the Project is tested to the Engineer's satisfaction.
1. The Contractor may elect to make a leakage test prior to backfilling the trenches, for his own purposes. However, the leakage tests of the pressure wastewater sewers, or sections thereof, for acceptance shall be conducted after the backfilling of the trenches has been completed.
 2. Provide tools, materials (including water), apparatus and instruments necessary for pressure wastewater sewer testing.
 3. When the length of the pressure wastewater sewer exceeds 1000 feet, test the sewer in sections, the length of each section to be determined by the Engineer.
 4. Conduct tests of every kind in the presence of and to the satisfaction of the Engineer.
- B. Cleaning Prior to Tests: Before tests are conducted, flush piping with clean water until free of all forms of dirt and construction debris.
1. The water for the flush cleaning operation shall be from the Contractor's source.
- C. Line Acceptance Test: After the pressure wastewater sewer or section thereof is constructed, backfilled, and successfully cleaned, perform a hydrostatic Line Acceptance Test as follows:
1. Seal pressure wastewater sewer at downstream end with a suitable pipe plug.
 2. Fill pressure wastewater sewer with clear water.
 3. Raise hydrostatic pressure to one and one-half times the operating pressure; measured at the low point of the particular section of sewer being tested.
 4. A preliminary test period will be permitted for the removal or absorption of air from the sewer before measuring the leakage.
 5. Maintain test pressure for a period of not less than four hours.
 6. Consider pressure wastewater sewers acceptable when measured leakage does not exceed ten gallons per day per mile per inch of pipe diameter.
- D. Repair and Retest: When the pressure wastewater sewer, or sections thereof, fails to meet test requirements specified previously, determine source or sources of leakage and repair or replace defective material, and if a result of improper workmanship, correct such.
1. Conduct such additional tests required to demonstrate that pressure wastewater sewers meet specified test requirements.
- E. The Owner reserves the right to retest piping throughout the duration of the Construction Period.
1. Make repairs as Work of this Section to piping found defective by such Owner conducted tests.

END OF SECTION

SECTION 03100

CONCRETE FORMWORK

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: This Section specifies the formwork for the formed vertical and horizontal concrete placements.

1.02 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 347; Formwork for Concrete Fifth Edition.
 - 2. ACI 350R; Environmental Engineering Concrete Structures.
- B. American Plywood Association: APA Grade-Trademarks.
- C. U. S. Department of Commerce Product Standards:
 - 1. PS-1-74 For Construction and Industrial Plywood.
 - 2. PS-20-70 The American Softwood Lumber Standard.
- D. Western Wood Products Association: WWPA Catalog 'A' Product Use Manual.
- E. Southern Pine Inspection Bureau (SPIB): Standard Grading Rules for Southern Pine.

1.03 QUALITY ASSURANCE

- A. Formwork Design: Provide formwork designed to maintain the tolerances indicated and to include factors pertinent to safety of personnel during construction.
 - 1. Design formwork in accordance with American Concrete Institute's Recommended Practice for Concrete Formwork ACI 347, and in accordance with the following:
 - a. Design forms and falsework to include assumed values of live load, dead load, weight of moving equipment operated on formwork, temporary construction material, foundation pressures, stresses, lateral stability, and such other factors pertinent to safety of structure during construction.
 - b. Design formwork to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent construction.
- B. Allowable Tolerances: Set and maintain concrete forms within tolerance limits stated in American Concrete Institute's Recommended Practice for Concrete Formwork ACI 347.

1.04 PROJECT CONDITIONS

- A. Protection: Protect formwork materials before, during and after erection to ensure acceptable finished concrete work. Also protect in-place materials and other operations of work in connection with concrete pours.
 - 1. In event of damage to erected forms, make necessary repairs or replacements prior to concrete pours. Perform such corrective work at no increase in Contract Price.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Form Lumber Materials: Provide lumber free of material defects that would deform the finished Concrete Product.
 - 1. Form framing, sheathing, struts, braces and shoring shall conform to WWPA Catalog A or SPIB Grading Rules.
 - 2. Rough Structural and Dimension Lumber: Provide lumber of allowable species, surfaced four sides as applicable, and grade stamped with the appropriate WWPA or SPIB stamp indicating product compliance with PS-20-70.
- B. Plywood Form Sheathing and Panels: Provide plywood of not less than 5/8-inch thickness, Exterior Type B-B Plywood Class I and II EXT-APA conforming to U.S. Product Standard PS-1-74.
 - 1. Provide Class II only on surfaces not exposed to view.
- C. Steel Forms: Metal Forms of a pre-engineered standard design, but conforming to the concrete sections indicated on the Drawings, may be used instead of wood forms.
- D. Form Ties: Provide factory fabricated, adjustable-length, removable or snap-off metal form ties conforming to ACI 347 and ACI 350R.
 - 1. Provide snap-off metal ties with ends that break at least 1-1/2-inches from the face of the wall.
 - 2. Removable ties that leave holes larger than 7/8-inches are not permitted.
 - 3. Form ties fabricated on the project site and wire ties or flat bands are not acceptable.
 - 4. Wood spacers are not permitted within the pour.
- E. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain, nor affect concrete surfaces, and will not impair subsequent treatment of concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds.

PART 3 EXECUTION

3.01 PREPARATION

- A. Final Preparation: Prior to placement of concrete, perform final cleaning of the formwork and verify the accuracy of alignment of the formwork.
- B. Form Coating Application: Apply form coatings in accordance with manufacturer's specifications and the following:
 - 1. Do not allow excess form coating material to accumulate in the forms.
 - 2. Do not allow form coatings to come in contact with construction joints or reinforcing steel.

3.02 CONSTRUCTION

- A. General Requirements: Construct forms in accordance with ACI 347 to required dimensions, plumb, straight and mortar tight, and paste tight where appearance is important.
 - 1. Securely brace and shore forms to prevent displacement, bowing and pillowing, and to safely support imposed concrete load.
 - 2. Provide offsets, sinkages, keyways, recesses, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and such other features as required. Use selected materials to obtain above requirements.
 - 3. Fabricate forms for easy removal without hammering or prying against concrete surfaces.
 - 4. Form intersecting planes to provide true, clean-cut corners, with edge grain of plywood not exposed to concrete.
 - 5. Build into forms, or otherwise secure in forms, items such as inserts, anchors, miscellaneous metal items, and such other embedded items as indicated on Drawings.
 - 6. Wet forms sufficiently to prevent joints in wood forms from opening prior to concrete pour.
- B. Openings: Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete.
 - 1. Securely brace temporary openings and set tightly to forms to prevent the loss of concrete mortar. Locate temporary openings on forms in as inconspicuous location as possible consistent with the requirements of the work.
 - 2. Provide openings in concrete formwork of the correct size and in the proper location to accommodate other items and operations of construction work passing through forms. Accurately place and securely support items to be built into forms.
- C. Earth Forms: Where soil conditions will permit excavation to accurate sizes without bracing, and soil subsidence can be prevented during the concrete pour, earth forms may be used.
 - 1. Before concrete is poured, lightly wet earth forms but not to a muddy condition.
- D. Re-Use of Forms: Forms for re-use shall meet new form requirements with respect to affect on poured concrete appearance and structural stability.

1. Re-use of forms shall in no way delay or change the concrete pour schedule as compared to the schedule obtainable if all forms were new (in the case of wood forms) or if the total required forms were available (in the case of metal forms).

3.03 FORM REMOVAL

- A. General Requirements: Upon removal of forms, notify the Engineer in order that a review of the newly stripped surfaces may be made before patching and finishing is performed. Additional requirements as follows:
 1. Remove forms in accordance with ACI 347, remove forms without damage to concrete, and remove forms in a manner to insure complete safety to the cast-in-place structure.
 1. Cutting form ties back from the face of the concrete is not permitted.
- B. Form Shoring Removal: In no case shall supporting forms or shoring be removed until the members have acquired sufficient strength to support safely their weight and the anticipated construction loads without distortion or excessive deflection.
 1. The Engineer's consent to remove forms shall not relieve the Contractor of the responsibility for the safety of the work.
- C. Temperature Limitations: When the atmospheric temperature at the site has been continuously above 50 degrees F. from the time of the pour, the forms shall be removed at the earliest practical time within the limits set forth in this paragraph and wet curing shall continue to proceed without delay.
 1. Forms for walls and other vertical faces may be carefully removed 24 hours after the last portion of concrete in the section involved has been placed provided the concrete has sufficiently hardened to preclude damage resulting from form removal and provided these members are not subjected to loads for a period of 14 days.
 2. Horizontal forms shall remain in place for a minimum of 14 days or until the concrete, as determined by job cured cylinders, has attained a compressive strength of 3,000 p.s.i. When a water reducing retarder is used in the concrete mix, the normal time periods for removing forms may have to be increased.
 3. When the atmospheric temperature at the site drops below 50 degrees F., all forms shall be left in place for at least 5 days regardless of the temperature within the protective covering or enclosure.

END OF SECTION

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: This Section specifies the various types of concrete reinforcement indicated or noted on the Drawings for the concrete placements.
- B. Related Sections:
 - 1. Concrete Formwork: Section 03100

1.02 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 315; Details and Detailing of Concrete Reinforcement.
 - 2. ACI 318; Building Code Requirements for Reinforced Concrete.
- B. American Society for Testing and Materials.
 - 1. ASTM A 82; Specification for Cold-Drawn Steel Wire for Concrete Reinforcement.
 - 2. ASTM A 185; Specification for Welded Steel Wire Fabric for Concrete Reinforcement.
 - 3. ASTM A 307; Specification for Carbon Steel Externally Threaded Standard Fasteners.
 - 4. ASTM A 320; Specification for Alloy Steel Bolting Materials for Low-Temperature Service.
 - 5. ASTM A 615; Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement, including Supplementary Requirement.
- C. Concrete Reinforcing Steel Institute: CRSI, Manual of Standard Practice for Reinforcing Concrete Construction.

1.03 SUBMITTALS

- A. Shop Drawings and Product Data: Prepare shop drawings of concrete reinforcement in accordance with American Concrete Institute's Standard ACI 315.
 - 1. Indicate bending diagrams, splicing and lap of rods, and shapes, dimensions and details of bar reinforcing and accessories.

- B. Test Reports: Submit two copies of reports showing the results of tests. Such tests conducted in accordance with the American Society for Testing and Materials Specifications.
 - 1. Test Requirements may be waived, based upon certified copies of mill test reports.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Storage of Materials: Store reinforcing materials in a manner to prevent excessive rusting and fouling with dirt, grease and other bond-breaking coatings.
 - 1. Identify bundles of reinforcing steel with stamped metal tags wired to steel.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Reinforcing Steel:
 - 1. Reinforcement Bars: Conforming to ASTM A 615, Grade 60, Deformed steel reinforcing bars, which shall satisfy the exceptions in ACI Building Code, AASHTO and Federal Specifications.
 - 2. Wire: Conforming to ASTM A 82.
 - 3. Welded Wire Fabric: Conforming to ASTM A 185.
 - 4. Metal Accessories: Conforming to CRSI Manual of Standard Practice for Reinforcing Concrete Construction.
- B. Anchors:
 - 1. Steel Anchor Bolts: Shapes as required; conforming to ASTM A 307.
 - 2. Stainless Steel Anchor Bolts: Shapes as required; conforming to ASTM A 320 Grade B8, AISI Type 304.

2.02 FABRICATION

- A. General Requirements: Perform bending of steel reinforcement by the cold bending method. Perform bar shape fabricating in a manner that will not injure the material or lessen the member strength.
 - 1. Do not use bars with kinks or bends not indicated on Drawings.
 - 2. Use a designed bending machine, either hand or power-operated.
 - 3. Do not field bend bars partially embedded in concrete unless approved by the Engineer.
- B. Field Bending: Perform field bending of steel reinforcement using workmen skilled in the practice of field bending, and observing the following requirements.
 - 1. Perform field bending of steel reinforcement as specified above under General.

PART 3 EXECUTION

3.01 INSPECTION

- A. Notification: Notify Engineer 48 hours before placing concrete so he can inspect placement of metal reinforcement.
- B. Field Inspection: Verify that items to be embedded in concrete are secured in place and block-outs in formwork are secured in place as required.
 - 1. Formwork constructed as work of Section 03100.

3.02 INSTALLATION

- A. Placing Reinforcement: Place metal reinforcement accurately and securely brace against displacement through the use of reinforcing accessories in accordance with ACI 318.
 - 1. Terminate reinforcement two inches from face of expansion joints.
 - 2. Continue reinforcement across or through construction joints.
 - 3. When obstructions interfere with the placement of reinforcing, pass such obstructions by placing reinforcing around and not bending the reinforcing to clear the obstructions.
 - 4. Install welded wire fabric as indicated, lapping joints six inches and wiring securely. Extend welded wire fabric to within two inches of sides and ends of slabs.
 - 5. Do not lay metal reinforcement on formwork. Raise reinforcement as concrete is placed.
 - 6. Support reinforcing using metal accessories; products other than metal accessories not permitted.
- B. Splicing Reinforcement: Splice metal reinforcement as indicated and in accordance with ACI 318.
 - 1. Welding of crossing bars (tack welding) is not permitted without approval of Engineer.
 - 2. Secure metal reinforcement at intersections with not less than No. 16-gauge annealed wire or appropriate size clips.
- C. Anchor Bolts Setting: Set at locations indicated on Drawings and secure in place to prevent movement during concrete pours.
- D. Cleaning Reinforcement: Clean or otherwise protect metal reinforcement so that at the time concrete is placed, reinforcement is free from rust, scale or other coatings that will destroy or reduce bond.
- E. Reinforcement Protection: Provide protection for reinforcement during concrete pours

in accordance with ACI 318, unless indicated otherwise on the Drawings.

1. On exterior exposed work, no ties or spacers will be permitted to remain within 3/4 inches of the finished surfaces.
2. Protection: Protect in-place reinforcing from excessive construction traffic and other work.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: This Section specifies the unformed concrete placements as well as the formed vertical and horizontal concrete placements.
- B. Related Sections:
 - 1. Concrete Formwork: Section 03100.
 - 2. Concrete Reinforcement: Section 03200.
- C. Work Specified Under Other Sections: Items to be embedded in concrete are as specified in the various Sections of this Project Manual. The responsibility for coordinating concrete pours with embedded items rests solely with the Contractor.

1.02 REFERENCES

- A. American Association of State Highway and Transportation Officials, AASHTO M 182 Burlap cloth made from Jute or Kenaf.
- B. American Concrete Institute:
 - 1. ACI 211.1; Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
 - 2. ACI 301; Specifications for Structural Concrete for Buildings.
 - 3. ACI 304; Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
 - 4. ACI 305R; Hot Weather Concreting.
 - 5. ACI 306R; Cold Weather Concreting.
 - 6. ACI 308; Standard Practice for Curing Concrete.
 - 7. ACI 318; Building Code Requirements for Reinforced Concrete.
- C. American Society for Testing and Materials.
 - 1. ASTM C 31; Methods of Making and Curing Concrete Test Specimens in the Field.
 - 2. ASTM C 33; Specification for Concrete Aggregates.
 - 3. ASTM C 39; Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - 4. ASTM C 42; Methods of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - 5. ASTM C 94; Specification for Ready-Mixed Concrete.
 - 6. ASTM C 143; Test Method for Slump of Portland Cement Concrete.
 - 7. ASTM C 150; Specification for Portland Cement.

8. ASTM C 156; Test Method for Water Retention By Concrete Curing Materials.
9. ASTM C 171; Specification for Sheet Materials for Curing Concrete.
10. ASTM C 172; Methods of Sampling Freshly Mixed Concrete.
11. ASTM C 173; Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
12. ASTM C 192; Method of Making and Curing Concrete Test Specimens in the Laboratory.
13. ASTM C 231; Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
14. ASTM C 260; Specification for Air-Entraining Admixtures for Concrete.
15. ASTM C 309; Specification for Liquid Membrane - Forming Compounds for Curing Concrete.
16. ASTM C 494; Specification for Chemical Admixtures for Concrete.
17. ASTM C 881; Specification for Epoxy-Resin-Base Bonding System for Concrete.
18. ASTM C 882; Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete.
19. ASTM D 6; Loss on Heating of Oil and Ashpaltic Compounds, Test Method for.
20. ASTM D 297; Standard Methods for Rubber Products-Chemical Analysis.
21. ASTM D 570; Test Method for Water Absorption of Plastics.
22. ASTM D 638; Test Method for Tensile Properties of Plastics.
23. ASTM D 695; Test Method for Compressive Properties of Rigid Plastics.
24. ASTM D 732; Test Method for Shear Strength of Plastics by Punch Tool.
25. ASTM D 790; Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
26. ASTM D 1751; Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
27. ASTM D 1752; Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

D. U. S. Army Corps of Engineers Specifications:

1. U. S. Corps of Engineers CRD-C 572 Specification for Waterstop.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's descriptive product data and current specifications covering the named manufacture's products specified herein. Include installation instructions.
- B. Samples: Submit samples of materials being used when requested by the Engineer including names, sources and descriptions.
- C. Test Reports: Submit concrete test reports specified hereinafter under Field Quality Control of PART 3 of this Specifications Section.
- D. Design Mix: Prior to production of concrete, submit for approval the mix designs proposed for this Project.

1. ACI Deviation Analysis: Include with the mix designs a standard deviation analysis in accordance with ACI 301 Section 3.9.1, or trial mixture test data as proposed in ACI 301 Section 3.9.3.3.
 2. Material Compliance: Use materials in such proposed design mixes as specified hereinafter.
 3. Adjustments: Make such adjustments in the proposed design mix as directed by the Engineer.
- E. Certificates: Furnish the Engineer and local authorities requiring same, certificates originated by the batch mixing plant certifying ready mixed concrete, as manufactured and delivered, to be in conformance with ASTM C 94.
- F. Delivery Tickets: A delivery ticket shall accompany each load of concrete from the batch plant.
1. Tickets shall be signed by the Contractor's representative, noted as to time and place of pour and kept in a record at the site. Make such records available for inspection upon request by the Engineer.
 2. Information presented on the ticket shall include the tabulation covered by ASTM C 94, 16.1.1 through 16.2.8, as well as any additional information the local codes may require.

1.04 QUALITY ASSURANCE

- A. Testing Agency: Provide the services of an agency regularly performing work conforming to The American Society for Testing and Materials ASTM E 329, Recommended Practice for Inspection and Testing Agencies for Concrete and Steel in Construction.
- B. Source Quality Control:
1. Laboratory Tests: In accordance with Article 1.06 of the General Instructions, materials stated herein require advance examination or testing according to methods referenced, or as required by the Engineer.
 2. Compression Test Cylinders: For laboratory trial batches, make in accordance with American Concrete Institute ACI 301. Test to consist of three compression test cylinders for each class of concrete with one broken at seven days and two broken at 28 days; ASTM C 192 and ASTM C 39.

1.05 PROJECT CONDITIONS

- A. ACI Compliance: Cast-in-place concrete work shall conform to ACI 301 except as modified by these Specifications.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Cements: Only one brand and manufacturer of approved cement shall be used for exposed concrete. Cement Type Requirements and usage are as follows:
 - 1. Concrete Work Exposed to Wastewater (Sewage and Sewage Gases) Contact: Type II, Moderate Sulfate Resistance Portland Cement conforming to ASTM C 150.
 - 2. Concrete Work for All Other Uses: Type I, Normal Portland Cement conforming to ASTM C 150.
- B. Normalweight Concrete Aggregates: Processed aggregate meeting requirements of ASTM C 33 and subject to the following limitations:
 - 1. Coarse Aggregate Size: Maximum size of coarse aggregate shall not exceed the following requirements but in no case larger than 1 ½-inches.
 - a. One-fifth narrowest dimension between sides of forms within which concrete is to be cast.
 - b. Three-fourths of the minimum clear spacing between reinforcing bars or between reinforcing bars and forms.
 - c. One-third the slab thickness for unreinforced slabs.
- C. Water: Clear and free from deleterious amounts of acids, alkalis, and organic substances.

2.02 CONCRETE QUALITY

- A. Classes of Concrete/Compressive Strengths: Provide only Class A concrete in the project except for those cases where indicated otherwise on the Drawings.
 - 1. Classes of Concrete:
 - a. Class A: 4000 psi minimum compressive strength at 28 days; 564 pounds per cubic yard minimum cement content.
 - b. Class B: 3000 psi minimum compressive strength at 28 days; 517 pounds per cubic yard minimum cement content.
 - 2. Piping Encasement: Where encasement of piping is required provide Class B concrete.
 - 3. Conduit Encasement: Where encasement of conduit runs is required provide Class B concrete.
- B. Proportions of Concrete Ingredients: Establish proportions, including water-cement ratio, on the basis of either laboratory trial batches or field experience, with the materials being as specified herein.
 - 1. Laboratory Trial Batches: According to ACI 301, Section 3.9 and ACI 318.
 - 2. Proportions by Field Experience Method: According to ACI 301, Section 3.9 and ACI 318.
 - 3. Selection of Proportions for Normalweight Concrete: According to ACI 211.1.
 - 4. Water-Cement Ratio: Class A Concrete only shall have a maximum water cement ratio of 0.50.
- C. Slump: Proportion and produce concrete to have a slump, not to exceed four inches if

consolidated by vibration. Slump, not to exceed five inches if consolidated by rodding, spading or other manual methods.

2.03 ADMIXTURES

- A. Concrete Admixtures: Provide admixtures produced and serviced by established, reputable manufacturers and use such admixtures in compliance with the individual product manufacturer's recommendations and printed instructions.
 - 1. Calcium Chloride: Not permitted as an admixture.
- B. Air Entraining Admixture: Conforming to ASTM C 260. Provide air-entrained concrete for each concrete pour except where indicated otherwise on the Drawings or specified otherwise herein. Total air content required as follows:
 - 1.

Maximum-size coarse aggregate, inches:	Air content per cent by volume:
1-1/2	5 plus/minus 1
3/4 or 1	6 plus/minus 1
3/8 or 1/2	7-1/2 plus/minus 1
 - 2. Do not provide air-entrained concrete where a hardener is indicated on the Drawings or specified herein.
- C. Water-Reducing Admixture: Conforming to ASTM C 494 Type A and a product that is free of chloride.
 - 1. Unless high temperatures occur or placing conditions dictate a change, use concrete containing a water-reducing admixture.
- D. Water-Reducing and Retarding Admixture: Conforming to ASTM C 494 Type D and a product that is free of chloride.
 - 1. When high temperatures occur or placing conditions dictate, a change from the water-reducing admixture (Type A) to a water-reducing and retarding admixture (Type D) may be required.
- E. Water-Reducing and Accelerating Admixture: Conforming to ASTM C 494 Type E and a product that is free of chloride.
 - 1. When low temperatures occur or placing conditions dictate, a change from the water-reducing admixture (Type A) to a water-reducing and accelerating admixture (Type E) may be required.

2.04 CONCRETE APPURTENANCES

- A. Curing Materials, Sheet Form: Use curing materials that will not stain or affect concrete finish or lessen the concrete strength and comply with the following requirements:
 - 1. Burlap: Materials conforming to AASHTO M 182.
 - 2. Sheet Materials: Material conforming to ASTM C 171.

- B. Liquid Curing Compounds: Material conforming to ASTM C 309, Type 1, free of wax or other adhesive bond breaking ingredients.
1. Note: Where a finish material is to be applied over concrete, provide certification by the curing compound manufacturer certifying the curing compound as non-detrimental to the bond of the finish material.
 2. Acceptable Manufacturers:
 - a. Master Builders; Master Kure.
 - b. Euclid Chemical Company; Kurez Formula E-100.
 - c. L & M Construction Chemicals, Inc.; L & M Cure.
 - d. Or equal.
- C. Liquid Curing and Sealing Compounds: Material conforming to ASTM C 309, Type 1, free of wax and composed of chlorinated rubber base material with a minimum of 27 percent solids contents.
1. Note: Where no other finish material is to be applied over interior concrete, provide an application of Liquid Curing and Sealing Compound in accordance with material manufacturer's instructions to achieve a dust-proof floor finish.
 2. Acceptable Manufacturers:
 - a. Master Builders; Masterseal.
 - b. Euclid Chemical Company; Super Floor Coat.
 - c. L & M Construction Chemicals, Inc.; L & M Surfaseal.
 - d. Or equal.
- D. Epoxy Bonding Compound: Provide a high-modulus, low-viscosity, moisture insensitive epoxy adhesive having the following properties of the mixed epoxy resin:
1. Compressive Properties at 28 days, conforming to ASTM D 695:
 - a. Compressive Strength: 8,500 psi. min.
 - b. Modulus of Elasticity: 375,000 psi. min.
 2. Tensile Properties at 14 days, conforming to ASTM D 638:
 - a. Tensile Strength: 4,000 psi. min.
 - b. Elongation at Break: one to three percent.
 - c. Modulus of Elasticity: 275,000 psi. min.
 3. Flexural Properties at 14 days, conforming to ASTM D 790:
 - a. Flexural Strength (Modulus of Rupture): 6,300 psi. min.
 - b. Tangent Modulus of Elasticity in Bending: 400,000 psi. min.
 4. Shear Strength at 14 days, conforming to ASTM D 732: 5000 psi. min.
 5. Total Water Absorption at 7 days, conforming to ASTM D 570: One percent maximum (two hour boil).
 6. Bond Strength, conforming to ASTM C 882:
 - a. Plastic concrete to hardened concrete at 14 days (moist cure): 1,700 psi. min.
 - b. Plastic concrete to steel at 14 days (moist cure): 1700 psi. min.
 7. Mixed epoxy resin adhesive shall conform to ASTM C 881, Type II, Grade 2, Class B and C.
 8. Mix Ratio: 100 percent solids, two-component; mixed one part by volume component A to one part by volume component B.

9. Acceptable Manufacturers:
 - a. Sika Corporation; Sikadur 32 Hi-Mod.
 - b. Euclid Chemical Company.
 - c. L & M Construction Chemicals, Inc.
 - d. Or equal.
- E. Preformed Expansion Joint Fillers:
 1. Nonextruding and Resilient Bituminous Types (Exterior Use): Conforming to ASTM D 1751.
 2. Sponge Rubber or Cork Type (Interior Use): Conforming to ASTM D 1752.
- F. Embedded (Vinyl) Waterstop: Ribbed type manufactured from virgin polyvinyl chloride plastic compound conforming to U. S. Corps of Engineers CRD-C 572.
 1. 6-inch Waterstop: 6 x 3/8-inch, such as Vinylex Corporation; Cat. No. R6-38.
 2. Acceptable Manufacturers:
 - a. Vinylex Corporation (Catalog Nos. as specified above).
 - b. W. R. Grace & Company.
 - c. W. R. Meadows, Inc.
 - d. Or equal.
- G. Surface (Expanding-Type) Waterstop: A specially formulated joint sealant which swells on contact with water. Provide waterstop packaged in continuous length coils. Material composition as follows:
 1. Chloroprene rubber and chloroprene rubber modified to impart hydrophilic properties.
 2. Waterstop shall have a coating formulated to inhibit initial expansion due to moisture presence in the fresh concrete.
 3. Waterstop configuration shall be of dual extrusion design and 10 mm by 20 mm dimensions.
 4. Waterstop shall be secured to hardened concrete with the waterstop manufacturer's standard adhesive binder.
 5. Acceptable Manufacturers:
 - a. Greenstreak, Inc.; Hydrotite VCJ.
 - b. Or equal.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Field Inspection: Inspect work to receive cast-in-place concrete for deficiencies which would prevent proper execution of the finished work. Do not proceed with concrete placement until such deficiencies are corrected.

3.02 PREPARATION

- A. Production of Ready-Mixed Concrete: Batched, mixed and transported in accordance with ASTM C 94.
 - 1. Plant equipment and facilities shall conform to the Check List for Certification of Ready Mixed Concrete Production Facilities of the National Ready Mixed Concrete Association.
- B. Formwork Construction: As specified in Section 03100.
 - 1. Formwork Preparation: Prepare formwork in advance and remove snow, ice, water and debris from within forms.
 - a. Wet subgrades in accordance with ACI to eliminate water loss from concrete.
 - b. Pre-position expansion joint material, anchors and embedded items.
 - 2. Embedded Waterstop Installation: Install in construction joints, expansion joints and where required for watertightness.
 - a. Hold end joints to a minimum.
 - b. Make watertightness of joints the same as continuous waterstop material and to permanently develop not less than 50 percent of the mechanical strength of the parent section and to permanently retain their flexibility.
 - c. Adequately support waterstops to prevent displacement and deformity of the waterstops during concrete pours.
 - d. In substructures and other structures required to be watertight, install waterstops if concreting is discontinued for a sufficient length of time, which in the opinion of the Engineer, may result in seepage cracks in concrete.
 - 3. Other Embedded Items: Place sleeves, inserts, anchors and embedded items required for adjoining work prior to concrete pours. Place embedded items accurately, and support them against displacement. Embedded items shall conform to the following requirements:
 - a. Maximum outside dimension of embedded item shall not be greater than one-third the overall thickness of the member in which it is embedded.
 - b. Minimum spacing between embedded items shall not be less than three widths on center nor less than three inches clear between the items.
 - c. Embedded items shall not impair the strength of the member.
 - d. Provide two inches minimum clearance from the embedded item to the face of the slab.
 - 4. Surface Waterstop Installation: Install surface applied waterstop at such locations where indicated on the Drawings, and otherwise only as directed by the Engineer.
 - a. Install the waterstop in strict accordance with the manufacturer's installation instructions and with respect to the environmental requirements specified therein and substrate preparation.
- C. Reinforcement Work: As specified in Section 03200.
 - 4. Pre-position reinforcement in advance of concrete pours.
- D. Preparation for Bonding To New (Hardened) Concrete: Bond fresh concrete with hardened previously poured new concrete in accordance with the following:

1. Thoroughly clean hardened concrete of foreign matter and laitance and saturate with water. Initial concrete pour shall have a rough surface.
 2. Cover the hardened concrete with a heavy coating of grout to approximately ½-inch thickness. Use grout of same material composition and proportions of concrete being poured except coarse aggregate omitted. Grout shall have a slump of 6-inches minimum.
 3. Place new concrete on grout before it has attained its initial set.
 4. Other bonding methods must be approved by Engineer prior to their use.
- E. Preparation for Bonding New Concrete To Existing Concrete: Roughen existing concrete in the area of bonding to produce exposed aggregate and an absolutely uncontaminated concrete surface.
1. Apply Epoxy Bonding Compound over existing prepared concrete in accordance with manufacturers instructions.

3.03 PLACING CONCRETE

- A. General Requirements: Perform concrete placement work in accordance with ACI 304 and such additional requirements as specified herein.
1. Discharge of the concrete shall be completed within 1-1/2 hours or before the mixing drum has revolved 300 revolutions, whichever comes first, after the introduction of the mixing water to the cement and aggregates or the introduction of the cement to the aggregates.
- B. Conveying/Placing: Handle concrete from mixer to final deposit rapidly by methods which will prevent segregation or loss of ingredients to maintain required quality of concrete. Carry on placing at such a rate that concrete which is being integrated with fresh concrete is still plastic.
1. Do not convey concrete through aluminum or aluminum alloy.
 2. Do not place concrete by pumps or other similar devices without prior written approval of Engineer.
 3. Do not allow concrete to drop vertically more than four feet.
 4. Deposit concrete in approximately horizontal layers of 12 to 18 inches.
 5. Do not allow concrete to flow laterally more than three feet.
 6. Do not deposit concrete on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within sections.
 7. Do not use concrete which has partially hardened or has been contaminated by foreign materials.
 8. Do not place concrete in forms containing standing water, or on frozen surfaces, or around embedded items which have a surface temperature below freezing.
 9. Make placement within sections continuously to produce monolithic unit.
 10. Do not begin placing of concrete in beams or slabs until concrete previously placed in walls or columns has attained initial set.
 11. Do not bend reinforcement out of position when placing concrete.
- C. Consolidation: Consolidate concrete by vibration, spading, rodding or other manual

methods. Work concrete around reinforcement, embedded items and into corners: eliminate all air or stone pockets and other causes of honeycombing, pitting or planes of weakness.

1. Use vibration equipment of internal type and not the type attached to forms and reinforcement.
2. Use vibrators capable of transmitting vibration to concrete in frequencies sufficient to provide satisfactory consolidation.
3. Do not leave vibrators in one spot long enough to cause segregation. Remove concrete segregated by vibrator operation.
4. Do not use vibrators to spread concrete.
5. Have sufficient reserve vibration equipment to guard against shutdown of work occasioned by failure of equipment in operation.

D. Cold Weather Concreting: In general, perform cold weather concrete work in accordance with ACI 306R and the following additional requirements.

1. Temperature of concrete delivered at the job-site shall conform to the following temperature limitations:

Minimum concrete temperature, deg. F.

Air temperature deg. F.	For sections with least dimension less than 12 in.	For sections with least dimension 12 in. or greater
30 to 45	60	50
0 to 30	65	55

2. Provide equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather.
3. Maintain concrete at temperatures listed in Table 1.4.1 of ACI 306R as follows, provided the concrete has developed a compressive strength of 500 psi. for pours in the following locations:
 - a. Slab-on-grade: Two days.
 - b. Walls or Vertical pours: Three days.
4. If the strength is not achieved, the minimum temperature shall be maintained an additional 24 hours or until the 500 psi strength is reached.
5. Make additional concrete cylinders to verify strength achievement of 500 psi; however, it will not be necessary to take them in every pour provided concrete temperatures are maintained fairly uniform. Once two sets of cylinders have been broken and a strength of 500 psi is achieved, additional cylinders will not be required except for random testing as determined by the Engineer.
6. Remove temperature protection after 500 psi is achieved, but in a manner so thermal shock does not occur to the exposed concrete. The removal criteria shall be as stated in ACI 306R.
7. Leave housing, covering, or other protection used in curing, intact at least 24 hours after artificial heating is discontinued.
8. If water or aggregate is heated above 100 degrees F, combine water with aggregate

in the mixer before cement is added. Do not mix cement with water or with mixtures of water and aggregate having a temperature greater than 100 degrees F.

- E. Hot Weather Concreting: In general, perform hot weather concrete work in accordance with ACI 305R and the following additional requirements.
 - 1. Temperature of concrete delivered at the job-site shall not exceed 90 degrees F.
 - 2. Cool ingredients before mixing to prevent temperature in excess of 90 degrees F.
 - 3. Make provisions for windbreaks, shading, fog spraying, sprinkling or wet cover when necessary.
- F. Underwater Placement of Concrete: When permitted by Engineer, foundation concrete may be placed in still water and according to the following:
 - 1. Concrete placed in water shall contain twenty-five percent of cement over and above the amount specified for the particular class of concrete used. No additional compensation will be allowed for this added cement.
 - 2. Do not deposit concrete in water which has a temperature below 40 degrees F.
 - 3. Place the concrete underwater continuously through a tremie pipe. Diameter of the tremie pipe shall be approximately eight times the maximum size of the largest coarse aggregate. Use seal in pipe to start concrete placement, and keep filled with concrete continuously with the end of the pipe embedded in the placed concrete at all times. If seal is lost, withdraw pipe and reseal and start charging operations again.
 - 4. Protect placed concrete from water motion for at least four days and longer if required.
- G. Construction Joints: Provide wall and slab construction joints as necessary but in compliance with the following:
 - 1. Locate construction joints so as to least impair the strength of the structure and near the middle of the span of slabs or beams.
 - 2. Space construction joints in slabs not greater than 30-feet in each direction, although some adjustments, as approved by the Engineer, may be permitted due to certain structural elements considerations.
 - 3. If a cast-in-place concrete beam intersects another beam at a proposed construction joint, offset the joint in the beam a distance equal to twice the width of the beam and provide adequate shear reinforcement as determined by the Engineer.
 - 4. Provide waterstops in construction joints where such joints are exposed to liquids, or in contact with earth, or subject to weather exposure.
 - 5. Place walls and slabs in alternate sections allowing at least five days elapsed time before concrete is placed against an adjacent vertical joint.
 - 6. When concreting is to be discontinued for more than forty-five (45) minutes and if the construction plane is to be horizontal, install keyways and embed reinforcing bar rods in the concrete before initial hardening. Use keyways and reinforcing bar rods in vertical concrete construction only when indicated or directed by the Engineer.

- H. Expansion Joints and Contraction Joints: Install where indicated on the Drawings. Do not extend reinforcing or other embedded metal items through expansion and contraction joints; except where indicated otherwise on Drawings.

3.04 FINISHING

- A. Form Tie Repairs: Following form removal repair holes vacated by removable components of form ties in accordance with the following.
 - 1. Hammer-pack holes with stiff mortar of same mix and ingredients as employed in surrounding concrete. Prepare mortar not more than 30 minutes prior to use.
 - 2. Render mortar patch work inconspicuous. Maintain mortar patches damp and cure as specified herein for Curing and Protection.
- B. Finishes: Finish exposed concrete surfaces true and even, free from open or rough areas, depressions or projections. Bring concrete up in vertical pours to the required elevation, strike-off with a straight edge and float-finish.
 - 1. Spade Finish: Obtained by forcing a flat spade or similar device, down adjacent to the form and pulling the top of the spade away from the form to bring mortar to the surface next to the forms. After forms are removed satisfactorily, correct concrete surface irregularities.
 - 2. Floated Finish: After concrete has been placed, consolidated, struck off and leveled, do not work further until ready for floating. Begin floating when water sheen has disappeared and when the surface has stiffened sufficiently to permit the operation. During or after first floating, check planeness of surface with a ten foot straightedge applied at not less than two different angles. Cut down high spots and fill low spots during this procedure to produce a surface with true planes within 1/4-inch in ten feet as determined by a ten foot straightedge placed anywhere on the slab in any direction. Following straightedge checking, refloat slab immediately to a uniform sandy texture.
 - 3. Smooth Rubbed Finish: Obtained by rubbing a Spade Finished vertical surface not later than one day after form removal. Wet surface and rub with carborundum brick or other abrasive until uniform color and texture are produced. Do not use cement grout other than the cement paste drawn from the concrete itself by the rubbing process.
 - 4. Steel Trowel Finish: Obtained by power troweling and hand troweling a Floated Finish. First troweling after power floating shall produce a smooth surface which is relatively free of defects but which may still show some trowel marks. Perform additional trowelings by hand after the surface has hardened sufficiently. Perform final troweling when a ringing sound is produced as the trowel is moved over the surface. Thoroughly consolidate surface by hand trowel operations. Produce finished surface essentially free of trowel marks, uniform in texture and appearance, with true planes within 1/4-inch in ten feet, as determined by a ten foot straightedge placed anywhere on the slab in any direction.
 - 5. Broom or Belt Finish: Immediately after concrete has received a Floated Finish, give surface a coarse transverse scored texture by drawing a broom or burlap belt across the surface.

- C. Application For Finishes:
1. Spade Finish:
 - a. Surfaces to be backfilled with earth.
 - b. Surfaces to be concealed by surface applied finish materials, excluding painting.
 - c. Surfaces to be rubbed.
 2. Floated Finish:
 - a. Bottoms of chambers, manholes, and other tank type structures.
 - b. Surfaces to receive Steel Trowel Finish.
 - c. Surfaces to receive Broom or Belt Finish.
 3. Smooth Rubbed Finish, Exterior Applications:
 - a. Exposed vertical surfaces of concrete structures, of whatever nature, down to one foot below finished grade elevation of earth.
 - b. Exposed vertical surfaces of troughs, channels and such other passages for the flow of liquids.
 4. Smooth Rubbed Finish, Interior Applications:
 - a. Exposed vertical surfaces of concrete structures, including overhead sloped or horizontal surfaces.
 - b. Inside vertical surfaces of chambers, manholes, and tank type structures, including wet wells, down to one foot below the average water level.
 - c. Inside vertical surfaces of troughs, channels and such other passages for the flow of liquids.
 5. Steel Trowel Finish:
 - a. Interior floor surfaces intended for pedestrian and vehicle traffic, and floor surfaces receiving decorative coverings.
 - b. Interior bottom surfaces of troughs, channels and such other passages for the flow of liquids.
 6. Broom or Belt Finish: Exterior concrete walks, steps and platforms.

3.05 CURING AND PROTECTION

- A. General Requirements: Immediately after placement, and finishing, protect concrete from premature drying, excessive hot or cold temperatures and mechanical injury. Perform curing by either water curing, sheet form curing or sealing methods in accordance with ACI 308. Cure concrete continuously for a minimum of seven days at ambient temperatures above 40 degrees F.
- B. Hot Weather Curing: See Hot Weather Concreting this Section.
- C. Cold Weather Curing: See Cold Weather Concreting this Section.
- D. Water Curing Methods: Perform only water curing methods on concrete surfaces receiving surface applied grouts and other cementitious overlays.
- E. Liquid Curing Compound Application: Apply the liquid membrane forming compound

at such rates to restrict the loss of water to not more than 0.055 g/sq. cm of surface in 72 hours when tested in accordance with ASTM C 156.

- F. Liquid Curing and Sealing Compound Application: Final troweling must be completed.
 - 1. Apply compound when concrete surface is damp but not wet and can no longer be marred by the walking workmen.
 - 2. Apply compound at the application rate and by methods consistent with compound manufacturer's application instructions.

3.06 FIELD QUALITY CONTROL

- A. Testing and Inspection: Make periodic inspections and tests of materials and operations as work is in progress. Failure to detect defective work will not prevent rejection when defect is discovered, nor will it obligate the Engineer for final acceptance.
 - 1. Obtain composite concrete samples in accordance with ASTM C 172.
 - 2. Mold and cure three test specimens for each strength test in accordance with ASTM C 31.
 - 3. Test specimens in accordance with ASTM C 39. Test one specimen at 7 days for information and two at 28 days for acceptance.
 - 4. Make one strength test for each 50 cu. yd. of concrete, unless waived by the Engineer, but not less than one test for each structure.
 - 5. Make slump tests for each strength test and whenever consistency of concrete appears to vary in accordance with ASTM C 143.
 - 6. Make air content test for each strength test in accordance with ASTM C 231 or ASTM C 173 except if aggregate with high absorptions are used, use the latter test method.

- B. Evaluation and Acceptance: The strength level of the concrete will be considered satisfactory if 90 percent of the strength test results and the averages of all sets of three consecutive strength test results equal or exceed specified strength and no individual test result is below specified strength by more than 500 psi.
 - 1. If the strength of cylinders falls below specified compressive strengths, the Engineer shall have the right to order a change in the mix proportions for the remaining concrete being poured.
 - 2. If required by the Engineer, obtain and test core specimens from hardened concrete in accordance with ASTM C 42.

END OF SECTION

SECTION 03600

GROUT

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: This Section specifies the grouts for the individual grouting requirements stated in other Sections of the Specifications and where indicated on the Drawings.
- B. Related Sections:
 - 1. Cast-In-Place Concrete: Section 03300.

1.02 REFERENCES

- A. American Society for Testing and Materials:
 - 1. ASTM C 109; Test Method for Compressive Strength of Hydraulic Cement Mortars (Using two inch or 50-mm Cube Specimens).
 - 2. ASTM C 191; Test Method for Time of Setting of Hydraulic Cement by Vicat Needle.
 - 3. ASTM C 596; Test Method for Drying Shrinkage of Mortar Containing Portland Cement.
 - 4. ASTM C 827; Test Method for Early Volume Change of Cementitious Mixtures.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's descriptive product data and current specifications covering named manufactured products specified in this Section. Include placing instructions. Submit product data for the following:
 - 1. Non-Shrink Non-Metallic Grout.

1.04 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Furnish the grout manufacturer's current independent laboratory test results indicating the grout as non-shrink from time of placement as conforming to the Following:
 - 1. Indicating no expansion after final set, according to ASTM C 827.
 - 2. Indicating 4,000 psi strength developed with a trowelable mix within 24 hours, according to ASTM C 109.
 - 3. Indicating placement time based on initial set of not less than 60 minutes, according to ASTM C 191.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Delivery and Handling: Provide protective covering over materials to prevent moisture damage and contamination of grout materials during delivery and handling.
- B. Storage: Store grout materials in undamaged condition with seals and labels intact as packaged by the manufacturer.

1.06 PROJECT CONDITIONS

- A. Environmental Requirements: Protect against high and low temperatures and unfavorable environmental conditions in accordance with American Concrete Institute standards for placement of concrete.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Non-Shrink Non-Metallic Grout: Provide a factory premixed material containing no corrosive irons, aluminums, chemicals or gypsums and complying with the following limitations:
 - 1. Grouts containing water reducers, accelerators, or fluidifiers shall have no drying shrinkage greater than the equivalent sand cement and water mix when tested according to ASTM C 596.
 - 2. Grout shall exhibit no shrinkage before initial set and show no expansion after set when tested according to ASTM C 827.
 - 3. Initial set of grout shall occur in not less than 60 minutes according to ASTM C 191 Test.
 - 4. Use Type I (Normal) cement for grout applications not in contact with sewage.
 - 5. Use Type II (Sulfate Resistant) cement for grout applications in contact with sewage.
 - 6. Acceptable Manufacturers:
 - a. U.S. Grout Corporation; FIVE STAR.
 - b. Or equal.
- B. Water: Clear and free from deleterious amounts of acids, alkalis, and organic substances.

2.02 GROUT QUALITY

- A. Non-Shrink Grout: Use ready-mix type requiring only the addition of water. Do not add other materials. Water requirement proportions shall conform to manufacturer's specifications for the desired mix consistency.

PART 3 EXECUTION

3.01 PREPARATION

- A. Preparation of Surface: Clean surfaces to be grouted to be free of oil, grease, laitance, dirt and other contaminants. Remove loose material. Remove rust, paint, and oil from metal components in contact with grout.
 - 1. Non-Shrink Grout: Perform additional surface preparation in accordance with manufacturer's instructions.
- B. Formwork: Use forming procedures that allow proper and complete placement of grout.
 - 1. Pre-treat wood forms with forming oils so that they do not absorb moisture.
 - 2. Anchor Support elements of formwork so no movement is possible. Remove supports only after grout has hardened.
- C. Grout Mixing: Use power operated mechanical mixer of sufficient capacity to carry out batch mixing without interruption.
 - 1. Mix Non-Shrink Grout in accordance with manufacturer's instructions.

3.02 INSTALLATION

- A. Non-Shrink Non-Metallic Grout: Perform grout placement in accordance with the recommendations of ACI and the manufacturer's published specifications for mixing and placing. Place Non-Shrink Non-Metallic Grout only where indicated on Drawings.

END OF SECTION

SECTION 11304

GRINDER PUMP UNITS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: The work specified in this Section consists of providing a grinder pump(s) unit with tank, internal piping, and operating controls.
- B. Related Sections:
 - 1. Trenching, Backfilling, and Compacting: Section 02221.
 - 2. Manholes: Section 02601.
 - 3. Pressure Wastewater Sewer: Section 02725.
 - 4. Cast-In-Place Concrete: Section 03300.

1.02 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI B2.1, Pipe Threads.
 - 2. ANSI B16.3, Malleable-Iron Screwed Fittings, 150 and 300 lb.
 - 3. ANSI C2, National Electrical Safety Code.
- B. American Society for Testing and Materials:
 - 1. ASTM A 48, Specification for Gray Iron Castings.
 - 2. ASTM A 536, Specification for Ductile Iron Castings.
 - 3. ASTM B 62, Specification for Composition Bronze or Ounce Metal Castings.
 - 4. ASTM B 371, Specification for Copper-Zinc-Silicon Alloy Rod.
 - 5. ASTM B 584, Specification for Copper Alloy Sand Castings for General Applications.
 - 6. ASTM C 581, Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass Fiber Reinforced Structures, Intended for Liquid Service.
 - 7. ASTM C 582, Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion Resistant Equipment.
 - 8. ASTM D 1784, Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 - 9. ASTM D 1785, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Schedules 40, 80 and 120.
 - 10. ASTM D 2241, Specification for Poly (Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series).
 - 11. ASTM D 2466, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 - 12. ASTM D 3139, Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
 - 13. ASTM D 3299, Specification for Filament-Wound Glass Fiber Reinforced

- Polyester Chemical-Resistant Tanks.
- 14. ASTM F 477, Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- C. Federal Specifications:
 - 1. Fed. Spec. WW-C-581D, Conduit, Metal, Rigid and Coupling Elbow and Nipple, Electrical Conduit, Zinc-Coated.
- D. Institute of Electrical and Electronics Engineers.
- E. National Bureau of Standards: Product Standard PS 15-69, Custom Molded Reinforced Polyester Chemical Resistant Process Equipment.
- F. National Electrical Code (NEC).
- G. National Electric Manufacturer's Association (NEMA) Standards of Construction.
- H. National Fire Protection Association (NFPA): NFPA 70; National Electrical Code, and current amendments.
- I. Underwriters' Laboratories (UL) Listings and Approvals on specified Products.
- 1.03 SUBMITTALS
 - A. Shop Drawings: Submit for approval completely dimensioned shop drawings and catalog cuts or other data as required to provide a complete description of the following:
 - 1. Submit evidence of Underwriters' Laboratories (UL) Listings and Approvals on the electrical control panel and grinder pump.
 - 2. Submit details of the Anti-Flotation Anchor indicating the size and weight required.
 - B. Operation and Maintenance Manuals: Within four weeks following the receipt of approved shop drawings, submit to the Engineer for review and approval, five copies of manuals prepared by the manufacturer/supplier, or the Contractor. Incomplete or inadequate manuals will be returned to the Contractor for correction and resubmission.
 - 1. Include the following elements in each manual:
 - a. Erection or installation instructions.
 - b. Start-up procedures.
 - c. Recommended and alternative procedures.
 - d. Schedule of preventive maintenance requirements.
 - e. Detailed maintenance procedures.
 - f. Schedule of lubrication requirements.
 - g. Data sheet listing pertinent equipment or system information, as well as the addresses and telephone numbers of the nearest sales and service

- representatives.
- h. Provide a list of the manufacturer recommended spare parts.

1.04 QUALITY ASSURANCE

- A. Tank Design Criteria: Provide completely watertight tank, of 60 gallon capacity minimum, and designed to withstand the minimum depth of bury earthload at the proposed tank location.
 - 1. The tank manufacturer shall calculate the anti-flotation anchor and provide an appropriate design for the anchor.
- B. Requirements of Regulatory Agencies: Comply with construction code requirements of State, County, and such other political subdivision specifications as may exceed the requirements of the codes, standards and approving bodies referenced throughout these Specifications.
 - 1. Provide electrical control panels and grinder pump units constructed in accordance with the requirements of the Underwriters Laboratory, or other nationally recognized certification agency, and labeled accordingly.
 - 2. Units shall comply with the applicable requirements of the Pennsylvania Department of Environmental Protection and the National Sanitation Foundation.
- C. Source Quality Control:
 - 1. Shop Tests: In accordance with Article 1.06 of the General Instructions, factory test each unit. The manufacturer shall 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.
 - a. Submit the proposed types of tests in the Shop Drawing submittal.
 - b. Test to assure watertightness of the Unit for the proposed installation depth.
 - c. Test pump output in gallons per minute at 15 psi and 35 psi.
 - d. Test amperage and wattage of electrical consumption.
 - 2. Laboratory Tests: The Engineer reserves the right to require that laboratory tests also be conducted on Units that have been shop tested. When the Engineer so orders, furnish without compensation, labor, materials, and equipment necessary packaging, and shipping the grinder pump unit to the Test Laboratory.
 - 3. Provide certification that the units have been tested successfully for watertightness.
 - 4. Single Source Responsibility: To ensure single source responsibility and part supply, provide the pump components, tank, internal piping system and electrical controls from one grinder pump manufacturer.
- D. West Hanover Township Water and Sewer Authority Inspections: A representative of the Owner will be present during Grinder Pump Unit initial installation and testing operations. To accommodate the Owner's representative concerning the Inspections

stated herein, the Contractor shall observe the following:

1. Notice: Give the Owner a minimum of two hours notice for an inspection. Call (Ph. No. 717-540-0124) between the 8:00 a.m. and 5:00 p.m. prevailing time Monday through Friday. Schedule inspection appointments with the Owner only between the hours of 8:00 a.m. and 3:00 p.m. prevailing time Monday through Friday.
 - a. No weekend or holiday inspection appointments allowed.
2. Initial Unit Installation and Inspection: To serve as the minimum acceptable conditions of installation throughout the Project, install the first unit in the Project to demonstrate the stages of installation stated in the following sentences. The Owner's representative shall inspect each of the following stages of installation:
 - a. Bedding and concrete construction.
 - b. Pipe connections to the Unit and watertightness of the complete Unit.
 - c. Proper electrical work operation of the Unit.
 - d. Proper backfilling procedures.

1.05 DELIVERY, STORAGE AND HANDLING

- A. To prevent damage and defects, transport, store and handle the units and Products specified herein in a manner recommended by the respective manufacturers.

1.06 SITE CONDITIONS

- A. Environmental Requirements: In no instance set units on subgrade containing frost or on unacceptable subgrade which condition has been determined unacceptable by the Engineer.
- B. Electrical Interface: Install or mount those electrical components or apparatus as furnished by the Product manufacturers of those Products specified herein.
 1. Property owner will be responsible for permanent power wiring, including final connections of such to the electrical components or apparatus of the grinder pump units.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Grinder pumps shall be one acceptable by Authority.

2.02 GRINDER PUMP UNIT

- A. General Requirements: Provide prefabricated, completely assembled Unit, suitable for conveying domestic sewage and for underground installation with the necessary

accessories as specified herein and as required for a completely operational unit.

1. Unit shall have only the sewage grinder pump(s) as specified herein, with mercury switch level controls, pump mounting plate and bottom rail supports, upper rail supports, pump guide rails and lifting chain or cable.
2. Unit shall include FRP tank and discharge piping with hydraulically sealed discharge flange.
3. Unit shall have a control panel, control panel enclosure, alarm devices and electrical wiring.
4. Where exposed to wastewater, provide materials that have inherent corrosion protection (i.e., cast iron, fiberglass, stainless steel, PVC).

B. Pump: Component construction as follows:

1. Casing: Pump casing, oil casing and motor casing of ASTM A 48 cast iron. Pump casing construction of single volute type, ribbed to prevent excessive deflection and hydrostatically tested to twice the design. Volute sized at all points to pass solids which can pass through the impeller and internally finished to provide smooth, unobstructed flow.
2. Impeller: Non-clogging type of ASTM A 536 ductile iron or bronze; statically, dynamically and hydraulically balanced.
3. Pump Shaft: Stainless steel of sufficient strength and size to safely transmit the maximum torque developed by the drive unit.
4. Hydraulically Sealed Discharge Flange: The hydraulically sealed discharge flange shall allow the pump to be removed periodically and shall result in a watertight seal when the pump is replaced. Fittings of threaded style, 150 lb. galvanized malleable iron conforming to ANSI B 16.3.

C. Grinder: Mounted immediately below pumping elements and constructed so as to eliminate clogging and jamming under normal operating conditions including starting. Unit shall create sufficient vortex action to scour tank free of deposits or sludge banks which would impair the operation of the pump. Components and construction as follows:

1. Direct drive with single, one piece motor shaft.
2. Abrader: AISI Type 316 stainless steel.
3. Cutter Bar: AISI Type 410 stainless steel, Rockwell hardness C-35.
4. Wear Plate: Stainless steel with micrometer adjustment for high head requirements and eliminating the need for shims.
5. Pump and grinder assembly balanced to operate without objectionable noise or vibration over the entire range of recommended operating pressures.

D. Motor: Two Hp. minimum, of 230 volt, single phase, 60 Hertz, 3,450 RPM, totally submersible design, constructed with open winding and designed to operate in clean dielectric oil for cooling winding. Air cooled stators and grease packed bearings not acceptable.

1. Motor shaft of stainless steel and designed for extremely difficult pumping

service. Motor shaft and housing sealed with two mechanical shaft seals with an oil chamber between the seals. The seals shall have carbon and ceramic seal faces.

2. Motors shall comply with Standards of IEEE and NEMA in all respects except where requirements exceed these Standards.

- E. Lifting Accessories: Provide stainless steel guide rails, supports, chains and shackles for raising and lowering the pumping equipment.

2.03 PIPING

- A. Discharge Piping and Fittings: Schedule 80 PVC manufactured from Class 12454-B Rigid PVC Compounds with a hydrostatic design stress of 13.8 MPa (2000 psi designated as PVC 1120) and conforming to ASTM D 1785; NPT couplings, pipe and fittings.
 1. Size: 1 1/4-inch diameter on the Simplex Unit and 1 1/2-inch diameter on the Duplex Unit.
 2. Material Option: Discharge pipe may SDR 21 PVC (Pressure Class 200 psi.) conforming to ASTM D 2241.
 - a. Pipe Joints: Push-on or compression type, joint performance conforming to ASTM D 3139, with rubber gasket suitable for domestic sewage service and conforming to ASTM F 477.
- B. Valves: Include a check valve, gate valve and hydraulically sealed discharge flange in pump discharge piping.
 1. General Requirements: Provide valves of the same type by the same manufacturer; suitable for the intended service. Markings factory cast on the bonnet or body of each valve shall indicate manufacturer's name or mark, year of valve casting, size of valve, directional flow arrow and designation of working water pressure.
 - a. Valve pressure-temperature ratings of not less than the design criteria applicable to system components.
 - b. Valves shall open to the left (counterclockwise). Provide extension stems with bronze bushed stem guides where required. Provide a top support and one intermediate support unless the unsupported stem length exceeds four feet, in which case provide an additional support every two feet of valve stem length.
 - c. Valve ends indicated on the Drawings, and unless indicated otherwise, shall be threaded in accordance with ANSI B2.1.
 2. Check Valve: Ball check valve designed for a minimum water working pressure of 150 pounds per square inch and factory tested to double that pressure before shipment. Check valve bodies to provide excess area through the valves to assure full delivery of line capacity. Include with each Unit one separate 1 1/4-inch check valve for installation in the discharge line between the Grinder Pump and the sewer main.
 - a. Double union type manufactured from PVC 12454-B conforming to ASTM

D 1784 with Vitron O ring seals. Valve to be as specified with the exception of the joint.

3. Gate Valve: Provide valves of designed working water pressure at 200 psi., of solid bronze construction with tapered split wedge disc. Physical properties of brass pressure containing parts shall conform to ASTM B 62.
 - a. Valves of rising stem pipe. Valve stuffing box of such design that valve can be packed under pressure when in fully open position.
 - b. Stems fabricated of ASTM B 371, Alloy A (rolled silicon brass), ASTM B 584 Copper Alloy No. 876 (silicon bronze + silicon brass), or other material equally resistant to dezincification.

2.04 PUMP CONTROLS

- A. Controls, Simplex Pump: Provide three mercury switches; one for pump start, one for pump stop, and one to signal high-level sump alarm. Operation as follows:
 1. On sump level rise, lower mercury switch shall first be energized, then upper level switch shall next energize and start pump.
 2. With pump operating, sump level shall lower to low switch turn-off setting and pump shall stop.
 3. If level continues to rise when pump is operating, alarm switch shall energize. Level switches adjustable for level setting, from the surface.
- B. Controls, Duplex Pumps: Provide four mercury switches; one for lead pump start, one for lag pump start, one for both pumps stop and one to signal high-level sump alarm. Operation as follows:
 1. On sump level rise, lower mercury switch shall first be energized, then upper level switch shall next energize and start lead pump. With lead pump operating, sump level will lower to low switch turn-off setting and pump shall stop.
 2. Alternating relay shall index on stopping of pump so that lag pump shall start on next operation.
 3. If sump level continues to rise when lead pump is operating, override switch shall energize and start lag pump. Both lead and lag pump shall operate together until low level switch turns off both pumps.
 - a. If level continues to rise when both pumps are operating, alarm switch shall energize.
 4. If one pump should fail for any reason, the second pump shall operate on the override control, and if level rises above override control, signal alarm switch shall energize.
 - a. Level switches adjustable for level setting, from the surface.
- C. Control Components: Provide the following items which are common to either Simplex or Duplex control systems:
 1. Power Cord: Provide SO type construction electric power cord, suitable for continuous submersion in sewage, to power the pump. Cord sealed by use of a cord grip, with individual conductors additionally sealed into the cord cap assembly with epoxy sealing compound. Cord cap sealed into the motor housing

with a Buna-N O-ring, providing a completely watertight electrical connection.

2. Sealed Float-Type Mercury Switches: For corrosion and shock resistance the mercury tube switches are factory sealed in a solid polypropylene float, with internal weight. The float power and support wire shall have a heavy Neoprene jacket.
 - a. Provide an intrinsically safe UL approved relay to be wired to each float type mercury switch.
 - b. Support the float switches by the cord that is connected to the junction box. Provide a junction box to be drilled and tapped for the four 3/4-inch diameter conduits for wiring to Pump Control Panel. Provide junction box labeled for Explosion-Proof application and conforming to the requirements under Article 500 of NEC for Class 1, Division 1, Group D, Hazardous Location.
3. Thermal Overload Sensors: Include in the pumping system sensors to determine thermal overload and hydraulic seal failure conditions in addition to high sump level.
4. Control Panel: NEMA 3R Enclosure with baked gray enamel finish or fiberglass, fully enclosed with panel hardware mounted on a separate inside plate organized to facilitate maintenance and repair. Panel factory equipped with an oxidation inhibitor and wall mounting brackets. Panel so designed to be wall or post mounted. Enclosure equipped with locking hardware and provided with weather-resistant padlock. Unnecessary punch-outs not permitted. Enclosure to contain the following:
 - a. Provide a circuit breaker for total panel and individual breakers for pumps and alarms so that alarms remain energized when pump breaker is tripped.
 - b. (Simplex) Hardware includes start and run capacitors, start relay, circuit breaker (quick-make/quick-break action on manual operation) with bi-metallic ambient compensated overload relay with heaters to protect both start and run windings, H-O-A switch and indicator lights. Provide individual circuit breaker for alarm system.
 - c. (Simplex) Provide terminal strip for float control wires and a 120 volt AC control circuit.
 - d. (Duplex) Hardware includes two sets of start and run capacitors, start relay, circuit breaker (quick-make/quick-break on manual operation) with bi-metallic ambient compensated overload relay with heaters to protect both start and run windings, H-O-A switch and indicator lights.
 - e. (Duplex) Provide one alternating relay and terminal strip for float control wires.
 - f. Visible and Audible Alarms:
 - 1) Visible red lights indicating overflow, thermal overload and hydraulic seal failure conditions.
 - 2) Audible alarm indicating overflow conditions with manual On/Off switch on exterior of enclosure. Red overflow light to remain on when alarm silenced.

- 3) (Duplex) Pump running lights.
- g. Provide electrical surge protection device as part of the unit package.

2.05 TANK

- A. FRP Tank: Tank construction of fiberglass reinforced polyester construction conforming to ASTM C 582 and C 581 Standards with a minimum wall thickness of 1/4-inch.
 - 1. Materials:
 - a. Tank Resin: Polyester; Atlac 382.
 - b. Tank Cover: Flush design, fiberglass reinforced polyester construction of same type as tank, with slip resistant surface. Cover bolted to tank and equipped with padlock feature. Bolts and padlock of corrosion-resistant construction.
 - c. Connections: Watertight and suitable for attaching PVC pipe; 4-inch diameter inlet and 1 1/4-inch diameter discharge with plugs or caps.
 - 2. Manufacturing Standards: Tank manufactured according to ASTM D 3299 Standards for filament wound tanks, or NBS PS 15-69 Standards for contact molded tanks.
- B. Anti-Flotation Anchor: Provide precast or field cast concrete anchor in accordance with tank manufacturer's recommendations. The tank manufacturer shall provide the design and size of the anchor as specified previously under Design Criteria.

2.06 MISCELLANEOUS MATERIAL

- A. Bedding and Backfill: As specified in Section 02221.
- B. Cast-In-Place Concrete: As specified in Section 03300.
- C. Pipe Connections: Make pipe connections according to the requirements of Section 02725.
- D. Preservative Treated Post (Control Panel Mounting Option): Nominal dimension 6 x 6, surfaced four sides (grade stamp S4S) and grade stamped indicating product compliance with PS-20-70 according to the American Softwood Lumber Standard, and preservative treated as follows:
 - 1. Preservative treatment by the pressure impregnation process for Ground Contact in accordance with the American Wood Preserver's Association AWWA P-5.
 - 2. Preservative injected into the wood at 0.60 pounds per cubic foot of wood. Preservative density determined by assay in accordance with AWWA Standard C-1.
- E. Underground Cable, Type UF: Multi-conductor cable with each conductor of annealed uncoated copper and individual color coded PVC insulation. Conductors assembled flat with grounding wire and encased in gray sunlight resistant PVC approval imprinted

jacket. Standards compliance as follows:

1. UL listed as Type NMC Cable per Standard 719 for Nonmetallic-Sheathed Cables.
2. UL listed as sunlight resistant Type UF cable per Standard 493 for underground Feeder and Branch-Circuit Cables.
3. Conforming to National Electrical Code, Article 339.
4. ROMEX and BX Cable not permitted for use in this Project.
5. Warning Tape: Printed polyethylene, magnetic tape of three inches width minimum, color coded red and labeled in one inch lettering with the word electric.

F. Wire and Cable Connections (Exposed Locations):

1. Wire Nuts: Preinsulated UL Listed hand or tool installed solderless connectors of the spring-lock type or compression type for making splices of solid COPPER wire.
2. Split Bolt Connectors or Compression Type Connectors: UL Listed connectors for making parallel or butt splices of stranded COPPER wire. Use companion preformed plastic insulating covers or tape insulation conforming to NEC requirements.
3. Screw-Lock Connectors: UL Listed connectors for making terminal connections or solid COPPER wire. Contractor option to use UL Listed crimp type ring tongue connectors.

G. Waterproof Splice Kit (Buried and Waterproof Locations): Molded rubber composition and designed to create a watertight seal on the cable jacket as well as the splice.

1. Acceptable Manufacturers:
 - a. Elastimold Division Amerace-Esna Corp.; Fused and Single & Multi-Conductor Connector Kits.
 - b. Joy Manufacturing Company.
 - c. Or equal.

H. Rigid Metal Conduits: Fabricated of mild steel piping, galvanized or sherardized inside and outside, and protected against corrosion by a dichromate rinse or a zinc chromate coating. Each conduit shall bear the UL label, be defect free, furnished in 10 ft. lengths minimum, and of the following type:

1. Rigid Metal Conduit and Fittings: Products meeting requirements of NEC Article 346 for materials and uses, and Fed. Spec. WW-C-581D.

I. Rigid PVC Conduit: High impact PVC (polyvinyl chloride) Conduit and Fittings conforming to NEMA Spec. TC-2, 90 C, UL rated and Labeled and made from compounds conforming to ASTM D 1784. Additionally, PVC conduit shall have

material strengths of 5500 psi tensile, 11,000 psi flexural and 8600 psi compression; all at 78 degrees F.

1. Provide schedule 40 conduit and fittings, except where required by NEC use schedule 80.

J. Grounding Materials: Provide materials conforming to UL requirements for such use as NEC Article 250. Basic materials as follows:

1. Ground Rods: 3/4-inch by ten foot copperweld type.
2. Ground Conductors: Code gauge stranded copper unless otherwise indicated.
3. Ground Clamps: Multi-bolt type, (Clamps for pipe, lugs for bars) saddle clamp or compression type for wire.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Field Inspection: Examine units for defects that will adversely affect installation or cause latent defects in completed work. Inform Engineer of defects. Do not proceed with installation until defects have been corrected.
 1. Verify other construction work is complete to the extent that substrates on which electrical apparatus is to be installed is ready to receive same.
- B. Manufacturer's Instructions: Refer to manufacturer's installation instruction manual for familiarization before proceeding with installation of units.
 1. Verify direction of motor rotation in equipment before making final connections to electrically operated equipment.

3.02 PREPARATION

- A. Field Measurement: The Drawings are generally indicative of the Work, but are not an exact representation of each condition involved. Therefore, set units, piping, etc. to suit actual field measurements. No extra compensation will be made for Work due to differences between indicated and actual dimensions.
 1. Where proposed changes to the Engineer's design are necessitated by field conditions or other causes, submit detail drawings of proposed changes to the Engineer for approval.
- B. Keep pipe and unit interiors cleared of debris as construction progresses.
- C. Earthwork: Perform earthwork for unit installation as specified in Section 02221 and according to the following:
 1. Make excavations for units to a nearly vertical plane and not to exceed the nominal dimensions of the concrete anchor outside diameter.
 2. If rock excavation is required, take rock out to limits specified previously.
 3. If surface pavement of any type is encountered, vehicle or pedestrian ways, cut such pavement to a rectangular shape as opposed to circular shape of unit. Make limits of cut not to exceed one-foot beyond excavation limit as specified previously.

3.03 INSTALLATION

- A. General Requirements: Install units in strict accordance with manufacturer's instruction and installation manual, and at locations and in accordance with Details indicated on the Drawings.

1. Install a check valve between the unit and the main sewer piping in accordance with the Detail Drawings.
 2. Install units on a six inch deep compacted layer of aggregate meeting requirements of Pipe Zone Bedding. Install Pipe Zone Bedding material as backfill up to highest pipe connection.
- B. Anti-Flotation Anchor Installation, Fiberglass Tank: Form and pour concrete anchors in accordance with requirements of Section 03300. Use Class B (3,000 psi) concrete.
1. Prefabricated anchors, as qualified previously in this Section, are acceptable.
- C. Underground Electrical System: Install underground electric cable in accordance with Article 300-5 of the NEC, in accordance with previous requirements of this Section, and the following requirements exceeding NEC:
1. Earthwork: Perform earthwork for buried electric cable as specified for piping under Section 02221.
 2. Provide two feet minimum cover over cable unless indicated otherwise on the Drawings.
 3. Make electrical cable penetrations through the tank absolutely watertight.
- D. Electrical System Grounding: Perform grounding of electrical system and metal enclosures in accordance with Article 250 of the NEC.
1. In addition to grounding and bonding requirements of NEC as referenced in the preceding paragraph, the following shall also apply:
 - a. Use approved grounding connectors only. Clean the surfaces involved in the made-grounds before connecting and finish the installation with touch-up painting or other protective coating to prevent corrosion.
- E. Control Panel Installation: Fasten control panel and cable to exterior of the building or post (for post mounted) using fasteners suitable for anchoring into the particular type of surface, and fasten in accordance with current accepted trade practices. Only screw-type corrosion-resistant fasteners are acceptable.
1. Install control panel four feet above existing grade, measured to the bottom of the panel.
 2. If post mount installation, provide post of sufficient length to permit three feet of embedment in ground and the four foot clearance requirement stated above.

3.04 FIELD QUALITY CONTROL

- A. General Requirements: Upon completion of installation of the grinder pump units, including but not limited to control panel mounting, electrical work installation and connections, pressure service lateral installation, and unit backfilling, each being performed in a manner satisfactory to the Engineer, advise the unit manufacturer that the units have been installed and are ready to be inspected and tested.
1. In cooperation with the unit manufacturer, determine a mutually acceptable schedule for inspection and testing of installed units.

2. Conduct the Performance Test specified herein prior to the property owner's electrical wiring and plumbing connections to the grinder pump units.
 3. Conduct tests as specified herein so that each unit installed in the Project is tested to the unit manufacturer's and Engineer's satisfaction. Provide the Owner with documentation of such manufacturer's acceptance test in the form of a letter to the Owner attesting to this test requirement.
 4. Provide tools, materials, water, temporary power, apparatus, and instruments necessary for unit testing. Conduct the specified tests in the presence of and to the satisfaction of the unit manufacturer and the Engineer.
- B. Performance Test: Demonstrate (with the Personnel of the Owner observing), to the satisfaction of the Engineer, the mechanical performance of each unit when operated in accordance with the design intent indicated by the Drawings and described in this Section of the Specifications.
1. Connect 120V temporary power source to the alarm circuit at the control panel.
 2. Fill the tank with sufficient water to test the high level audible and visual alarms at the control panel.
 3. Connect 24V temporary power source to the power circuit at the control panel and run the unit through a minimum of three operation cycles to check pump operation and shut-off.
 4. If the demonstrations are satisfactory to the Engineer, the test will be considered concluded. If deficiencies are found, they shall be corrected as follows and the test repeated until the Engineer determines that the unit has performed satisfactorily.
 - a. Unit manufacturer shall correct pump, internal piping and control panel deficiencies.
 - b. Installer shall correct installation deficiencies.
- C. Tank Watertightness Test: Perform both an exfiltration and an infiltration test of each unit in the Project. Test procedures as follows:
1. Fill the completely installed units above the highest tank wall penetration (including electrical) with clear water. Allow a one hour stabilization period and then commence a three consecutive day exfiltration test.
 2. Measure and record the water level, with the Engineer observing, both at the beginning and end of the test period.
 3. An acceptable exfiltration test will be when no water leakage in the closed unit is detectable by the measurements.
 4. Conduct an infiltration test of the completely installed units over a three consecutive day time period with the Engineer observing.
 5. An acceptable infiltration test will be when no water enters the closed unit.
- D. Electrical Systems Test: Unless waived in writing by the Engineer, perform tests and trials in the presence of a duly authorized representative of the Engineer. When the presence of such representative is so waived, furnish to the Engineer sworn statements, in duplicate, of the tests made and the results thereof.
1. Inspection: Have the work inspected by an authorized inspection agency, and

such other agencies having jurisdiction, for compliance with National Electrical Code and obtain certificates of approval, acceptance, and compliance with code regulations. Work shall not be deemed complete until such certifications have been delivered to the Owner.

2. Testing: Test materials, supplies and parts and assemblies thereof, entering into the Work, in conformity with the best currently approved method for the particular type and class of work.
 - a. Render the entire installation free from short circuits and improper grounds. Test feeders cable disconnected from the power source. Then test the entire power circuit and the panel with the pumping equipment operating. In no case, shall the insulation resistance be less than one hundred thousand ohms.
 - b. Perform initial electrical system tests using meggers, ammeters, voltmeters, insulation resistance testers, and high-pot testers prior to placing electrical systems into complete operation.
 - 1) Use meggers with an adjustable 2.5/5.0 KV range which will permit reading of 0.05 to 100,000 Megohms. The minimum testing voltage obtained by adding 1000 volts to twice the rated voltage of the cable, device, apparatus or equipment. in no case shall the insulation resistance be less than one Megohm. However, the recommended insulation resistance measurements of each test shall conform to IEEE and ANSI Standards.
 - c. Correct failures in a manner satisfactory to the Engineer or his authorized representative.

END OF SECTION

SAMPLE DOCUMENTS

**WEST HANOVER TOWNSHIP WATER AND SEWER AUTHORITY
SEWER EXTENSION AND SECURITY AGREEMENT**

THIS AGREEMENT made this _____ day of _____,
_____, by and between _____,
a (partnership) (a corporation existing under the laws of _____),
having a principal place of business at _____,
(Street)

_____, hereinafter called "
(City) (State)
"Applicant" and WEST HANOVER TOWNSHIP WATER AND SEWER AUTHORITY, a
Pennsylvania municipal authority of Dauphin County, Pennsylvania, hereinafter called
"Authority."

WITNESSETH:

WHEREAS, the Applicant is the _____ of certain real
estate situate in West Hanover Township, Dauphin County, Pennsylvania (hereinafter called
"Township"), bounded and described as shown on a (Subdivision Plan) (Land Development
Plan) dated _____, by _____
(Date) (Surveyor) (Architect) (Engineer)

Entitled _____
(hereinafter called "Plan"); and

WHEREAS, Applicant has made application to Authority for permission to construct or
to cause to be constructed, at its own cost and expense, and by its own contractor, a sanitary
sewer system leading to, abutting, and/or within the aforesaid tract of land and to connect same
when completed to the existing sewage collection system of the Authority, such application
having been made after Applicant had received information from officials of Authority as to the
optional methods by which such construction and connection may be accomplished and the
relative costs and expenses thereof under the uniform rules and regulations of the Authority and
the ordinances of West Hanover Township.

WHEREAS, Applicant has submitted to West Hanover Township for approval of said
Plan, said "West Hanover Township Water and Sewer Authority Subdivision and Land
Development Resolution," hereinafter called "Resolution" requires the Applicant to submit to the
Authority financial security sufficient in amount as shall be determined as hereinafter set forth to
cover the costs and to guarantee the construction and proper and satisfactory operation and
functioning of certain sanitary sewer lines, apparatus, and facilities which financial security
includes, without limitation, Federal or Commonwealth chartered lending institutions,
irrevocable letters of credit and restrictive or escrow accounts in such lending institutions and
corporate surety bonds; and,

WHEREAS, Paragraph 4 of such Resolution requires a written agreement that the necessary sanitary sewer lines, apparatus, and facilities, as may be required by the Township, shall be installed in strict accordance with the plans, specifications, schedules, Plat, rules, and regulations of the Authority and the Township; and,

WHEREAS, the cost of the sanitary sewer lines, appurtenances, and facilities has been determined to be the sum of \$ _____ Dollars, as determined in accordance with paragraph 12 of this agreement.

NOW, THEREFORE, in consideration of the payments and promises hereinafter made, the parties hereto, intending to be legally bound hereby, it is mutually agreed as follows:

1. (a) Applicant, at Applicant's own cost and expense, will cause to be prepared, by qualified professional engineering personnel, detailed plans and specifications for the proposed extension to the sewer collection system of the Authority in accordance with all applicable ordinances, resolutions, and regulations.

(b) Such plans and specifications shall be drawn or imprinted upon sheets of dimensions 24" x 36", shall be drawn to a scale no less than 1 inch equals 50 feet, and shall incorporate the same data as required by the current Pennsylvania Department of Environmental Protection (hereinafter "DEP") Sewage Manual, as amended and supplemented, from time to time.

(c) All such plans, specifications, and DEP permit application and supporting data shall be furnished to the Authority in at least three (3) counterparts. The DEP permit application shall be prepared by the Applicant in the name of the Authority.

(d) Promptly upon receipt of such plans and specifications, Authority shall cause same to be submitted to the Consulting Engineers then representing the Authority. Such plans, specifications, and permit data shall be revised or amended, if necessary, until they are unequivocally approved by the Authority's Consulting Engineers as providing for an extension of a type and nature and so planned and to be constructed as to readily become an integral part of the collection system of the Authority.

(e) Promptly upon the Authority's approval, as aforesaid, the approved plans, specifications, and permit data shall be submitted by the Authority to DEP, requesting approval thereof and the issuance of a Water Quality Management Permit, if required. Upon receipt of such permit or approved module, and upon compliance by applicant with all applicable local ordinances and regulations, the Authority will notify the Applicant that work may be started on the project.

(f) Applicant shall be responsible for compliance with all DEP soil erosion and sedimentation control requirements. All charges, fees, and fines in connection with these requirements shall be the Applicant's responsibility.

2. Applicant shall construct or cause to be constructed the subject extension according to the aforesaid approved plans, specifications, schedules, Plan, rules, and regulations of the Authority and DEP permit. The Authority, its officers, agents, employees, solicitors, and consulting engineers shall have no responsibility or liability for payment of any part of the costs of expenses arising out of or relating to said construction or the labor, materials, and equipment used therein or thereon or for injury or damage to any persons or property occurring upon or associated with the construction of the project. Applicant shall, unless otherwise agreed, procure all necessary permits and licenses, pay all charges and fees, and shall file all notices necessary to the proper and lawful prosecution of the work.

3. Applicant agrees to give the Authority ten (10) days written notice of Applicant's intention to begin construction of the Collection System so that its construction may be properly inspected by the Authority. Any work which has begun before the expiration of such ten (10) day period without the consent of the Authority will not be approved, as well as any improperly constructed work, the existence of which the Authority has notified Applicant promptly after the inspection which has disclosed such improper construction. At all times, the sewer contractor shall keep on the construction site, available to the Authority one (1) copy of the Approved Plans and Specifications, any shop drawings approved by the Authority, and the Authority's rules and regulations.

4. During the course of the construction, all materials, workmanship, and compliance with the approved plans and specifications shall be subject to the inspection and approval of the designated representative or Consulting Engineer for the Authority. Final inspection shall be in accordance with the Authority's standard construction and materials specifications. Upon completion of the construction and prior to connection of the extension to the collection system of the Authority, the said representative or Consulting Engineer for the Authority shall certify the satisfactory completion thereof to the Authority.

5. Promptly upon completion of the extension, the Applicant shall:

(a) Cause to be prepared and furnished to the Authority, at the expense of Applicant, two (2) sets of "as-built" drawings of the completed sewer extension, including the location and depth of each lateral, together with one (1) set of reproducible plans thereof; and

(b) Cause to be prepared, executed, acknowledged, and delivered to Authority, at the sole expense of Applicant, an appropriate instrument or instruments transferring the said entire extension, its pipes, manholes, and all of its appurtenances, as well as all rights, liberties, and privileges appurtenant thereto, including easements and rights-of-way, necessary to the existence, operation, and maintenance of said extension, said conveyances to be free and clear of all liens and encumbrances. Applicant will also produce a record owner and lien search from an attorney or reputable title company listing all liens and encumbrances and shall supply the consents, releases, or satisfactions necessary to make the conveyance free and clear of such interests, liens, and encumbrances.

6. This Agreement shall not obligate the Authority to take by eminent domain proceedings any necessary easement or right-of-way. It is the responsibility of Applicant to provide or obtain any necessary easement or right-of-way. In the event that the Authority, in its

sole and absolute discretion, institutes eminent domain proceedings, Applicant shall be responsible for and pay all costs, fees, and expenses incurred by Authority with respect thereto, including but not limited to filing fees, surveys, expert witness' fees, engineers' fees, and attorneys' fees, and shall be responsible for any and pay all damages, including interest, awarded in favor of any condemnee.

7. Upon receipt (and recording, if required) of said instrument or instruments of transfer, the extension and all parts and appurtenances thereof shall be, become, and remain the sole, absolute, and permanent property of the Authority, its successors and assigns, free and clear of any lien, obligation, or other liability, except as provided in paragraph 8 of this agreement, in favor of the Applicant, his successors, assigns, or constructors, and his or their laborers and materialmen and any of their creditors, or in favor of any other person or corporation, to the same end and effect as if the Authority had constructed the extension with its own labor and at its own expense; and thereafter the Authority, its successors or assigns, shall maintain and repair said extension as its own property and at its own cost and expense and the Applicant shall have no further obligation or responsibility thereto, except as hereinafter provided. Applicant shall and does hereby, for a period of eighteen (18) months following the delivery of said instrument or instruments, guarantee the said sewer system as to workmanship and materials and shall perform any required maintenance or replacement thereof during such period. Applicant shall also provide financial security to assure such maintenance or replacement as hereinafter set forth in paragraph 17 of this Agreement.

8. Applicant shall pay to Authority such Connection Fees, Customer Facilities Fees, and Tapping Fees as may be established by the Authority. The Fees shall be payable in the amounts and at the times established by the Authority. When the owner of another property not in the development for which the extension was constructed connects a service line directly to the extension within ten (10) years of the date of the dedication of such extension to the Authority, Applicant shall be entitled to reimbursement in accordance with the following provisions:

(a) Such reimbursement shall be equal to the distribution or collection part of each tapping fee collected as to result of subsequent connections. Authority shall be entitled to deduct from each reimbursement payment of an amount equal to five per centum which shall be deemed to represent the appropriate charge for administrative expenses and services rendered in calculating, collecting, monitoring, and disbursing the reimbursement payments to the Applicant.

(b) Reimbursement shall be limited to those lines which have not previously been paid for by the Authority.

(c) The Authority shall attach as an exhibit to this Agreement an itemized listing of all sewer and water facilities for which reimbursement shall be provided.

(d) The total reimbursement to which Applicant shall be entitled shall not exceed the cost of all labor and material, engineering design charges, the cost of performance and maintenance bonds, Authority review and inspection charges, as well as flushing and televising charges and any and all charges involved in the acceptance and dedication of such facilities by the Authority, less the amount which would be chargeable to such Applicant based upon the Authority's collection and distribution tapping fees which would be applicable to all lands of the

Applicant served directly or indirectly through such extensions if the Applicant did not fund the extension. The Applicant shall provide an itemized listing of such costs and charges, other than Authority charges, and supporting documentation as required by the Authority at the time of tender of the Deed of Dedication.

(e) The Authority shall be required to notify by certified mail, to Applicant's last known address, the Applicant for whose benefit such reimbursement shall apply within thirty (30) days of the Authority's receipt of any such reimbursement payment. In the event that the Applicant has not claimed a reimbursement payment within one hundred twenty (120) days of the mailing of the notice, the payment shall revert to and become the sole property of the Authority with no further obligation on the part of the Authority to refund the payment to the Applicant.

(f) Any addendum attached hereto will control and supersede any inconsistent provisions of this paragraph. (Enter check mark if addendum is attached and number thereof if more than one _____.)

9. On or prior to the date of this Agreement, Applicant has deposited with Authority, the receipt whereof is hereby acknowledged, the sum of \$ _____ Dollars, which shall be held by the Authority, without interest, for application by the Authority to or toward the following costs chargeable against it in the performance of this Agreement:

(a) The reasonable charges of its Consulting Engineers for examination and approval of the plans and specifications as referred to in Paragraph 1(d) hereof.

(b) The fees and charges of DEP for the permit referred to in Paragraph 1(e) hereof.

(c) The expenses and charges of inspection and approval in accordance with Paragraph 4 hereof, testing and flushing as referred to in Paragraph 3 hereof.

(d) The legal expenses of Authority in connection with the preparation and/or review of this Agreement, the aforesaid instrument or instruments of transfer, any required easements, title searches, etc., relating to the matters covered hereby.

Should the fund above deposited exceed the actual cost to the Authority of said specified charges and fees, the balance remaining upon the completion and acceptance of the sewer extension as provided in Paragraph 19 of this Agreement shall be refunded to the Applicant; but should said deposit be insufficient to cover the above costs, Applicant shall pay the deficiency to Authority upon demand and prior to the connection of the extension to the sewer system of Authority.

10. The Applicant agrees that the aforesaid construction and installation will be completed within _____ year(s) from the date hereof.

11. Applicant shall deposit with the Authority financial security in an amount sufficient to cover the cost of all required improvements and the estimated cost of any eminent domain proceedings. The financial security shall guarantee performance of this Agreement in completion of the improvements by the Applicant schedules, plat, rules, and regulations of the

Authority and DEP permit. The financial security shall be (corporate surety bond) (irrevocable letter of credit) in the amount of \$ _____ Dollars. The amount of the financial security shall be equal to one hundred ten (110%) percent of the costs of the required improvements and estimated cost of eminent domain proceedings for which the financial security is to be posted.

12. The cost of improvements shall be established in the following manner:

(a) By submission to the Authority of bona fide bid or bids from the contractor or contractors chosen by the Applicant to complete the improvements, or

(b) In the absence of such bona fide bid or bids, the costs shall be established by estimates prepared by the Consulting Engineer.

13. If the Applicant requires more than one (1) year from the date of posting of such financial security to complete the required improvements, the amount of such financial security shall be increased by an additional ten (10%) percent for each one (1) year period beyond the first anniversary date from posting of financial security or to an amount not exceeding one hundred ten (110%) percent of the cost of completing the required improvements as re-established on or about the expiration of the preceding one (1) year period by using the above bidding procedure or, in the absence of such bidding procedure, as established by estimates prepared by the Consulting Engineer. Any such increase in financial security shall be delivered to the Authority, not later than the applicable anniversary date, subject to the provisions of this Agreement.

14. If the aforesaid improvements are not completed within said period of time and the Applicant fails to increase the security as provided in Paragraph 12 hereof or if the said improvements are not constructed and installed in strict compliance with the provisions of this Agreement or instructions of the Consulting Engineer or applicable laws and regulations of the Commonwealth of Pennsylvania, the corporate surety or financial institution shall immediately turn over to the Authority so much of the financial security as is requested by the Authority in writing so that the Authority may make or complete the aforesaid improvements.

15. The Authority shall be the sole judge as to whether the improvements are constructed and installed in strict accordance with the provisions of this Agreement or instructions of the Authority Engineer.

16. When the Applicant has completed all of the required improvements, the Applicant shall notify the Authority in writing, by certified or registered mail, of the completion of the aforesaid improvements and shall send a copy thereof to the Engineer.

(a) The Engineer shall, within ten (10) days after receipt of such notice, perform a final inspection of the improvements.

(b) The Consulting Engineer shall thereafter file a report, in writing, with the Authority and shall promptly mail a copy of the same to the Applicant by certified or registered mail. The report shall be made and filed within thirty (30) days after the final inspection.

(c) The report shall be detailed and shall indicate approval or rejection of such improvements, or any portion thereof, are not approved or are rejected by the Consulting Engineer, the report shall contain a statement of the reasons for non-approval or rejection.

(d) The Authority shall notify the Applicant in writing by certified or registered mail, of the action of the governing body with relation thereto.

(e) If items (a)-(d) above are not completed within ninety (90) days all improvements will be deemed to have been approved and the Applicant shall be released of all liability, except as set forth in Paragraph 17 hereof.

(f) If any portion of the improvements are not approved or are rejected by the Authority, the Applicant shall proceed to complete the same, and upon completion, the same procedure of notification as listed above shall be followed.

17. Prior to the acceptance by the Authority of all or some of the required improvements, the Applicant shall post financial security to secure structural integrity of said improvements as well as the functioning of said improvements in accordance with the design, specifications, and schedules for a term of eighteen (18) months from the date of acceptance thereof by the Authority.

(a) Said financial security shall be of the same type as allowed by Paragraph 11 of this Agreement.

(b) The amount of such financial security shall be fifteen (15%) percent of the costs of said improvements as provided by Paragraph 12 of this Agreement.

18. Applicant represents that no lots have thus far been conveyed in such Plan, no rights-of-way have been granted to any utilities to use any of the streets in such Plan, and the entire premises set forth on such Plan still is held intact in fee by Applicant. All sanitary sewers satisfactorily built and installed shall become the property of West Hanover Township Water and Sewer Authority free of any and all encumbrances after the Consulting Engineer of the Authority certifies completion, and Applicant agrees to tender to West Hanover Township Water and Sewer Authority a Deed of Dedication to the sewer lines installed therein upon their completion prior to the connection of any lots from such Plan.

19. Prior to release of any financial security as required by Paragraphs 11 and 13 of this Agreement and prior to release of escrow as set forth in Paragraph 9 of this Agreement, the Applicant shall cause to be prepared at Applicant's sole expense a Deed of Dedication for the extension, shall provide as-built drawings as required in Paragraph 5 of this Agreement, shall provide financial security as required by Paragraph 17 of this Agreement, and shall provide affidavits and waivers as required by Paragraph 20 of this Agreement, and shall obtain approval from the Consulting Engineer as set forth in Paragraph 16(c) of this Agreement.

20. Upon completion of such improvements and as a condition of acceptance by Authority, Applicant shall submit to Authority an affidavit, waiver of mechanics liens, and such other satisfactory evidence as Authority may required, that all labor, material, rental, contractors

21. This Agreement shall be binding upon and inure to the benefit of the parties hereto and their respective successors and assigns.

IN WITNESS WHEREOF, the parties hereto have caused this Agreement to be executed the day and year first above written.

WEST HANOVER TOWNSHIP
WATER AND SEWER AUTHORITY

By: _____
(Vice) Chairman

(Vice) Chairman

(SEAL)

Trading and doing business as

Witness:

(Name of Partnership)

By: _____ (SEAL)
Partner

By: _____ (SEAL)
Partner

By: _____ (SEAL)
Partner

By: _____ (SEAL)
Partner

(Corporation)

Witness:

(Name of Corporation)

By: _____
(Vice) President

ATTEST:

(Assistant) Secretary

(CORPORATE SEAL)

or (if appropriate)

(Name of Corporation)

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS, that a DEVELOPER known as

hereinafter called PRINCIPAL, and _____

of the City of _____, State of _____ a
corporation created and existing under the laws of the State of _____,
hereinafter called SURETY, are held and firmly bound unto the WEST HANOVER TOWNSHIP
WATER AND SEWER AUTHORITY, Dauphin County, Pennsylvania, as Obligee in the full
and just sum of _____ Dollars
(\$_____.____), lawful money of the United States of America, for the payment of which
sum we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and
severally, firmly by these presents,

WITNESSETH THAT:

WHEREAS, The Principal heretofore has entered into a Sewer Agreement with the Obligee,
dated _____, 20____, (the "Agreement"), to construct a sewer
extension at the Principal's expense; and

WHEREAS, It is a condition of the Agreement that this Bond shall be furnished by the
Principal to the Obligee.

NOW, THEREFORE, the terms and conditions of this Bond are and shall be that if: (a) the Principal well, truly and faithfully shall comply with and shall perform the work in accordance with the Agreement, and if the Principal shall satisfy all claims and demands incurred in or related to the performance of the Agreement by the Principal or growing out of the performance of the Agreement by the Principal, and if the Principal shall indemnify completely and shall save harmless the Obligees and all of its officers, agents and employees from any and all costs and damages which the Obligees and all of its officers, agents and employees may sustain or suffer by reason of the failure of the Principal to do so, and if the Principal shall reimburse completely and shall pay to the Obligees any and all costs and expenses which the Obligees and all of its officers, agents and employees may incur by reason of any such default or failure of the Principal; and (b) if the Principal shall remedy, without cost to the Obligees, all defects which may develop during the period of one (1) year from the date of acceptance of the Obligees of the work to be performed under the Agreement, which defects, in the sole judgment of the Obligees or its legal successors in interest, shall be caused by or shall result from defective or inferior materials or workmanship, then this Bond shall be void; otherwise, this Bond shall be and shall remain in force and effect.

Provided however, that: (i) to the extent the work to be performed under the Agreement is required to be performed under permit from the Department of Transportation of the Commonwealth of Pennsylvania, the Principal shall make, without cost to the Obligees, all temporary and permanent restoration of any failure of a highway, including the slope or any other appurtenance thereto, during the period of two (2) years from date of completion of such work; and (ii) to the extent the work to be performed under this Agreement is required to be performed under permit from the Department of Transportation of the Commonwealth of Pennsylvania, the Principal shall make, without cost to the Obligees, all temporary and permanent restoration of any failure of a highway, including the slope or any other appurtenances thereto, or of the area adjacent to such highway or of the area beyond such adjacent area, to the extent such work shall be determined to be the proximate cause of such failure, during the period of five (5) years from the date of completion of such work; then this Bond shall be void; otherwise, this Bond shall be and shall remain in force and effect.

The Principal and the Surety agree that any amendments to the Agreement, and/or any act of forbearance of either the Principal, or the Obligees toward the other with respect to the Agreement shall not release, in any manner whatsoever, the Principal and the Surety, or either of them, or their heirs, executors, administrators, successors and assigns, from liability and obligations under this Bond; and the Surety, for value received, does waive notice of any such amendments and/or acts of forbearance.

If the Principal is a foreign corporation (incorporated under any laws other than those of the Commonwealth of Pennsylvania) then further terms and conditions of this Bond are and shall be that the Principal or the Surety shall not be discharged from liability on this Bond, nor this Bond surrendered until such Principal files with the Obligees a certificate from the Pennsylvania Department of Revenue evidencing the payment in full of all bonus taxes, penalties and interest, and a certificate from the Bureau of Employment and Unemployment Compensation of the Pennsylvania Department of Labor and Industry, evidencing the payment of all unemployment

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS, that a DEVELOPER known as

hereinafter called PRINCIPAL, and _____

of the City of _____, State of _____ a
corporation created and existing under the laws of the State of _____,
hereinafter called SURETY, are held and firmly bound unto the WEST HANOVER TOWNSHIP
WATER AND SEWER AUTHORITY, Dauphin County, Pennsylvania, as Obligee in the full
and just sum of _____ Dollars
(\$ _____), lawful money of the United States of America, for the payment of which
we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and
severally, firmly by these presents,

WITNESSETH THAT:

WHEREAS, The Principal heretofore has entered into a Sewer Agreement with the Obligee,
dated _____, 20____, (the "Agreement"), to construct a sewer
extension at the Principal's expenses; and

WHEREAS, It is a condition of the Agreement that this Bond shall be furnished by the
Principal to the Obligee.

NOW, THEREFORE, the terms and conditions of this Bond are and shall be that if the
Principal and any subcontractor of the Principal to whom any portion of the work under the
Agreement shall be subcontracted, and if all assignees of the Principal and of any such

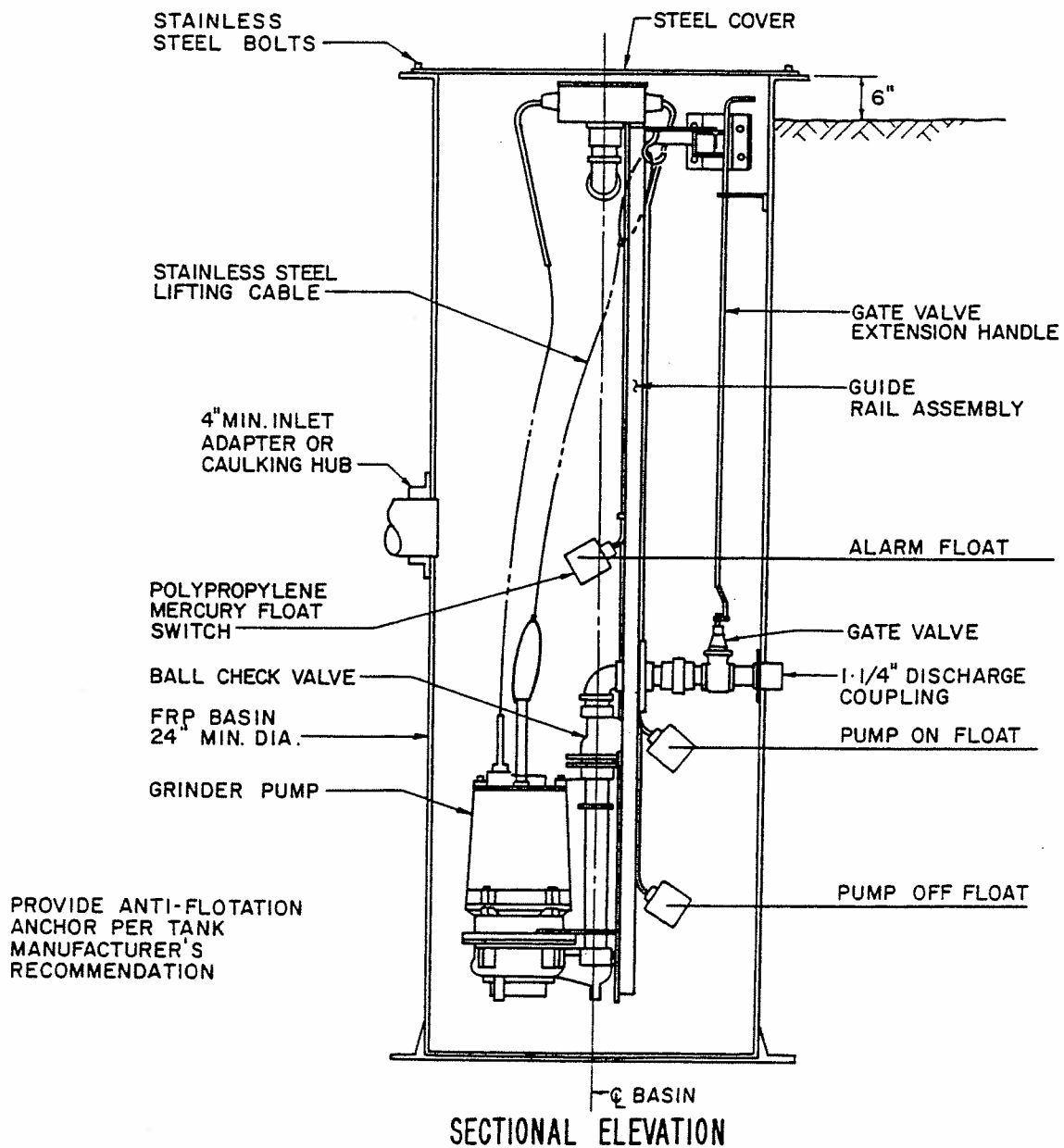
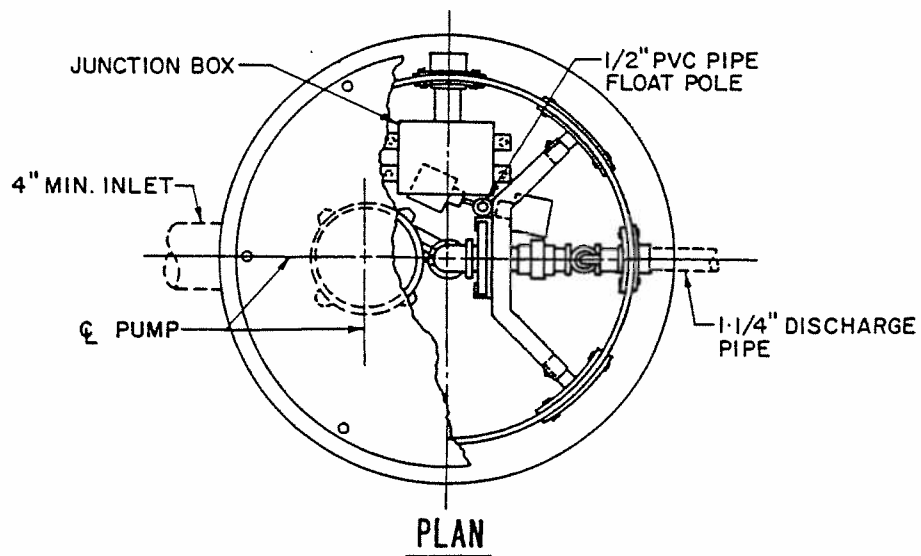
subcontractor, promptly shall pay or shall cause to be paid, in full, all money which may be due any claimant supplying labor or materials in the prosecution and performance of the work in accordance with the Agreement including any amendments to the Agreement, for material furnished or labor supplied or labor performed, then this Bond shall be void; otherwise, this Bond shall be and shall remain in force and effect.

This Bond shall be solely for the protection of claimants supplying labor or materials to the Principal or to any subcontractor of the Principal in the prosecution of the work covered by the Agreement, including any amendments to the Agreement. The term "claimant", when used herein, shall include public utility services and reasonable rentals of equipment, but only for periods when the equipment rented is actually used at the site of the work covered by the Agreement. The provisions of this Bond shall be applicable whether or not the material furnished or labor performed enters into and becomes a component part of the public work or public improvement contemplated by the Agreement.

The Principal and the Surety agree that any claimant, who has performed labor or furnished material in the prosecution of the work in accordance with the Agreement, including any amendments to the Agreement, and who has not been paid therefor, in full, before the expiration of ninety (90) days after the day on which such claimant performed the last of such labor or furnished the last of such materials for which payment is claimed, may institute an action upon this Bond, in the name of the claimant, in assumpsit, to recover any amount due the claimant for such labor or material, and may prosecute such action to final judgement and may have execution upon the judgment; Provided, however, that: (a) any claimant who has a direct contractual relationship with any subcontractor of the Principal, but has no contractual relationship, express or implied, with the Principal, may institute an action upon this Bond only if such claimant first shall have given written notice, serviced in the manner provided in the Act, to the Principal, within ninety (90) days from the date upon which such claimant performed the last of the labor or furnished the last of the materials for which payment is claimed, stating, with substantial accuracy, the amount claimed and the name of the person for whom the work was performed or to whom the material was furnished; and (b) no action upon this Bond shall be commenced after the expiration of one (1) year from the day upon which the last of the labor was performed or material was supplied, for the payment of which such action is instituted by the claimant; and (c) every action upon this Bond be instituted either in the appropriate court of the County where the work is to be performed or of such other County as Pennsylvania statutes shall provide, or in the United States district court for the district in which the work is situated, and not elsewhere.

The Principal and the Surety agree that any amendments to the Agreement and/or any act of forbearance of either the Principal or the Obligee toward the other with respect to the Agreement shall not release, in any manner whatsoever, the Principal and the Surety, or either of them, or their heirs, executors, administrators, successors and assigns, from liability and obligations under this Bond; and the Surety, for value received, does waive notice of any such amendments and/or acts of forbearance.

SEWER DETAIL DRAWINGS



PROVIDE ANTI-FLOTATION
ANCHOR PER TANK
MANUFACTURER'S
RECOMMENDATION

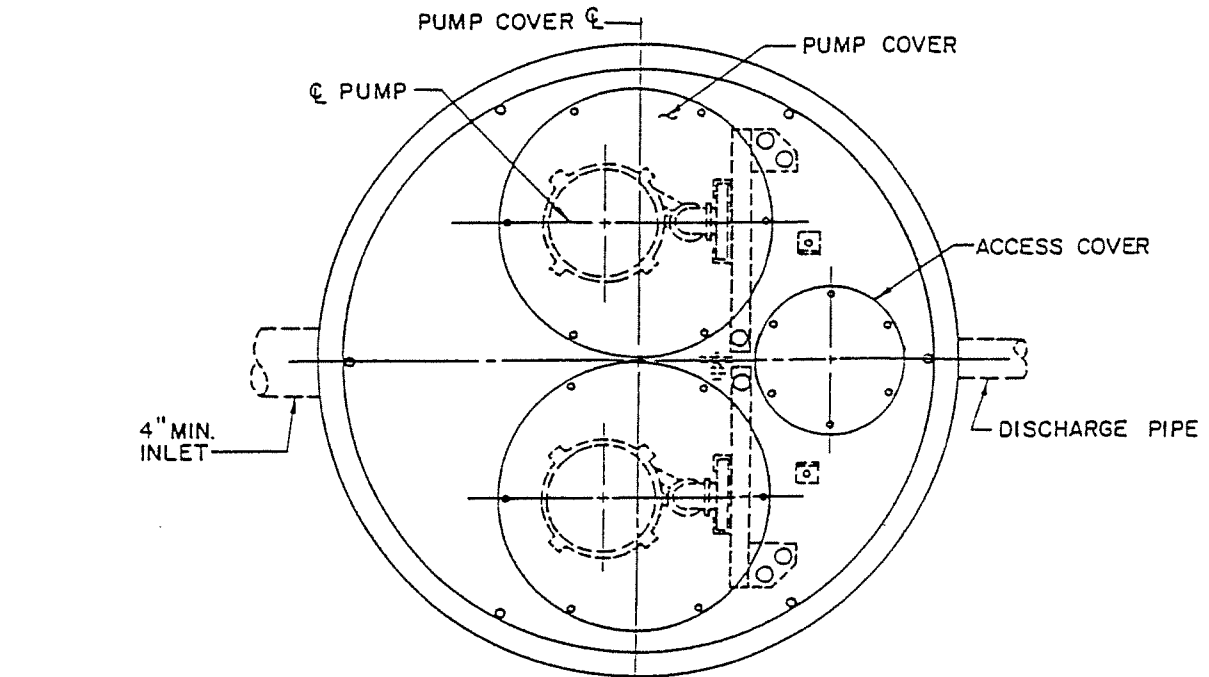
SIMPLEX GRINDER PUMP



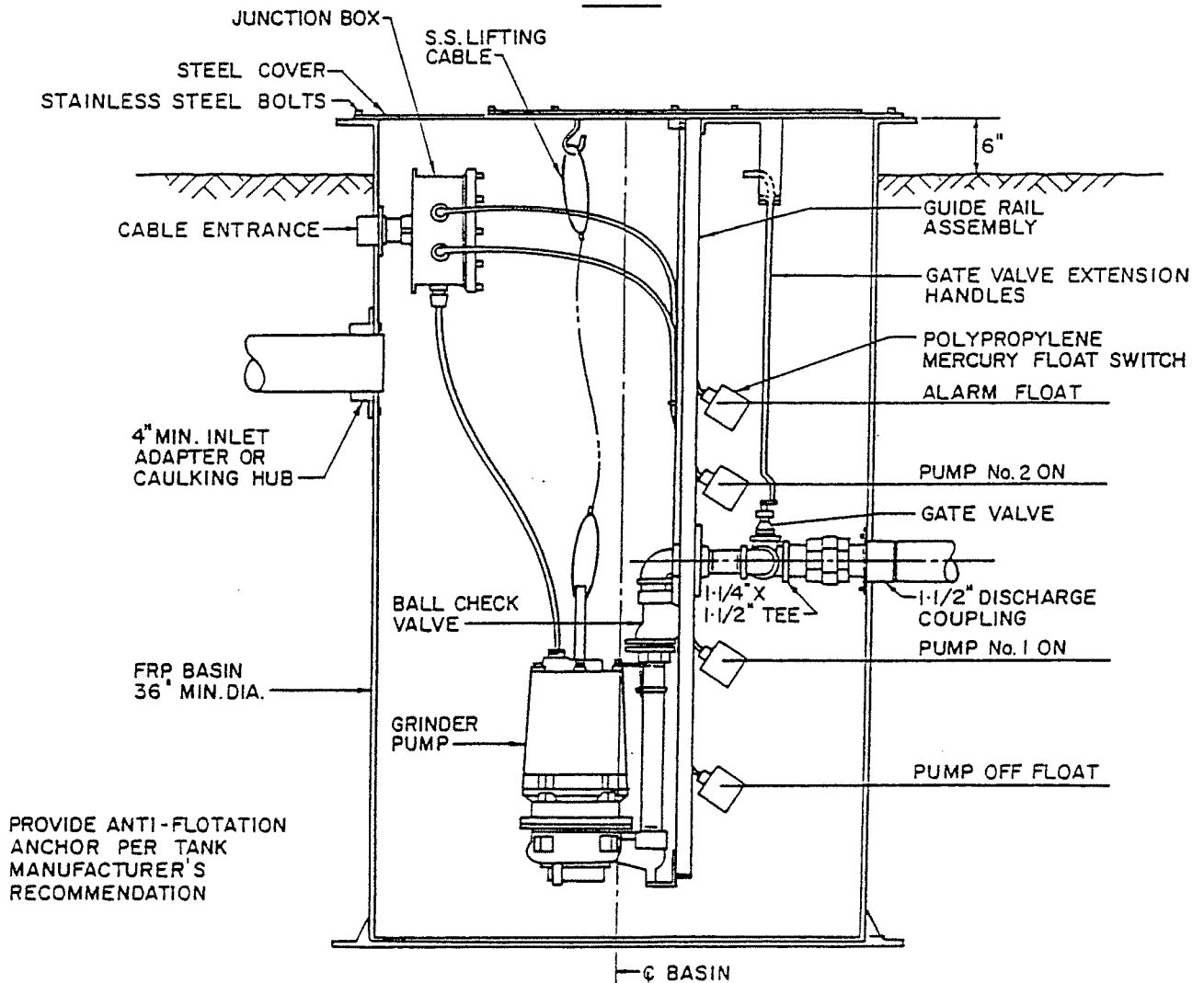
GANNETT FLEMING

DWG. NO. A-35876

JUNE 1988



PLAN



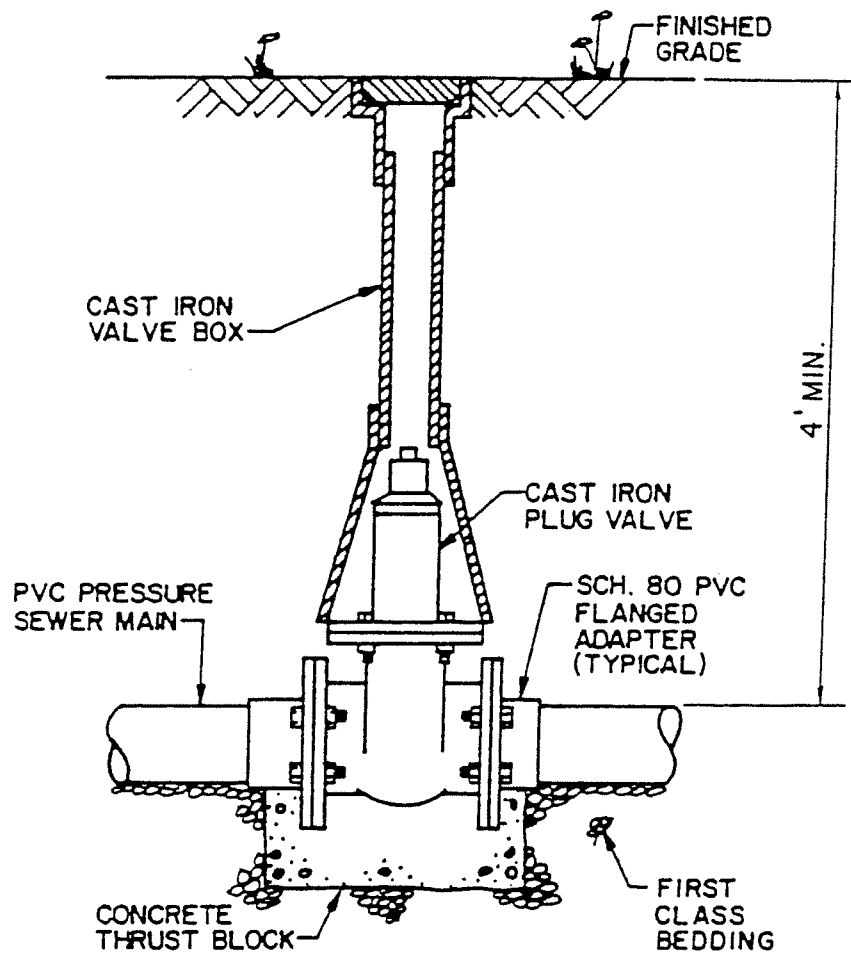
SECTIONAL ELEVATION

DUPLEX GRINDER PUMP



PROVIDE ANTI-FLOTATION
ANCHOR PER TANK
MANUFACTURER'S
RECOMMENDATION

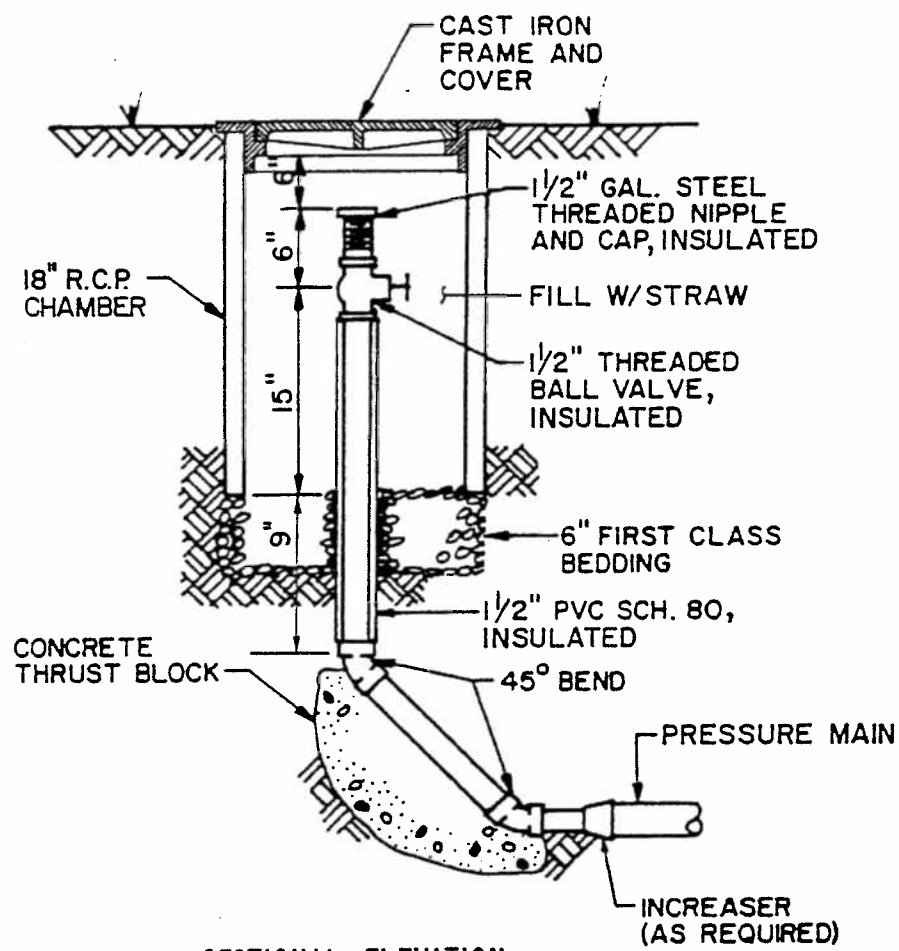
GANNETT FLEMING



SECTIONAL ELEVATION

IN-LINE VALVE (V-3)

PRESSURE WASTEWATER SEWER

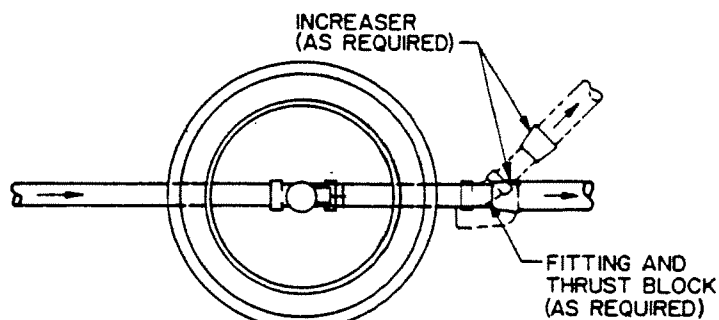


SECTIONAL ELEVATION

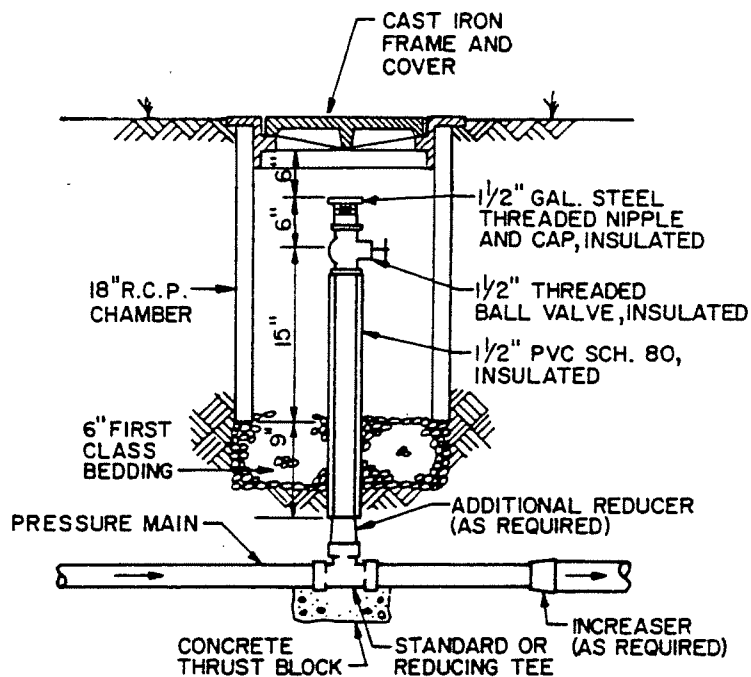
TERMINAL CLEANOUT (TC)

PRESSURE WASTEWATER SEWER

GANNETT FLEMING



PLAN



SECTIONAL ELEVATION

IN-LINE CLEANOUT

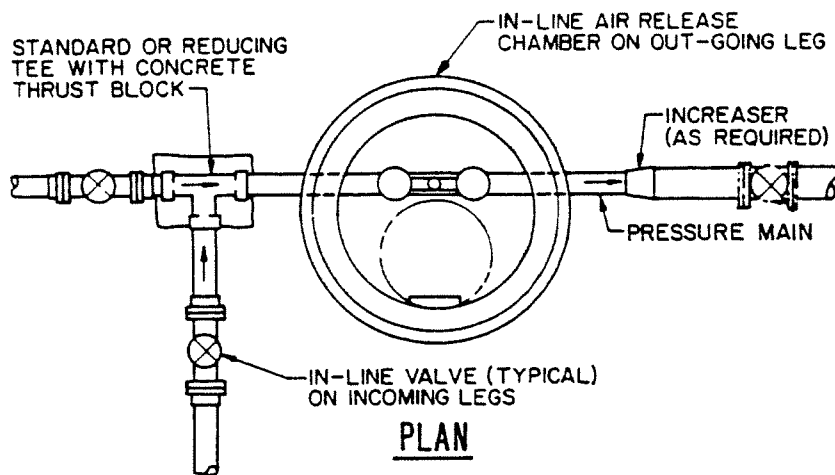


PRESSURE WASTEWATER SEWER

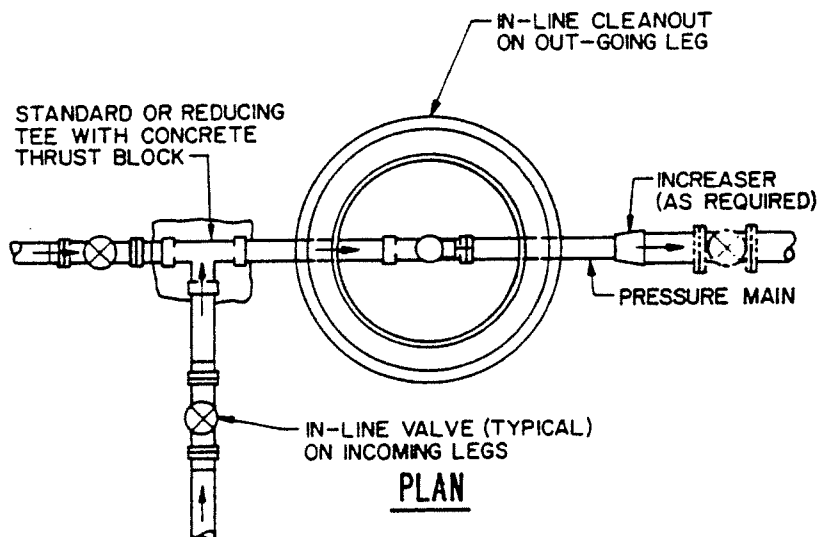
GANNETT FLEMING

DWG. NO. A-35880

JUNE 1988



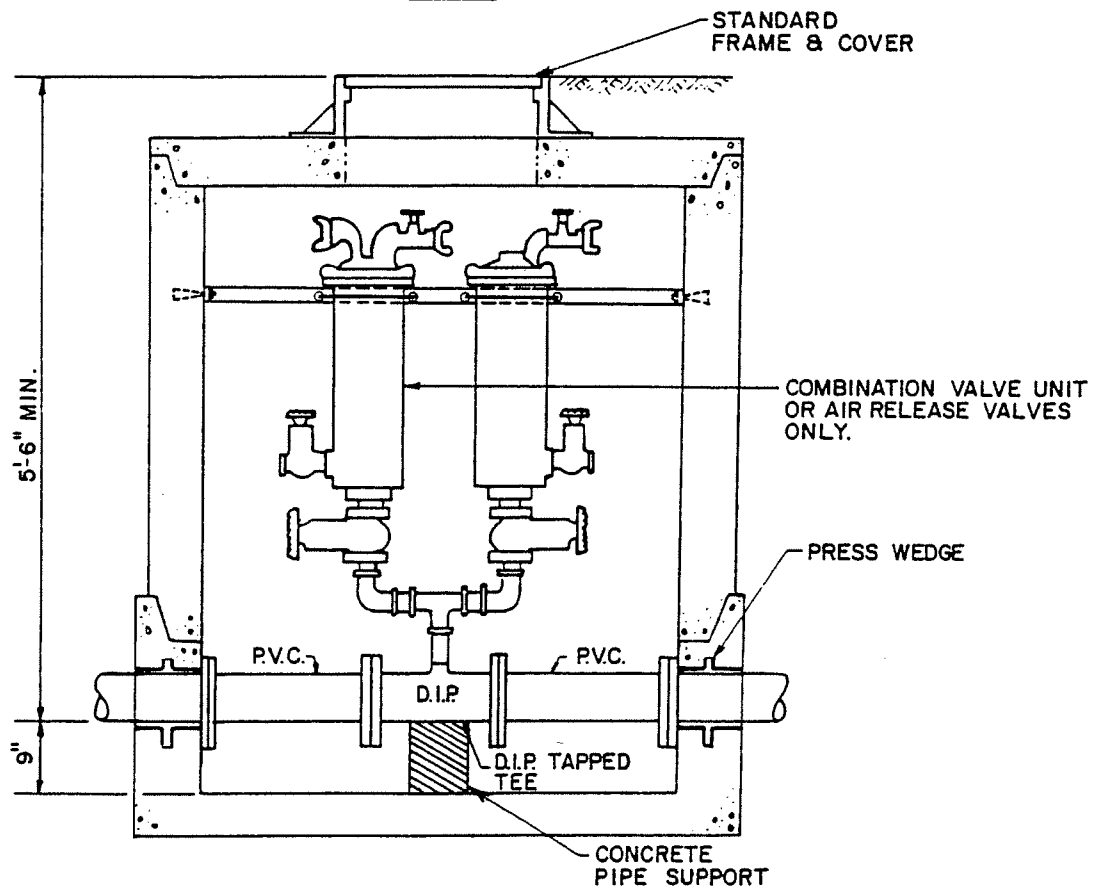
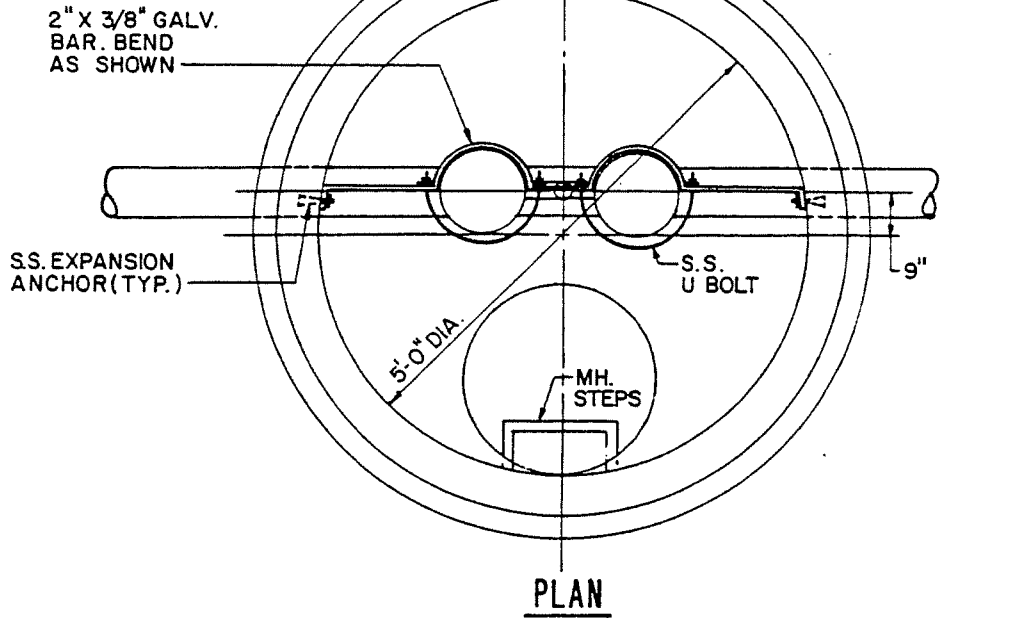
AIR RELEASE JUNCTION CHAMBER (AJ)



JUNCTION CLEANOUT (JC)

PRESSURE WASTEWATER SEWER

NOTE: FASTENING HARDWARE
TO BE 304 STAINLESS
STEEL.



SECTIONAL ELEVATION

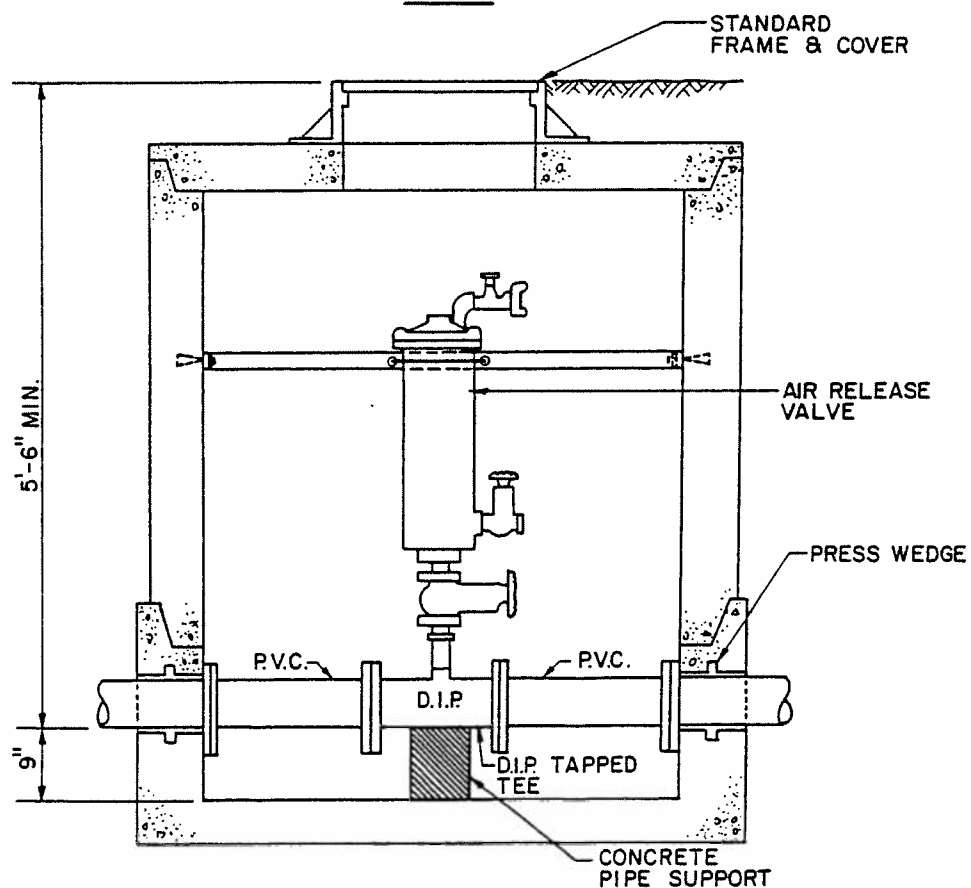
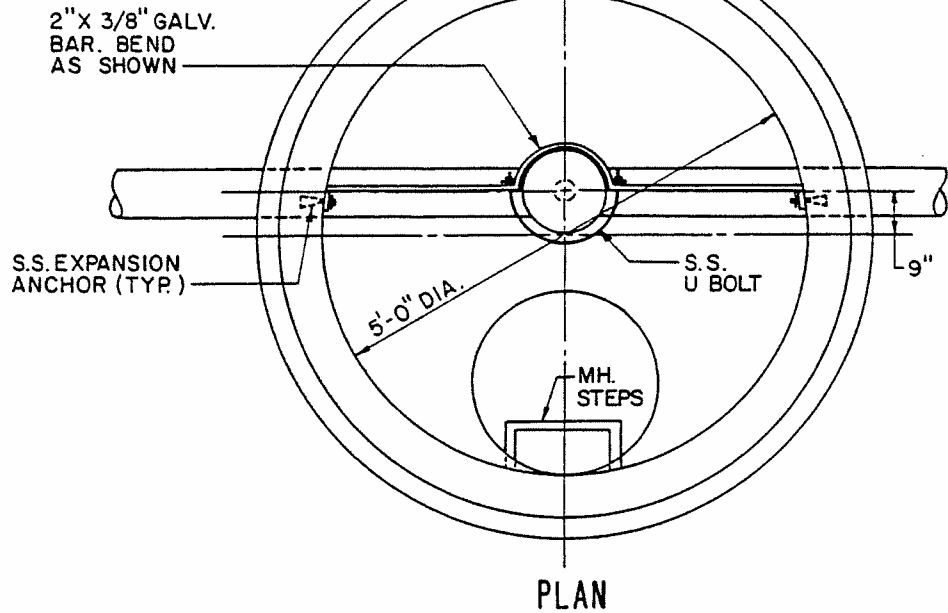
AIR RELEASE CHAMBER (AD)
PRESSURE WASTEWATER SEWER

GANNETT FLEMING

DWG. NO. A-35882

JUNE 1988

NOTE: FASTENING HARDWARE
TO BE 304 STAINLESS
STEEL.



AIR RELEASE CHAMBER (AS)
PRESSURE WASTEWATER SEWER

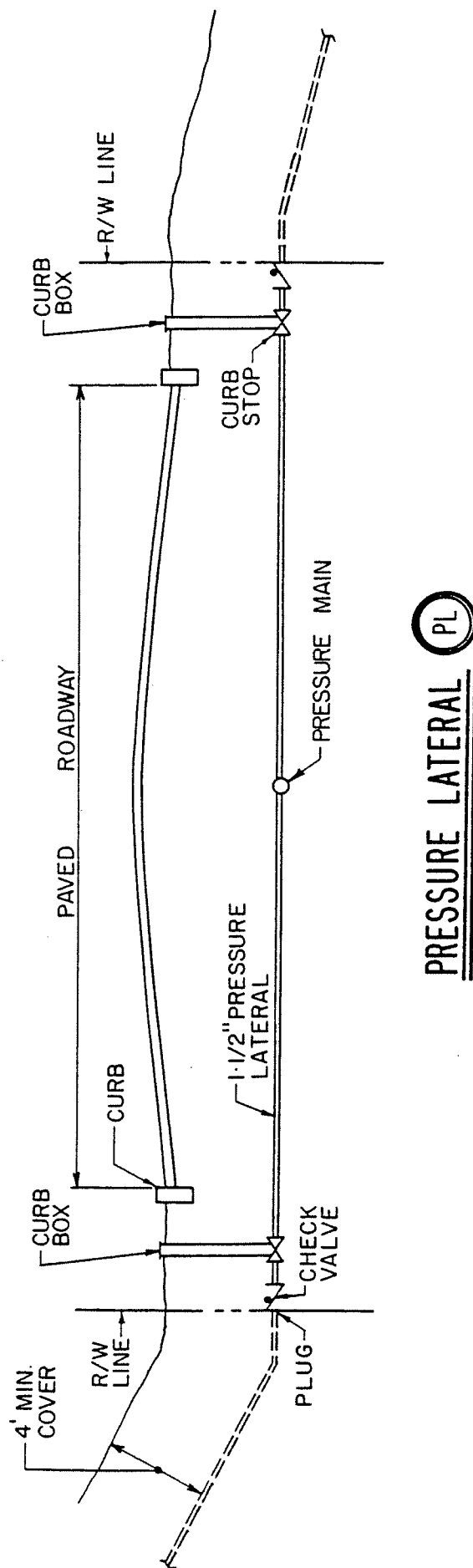
GANNETT FLEMING

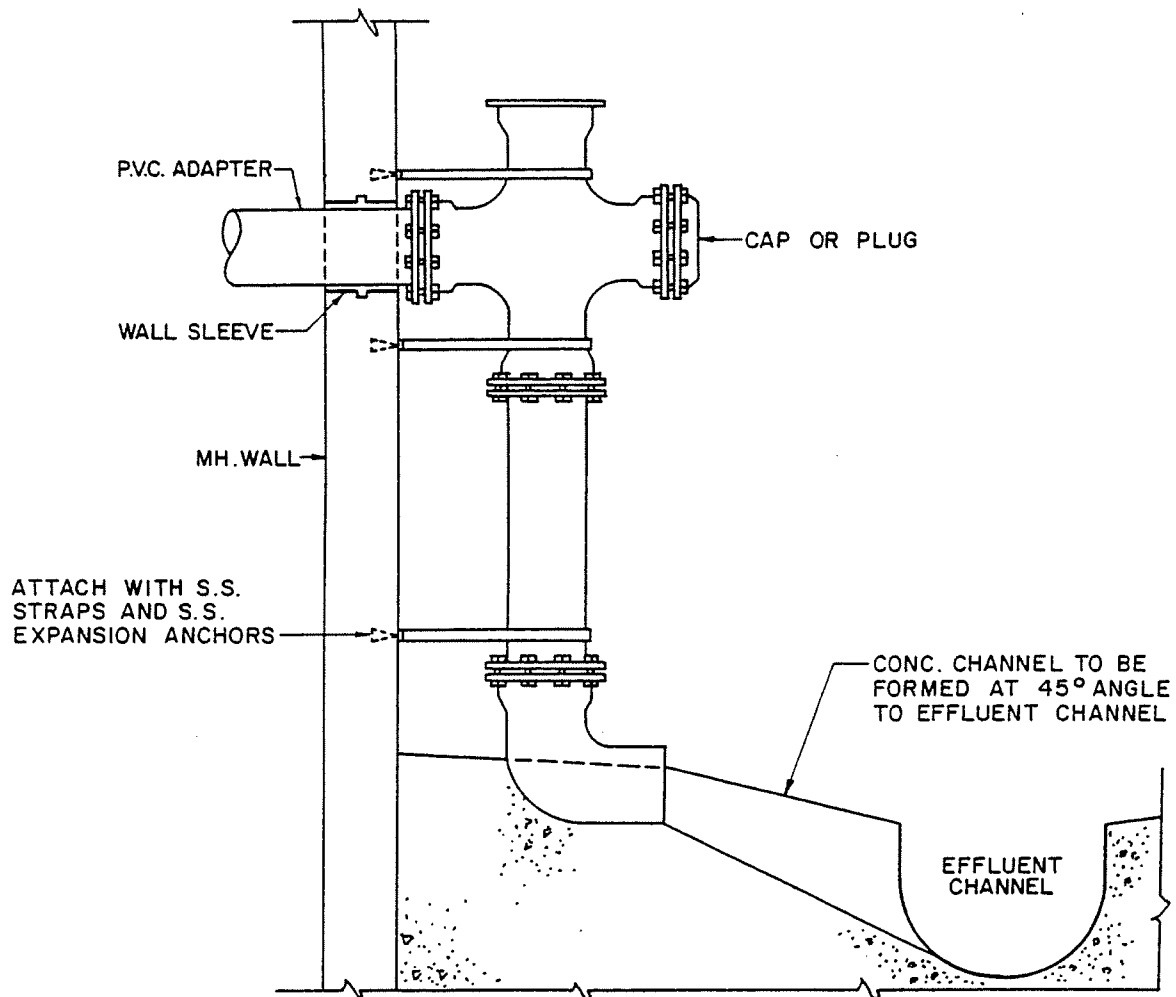
DWG. NO. A-35957

AUG. 1988

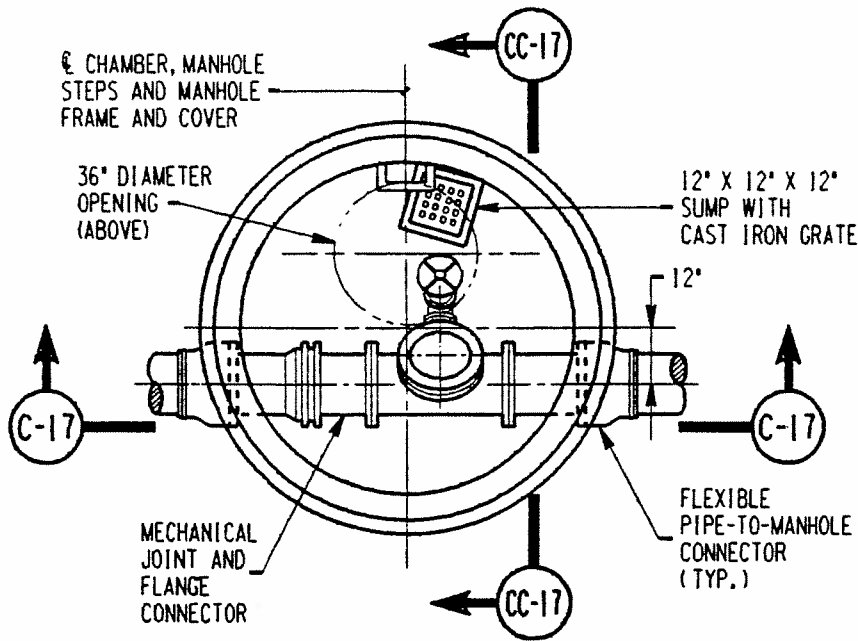
GANNETT FLEMING

DWG. NO. A-36174

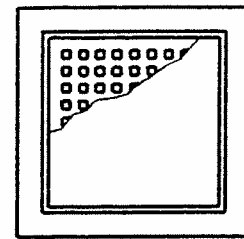




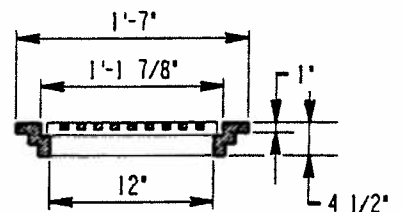
LOW PRESSURE
DROP CONNECTION (DC)



SECTIONAL PLAN



PLAN

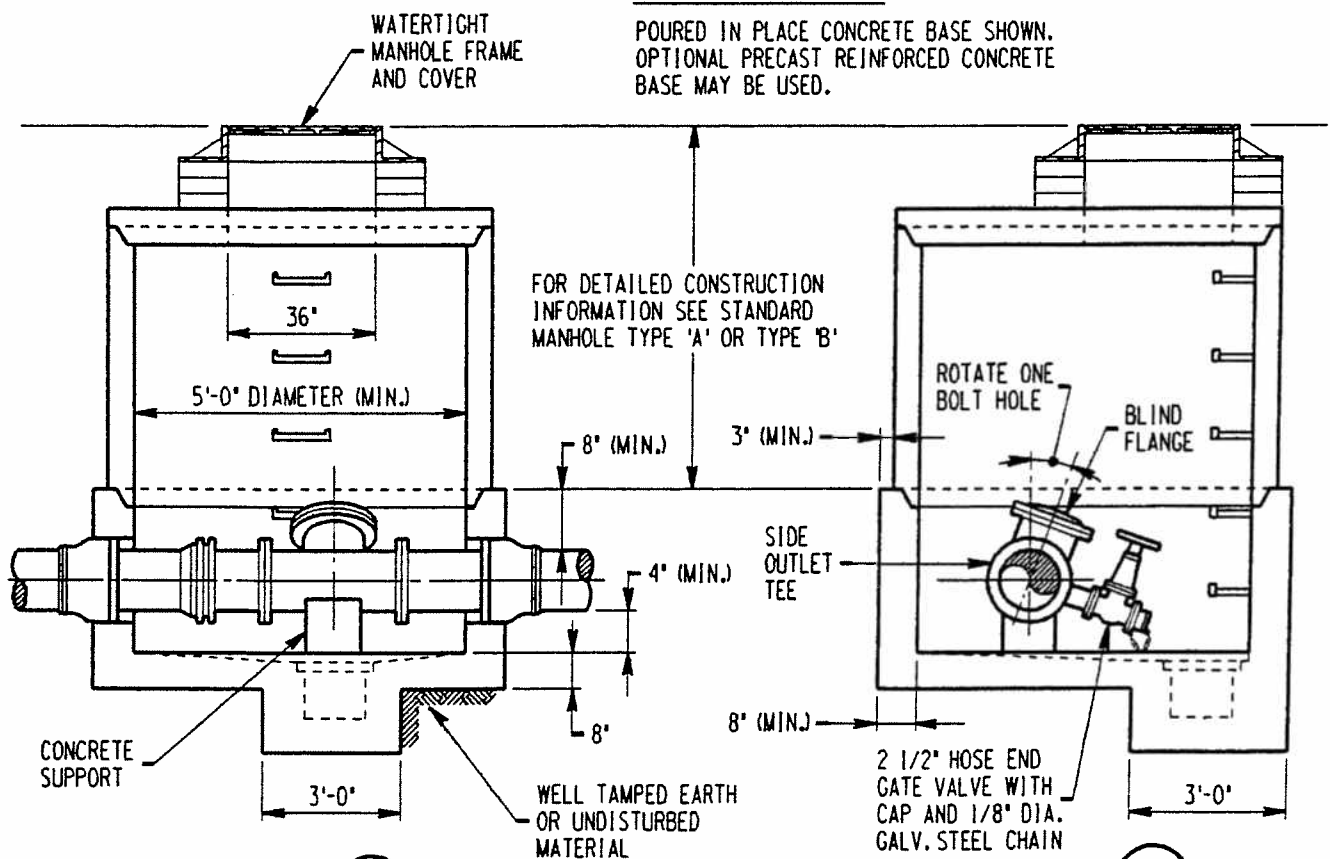


SECTIONAL ELEVATION

SUMP FRAME AND GRATE

CLEANOUT CHAMBER NOTE

POURED IN PLACE CONCRETE BASE SHOWN. OPTIONAL PRECAST REINFORCED CONCRETE BASE MAY BE USED.



SECTION C-17

SECTION CC-17

CLEANOUT CHAMBER



MISC7.dgn

MICRO-STATION

CLCH

CHAMBER, MANHOLE
STEPS AND MANHOLE
FRAME AND COVER

24" DIAMETER
OPENING
(ABOVE)

MANHOLE STEPS

12"

MECHANICAL
JOINT AND
FLANGE
CONNECTOR

FLEXIBLE
PIPE-TO-MANHOLE
CONNECTOR
(TYP.)

SECTIONAL PLAN

WATERTIGHT
MANHOLE FRAME
AND COVER

FOR DETAILED CONSTRUCTION
INFORMATION SEE STANDARD
MANHOLE TYPE 'A' OR TYPE 'B'

8" (MIN.)

4" (MIN.)

24"

5'-0" DIAMETER (MIN.)

AIR RELEASE VALVE

VACUUM VALVE
(WHEN REQUIRED)

POURED IN
PLACE
CONCRETE
BASE

CONCRETE
SUPPORT

8"

TAPPED TEE

WELL TAMPED EARTH OR
UNDISTURBED MATERIAL

SECTIONAL ELEVATION

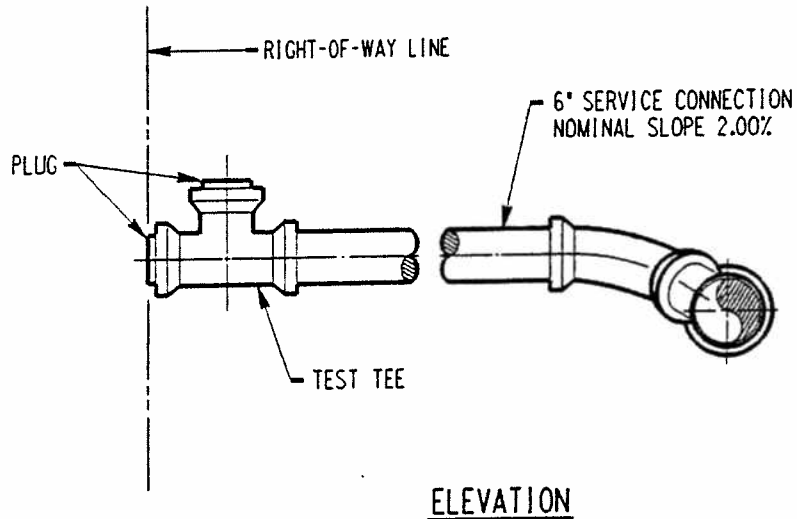
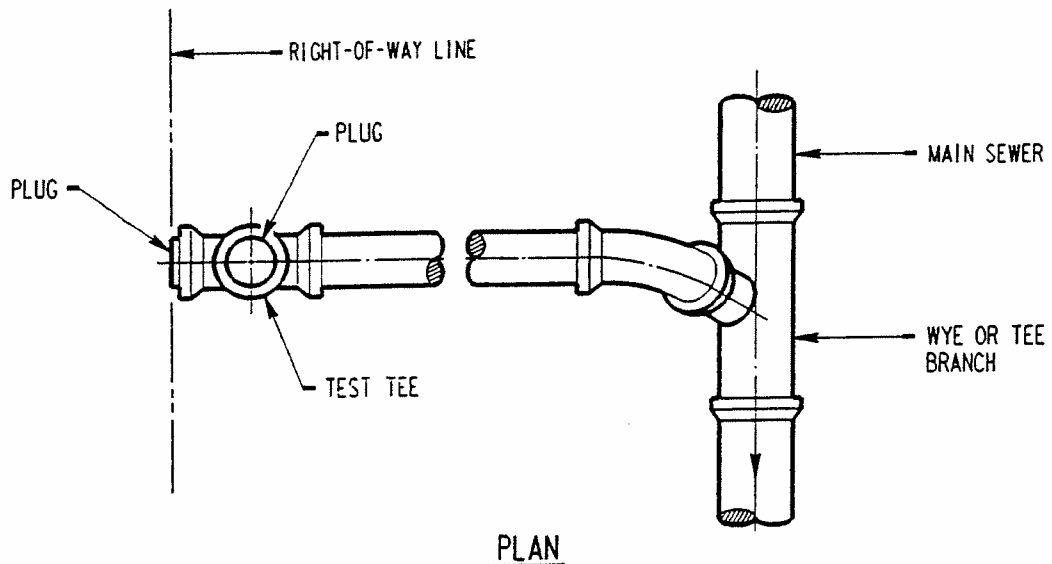
AIR RELEASE CHAMBER



MISC7.dgn

MICRO-STATION

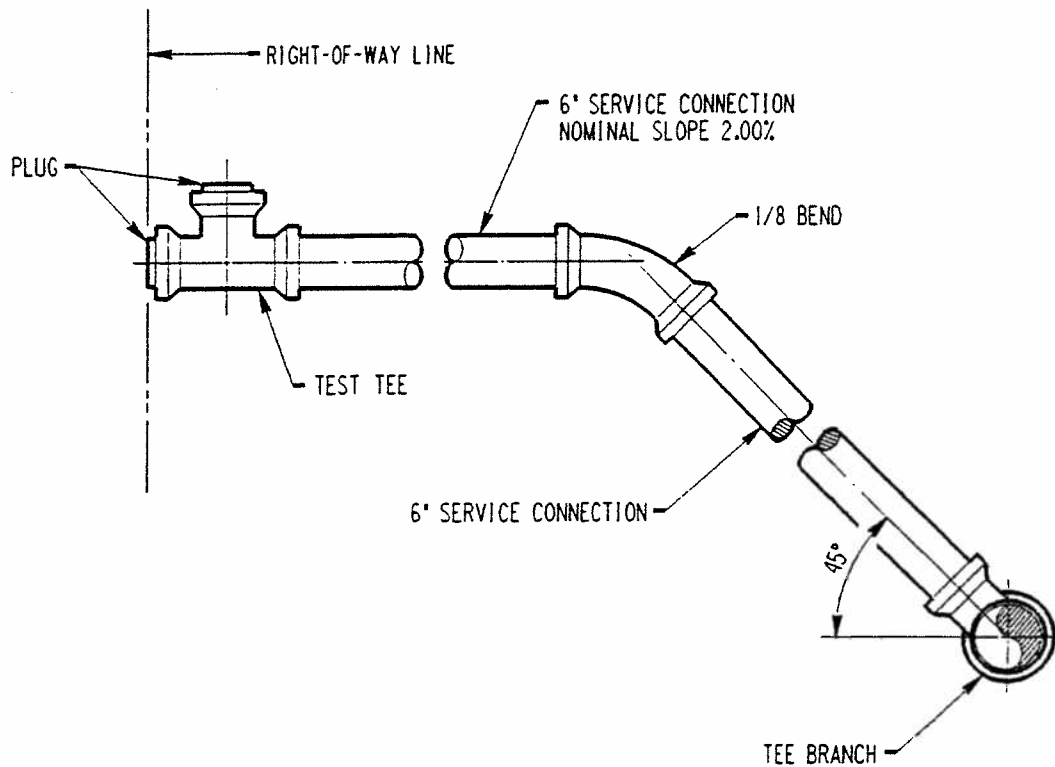
ARCH



SERVICE CONNECTION
SHALLOW SEWER

(S-35)

GANNETT FLEMING



ELEVATION

SERVICE CONNECTION
DEEP SEWER



MISC4.dgn

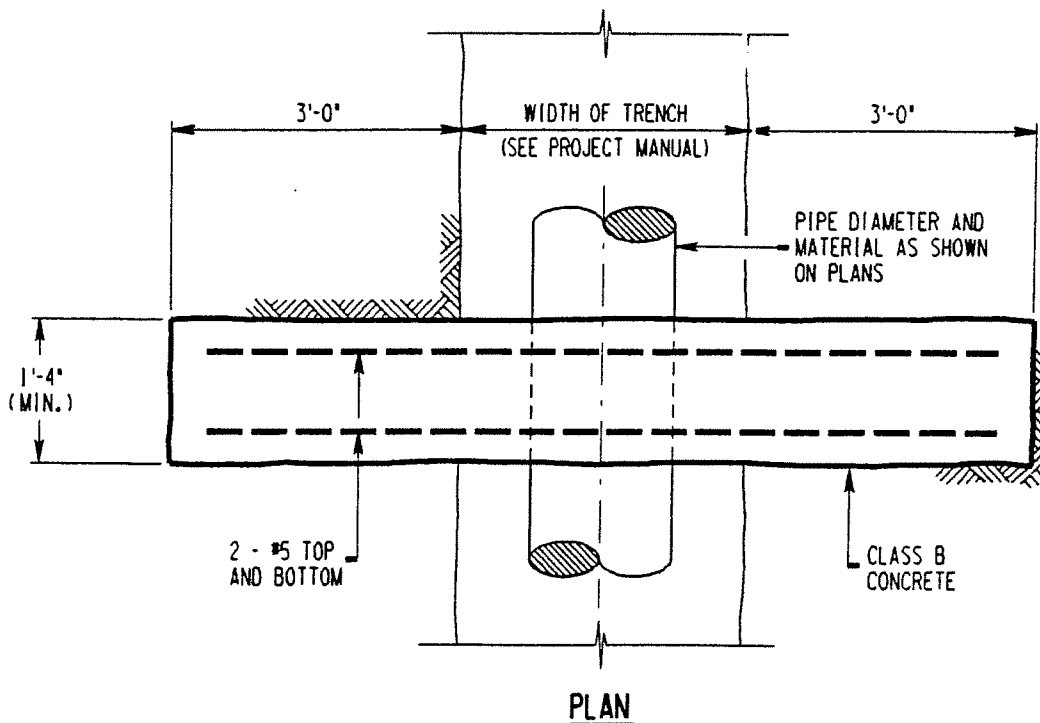
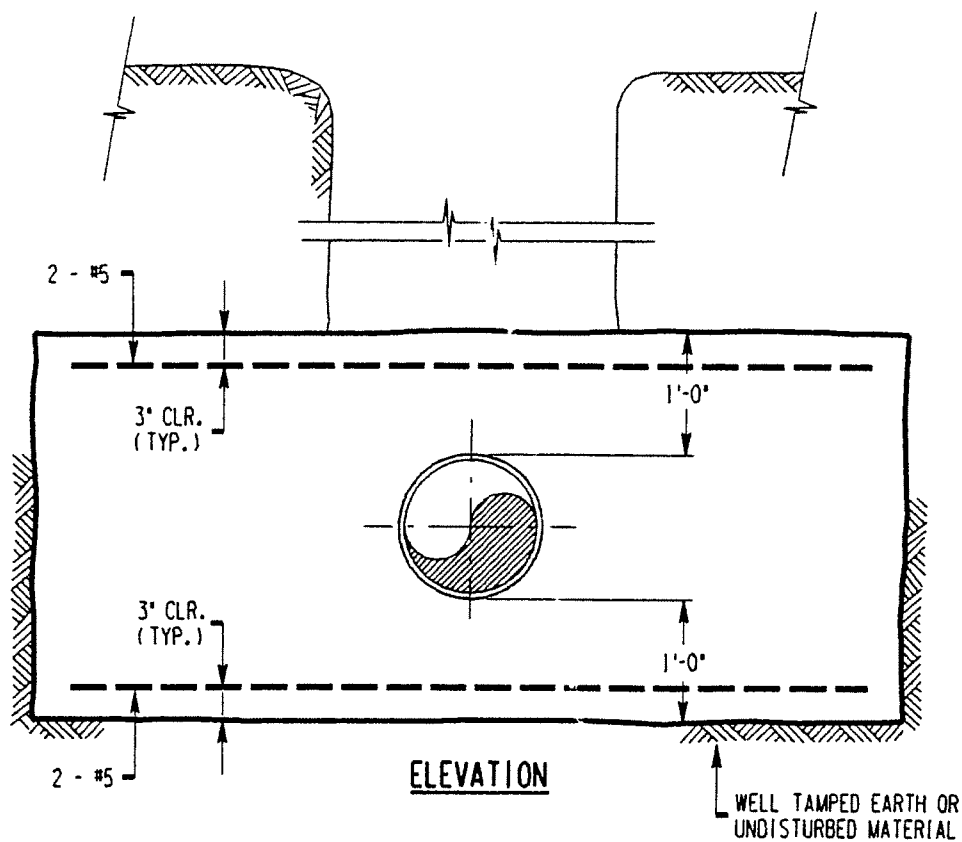
MICRO-STATION

SCONDS

MISC3.dgn

MICRO-STATION

CONANC



CONCRETE ANCHOR



GANNETT FLEMING

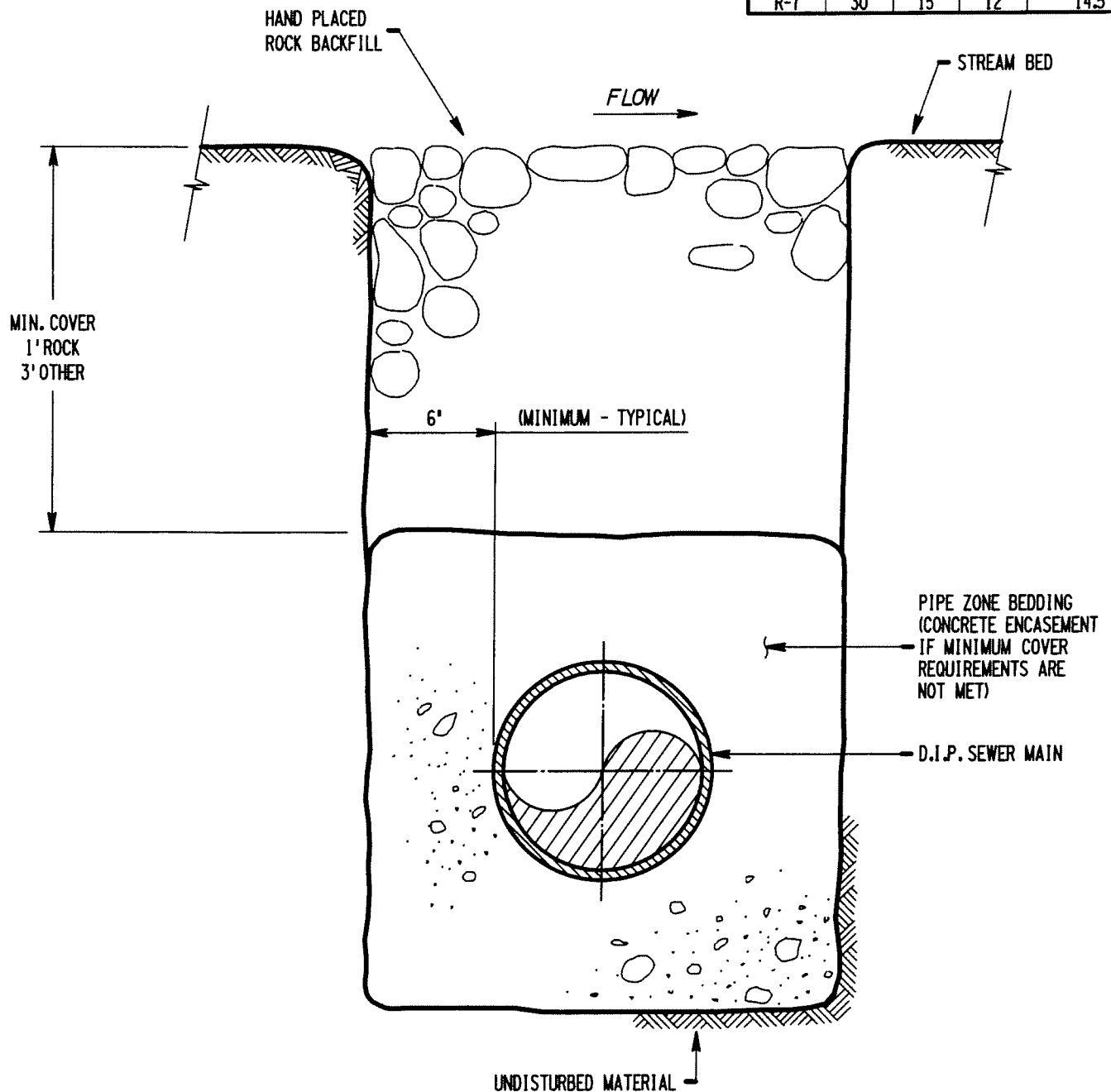
REV. MARCH 1993

18

DWG. No. A-28778

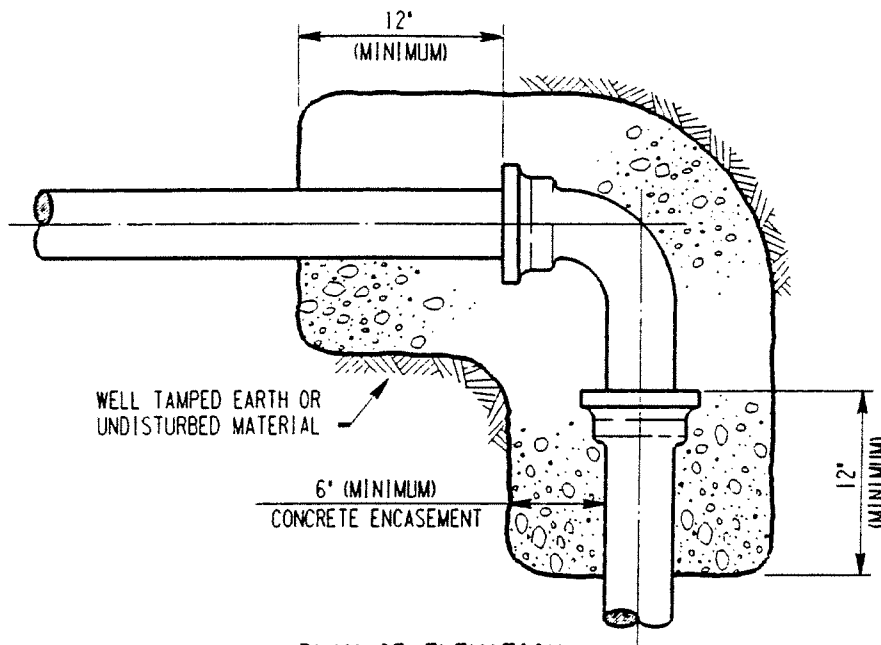
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 DATE: 18-Jul-2003 16:26
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MAXIMUM PERMISSIBLE VELOCITIES FOR ROCK LINED CHANNELS AND RIPRAP				
NSA No.	GRADED ROCK SIZE (IN.)			PERMISSIBLE VELOCITY FPS
	MAX.	D ₅₀	MIN.	
R-1	1.5	.75	No. 8	2.5
R-2	3	1.5	1	4.5
R-3	6	3	2	6.5
R-4	12	6	3	9.0
R-5	18	9	5	11.5
R-6	24	12	7	13.0
R-7	30	15	12	14.5



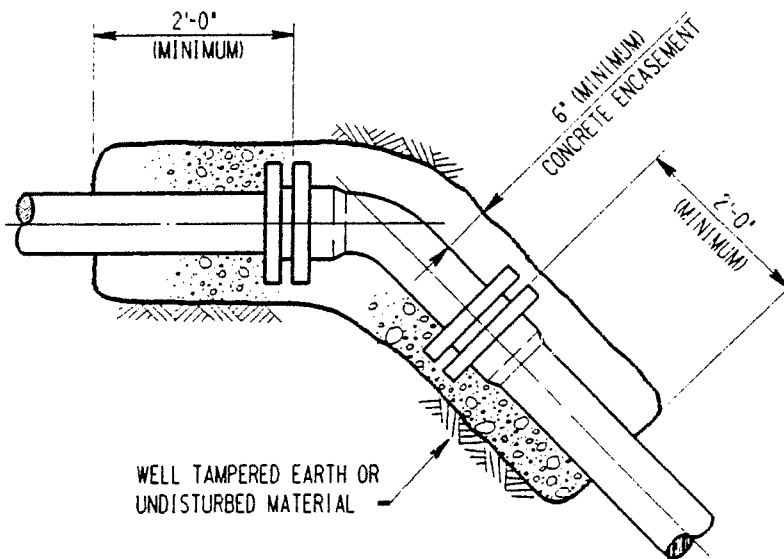
SECTIONAL ELEVATION
STREAM CROSSING (E-20)

GANNETT FLEMING



PLAN OR ELEVATION

TYPICAL GRAVITY LINE FITTINGS NOTED



PLAN OR ELEVATION

TYPICAL ALL PRESSURE LINE FITTINGS

CONCRETE THRUST BLOCKS

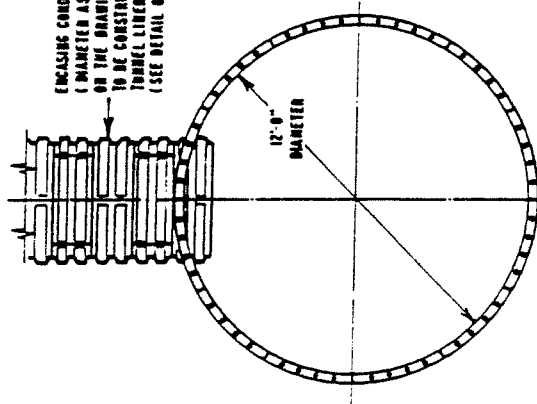


GANNETT FLEMING

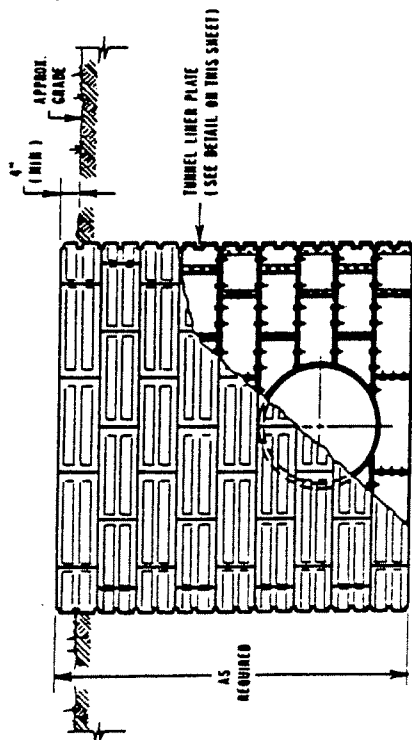
**TUNNEL WORK PIT
AND TUNNEL LINER PLATE**

PLAN

WP

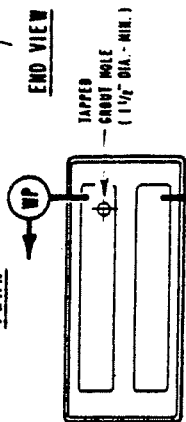


ELEVATION



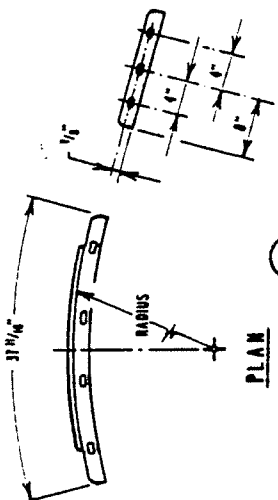
TUNNEL LINER PLATE DETAIL

FRONT VIEW

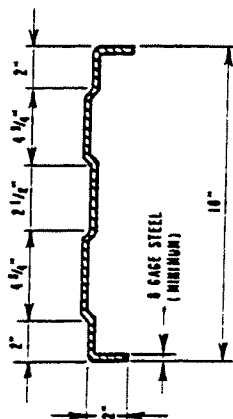


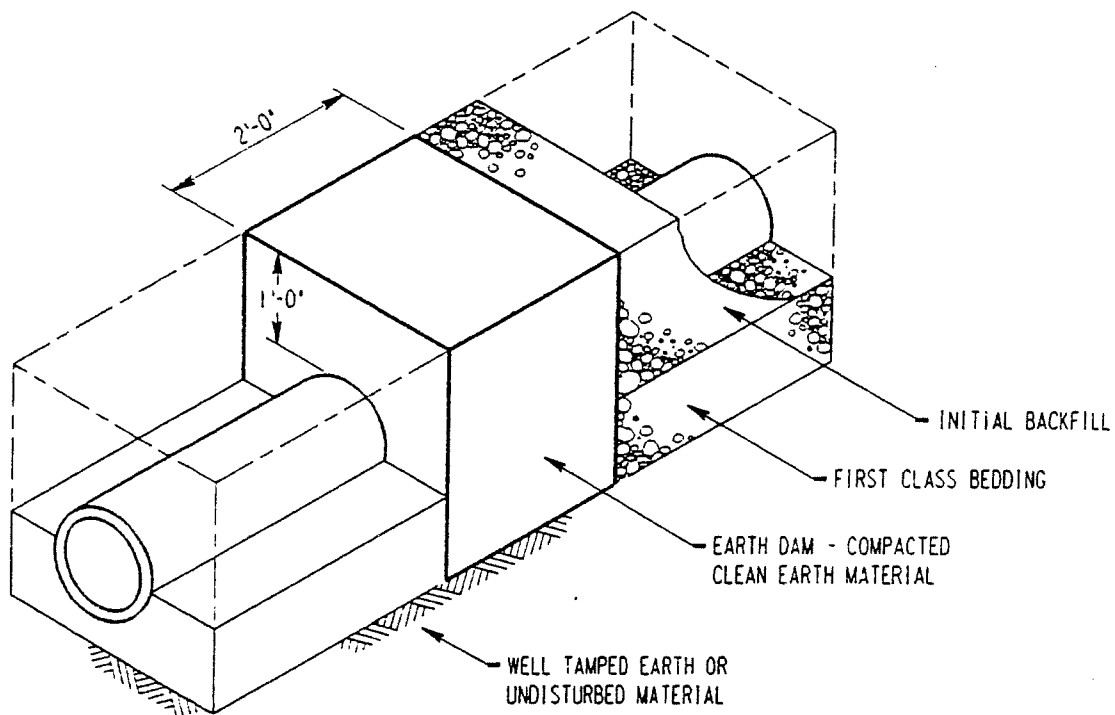
PLAN

END VIEW



SECTION WP





ISOMETRIC VIEW

EARTH DAM



GANNETT FLEMING

REV. JULY 1989

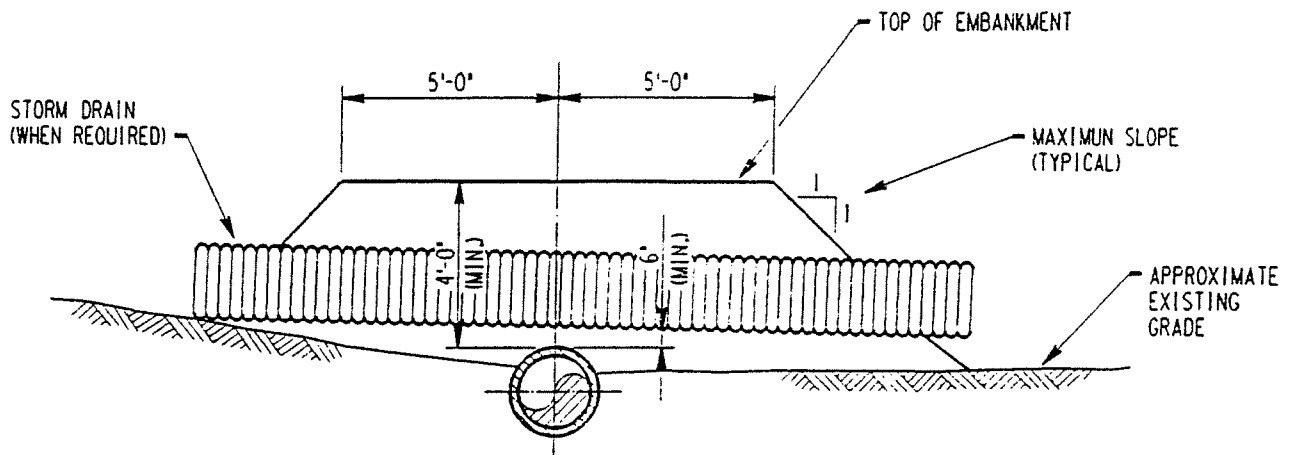
33

DWG. No. A-28777

MISC.dgn

MICRO-STATION

ERTHDA



SECTIONAL ELEVATION

EMBANKMENT



MISC2.dgn

MICRO-STATION

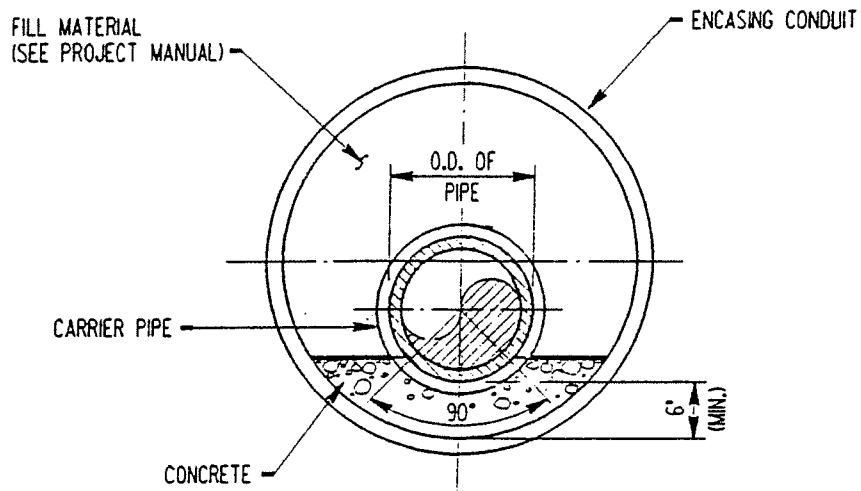
EMBANK

GANNETT FLEMING

REV. AUGUST 1990

34

DWG. No. A-23528



SECTIONAL ELEVATION

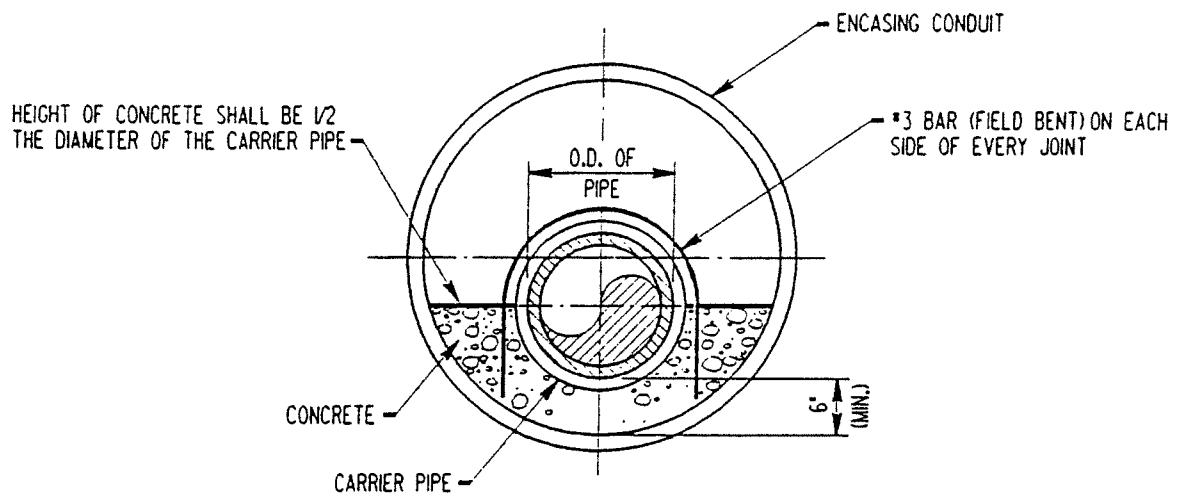
ENCASING CONDUIT

(E-8)

MISC2.dgn

MICRO-STATION

ENCOND

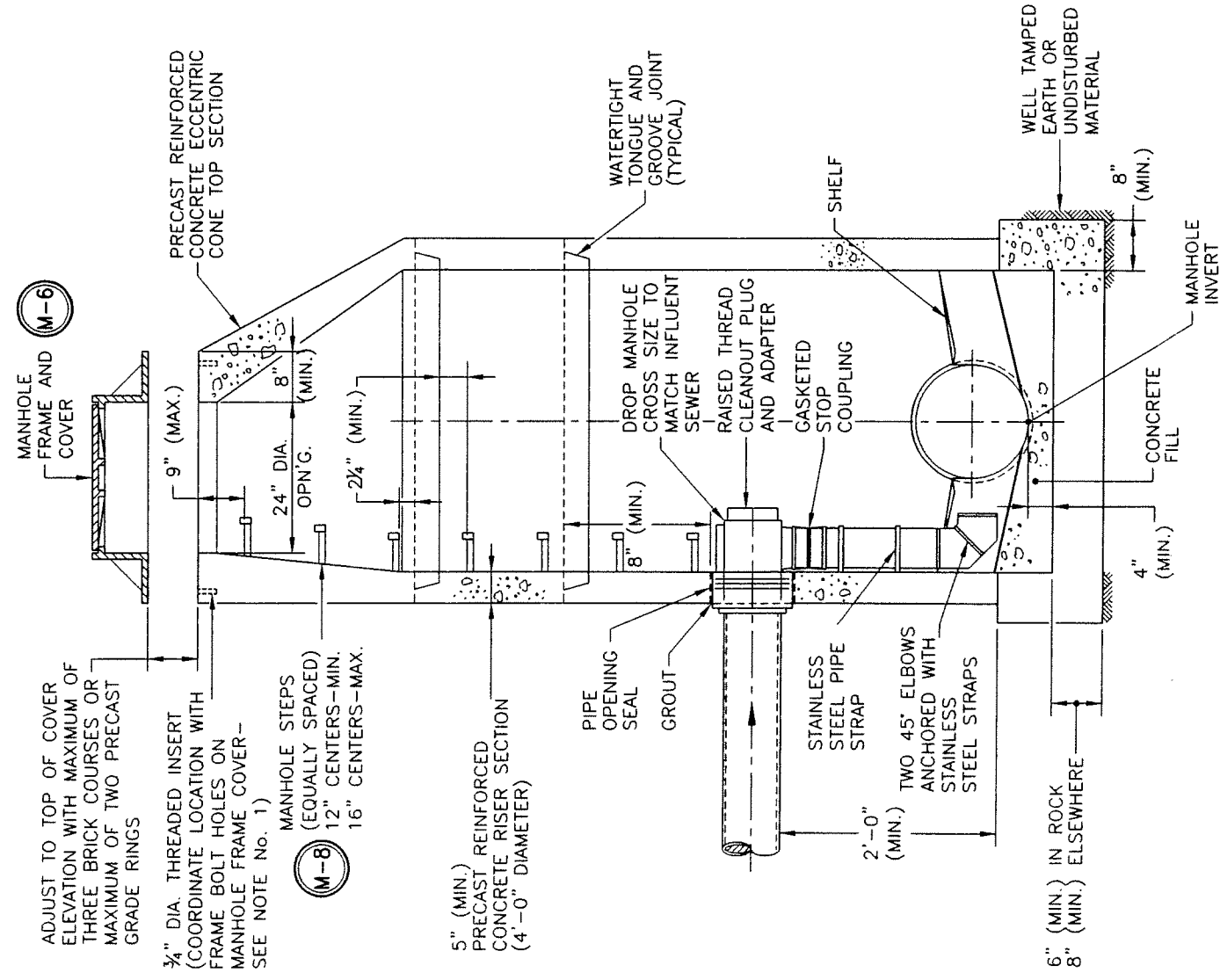


SECTIONAL ELEVATION

ENCASING CONDUIT (E-9)
(ANCHORED)

ECO:DA MICRO-STATION MISC2.dgn

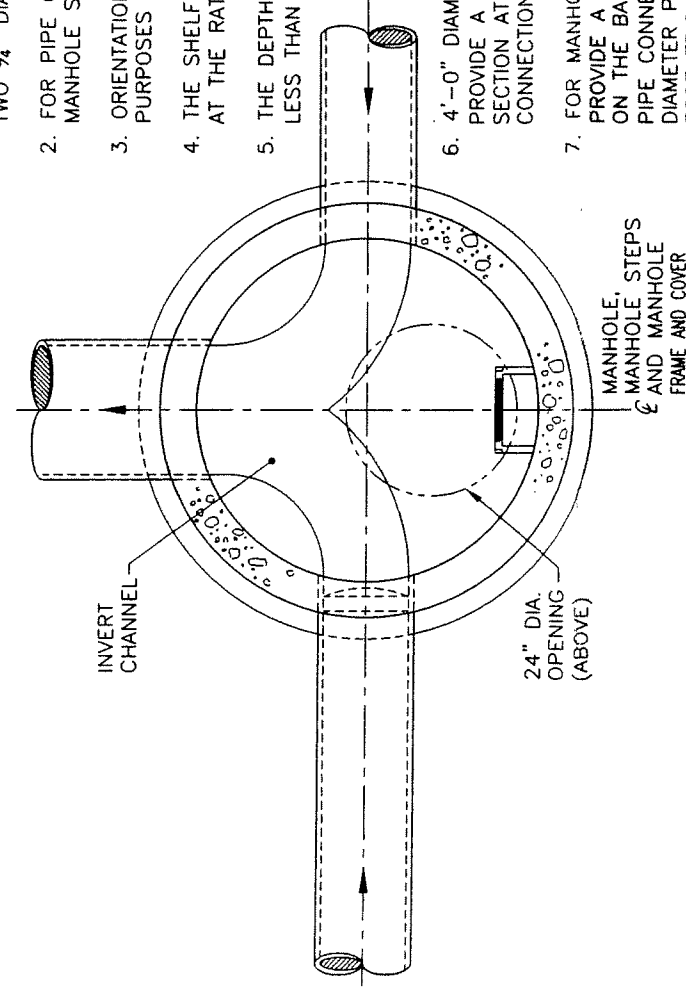
GANNETT FLEMING



SECTIONAL ELEVATION

DROP MANHOLE-TYPE "A" NOTES

1. MANHOLE FRAME TO BE BOLTED IN PLACE WITH TWO 3/4" DIA. BOLTS AND FLAT WASHERS.
2. FOR PIPE CONNECTION TO CONCRETE BASE, SEE MANHOLE SECTION OF THE PROJECT MANUAL.
3. ORIENTATION OF PIPES SHOWN FOR ILLUSTRATION PURPOSES ONLY. FOR ACTUAL LOCATIONS SEE PLANS.
4. THE SHELFF SHALL SLOPE TOWARD THE INVERT CHANNEL AT THE RATE OF 1" PER FOOT (MINIMUM)
5. THE DEPTH OF THE INVERT CHANNEL SHALL BE NOT LESS THAN 3/4 OF THE DIAMETER OF THE PIPE.
6. 4'-0" DIAMETER BASE SHOWN. FOR 5'-0" DIAMETER BASE, PROVIDE A 5'-0" TO 4'-0" ECCENTRIC CONE REDUCING SECTION AT THE FIRST JOINT ABOVE THE UPPERMOST PIPE CONNECTION TO WALL.
7. FOR MANHOLES HAVING A 6'-0" DIAMETER BASE OR LARGER, PROVIDE A FLAT SLAB TOP WITH A 4'-0" DIAMETER OPENING ON THE BASE AT THE FIRST JOINT ABOVE THE UPPERMOST PIPE CONNECTION TO WALL FOR INSTALLATION OF THE 4'-0" DIAMETER PRECAST REINFORCED CONCRETE RISER SECTION OR ECCENTRIC CONE TOP SECTION.
8. FOR LENGTH OF PIPE CONNECTIONS TO MANHOLES, SEE MANHOLE SECTION OF THE PROJECT MANUAL.
9. FINISHED GRADE SHALL BE FLUSH WITH TOP OF COVER ON MANHOLE FRAME AND COVER UNLESS OTHERWISE NOTED.

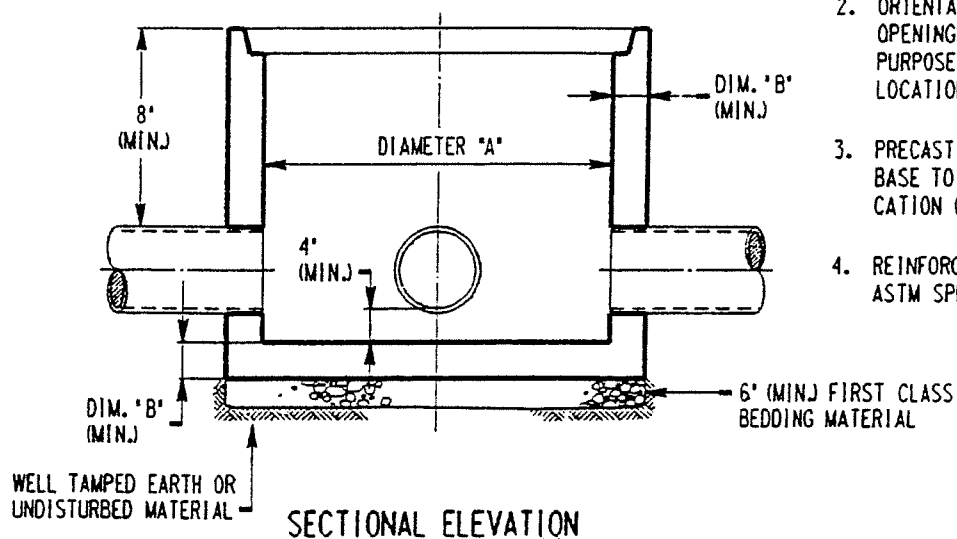


SECTIONAL PLAN THRU BASE

DROP MANHOLE-TYPE "A"
(INTERIOR DROP)

M-2

PRECAST REINFORCED CONCRETE MANHOLE BASE SCHEDULE OF DIMENSIONS	
DIA. 'A'	DIM. 'B'
4'-0"	5'
5'-0"	6'
6'-0"	7'
7'-0"	8'
8'-0"	9'
10'-0"	10'

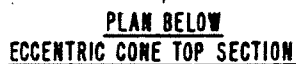


PRECAST REINFORCED CONCRETE MANHOLE BASE NOTES

1. FOR PIPE OPENINGS THRU PRECAST REINFORCED CONCRETE MANHOLE WALLS, SEE MANHOLE SECTION OF THE PROJECT MANUAL.
2. ORIENTATION AND DIAMETER OF PIPE OPENINGS SHOWN FOR ILLUSTRATION PURPOSES ONLY. SEE PLANS FOR LOCATION AND DIAMETER.
3. PRECAST REINFORCED CONCRETE MANHOLE BASE TO CONFORM TO ASTM SPECIFICATION C-478.
4. REINFORCING STEEL TO CONFORM TO ASTM SPECIFICATION A-185.

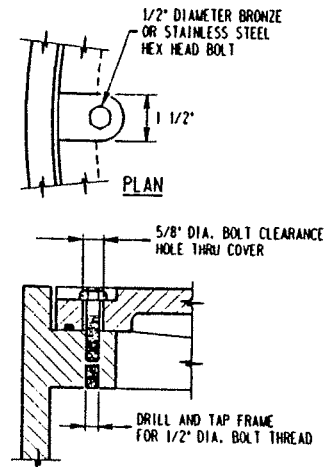
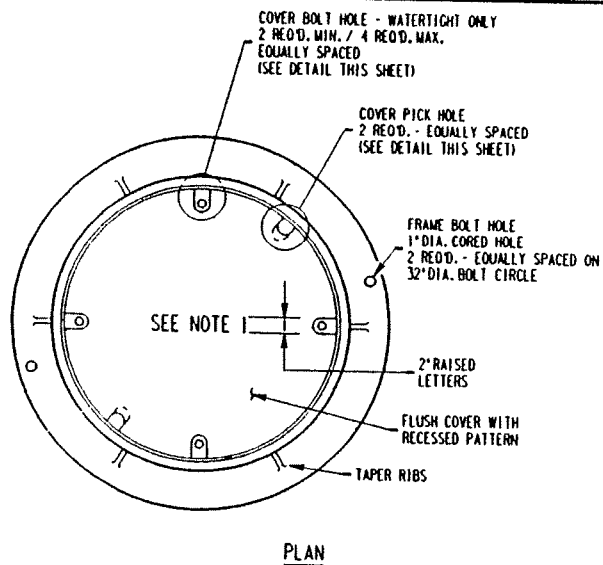
PRECAST REINFORCED CONCRETE MANHOLE BASES

(M-3)



- 漢

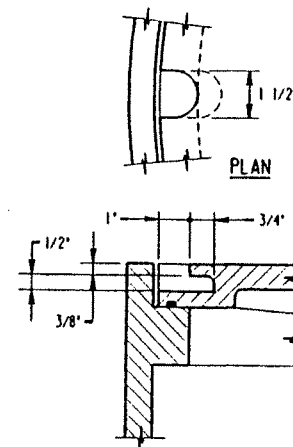




SECTIONAL ELEVATION

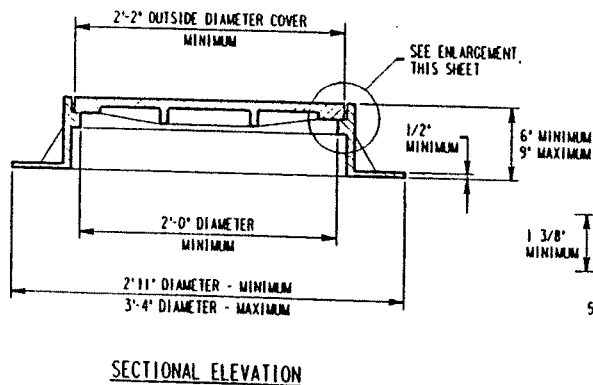
COVER BOLT HOLE

REQUIRED ONLY ON MANHOLES DESIGNATED TO HAVE "WATERTIGHT" COVERS

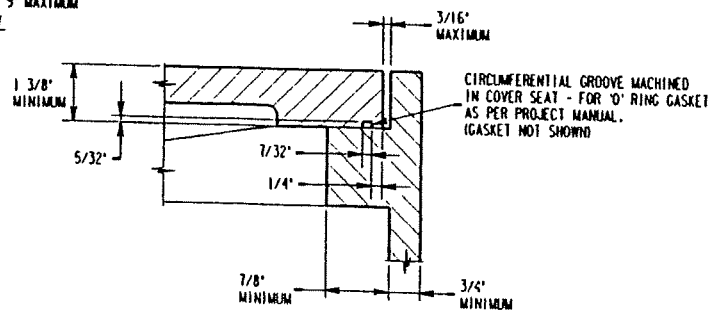


SECTIONAL ELEVATION

COVER PICK HOLE



SECTIONAL ELEVATION



ENLARGEMENT

MANHOLE FRAME AND COVER NOTES

1. SEE PROJECT MANUAL FOR LETTERING AND SIZE.
2. ALL MANHOLE FRAMES AND COVERS SHALL BE FOR HEAVY DUTY TRAFFIC, AASHTO HIGHWAY LOADING CLASS HS-20.

STANDARD AND WATERTIGHT MANHOLE FRAME AND COVER

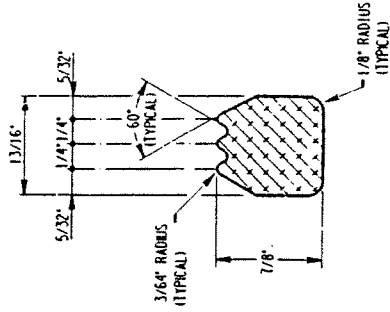
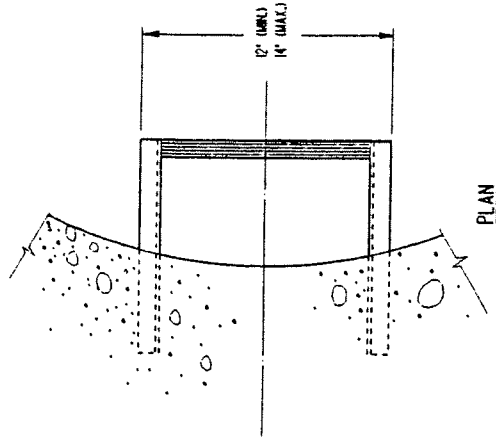
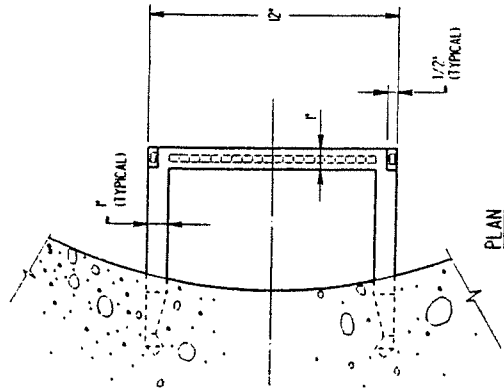
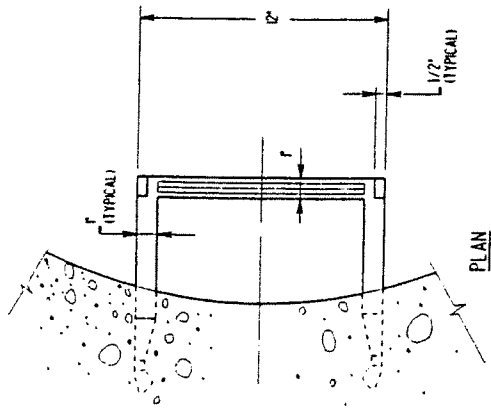
(M-6)

REV. JULY 1989

GANNETT FLEMING

67A

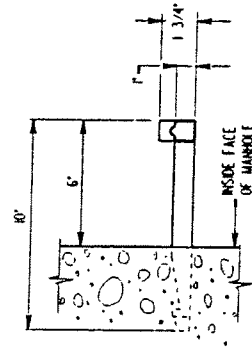
DWG. No. A-27056-A



TYPICAL SECTION THRU
ALUMINUM MANHOLE STEP

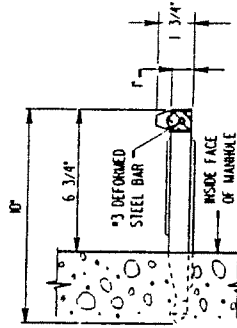
MANHOLE STEPS NOTE

PROVIDE A HEAVY COAT OF BITUMINOUS
PAINT ON ALUMINUM SURFACES IN
CONTACT WITH CONCRETE.



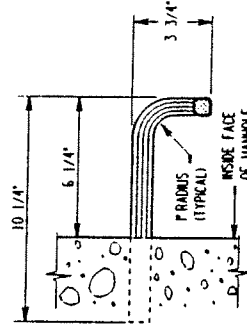
SECTIONAL ELEVATION

CAST IRON



SECTIONAL ELEVATION

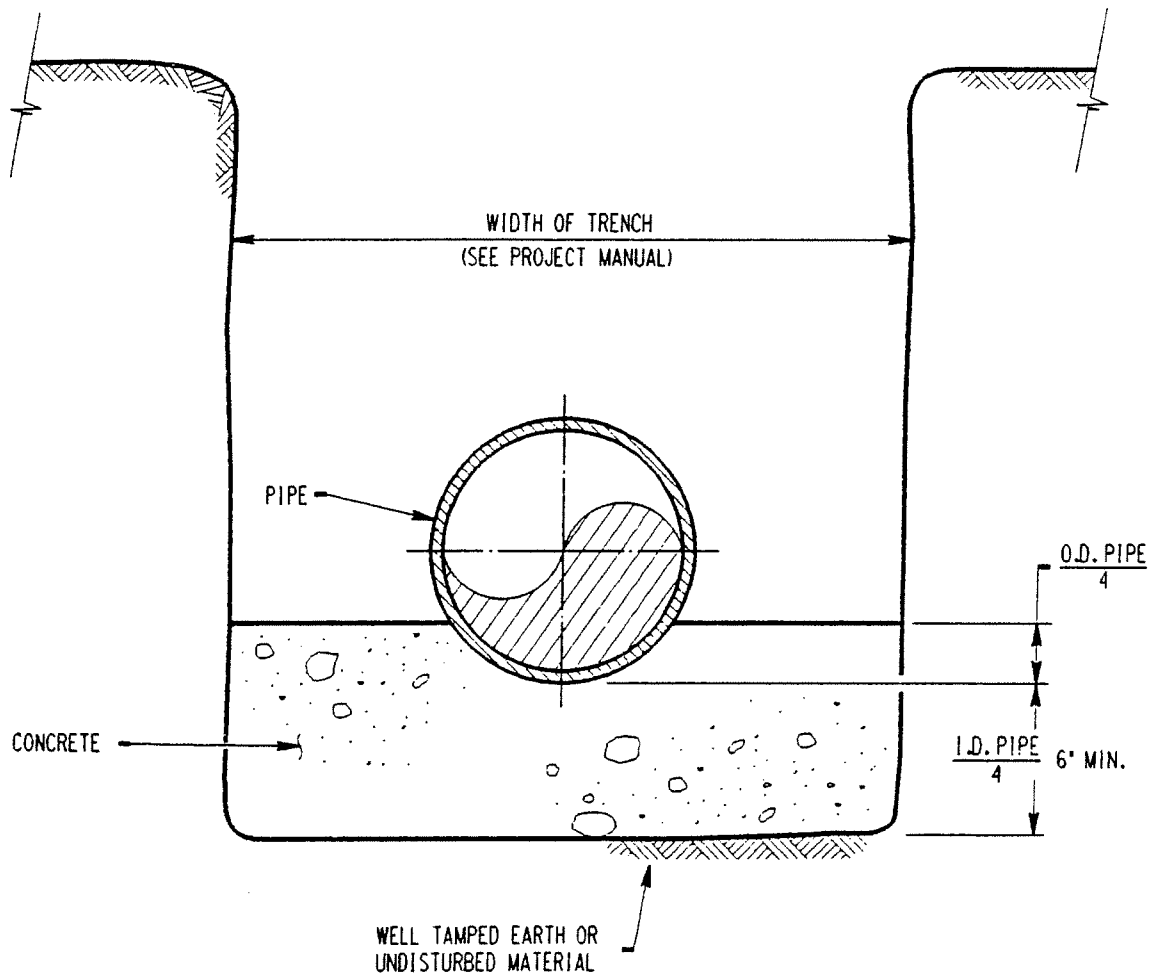
REINFORCED PLASTIC



SECTIONAL ELEVATION

ALUMINUM
ALLOY 6061-T6

MANHOLE STEPS (M-8)



SECTIONAL ELEVATION

CONCRETE CRADLE

(P-1)

PIPE BEDDING

MISC2.dgn

MICRO-STATION

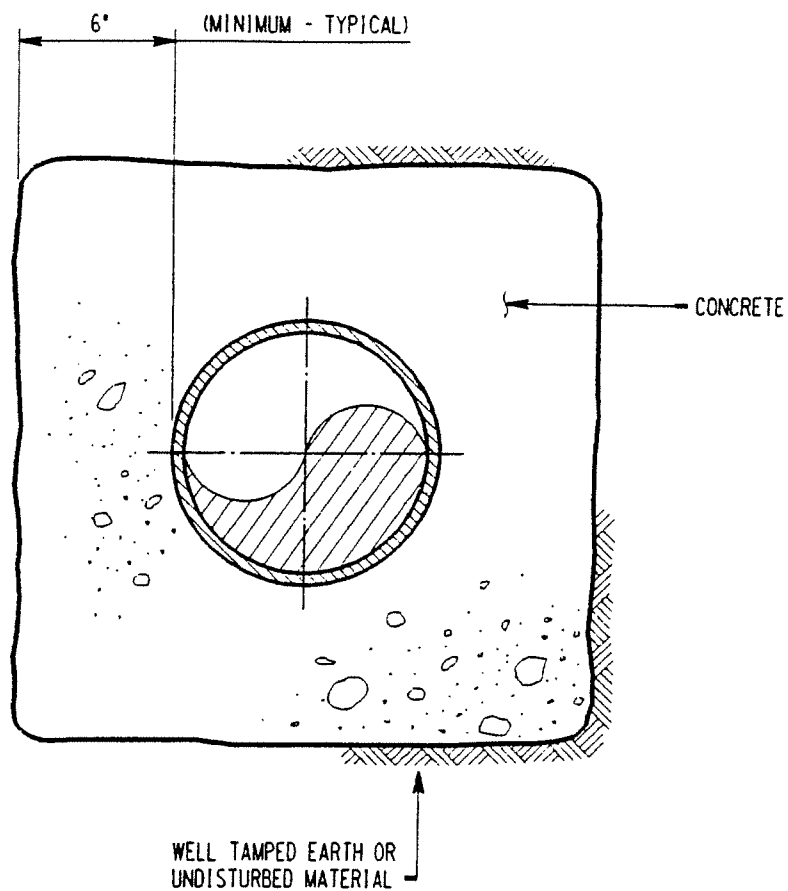
CONCRL

REV. JULY 1989

73

GANNETT FLEMING

DWG. No. A-27017



SECTIONAL ELEVATION

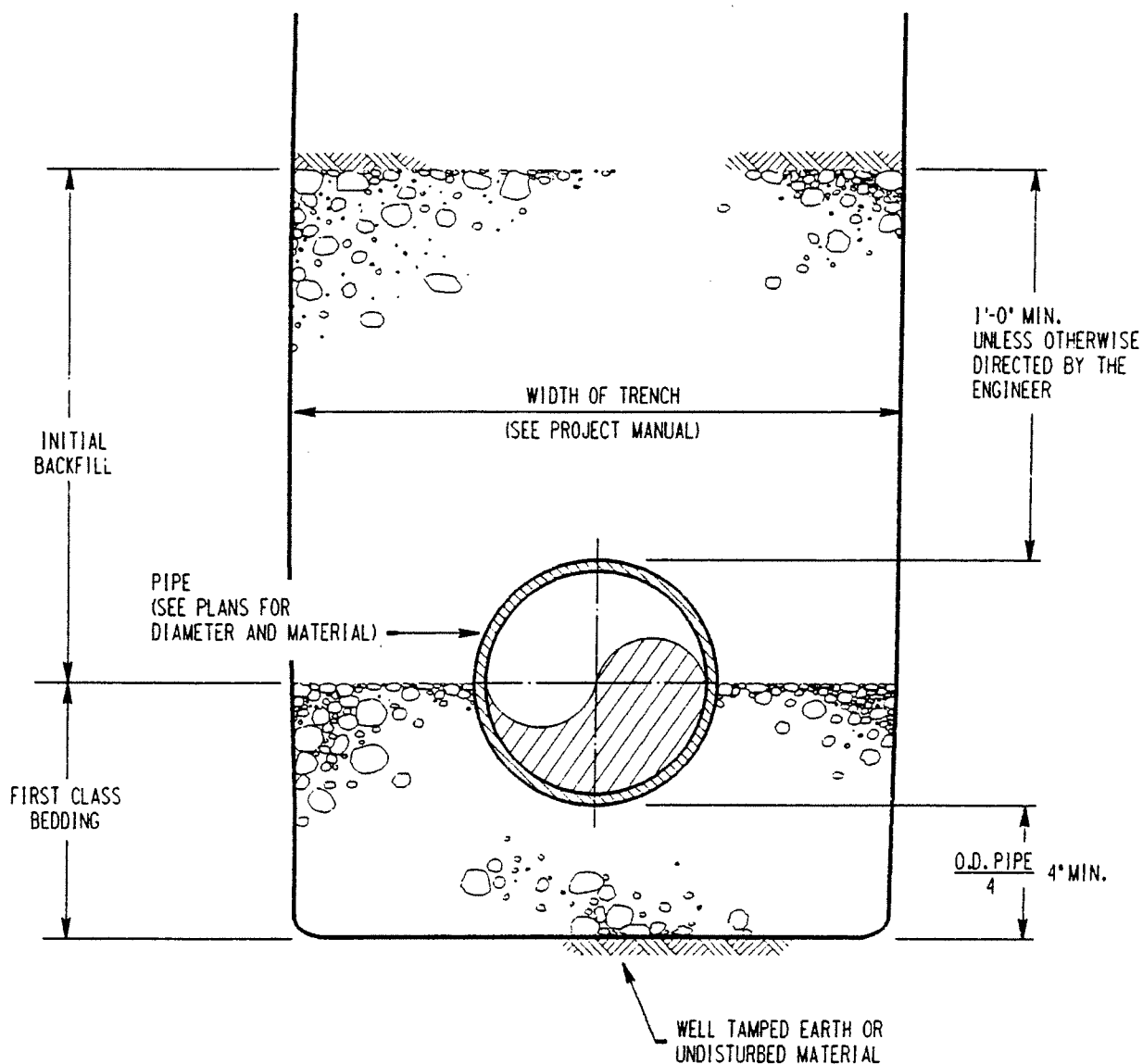
CONCRETE ENCASEMENT

(P-2)

MISC2.dgn

MICRO-STATION

CONENC



SECTIONAL ELEVATION

FIRST CLASS BEDDING
AND INITIAL BACKFILL

(P-3)

PIPE BEDDING

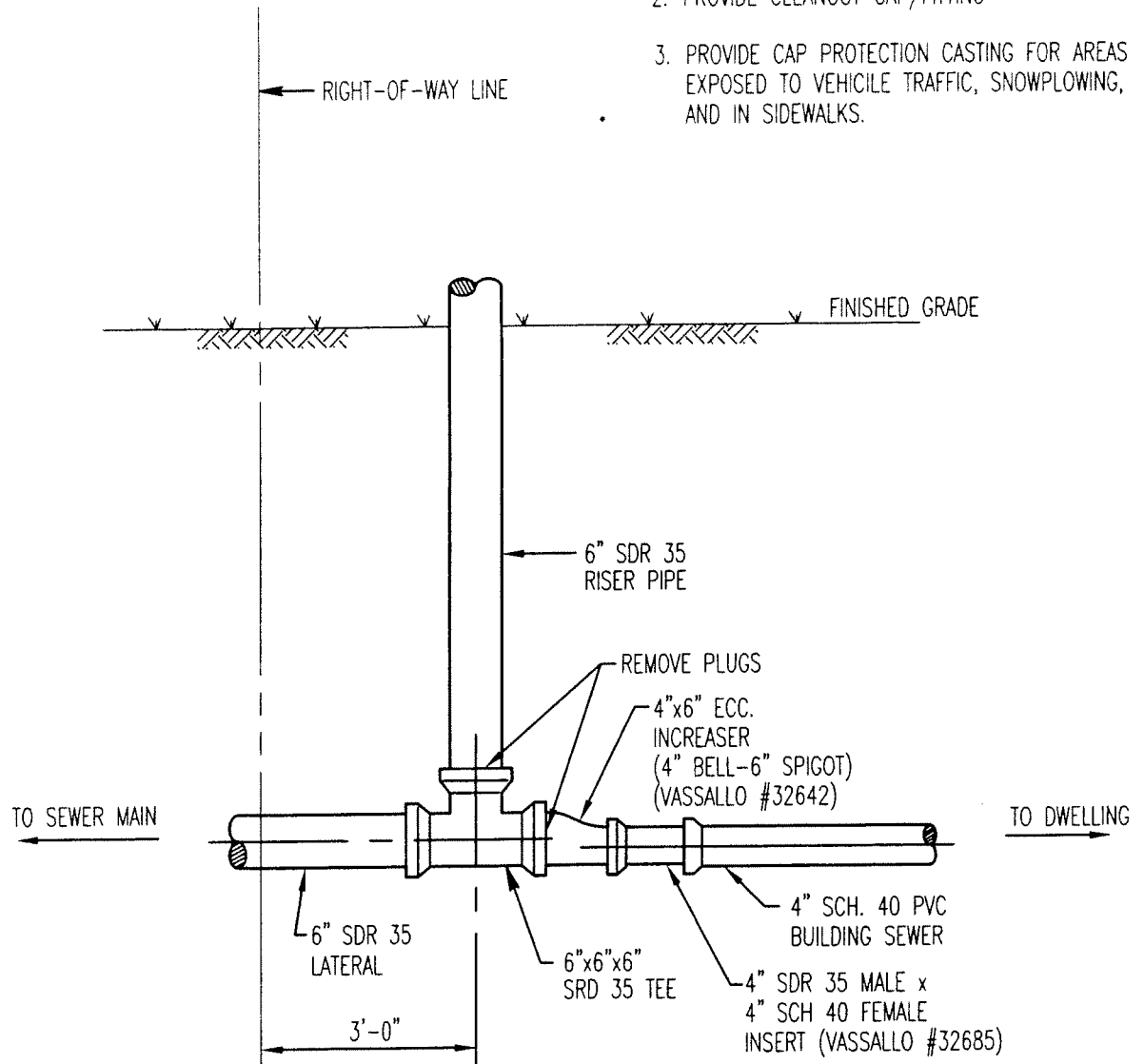
MISC2.dgn

MICRO-STATION

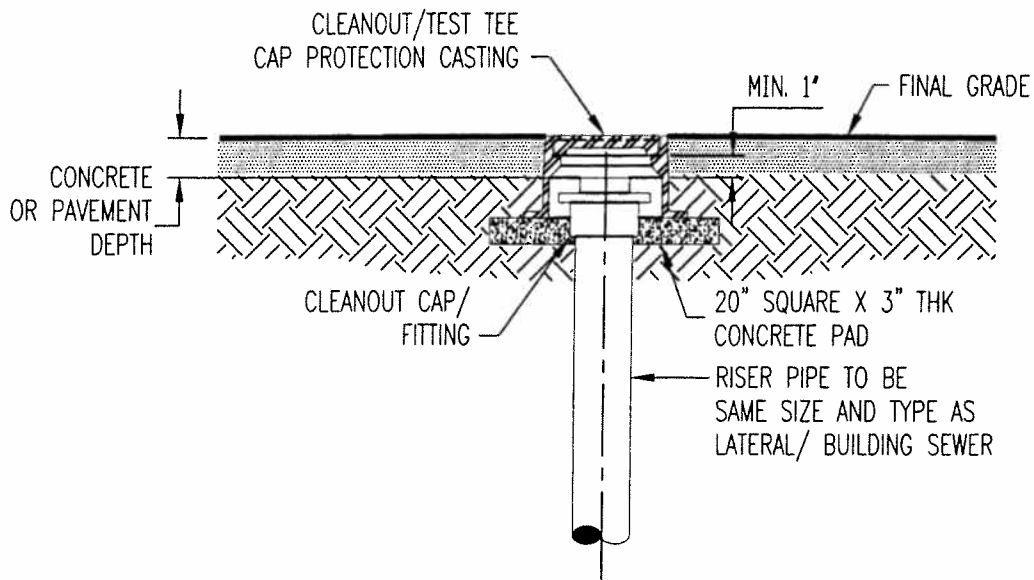
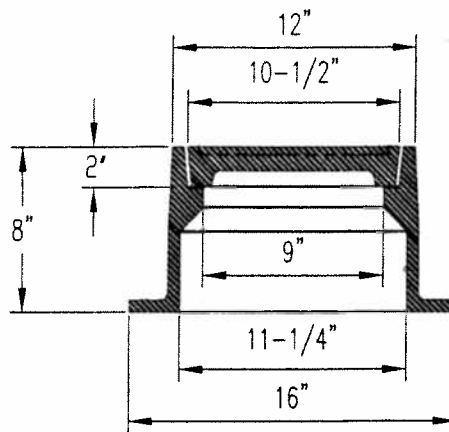
FICLBD

NOTES:

1. INSTALL RISER AFTER PERFORMING AIRTEST ON BUILDING SEWER.
2. PROVIDE CLEANOUT CAP/FITTING
3. PROVIDE CAP PROTECTION CASTING FOR AREAS EXPOSED TO VEHICLE TRAFFIC, SNOWPLOWING, AND IN SIDEWALKS.



INSPECTION RISER AND
BUILDING SEWER DETAIL



ELEVATION

CAP PROTECTION CASTING DETAIL FOR
AREAS EXPOSED TO VEHICULAR TRAFFIC,
SNOWPLOWING, AND IN SIDEWALKS