AQUA PENNSYLVANIA WASTEWATER COMPANY, INC.
762 West Lancaster Avenue
Bryn Mawr, Pennsylvania 19010

STANDARD SPECIFICATIONS FOR BUILDER WASTEWATER EXTENSION PIPELINE CONSTRUCTION

prepared by

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DETAILS

AQUA PENNSYLVANIA WASTEWATER COMPANY, INC.

BUILDER'S WASTEWATER EXTENSION AGREEMENT

This Agreement incorporates and is made up of the documents referenced herein, including:

BUILDER'S WASTEWATER EXTENSION AGREEMENT

EXHIBITS

1. Requirements for As Built Information
2. Specifications for Builder Wastewater Extension Pipeline
3. Form for Certification of Final Project Cost

ATTACHMENTS

A. Applications for Domestic Wastewater Service
B. Description and Plan of Extension Project
C. Preliminary Cost Estimate for Extension Project
D. Commitment and Release of Contractor
E. Assignment of Contractor's Warranty by Builder
F. Easements
G. Permits and Regulatory Approvals
H. Administrative Fee and Administrative Services
I. Value Added Fee and Value Added Services
J. Performance Bond or Irrevocable Letter of Credit
K. Insurance

EXTENSION:

BUILDER'S WASTEWATER EXTENSION AGREEMENT

THIS BUILDER'S WASTEWATER EXTENSION AGREEMENT is made as of August 4, 2008 by and between **AQUA PENNSYLVANIA WASTEWATER COMPANY, Inc.,** a Pennsylvania corporation, with its principal office at 762 W. Lancaster Avenue, Bryn Mawr, Pennsylvania 19010 (hereinafter referred to as "AQUA"), and **_____,** a Pennsylvania corporation with its principal office at _____ (hereinafter referred to as "Builder").

BACKGROUND

The Builder is the owner and developer, or the authorized representative of the owner or developer, of a certain real estate development known as _____ which is planned for approximately _____ residential units, and/or _____ commercial, industrial or other types of units located in _____ Township, _____ County, Pennsylvania (hereinafter referred to as "Development").

The Builder wishes to obtain wastewater service from AQUA, and AQUA wishes to provide wastewater service, for the Development.

The Builder wishes to take sole responsibility to furnish and install, at Builder's expense, and to contribute to AQUA, a wastewater system extension and related improvements for the Development.

The Builder has furnished a completed Attachment Package for Builder's Wastewater Extension Agreement (the "Package"). The information contained in the Package, all Attachments referred to in the Package, the final, executed documents for which forms are set forth in the Attachments, and all Exhibits to the Agreement, are incorporated into this Agreement.

The Builder represents that _____ will be the Contractor for the Extension Project under this Agreement (the "Contractor") and the parties acknowledge that the Contractor has certain binding obligations under this Agreement that inure to the benefit of AQUA as well as the Builder; the Builder is required to have the Contractor execute this Agreement for the purpose of having the Contractor acknowledge and agree to the terms and obligations imposed on the Contractor by this Agreement.

In the event that more than one Contractor is involved in the work of the Extension Project, then in such event the parties hereto acknowledge that the Package shall specifically delineate the various responsibilities between or among the Contractor which Builder acknowledges shall constitute, in the entirety, the Extension Project.

In consideration of the mutual covenants contained in this Agreement, and intending to be legally bound, the parties agree as follows:

A. OBLIGATIONS REGARDING THE MAIN EXTENSION

1. **Construction.** The Builder agrees and undertakes as its sole responsibility to design, furnish and install, at Builder's sole expense and in accordance with the terms and conditions of this Agreement, but not limited to, the sanitary sewer main, valve boxes, manholes and /covers, and service lines from the sanitary sewer main to the clean outs, and any restoration work, as further described in Attachment B to this Agreement (the "Extension Project"). The Builder is responsible for supplying all necessary materials and performing the installation in accordance with this Agreement.

2. **Commencement of Construction.** Builder may give notice of intention to commence construction on or after the execution of this Agreement by AQUA, and may commence construction not less than two (2) weeks after providing written notice.

3. **Contractor.**

(a) Qualifications. AQUA acknowledges that the Builder plans to have the work on the Extension Project performed by Contractor. The Builder will cause the Contractor to perform the work on the Extension Project in accordance with this Agreement. The Contractor must be on the current list of contractors, if applicable, which AQUA has pre-qualified as having sufficient experience to install all portions of the Extension Project. Builder must notify AQUA of any change of Contractor, and any new contractor must comply with all terms and obligations of this Agreement which apply to the Contractor, including without limitation this Section 3 and the insurance and indemnification provisions.

(b) Responsibility. Builder and the Contractor will be liable on a joint and severable basis to AQUA for failure to perform the Extension Project in compliance with this Agreement. The Builder will cause a copy of this Agreement to be attached to the contract between the Builder and the Contractor. The Builder will provide AQUA with a copy of the construction contract between the Builder and the Contractor. The Contractor is obligated directly to AQUA by signing and delivering to AQUA the Commitment and Release to Contractor in the form of Attachment D, which includes, without limitation, Contractor's agreements to indemnify AQUA, to maintain certain insurance coverage and, in performing work on the Extension Project, to be responsible for worksite safety and comply with all requirements contained in this Agreement and applicable laws and regulations.

4. **Conduct of Construction.**

(a) Progress. Builder agrees to proceed diligently to completion of construction of the Extension Project.

(b) As Built Information. Builder will provide accurate and complete as built information in accordance with Exhibit 1 ("As Built Information") concurrently with progress of

construction; will make the As Built Information available to the AQUA representative upon request of AQUA; and, will supply complete As Built Information to AQUA prior to or upon Contribution (as hereinafter defined) of the Extension Project.

(c) Worksite Responsibility. The Builder and the Contractor are responsible for the worksite, including the means and methods of construction, and safety precautions, procedures and programs. Builder will have an OSHA-competent person on-site at all times. AQUA shall have no duty to the employees or contractors of the Builder or Contractor for any safety aspects of the work. Under no circumstances shall AQUA be deemed to be responsible for the methods of construction or the safety precautions and procedures at the worksite, whether or not a AQUA representative is on site. Builder and Contractor are responsible for reviewing and executing all plans and changes in plans, construction methods and procedures, and changes in construction methods and procedures, whether or not required or reviewed by AQUA, so that work is conducted in a safe manner for the protection of anyone on or near the Extension Project.

(d) Compliance with Applicable Laws, Regulations and Specifications. The Builder will install and complete the Extension Project in a workmanlike manner, in accordance with this Agreement, all applicable laws, regulations and ordinances, including without limitation the Pennsylvania Underground Utility Protection Law (or any successor) and any regulations thereunder, general wastewater industry standards, environmental laws and regulations, and the AQUA specifications in effect for materials and for construction of the Extension Project as set forth in the Specifications for Builder's Extension Project in Exhibit 2 attached hereto, as may be modified and amended from time to time (hereinafter collectively referred to as "Specifications"). Pursuant to the Pennsylvania Underground Utility Protection Law, before starting work, Builder will independently investigate and verify in the field the existence and location of underground utilities, whether or not indicated on the plans.

(e) Maintenance and Repair. Builder is responsible for all maintenance and repair of the installed Extension Project prior to Contribution, whether or not AQUA has commenced wastewater service.

5. Representations and Warranties.

(a) Warranty of Extension Project by Builder. The Builder hereby warrants that the Extension Project, including without limitation integrity of trenches and integrity of paving and other restoration work, will not leak and will be free from defects in materials and workmanship for a period of one (1) year from the date of Contribution of the final portion of the Extension Project and agrees to assign any Contractor's warranty pursuant to the Assignment of Contractor's Warranty by Builder form contained in Attachment E, and that the final As Built Information, when delivered to AQUA, will be accurate and complete. The Builder will promptly proceed at its own cost and expense to make good all portions of the work or materials determined by AQUA to fail to conform with the Specifications or which are damaged or destroyed by removal of the non-conforming

work or materials, and will replace or repair those portions to be in accordance with the Specifications, and will revise the As Built Information to be accurate and complete. If Builder fails to remedy or correct non-conforming work or materials or to revise the As Built Information to be accurate and complete, AQUA may bring the work or materials or As Built Information into conformation at the expense of Builder (for which AQUA may draw down on the Performance Bond or Letter of Credit and/or pursue any other available remedy).

(b) Adequate Financing. Builder represents and warrants that it has adequate financing for completion of the Development, including the Extension Project.

(c) Authorization. Builder represents that it is duly organized and validly existing in the jurisdiction in which it is organized and that the execution, delivery and performance of this Agreement have been duly authorized by Builder.

6. Employees. The Builder and/or the Contractor will be the legal employer(s) of any and all employees and the sole contractually-obligated parties with any independent contractors working on the Extension Project. AQUA will not be the employer or joint employer of any such employees, and neither AQUA nor its representative will have any right to control or supervise the manner and means by which the work is performed. The Builder is responsible for any and all obligations arising by virtue of the employment or independent contract relationship, and compliance with all laws, ordinances, and regulations governing employment and independent contract relationships including, without limitation, obligations arising under the National Labor Relations Act, the Fair Labor Standards Act, the Older Workers Benefit Protection Act, Title VII of the Civil Rights Act, the Age Discrimination in Employment Act, the Americans with Disabilities Act, the Employee Retirement Income Security Act, the Occupational Safety and Health Act, and any similar federal, state or local laws, ordinances, or regulations, as well as all obligations to withhold income or wage taxes, to pay unemployment compensation taxes, to provide workers compensation insurance, and to pay any unemployment compensation, workers' compensation benefits, or other compensation or benefits to such employees or contractors.

7. Indemnification and Insurance.

(a) Indemnity. The Builder acknowledges and agrees that it has undertaken sole responsibility for the Extension Project pursuant to this Agreement. The Builder shall release, indemnify, protect, defend, and save harmless AQUA, and all of its directors, officers, employees and agents (hereinafter sometimes referred to as "indemnified parties"), from and against any and all claims, demands, actions, liabilities, losses, damages, fines, penalties, costs and expenses (including reasonable attorneys' fees and costs of investigation) that may be asserted against or incurred by any of such indemnified parties resulting from, arising out of or related to the Extension Project, and, with respect to the period prior to Contribution of the final portion of the Extension Project, the premises covered by grant(s) of Easement, whether or not caused in whole or

in part by the active or passive, sole, concurring, contributory negligence or inherent nature of the operations of a party indemnified hereunder, including, without limitation, claims or liabilities arising out of or related to any and all damage or injury to any person (including loss of life), including any injury or injuries or loss of life to the employees of the Builder or Contractor or any other worker, or any property of any persons, corporations or other associations (including the parties hereto and their directors, officers, employees and agents).

(b) Interpretation. It is the intent of this provision to absolve, protect and defend AQUA and its directors, officers, employees and agents from any and all claims, demands, actions, liability, losses, damages, fines, penalties and expenses (including reasonable attorneys' fees and cost of investigation) arising out of or related to the Extension Project. This indemnity shall be liberally construed in favor of indemnification to the benefit of AQUA.

(c) Notice of Potential Claims. In furtherance of this indemnification, Builder must promptly report, in writing, to AQUA all accidents whatsoever arising out of, or in connection with, the performance of the work, whether on or adjacent to the work site, which caused death, personal injury, or property damage, giving full details and statements of witnesses. In addition, if death, serious personal injury or serious property damage occurs, Builder will immediately report by telephone or messenger, or both, to AQUA.

(d) Approval of Counsel; Costs and Expenses. An indemnified party shall have the right to approve counsel appointed on its behalf pursuant to this indemnification, and shall be entitled to receive costs and expenses from Builder pursuant to this indemnification beginning upon receipt by indemnified party of formal notice of any claim. An indemnified party shall be entitled to costs and expenses from Builder regardless of the nature of the claim or claims asserted or the dismissal, resolution, settlement or discharge of any claim.

(e) Environmental and Other Claims. Indemnification pursuant to this Section shall include, without limitation, indemnification for action of any kind whatsoever, whether direct or indirect, by the United States Environmental Protection Agency (hereinafter referred to as "EPA") or the Pennsylvania Department of Environmental Protection (hereinafter referred to as "DEP") related to or involving any work by Builder under this Agreement.

(f) Severability. The individual provisions of this indemnification are deemed to be severable, and the invalidity or unenforceability of any portion of this indemnification shall not affect or impair such portion to the extent it has been deemed valid and enforceable, nor the remaining provisions of this indemnification, which shall continue in full force and effect.

(g) Insurance. The Builder and the Contractor are obligated to provide and maintain the types and levels of insurance set forth in Attachment K to this Agreement.

8. Easements.

(a) Grant of Easement. Prior to beginning work on the Extension Project, the Builder shall provide to AQUA easement rights for all areas (excepting existing public rights-of-way where proper occupancy rights have been obtained for the Extension Project) in which any part of the Extension Project will be installed (hereinafter referred to as "Easements"). Builder has also supplied AQUA with copies of the underlying owners' deed(s). If Builder is not the owner of all of the property through which the Extension Project will pass, Builder will also need to obtain easement(s) from the owner(s) of the property to allow it access to install the Extension Project.

(b) Easement Corrections. The Builder is responsible for all expenses incurred by AQUA in the event that the Extension Project or other utilities are installed in violation of the terms of the Easements. In the event that any part of the Extension Project is installed by the Builder outside of the easement areas granted to AQUA, the Builder agrees to relocate them within the easement areas and reimburse AQUA for all costs attributable to the improper location of the Extension Project or, with the approval of AQUA, to obtain an additional easement or relocate or widen the easement area so as to locate the Extension Project within the easement areas granted to AQUA.

(c) Further Assurances. During the term of this Agreement, and after Contribution or termination of this Agreement, without further consideration, Builder will provide, obtain, do, execute, acknowledge and deliver, all and every further act, conveyance, transfer, assignment, power of attorney and assurance as AQUA reasonably may require to more effectively convey, transfer to or vest in, and put AQUA in possession of, the required easements for all areas in which any part of the Extension Project is installed.

(d) Encumbrances. Prior to beginning work on the Extension Project, the Builder shall provide to AQUA Easements in proper form to convey perpetual access to the easement areas granted to AQUA, accompanied by a title insurance policy issued by a reputable title insurance company; which title insurance policy shall guarantee to AQUA that the title to the Easement to be conveyed by Builder to AQUA is good and marketable, and free and clear of all mortgages, judgments, liens or encumbrances, and all taxes which might affect the rights of AQUA provided herein by the Builder.

9. Cost Certification.

(a) Final Cost Certification. Upon completion of the Extension Project, the Builder will certify to AQUA the actual cost of the construction. Builder will complete a certification form, satisfactory to AQUA using the format included in Exhibit 3 to this Agreement, which will provide the actual cost of the Extension Project (including the Administrative Fee and Administrative Services Fee contained on Attachment H and the Value Added

Fee and Value Added Services Fee contained on Attachment I). Upon AQUA's request, Builder will supply the actual invoices to support the cost certification. Builder will represent that the stated cost is complete and accurate and indemnify AQUA against any claim that the cost is not complete and accurate. AQUA reserves the right to review and make the final determination of cost.

(b) Books, Records and Auditing. The Builder will keep adequate books and records with respect to the costs of the Extension Project and AQUA shall have the right at reasonable times to review and audit those books and records for a period of five (5) years after Contribution.

(c) Determination of Final Costs by Audit. If Builder has not provided a final cost certification to AQUA within one (1) month following Contribution of the final portion of the Extension Project, AQUA will have the right to make such final cost certification based on an audit of the books and records of Builder conducted by AQUA or on its behalf, at the expense of Builder (for which AQUA may draw upon the Performance Bond or Letter of Credit and/or pursue any other available remedy).

10. Contribution.

(a) Time of Contribution. Upon completion of the Extension Project as described in **Attachment B**, and provided that Builder is not in breach of any provision of this Agreement, AQUA will notify the Builder in writing of its acceptance of the contribution of the Extension Project (hereinafter referred to as "Contribution"). In order to effect Contribution, AQUA may waive the condition that Builder is not in breach of the Agreement; however, waiver of the condition will not constitute a waiver of Builder's contract breach. In its sole discretion, from time to time, AQUA may effect Contribution of a completed portion or portions of the Extension Project prior to completion of the entire Extension Project, by giving written notice to Builder. AQUA will receive Contribution for no additional consideration, such that the facilities become the property of AQUA (from which AQUA may service customers).

(b) Title. Builder hereby grants, sells, conveys, assigns, transfers, sets over to, and vests in AQUA, its successors and assigns, effective the date of Contribution, all of Builder's right, title and interest, legal and equitable, in and to the Extension Project, free from all liens, security interests, encumbrances, restrictions and claims, to have and to hold the Extension Project, including its appurtenances, to AQUA, its successors and assigns, forever, to its and their own use and benefit. The Builder agrees to make the proper reservations of title in its conveyances to others and to obtain the joinder of all parties necessary to give good and marketable title, so that the Extension Project is properly conveyed to AQUA at the time of Contribution, and all necessary and appropriate easements and rights-of-way are conveyed to AQUA. Upon AQUA's request during the term of this Agreement, Builder will supply to AQUA such additional assurances as AQUA may request that the contractual arrangements necessary to convey good and marketable title have been made by Builder.

(c) Matters in Connection with Contribution. The following must be completed prior to Contribution of the final portion of the Extension Project, or, with the permission of AQUA, within one (1) month after Contribution of the final portion of the Extension Project:

(i) Completion of the Extension Project in accordance with the Specifications;
(ii) The Extension Project passing all inspection and testing procedures performed by AQUA in accordance with its regular pre-service procedures;
(iii) Provision of accurate As Built Information to AQUA indicating portions of the Extension Project to be contributed;
(iv) Final cost certification;
(v) Builder's certification, and provision of evidence satisfactory to AQUA, that it has paid or discharged any mechanic's liens or other encumbrances which may have been filed against the Extension Project;
(vi) Builder's certification, and provision of evidence satisfactory to AQUA, that Builder has paid or discharged the Contractor;
(vii) Payment to AQUA of any outstanding fees or other amounts owing AQUA pursuant to this Agreement;
(viii) Such grant, revision, correction or confirmation of Easements, in addition to Easements granted prior to construction, which AQUA may require to convey all necessary and appropriate easements and rights-of-way; and
(ix) Transfer of all regulatory permits and approvals as indicated on Attachment G attached hereto.

(d) Further Assurances. Builder for itself, its successors and assigns, agrees that, at any time, and from time to time after Contribution, at the request of AQUA, its successors and assigns, and without further consideration, the Builder will provide, obtain, do, execute, acknowledge and deliver, all and every such further act, conveyance, transfer, assignment, power of attorney and assurance as AQUA, its successors and assigns reasonably may require to more effectively convey, transfer to or vest in, and put AQUA, its successors and assigns, in possession of, any of the Extension Project. Builder irrevocably constitutes and appoints AQUA, its successors and assigns, as the Builder's true and lawful attorney with full power to institute and prosecute in the Builder's name or in the name of AQUA, its successors and assigns, as the legal attorney of and for the Builder, duly authorized, for the benefit of AQUA, its successors and assigns, any and all proceedings at law, in equity or otherwise, which AQUA, its successors and assigns, may deem proper for the collection and enforcement of any claim or right of any kind granted, sold, conveyed, transferred or assigned, or intended so to be by Contribution pursuant to this Agreement.

11. Wastewater Service upon Application. Upon proper request being made to AQUA pursuant to the Attachment Package attached hereto, AQUA will furnish wastewater service to each anticipated customer, under AQUA's tariff, rules, regulations and rates

then in effect and subject to any changes, which may thereafter become effective. All charges for wastewater service shall be payable to and collected by AQUA.

B. RIGHTS AND REMEDIES

1. **Event of Default**. The occurrence of any of the following events shall constitute an Event of Default under this Agreement:

(a) The Builder abandons work on the Extension Project, and does not provide AQUA with assurances and evidence satisfactory to AQUA, within ten (10) days after written notice to Builder from AQUA, of Builder's intention and ability to promptly recommence and complete work.

(b) The Builder fails to comply with any other provision of this Agreement and such failure continues for ten (10) days after written notice to Builder from AQUA provided that if within such ten (10) day period, Builder commences to correct such failure and diligently proceeds with such correction, the ten (10) day period shall be extended for such additional time as may be reasonably necessary for Builder to complete such correction.

(c) A case or proceeding by or against the Builder or otherwise affecting the Development is commenced under any federal or state bankruptcy, reorganization, insolvency, liquidation or similar law.

(d) Builder notifies AQUA it intends to terminate the Agreement.

2. **Rights and Remedies of AQUA upon Default by Builder.** Upon an Event of Default as defined in Section B(1), AQUA may, in addition to and not in lieu of any other rights and remedies it may have as set forth in this Agreement or at law or in equity, exercise the following remedies separately and/or cumulatively:

(a) Draw Upon the Performance Bond or Letter of Credit and Other Security. AQUA shall have the right to draw upon the Performance Bond or Letter of Credit and any other security furnished by Builder in the form of Attachment J to this Agreement.

(b) Require Additional Security. AQUA shall have the right to require Builder to advance funds and/or provide additional security satisfactory to AQUA, as may be permitted under regulations of the Pennsylvania Public Utility Commission ("PUC"), applicable law and/or AQUA's tariff on file with the PUC.

(c) Terminate Agreement. AQUA may terminate this Agreement upon notice to Builder.

(d) Complete Extension Project. AQUA shall have the right (but not the obligation) to complete the Extension Project, in its entirety or to any intermediate point, by independent contractors or by its own workers or such other persons, or in such other manner, or in any combination of the foregoing as AQUA may determine in its sole

discretion. If AQUA elects to proceed with the work on the Extension Project, AQUA shall have the right to take possession of all existing materials and supplies of the Builder relating to the Extension Project for the purpose of including them in the improvement, and the Builder hereby assigns to AQUA all its right, title, easements and interest in and to such materials, subject to the contingency of AQUA's election to proceed with work under this Section.

3. **Rights of AQUA.** Among other rights and remedies that AQUA may have under this Agreement, and notwithstanding any other provisions of this Agreement, AQUA shall have the following rights which it may exercise in addition to and not in lieu of any other rights and remedies it may have as set forth in this Agreement or at law or in equity:

(a) Right to Make Further Main Extension. AQUA shall have the right to extend or expand the Extension Project installed under this Agreement, connect thereto and renew or enlarge the same without in any way changing the terms under this Agreement.

(b) Right to Specific Performance of Offer of Contribution and Grant(s) of Easement. The parties acknowledge and agree that money damages would be insufficient to compensate AQUA for breach of the Builder's covenants to contribute the Extension Project to AQUA, to the extent the Extension Project is actually installed, and to provide Easements to AQUA, as provided in this Agreement, and that, therefore, AQUA is entitled to specific performance of Builder's Contribution for completed portions of the Extension Project and to the Easements pursuant to Section A(8) and (10), and Attachment F.

(c) Refusal to Accept Contribution. If the Extension Project is not done in accordance with the Specifications or if the Builder does not comply with any of the Builder's obligations set forth in this Agreement, AQUA may refuse to accept Contribution of the Extension Project, in which event AQUA may (a) refuse to provide wastewater service through the Extension Project main extension and to any parcel or building lots that would otherwise request service from that main extension, or (b) treat Builder as the owner of the Extension Project resulting in (i) Builder bearing all continuing responsibility for maintenance and repairs, (ii) requirement that Builder install a single flow meter pit for the Extension Project to receive wastewater service as a single customer, if applicable, and (iii) preservation of AQUA's rights to any unpaid amounts under this Agreement and other remedies for Builder's breach of the Agreement.

(d) Right of Set-Off. AQUA may offset any of its claims against the Builder against any amounts which AQUA or Aqua Pennsylvania, Inc. (hereinafter referred to as "Aqua") may owe the Builder, or parties controlling, controlled by or under common control with the Builder (hereinafter referred to as "Builder's Affiliates") either under this Agreement or other agreements between AQUA or Aqua and the Builder or Builder's Affiliates, whether or not related to the Extension Project.

(e) Emergency Repairs. In the event of an emergency during or after the term of this Agreement prior to Contribution, AQUA shall have the right to make repairs to the Extension Project and charge the cost to Builder.

(f) Attorneys' Fees. The Builder agrees that if suit is brought by AQUA against it to enforce this Agreement, including, but limited to, AQUA's right of indemnification, and AQUA prevails in such suit, AQUA shall be entitled to collect all reasonable costs and expenses of suit, including but not limited to reasonable attorney's fees.

4. Rights and Remedies Cumulative; No Waiver. No right or remedy conferred in this Agreement upon AQUA or otherwise available to AQUA is intended to be or shall be construed to be exclusive of any other right or remedy, but each and every such right and remedy shall be cumulative and shall be in addition to every other right and remedy given under this Agreement, under any of the documents or instruments to be furnished or delivered to AQUA pursuant to this Agreement, and now or hereafter existing at law, in equity or by statute. No delay or omission by AQUA to exercise any right or power under this Agreement shall impair such right or power or shall be construed to be a waiver or acquiescence in any event of default, default or breach of this Agreement, nor shall the giving, taking or enforcement of any other or additional security under this Agreement operate to waive any rights, powers or remedies of AQUA, and any single or partial exercise of any right or power by AQUA will not preclude other or further exercise thereof or the exercise of any other right, and no waiver will be valid unless in writing and signed by AQUA, and then only to the extent specified.

C. GENERAL

1. Term and Termination. This Agreement shall continue in effect until the earlier of Contribution of the final portion of the Extension Project, termination of this Agreement, or the date which is five (5) years after the effective date of this Agreement, subject to the survival of certain provisions pursuant to Section C(5). Upon termination of this Agreement prior to Contribution of the final portion of the Extension Project, Builder will cease all work on the Extension Project and will cause Contractor to cease all work on the Extension Project.

2. Exhibits and Attachments. All exhibits and attachments referenced herein are incorporated in this Agreement and are made fully a part thereof as though fully set forth in the body of this Agreement.

3. Governing Law. This Agreement, all attachments and exhibits hereto, and all documents and instruments to be furnished or delivered hereto, shall be governed by the laws of the Commonwealth of Pennsylvania without giving effect to conflicts of laws principles.

4. Assignment; Change in Ownership. The Builder shall not assign its rights and obligations under this Agreement, or transfer control or ownership of the Extension

Project or any part thereof, directly or indirectly, voluntarily or involuntarily, without the prior written approval of AQUA.

5. **Taxes and Fees.** All federal, state and local taxes, excise taxes, permit fees, and similar fees and taxes in connection with this Agreement, including without limitation, any sales or use taxes and taxes on contributions in aid of construction, any and all income taxes imposed on AQUA in connection with the Extension Project as a result of Contribution or otherwise, and any and all income taxes imposed on AQUA as a result of Builder's obligation to pay taxes pursuant to this Section, in each case whether in effect on the date of the execution of this Agreement or subsequently imposed or assessed, are for the account of, and are to be paid by, Builder. The Customer Advance Contribution (hereinafter referred to as "CAC") tax on service line installations, as defined under Section 118 (c) of the Internal Revenue Code, will be a non-refundable deposit made by the Builder at the time of executing this Agreement which will be based on the estimated contributed value of the service lines. AQUA will utilize a Present Value tax rate, which will equal the difference between the total tax liability (Grossed-up) and Present Value of the tax depreciation cash flow. The applicable tax rate for the CAC tax will be 41.5%.

6. **Survival of Provisions on Contribution or Termination.** All warranties, representations, agreements and covenants made by Builder in this Agreement, or in any document or instrument referred to in, or to be delivered or furnished pursuant to, this Agreement, will survive Contribution of the final portion of the Extension Project and any termination of this Agreement.

7. **Entire Agreement; Amendments.** This Agreement, together with all exhibits and attachments, and the final executed form of all documents for which the form is set forth in the attachments, constitute the entire agreement between AQUA and Builder with respect to the Extension Project. Prior or contemporaneous discussions or agreements are not part of this Agreement, and are of no force or effect. This Agreement may be modified or amended only by a writing signed by the party against whom enforcement is sought**.**

8. **Severability.** The provisions of this Agreement and all other agreements and documents referred to herein are to be deemed severable, and the invalidity or unenforceability of any provision shall not affect or impair such provision to the extent it has been deemed valid and enforceable, nor the remaining provisions, which shall continue in full force and effect.

9. **Third Parties.** Nothing contained in this Agreement shall be deemed to confer upon the Contractor or any third party any right against AQUA.

10. **Headings.** The headings of any section or subsection of this Agreement are for convenience only and shall not be used to interpret any provision of this Agreement.

11. Binding Agreement; Successors and Assigns. This Agreement is binding on and will inure to the benefit of the parties and their successors and permitted assigns.

12. Notices. Notices, demands and requests required or permitted to be given under this Agreement (hereinafter collectively referred to as "Notices") must be in writing and must be delivered personally or by nationally-recognized courier or sent by United States certified mail, return receipt requested, postage prepaid. Notices must be addressed to the party at its address set forth below. A notice is effective when actually received or rejected. The initial addresses of the parties may be changed by appropriate notice:

To Builder:

Attn:

To AQUA:
Aqua Pennsylvania Wastewater Company
762 W. Lancaster Avenue
Bryn Mawr, PA 19010
Attn: New Business Representative

IN WITNESS WHEREOF, the parties have duly executed this Agreement as of the day and year first above written.

AQUA PENNSYLVANIA WASTEWATER COMPANY, INC.,
a Pennsylvania corporation

By: _____
Marc A. Lucca, President

Attest: _____
New Business Coordinator

BUILDER:
a Pennsylvania corporation

By: _____

Attest: _____

Federal E.I. Number: _____

JOINDER:

The Contractor executes this Agreement to acknowledge and agree to the terms and obligations imposed on the Contractor by this Agreement.

By: _____
[Authorized Signature]

Attest: _____
[Authorized Signature]

Exhibit 1

Requirements for As Built Information

The As Built Information for the Extension Project will accurately represent actual construction of the sewer main and appurtenances, be sufficient to permit Aqua Pennsylvania Wastewater Company to obtain the full benefit of the protections of the Pennsylvania Underground Public Utility Protection Law upon and after Contribution, and contain the following legible information, documented in detail in a project construction log and noted on a copy of the drawings:

(1) Variations from the final Plan (which is incorporated by reference in Attachment B to this Agreement).

(2) Limits of any rock encountered in the excavation.

(3) Locations of manholes, wyes, connections, valves, etc. relative to fixed points (*e.g.,* edge of curb, existing manholes or valve boxes, telephone poles, etc.).

(4) Final elevation information including Rim, invert, and outfall elevations including revised profile plans.

EXHIBIT 2

SPECIFICATIONS FOR BUILDER WASTEWATER EXTENSION PIPELINE CONSTRUCTION

SECTION 1 -GENERAL CONDITIONS

1.01 INTRODUCTION

All work shall be done in accordance with the requirements and regulations of the Aqua Pennsylvania Wastewater Company ("AQUA") Specifications and the DEP Domestic Wastewater Facilities Manual (latest revision).

The Builder is the party who is ultimately accountable to AQUA for all work and responsible for all work, regardless if the work is performed by the Builder's Contractor. This condition is implied throughout these Specifications.

The Builder and Contractor shall obtain a copy of the "Standard Specifications for Construction of Sanitary Sewers and Appurtenances" from AQUA and comply with these documents.

1.02 DEFINITIONS

The following definitions shall be applicable in these Specifications:

a. AQUA shall mean the Aqua Pennsylvania Wastewater Company, a public utility of the Commonwealth.
b. Builder shall mean any landowner, agent of such landowner, or tenant with the permission of such landowner, who makes or who causes to make a subdivision of land or a land development, or who constructs, or causes to be constructed a sanitary sewer extension, or sewerage facilities.
c. Contractor shall mean any individual, partnership, or corporation performing sewer construction work for the Builder.
d. AQUA Representative shall mean a construction observer either employed by AQUA or a Consulting Engineer that represents AQUA.
e. Equal shall mean equal as approved by AQUA.
f. Construction Details shall mean those drawings which are approved by AQUA as AQUA's "Standard Details", and included in this project manual to show general and typical construction details.
g. Municipality shall mean Township(s) or Borough(s) that the work is being performed in.
h. Building Sewer shall mean the extension from any structure to the public sewer lateral.
i. Builder's Construction Drawings shall mean those drawings prepared by the Builder or his engineer and approved by AQUA to show the detailed design of the specific project including plan layout and design details.
j. Subdivision shall mean the division or subdivision of a lot, tract, or parcel of land by any means into two or more lots, tracts, parcels, or other divisions of land.

k. Work shall mean labor, services, materials, and equipment as required for the successful completion of the project.

l. Lateral shall mean that part of the sewer system extending from a sewer, located in the street right-of-way to the structure side of the building sewer serving an improved property. If there shall be no improvement on the property, the "lateral" shall mean that part of the sewer system extending from said sewer to the right-of-way or easement boundary to a point of future connection to the building sewer, if and when said property is improved.

1.03 TEMPORARY PROVISION FOR PUBLIC TRAVEL

The Builder shall perform his work in such a manner as to interfere as little as possible with the use of intersecting roads or adjoining property. No excavation shall be left open or other obstruction allowed to remain longer than is absolutely necessary; and the Builder shall provide all safeguards and temporary passageways that may be necessary for the convenience and protection of all persons using said property either day or night.

1.04 SHOP DRAWINGS

The Builder shall check and verify all field measurements and shall submit with such promptness as to cause no delay in his own work four copies, checked and approved by him, of all shop or setting drawings and schedules required for the work of the various trades. AQUA shall check and approve, with reasonable promptness, such schedules and drawings only for compliance with the information given in the Specifications. The Builder shall make any corrections required by AQUA, file with him two copies and furnish such other copies as may be needed. AQUA's approval of such drawings or schedules shall not relieve the Builder from responsibility for deviations from Specifications, unless he has in writing called AQUA's attention to such deviations at the time of submission, and secured his written approval, nor shall it relieve him from responsibility for errors in shop drawings or schedules.

1.05 USE OF PREMISES

The Builder shall confine his equipment, storage of materials, and construction operations to the Projects Limit as prescribed by ordinances or permits, and shall not unreasonably encumber the site or public rights of way with his materials and construction equipment.

The Builder shall comply with all ordinances and codes of the local government regarding signs, advertising, traffic, fires, explosives, danger signals, and barricades.

1.06 MATERIALS AND WORKMANSHIP

Unless otherwise specifically provided, all workmanship, equipment, materials and articles incorporated in the work shall be new and the best grade of the respective kinds

for their purpose. Where equipment, materials, articles, or workmanship are referred to in the Specifications as "Equal to" any particular standard, AQUA shall decide the question of equality.

Materials specified by reference to the number or symbols of a specific standard, such as an A.S.T.M. Specification, a Federal Specification or other similar standard, shall comply with requirements in the latest revision thereof and any amendment or supplement thereto except as limited to type, class or grade, or modified in such reference. The standards referred to, except as modified in the Specifications, shall have full force and effect as though printed therein.

1.07 SAMPLES, CERTIFICATES AND TESTS

The Builder shall promptly submit all material or equipment samples, certificates, affidavits, etc., as called for in the contract documents or required by AQUA. No such material or equipment shall be manufactured or delivered to the site, except at the Builder's own risk, until the required samples or certificates have been approved in writing by AQUA. Each sample submitted by the Builder shall carry a label giving the name of the Builder or Contractor, the project for which it is intended, and the name of the producer. The accompanying certificates or letter from the Builder shall state that the sample complies with the Specifications, shall give the name and brand of the product, its place of origin, the name and address of the producer and all specifications or other detailed information which will assist AQUA in passing upon the acceptability of the sample promptly. It shall also include the statement that all materials or equipment furnished for use in the project will comply with the samples and/or certified statements.

After actual deliveries, AQUA will have such check tests made as it deems necessary in each instance and may reject materials and tests made as it deems necessary in each instance and may reject materials and equipment and accessories for cause, even though such materials and articles have been given general approval. If materials, equipment or accessories which fail to meet check tests have been incorporated in the work, AQUA will have the right to cause their removal and replacement by proper materials or to demand and secure such reparation by the Builder as is equitable.

1.08 CHANGES IN EQUIPMENT AND/OR MATERIALS

In these specifications and on accompanying drawings, there are specified and shown certain pieces of equipment and/or materials which are deemed most suitable for service anticipated. This is not done to eliminate other equipment and material equally as good and efficient. Should Contractor desire to use some other make to equipment or material, he shall submit to AQUA a written request for such change and in same shall state advantage to AQUA. Determination as to whether or not such change will be permitted rests solely with AQUA.

1.09 AQUA REPRESENTATIVE

AQUA reserves the right, but is not obligated, to assign a Representative to witness the construction activity. The Representative will make periodic visits to the site to familiarize themselves generally with the progress and quality of the work and to determine in general if the work is proceeding in accordance with the specifications. They will not be required to make exhaustive or continuous onsite inspections to check the quality or quantity of the work and they will not be responsible for the Builders failure to carry out the construction work in accordance with the specifications and construction drawings. During such visits and on the basis of their observations while at the site, they will keep AQUA informed of the progress of the work of Contractor, and they may condemn work as failing to adhere to the specifications and/or construction drawings. They shall request that AQUA reject the work whenever such rejection may be necessary in their reasonable opinion to insure the proper completion of the project.

1.10 PROGRESS SCHEDULE

The Contractor or Builder shall submit for approval immediately after execution of the Contract, a carefully prepared Progress Schedule, showing the proposed dates of starting and completing each of the various sections of the work.

1.11 LINES, GRADES AND CONSTRUCTION SURVEYING

The Contractor/Builder shall be responsible for the stake-out for the construction of the project. The Contractor shall provide all surveying required to layout the construction work from horizontal and vertical reference points. The Contractor shall provide all engineering personnel, materials, equipment and labor required to stake-out the baselines and/or centerlines and all offset lines and grades.

On jobs where the Contractor intends to use a laser he shall either: provide offset stakes at a minimum of 100' intervals and use them to spot check his grades or provide a level, rod and level operator to spot check his grades.

1.12 CONSTRUCTION LIMITS AND CLEAN-UP

Upon completion of work, the Contractor shall cleanup and restore the area of his operations to a condition at least equal to original conditions. The Contractor shall at all times keep the construction site free from accumulation of waste materials or rubbish.

1.13 COORDINATION

The Contractor shall be required to coordinate his activities with AQUA and in no way shall the Contractor's activities interfere with facility operations unless suitable arrangements are made five (5) days in advance to minimize the interference to the satisfaction of AQUA.

1.14 PROTECTION OF WORK AND PROPERTY

The existing facilities shall remain in operation at all times. Contractor shall protect and maintain existing structures, equipment and new construction in an undisturbed condition during the contract period unless otherwise specified.

1.15 SHOP DRAWINGS

The Contractor/Builder shall submit Shop Drawings to AQUA for review. Drawings shall be presented in a clear and thorough manner.

1.16 PRODUCT DATA

The Contractor/Builder shall submit Product Data to AQUA for review. Preparation shall include, but not be limited to:

1. Clearly mark each copy to identify pertinent products or models.
2. Show performance characteristics and capacities.
3. Show dimensions and clearances required.
4. Show wiring or piping diagrams and controls.

Manufacturer's standard schematic drawings and diagrams shall include, but not be limited to:

1. Modify drawings and diagrams to delete information which is not applicable to the Work.
2. Supplement standard information to provide information specifically applicable to the Work.

1.17 SAMPLES

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

1. Functional characteristics of the product, with integrally related parts and attachment devices.
2. Full range of color, texture and pattern.

1.18 MANUFACTURERS' OPERATING AND MAINTENANCE INSTRUCTIONS

The Contractor shall initially submit two (2) copies of the manufacturer's operating and maintenance instructions for all equipment for AQUA's approval. Information shall include description of equipment, operating instructions, troubleshooting techniques, schematic wiring diagrams, maintenance instructions, etc. Operating and maintenance instructions shall be sufficiently detailed as to be self-instructive.

Upon AQUA's approval, four (4) sets of the approved Operating and Maintenance Instructions, Technical Bulletins, Diagrams, and other printed materials shall be furnished and delivered bound to AQUA, prior to initial operations. Photo-copied literature will not be acceptable.

1.19 SUBMISSION REQUIREMENTS

Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Work or in the work of any other contractor. Number of Submittals Required:

1. Shop Drawings: Submit four (4) copies.
2. Product Data: Submit four (4) copies.
3. Samples: Submit the number stated in each specification section.
4. Instruction Manuals: See Paragraph 1.5.

Submittals shall contain:

1. The date of submission and the dates of any previous submissions.
2. The Project title.
3. The names of:
    a. Contractor.
    b. Supplier.
    c. Manufacturer.
4. Identification of the product, with the specification section number.
5. Field dimensions, clearly identified as such.
6. Relation to adjacent or critical features of the Work or materials.
7. Applicable standards, such as ASTM or Federal Specification numbers.
8. Identification of deviations from Contract Documents.
9. Identification of revisions on re-submittals.
10. An 8 in. x 3 in. blank space for Contractor and AQUA stamps.
11. Contractor's stamp, initialed or signed, certifying to review of submittal, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the Work and of Contract Documents.

1.20 RESUBMISSION REQUIREMENTS

Builder and/or Contractor shall make any corrections or changes in the submittals required by AQUA and resubmit until approved.

For Shop Drawings and Product Data:

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

2. Indicate any changes which have been made other than those requested by AQUA.

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

1.21 DISTRIBUTION

Two (2) sets of shop drawings and product data which carry AQUA's stamp will be returned to the Contractor.

Contractor shall distribute reproductions (if necessary) of Shop Drawings and copies of Product Data which carry AQUA's stamp of approval to:

1. Job site file.
2. Record Documents file.
3. Other affected contractors.
4. Subcontractors.
5. Supplier or Fabricator.

Distribute samples which carry AQUA's stamp of approval as directed by AQUA.

1.22 AQUA'S DUTIES

1. AQUA shall review submittals with reasonable promptness.
2. Affix stamp and initials or signature, and indicate requirements for re-submittal, or approval of submittal.
3. Return submittals to Contractor for distribution, or for resubmission.

1.23 TRENCH EXCAVATION

Excavation shall be in open cut, unless written permission is given by AQUA or permitting agencies to excavate by other methods. Hand excavation and backfill shall be required under special circumstances (such as fragile utilities nearby). It shall be the responsibility of the contractor to plan the trench work to avoid conflicts, obstructions, etc.

All work by the Builder and/or Contractor shall be done in accordance with all Federal, State, Municipal, including OSHA regulations governing work of this nature.

Dimensions for excavation will be according to the depth and width specified for the pipe size. Except at locations where rock or unsuitable material is encountered, extra care should be taken not to exceed the depth specified. If the excavation does exceed the proposed depth, the bottom of the trench should be back-filled in six-inch lifts and properly compacted until the desired level is reached to lay the pipe.

Sub-grade material must be suitable.

Sides of trenches shall be practically plumb and under no circumstances shall they be sloped unless. Where more than one pipe is placed in a trench, a maximum clear distance of 12 inches shall be allowed from the wall of the nearest pipe.

Trenches shall be excavated to necessary width and depth, as specified herein or as directed:

Up to and including: 2" pipe: 2.00' trench width
4" pipe: 2.00' trench width
6" pipe: 2.00' trench width
8" pipe: 2.00' trench width
12" pipe: 2.50' trench width

In areas of existing roadway, the excavation shall be completed closed at the end of each work day. The Builder shall provide temporary restoration of roadway immediately upon back-filling the trench.

1.24 ROCK EXCAVATION

Excavation in rock shall be carefully performed and where blasting is necessary, care shall be taken to prevent damage of any kind to persons or property. Blasting shall be done in accordance with Federal, State and Municipal ordinances by qualified Operators, and shall be done in accordance with present day standards of good practice. Builder, at its sole expense, shall secure all permits and shall meet all Federal, State, and Municipal requirements regulating the transportation, storage, and use of explosives.

Trenches excavated in rock shall be excavated to a depth of six (6) inches below the grade prescribed for the bottom of the pipe, and shall be re-filled to the proper grade with bedding materials, such as sand or highway screenings, that will provide an adequate cushion for the pipe.

In no case will excavated rock materials be acceptable for use in any portion of the backfill.

1.25 EARTH EXCAVATION

"Earth", as a term for excavated material, shall mean all kinds of material excavated except rock as described in the foregoing, and roadway, driveway, and sidewalk paved surfaces.

1.26 PREPARATION OF SUBGRADE

The bottom of the trench shall be prepared at the depths stated in Section 1.23 or as shown on the drawings, or as otherwise specified to provide a uniform and continuous

support for the pipe. The sub-grade shall be prepared accurately by hand to insure the elimination of rock or other objects that may cause damage to the main.

1.27 ALIGNMENT AND GRADE

The pipeline shall be laid and maintained to the required lines and grades as shown on the drawings or otherwise specified. The Builder shall provide survey stakes for all property lines, easements, service locations and curbs (if not installed).

1.28 LAYING PIPE

Every precaution must be taken to insure that foreign materials are kept from entering the pipe, both while it is setting above ground and especially while it is being installed. At no time should any debris, tools, rags, or any other material, be placed inside the pipe or fittings. At times when pipe laying is not in progress, a watertight plug shall close the open ends of the pipe. If pipes are dirty from sitting, or from transport, they must be washed and swabbed out before being installed.

1.29 BACKFILLING

The Contractor shall backfill all excavations as rapidly as practicable after the pipe has been satisfactorily laid and jointed. The method of back-filling will be determined by the nature and character of the back-fill material available, and Federal, State, and Municipal regulations governing this work.

No part of a pipe line or other structure that needs to be tested, located or measured, shall be filled over or around until required tests and measurements have been made.

1.30 HAND OR MECHANICAL TAMP

Special attention and supervision will be given to back-filling trenches. The space between pipe and sides of trench shall be backfilled by hand and thoroughly tamped with a light tamper in layers not to exceed 4 inches in thickness to a depth of at least one foot above top of pipe.

The method of backfilling above 1 foot over top of pipe to grade or bottom of paving shall then be filled and compacted by tamping or rolling. The backfill material shall be evenly spread in built up layers not exceeding 8 inches for material compacted by heavy compaction equipment and 4 inches for material compacted by hand operated tampers. No stone will be allowed in refilling until earth or granular backfill has been placed at least 2 feet above pipe or structure as directed above. Backfill material placed above earth or granular backfill may contain some rock but in no case shall it exceed more than 20 percent by volume.

It is imperative that the back-fill material be carefully placed under and around the pipe and thoroughly compacted to provide complete and uniform support to the pipe. Bulldozers and other heavy equipment are not to be permitted to operate over the pipe until back-filling has been completed to within six (6) inches of the ground level or road surface.

When the opening is across or within completed road paving, the method of backfilling above 12 inches over the top of pipe to grade or bottom of paving shall be backfilled as specified above except that the backfill material shall consist of PENNDOT 2RC stone.

1.31 RESTORATION

The work covered under this item includes the replacement of all pavement removed for excavation of trenches or ordered for other purposes to complete the work indicated in the contract documents. Such restoration shall comply with the requirements and specifications of the State or municipal Authority who have jurisdiction and shall be completed within 90 days (or less if designated by the permit) after the date of the road opening.

1.32 ACCOMMODATION OF TRAFFIC

The Contractor shall, where required, maintain roads open for traffic with satisfactory barricades, warning signs and lights. Where permission for detouring traffic is granted, the Contractor shall post detour signs, and the Contractor shall maintain such detour routes. During progress of the work, sidewalks and crossings shall be kept open for passage of pedestrians, unless otherwise authorized.

The Contractor shall furnish, place and maintain safety fence around all excavations and other areas during non-work hours. Safety fencing shall be the product of Tenax Corporation, bright orange, no less than five feet in height, or approved equal.

The Contractor shall construct and maintain, without compensation, adequate and approved bridges over excavations as may be necessary for purpose of accommodating pedestrians or vehicles.

All fire hydrants, water valves, and fire alarm boxes shall be left uncovered and readily accessible for use.

1.34 PROTECTION OF PROPERTY AND STRUCTURES

The Contractor shall sustain in their places and protect from direct or indirect injury, all pipes, conduits, poles, tracks, walls, buildings, pavement, guide rails, driveways, curb, street signs, sidewalks, lawns, fields, mailboxes, shrubs, bushes, plantings, and other structures or property in vicinity of his work, whether above or below ground. He shall replace any pipe if it is a functioning pipe. Contractor shall restore any existing property

damaged by construction activity. Restoration, when complete, shall render the disturbed area equal to or better than its original condition prior to construction.

The Contractor shall have sufficient sheeting or shoring available for supporting his excavations and for sustaining or supporting any structures that are uncovered, undermined, endangered, threatened or weakened.

1.35 MAINTENANCE OF BACKFILLED EXCAVATIONS

The Contractor shall maintain all backfilled excavations in proper conditions as specified. All depressions appearing in backfilled excavations shall be promptly repaired by the Contractor. If the Contractor fails to make repairs within forty eight (48) hours after receipt of written notice from AQUA, AQUA may backfill said depression and, in an emergency, AQUA may backfill or protect any dangerous depression wherever necessary without giving previous notice to the Contractor, and AQUA shall charge expense thereof to the Contractor.

SECTION 2 -UTILITY CASTINGS

2.01 UTILITY CASINGS GENERAL

This Section includes casing pipe and casing pipe installation where indicated to pass under State highways without open excavation where subsurface soil conditions are suitable, and as required by AQUA.

Prior to commencing construction, the Contractor shall conduct subsurface investigations at the locations of the indicated highway crossings to determine the type and properties of the material to be excavated and construction method to be utilized. All preliminary investigations shall be subject to the approval of PENNDOT and any other agency having jurisdiction.

Builder and/or Contractor shall provide all materials, equipment and labor as required to install utility casings beneath State highways in accordance with PENNDOT requirements, as indicated and as specified.

2.01 SUBMITTALS

Builder and/or Contractor shall submit the following to AQUA for review and approval prior to commencing work:

1. Manufacturer's catalog cuts of material being supplied.
2. Copies of all subsurface investigation test results.
3. Details of construction methods to be utilized.
4. Casing pipe, end seal materials and pipe alignment guides.
5. Protective coatings and linings.
6. Certificates of Compliance with the applicable Standards.

2.02 CASING PIPE MATERIALS

Casing pipe shall conform to ASTM A139, Grade B steel with a minimum yield strength of 35,000 psi.

2.03 CASING PIPE FABRICATION

Fabrication shall conform to AWWA C200. Builder and/or Contractor shall fabricate in a manner to keep field welds to a minimum.

2.04 PROTECTIVE COATINGS AND LININGS.

Coat exterior and line interior of all casing pipe with a prime paint equivalent to Pennsbury Coatings Corporation's 1-R-2, Bulldog Primer.

Hold coatings back from the end of joints to be welded at least 2 inches each side of joint.

2.05 CASING JOINTS

All joints in steel pipe casings shall be field welded to conform to AWWA C206. Contractor shall brush clean and apply field prime paint coating to all exterior joints after field welding. Contractor shall brush clean and apply field prime paint field lining to all interior joints after field welding.

2.06 CASING PIPE INSTALLATION

All work shall, as a minimum, meet the requirements of PENNDOT and any other agencies having jurisdiction and shall be subject to their inspection and approval.

Install casing pipe as follows:

1. By open cut methods or by boring with continuous flight auger, pneumatic jacking or other acceptable method. Reinforce leading end of casing with jacking band if jacking method is used.
2. Include measures for maintaining indicated line and grade for casings within a plus or minus tolerance of 2 inches.
3. Working pits shall be of adequate size to provide safe working conditions.
4. Install in such a manner as not to disrupt traffic or damage the roadway grade or surface.
5. Casings rejected due to misalignment or other failures to conform to specifications shall be abandoned in place and filled with concrete grout. Casing pipe shall not be recovered for reuse, except in the case of open-cut installation.

All required welding shall be by experienced welders and all welds shall be of the butt type of sufficient strength to resist drilling or jacking forces exerted. Joints shall be watertight.

After completion of jacking operation, fill voids around the exterior of the casing pipe with grout placed under pressure. Properly protect the grout for not less than three days.

2.07 CARRIER PIPE

Carrier pipe shall be installed within casing pipe in accordance with manufacturer's instructions.

Carrier pipe shall be installed at the indicated grade.

2.08 ALIGNMENT GUIDES FOR CARRIER PIPE

Contractor shall provide pipe alignment guides for all carrier pipes to be installed in casings.

The alignment guides shall be fusion coated steel casing insulators with a 12-inch band width and glass reinforced runners as manufactured by Pipeline Seal and Insulators, Inc., or approved equal.

The alignment guides shall be sized to fit the outside diameter of the carrier pipe and inside diameter of the casing pipe.

Spacing of the alignment guides shall be in accordance with the manufacturer's recommendations.

2.09 END SEALS FOR CASING PIPE

Contractor shall provide end seals at each end of the casing pipe to cap the annular space between the carrier pipe and casing pipe.

End seals shall be the Standard Pull-On type (Model S) as manufactured by Pipeline Seal and Insulator, Inc., or approved equal.

End Seals shall be made of synthetic rubber. Steel bands and clamps shall be stainless steel.

End Seals shall provide a watertight seal.

In lieu of a manufactured seal, the Contractor, at his option, may seal the ends of the casing with a 12-inch thick grout plug, or brick conforming to ASTM C32 Grade MS. Mortar shall conform to ASTM C270, Type M, with Type II portland cement and Type S lime.

SECTION 3 - FORCE MAINS

3.01 FORCE MAINS GENERAL

Work included in this section shall consist of force main piping, air release valves, gate valves, clean outs, flushing stations, and all necessary or required fittings.

3.02 SUBMITTALS

Prior to commencing any work, the Builder and /or Contractor shall submit this following to AQUA for review and approval:

1. Shop drawings and product data to AQUA for review.

2. Certificates of Conformance for all materials shall be submitted assuring conformance with these specifications. All pipe and appurtenances specified herein shall be covered by a guarantee certificate furnished by the Contractor and signed by an officer of the respective manufacturer.

3. Record Drawings: At project closeout, submit record drawings of installed force main and products. AQUA record drawings may be submitted along with Township(s) and Borough(s) record drawings.

4. Maintenance Data: Submit maintenance data and parts lists for sewer system materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual.

3.03 MATERIALS

Specifications cite acceptable manufacturers. Alternative manufacturers meeting the performance specification may be accepted at AQUA's discretion. All materials and products shall be in accordance with ASTM, ANSI, and AWWA sections identified herein.

DUCTILE IRON PIPE

1. All buried ductile iron shall conform to AWWA C151. Pipe shall be Class 52 with mechanical joints conforming to AWWA C111. Ductile iron pipe and fittings shall be used for all force mains that are 4-inches and larger.

Suggested Suppliers: American Cast Iron Pipe Co.,
U.S. Pipe & Foundry Company
Griffin Pipe Company
Clow Corporation

2. Ductile Iron Fittings: Fittings for buried ductile iron pipe shall be mechanical joint, conforming to AWWA C110 and AWWA C111 Class 350. Fittings shall be furnished suitable for use with the type of pipe specified herein.

3. Coatings and Linings: All buried ductile iron piping and fittings shall have standard bituminous coating applied to exterior surfaces. Interior surfaces of all ductile iron pipe and fittings shall have a double cement-mortar lining conforming to AWWA C104, seal coated inside, or ceramic epoxy coating.

PVC PIPE

1. PVC pressure pipe and fittings may be provided for buried sanitary sewer force main 3 inches or less in diameter. Pipe shall conform to ASTM D2241, SDR21, Class 200. PVC Material for pipe shall conform to ASTM D1784, Cell Class 12454B. Gaskets for pipe shall conform to ASTM F477, joints shall conform to ASTM D3139.

Suggested Suppliers: Certain Teed Corp.
J-M Manufacturing Co., Inc.

2. Fittings shall be manufactured in one piece of injection molded PVC compound meeting ASTM D1784. Fittings shall be Class 200, designed to withstand a minimum of 630 psi quick burst pressure at 73 degrees F tested in accordance with ASTM D1599. Bell shall be a gasket joint conforming to ASTM 3139 with gaskets conforming to ASTM F477.

3.04 IDENTIFICATION

Underground Type Plastic Line Markers: Manufacturer's standard permanent, bright colored, continuous printed plastic tape, intended for direct burial service; not less than 6" wide x 4 mils thick. Provide green tape with black printing reading "CAUTION - SEWER LINE BURIED BELOW".

Suggested Suppliers: Allen Systems, Inc.
Emed Co., Inc.
Seton Name Plate Corp.

Non-ferrous metal piping shall also have a magnetic location tape placed above the pipe.

3.05 GASKETS AND BOLTING MATERIALS

All bolting shall conform to the appropriate standards: ASTM A307 Grade B for bolts and ASTM A194 Grade 2 for nuts. All bolting shall be cadmium plated, except for submerged conditions where stainless steel shall be provided.

Dimensions shall conform to ANSI B18.2.1 for bolts and ANSI B18.2.2 for nuts. Threading shall conform to ANSI B1.1 Class 2A fit for bolts and Class 2B fit for nuts.

Bolts shall extend completely through the nuts and may have reduced shanks of a diameter not less than the diameter at the root of threads.

Washers shall be steel, cadmium plated, to fit within the bolt facing on the flange. Stainless steel washers shall be used for submerged conditions.

Gaskets shall be 1/8 inch thick cloth inserted synthetic rubber full face gaskets with holes punched for flanges conforming to AWWA C111. Gaskets for ductile iron flanged pipe and fittings 12 inch and smaller shall have "nominal" inside diameters, not the larger inside diameters per ANSI B16.21.

Gaskets and bolts for other than flanged joints shall be as required for mechanical joints and/or push-on joints as applicable, in accordance with AWWA requirements.

3.06 GATE VALVES 3-INCHES TO 12-INCHES

Valves shall conform to AWWA C509. Valves shall be flanged, mechanical joint, or any combination of ends thereof as required or as indicated. Valves shall be rated per 200 psi working pressure, resilient seated type, bonded encapsulated double sealing disc, high strength cast iron body, double "O" ring at stem with reinforced flanged, corrosion resistant threaded bronze stem with bronze or plated steel stem nut. Valves shall be of the non-rising stem type (NRS).

Double sealing disc (gate) shall be solid heavy duty cast iron coated with corrosion resistant permanently bonded synthetic elastomer or permanently bonded vulcanized synthetic rubber. Coatings shall meet or exceed ASTM D-429.

Encapsulated wedge and valve sealing shall be bubble tight in both directions with zero leakage. Gate shall be made with low friction, non-abrasive thermoplastic inserts in order to minimize wear on the internal coating of the valve body.

Wedge travel shall be smooth up and down and shall not abrade the protective coating.

Valve body and bonnet shall be fusion bonded epoxy, coated inside and outside to a minimum thickness of 8 mils. All other ferrous metal surfaces shall be provided with a permanent fusion bonded epoxy coating and no exceptions to this shall be permitted. All protective coatings shall conform to AWWA C550 latest revision.

Waterway area shall be unobstructed and valves shall be capable of passing a full size shell cutter. Valve interior shall be of very smooth contours, free of ledges, pockets or other areas which can collect debris or sediment.

Stem seal design shall allow replacement of "O" ring seals while valve is in any position of service. Stem shall also include thrust washers.

Valves shall be factory tested. Valves shall be tested in the "Disc Up" position at 400 psi, and there shall be no leakage at joints or connections.

All valves shall open counterclockwise. Buried valves shall be furnished with a 2 inch square operating nut. Non-buried valves shall be furnished with a hand wheel operator.

Valves shall have flanged, mechanical joint, or any combination of ends thereof as required or indicated. Flanged end connections shall have a drilling pattern conforming to ANSI B16.1, Class 125. Mechanical joint end connections shall conform to AWWA C111.

Suggested Suppliers: A.P. Smith
American Darling
Waterous Company
U.S. Pipe

3.07 VALVE BOXES

All valve boxes shall be cast iron screw style three part boxes (lid, top, and bottom).

As manufactured by: Tyler Pipe
Bingham & Taylor

3.08 SLEEVES AND COUPLINGS

Shall be provided for joining buried ductile iron pipe where approved by AQUA. Sleeves for buried piping shall be gray iron ASTM A-126 Class B.A.

Suggested Suppliers: Rockwell International (Smith-Blair Type 431)
Dresser Industries, Inc. (Dresser Style 53)
Ford Meter Box Company, Inc., (Ford Style FC1)

3.09 AIR RELEASE VALVE (INSTALLED IN MANHOLE)

Valve shall be equipped with a Ford Meter Box Company Style F202 service saddle, Smith Bros. Style 313 service saddle or an approved equal.

3.10 FORCE MAIN FLUSHING STATIONS

Provide two-way sanitary sewer flushing connections on all sewer force mains as shown on the details.

Distances: The maximum distance between the two-way flushing stations, or between the force main beginning or terminus and a flushing station, is 1000 feet.

3.11 FORCE MAIN CLEANOUTS

In lieu of putting two way flushing stations along the force main as described in the preceding paragraph, one-way force main cleanouts can be provided as shown on the details.

Distances: The maximum distance between the one-way cleanouts, or between the force main beginning or terminus and a cleanout, is 1000 feet.

3.12 ACCESSORIES

Provide anchorages for tees, wyes, crosses, plugs, caps, bends and valves. After installation, apply full coat of asphalt or other approved corrosion-retarding material to surfaces of ferrous anchorages.

1. Clamps, Straps, and Washers: Steel, ASTM A506.
2. Rods: Steel, ASTM A575.
3. Rod Couplings: Malleable-iron, ASTM A197.
4. Bolts: Steel, ASTM A307.
5. Cast-Iron Washers: Gray-iron, ASTM A126.
6. Thrust Blocks: Concrete, minimum 28 day compressive strength of 3000 psi, in accordance with the Sanitary Sewer Details.
7. Crushed Stone: AASHTO No. 57 or PENNDOT No. 2A coarse aggregate in accordance with the requirements of PENNDOT Specifications Section 703.2.

3.13 PIPE LAYING

Pipe laying shall conform to AWWA C600 with excavation and backfill in accordance with Section 02221. Adequate and suitable equipment and appliances for safe and convenient handling and laying of pipes shall be used.

Prior to being lowered into the trench, each pipe and fitting shall be carefully inspected and those not meeting specifications or are otherwise defective shall be rejected and removed from the project.

Pipes shall be thoroughly cleaned before they are laid and shall be kept clean until acceptance of complete work. Open ends shall be provided with a stopper carefully fitted so as to keep dirt and other substances from entering the main. Unless approved otherwise, a stopper shall be kept in the end of the line when work is not in progress.

Pipe shall be laid so that when completed, the interior bore will conform accurately to grades and alignment indicated by the plans.

. Before joints are made, each pipe shall be well bedded and no pipe shall be brought into position until the preceding length has been thoroughly secured in place. Coupling or bell holes shall be dug sufficiently large to insure the making of a proper joint. All joints shall be made in strict conformance with the manufacturer's instructions.

. The excavation into which the pipe is being laid shall be kept free from water and no joints shall be made under water. Water shall not be allowed to rise in excavation until joint is complete. Care shall be used to secure water tightness and to prevent damage to joints during backfilling. All pipe joints shall be watertight within allowances established by these specifications.

No pipe shall be laid upon a foundation into which frost has penetrated or there is a danger of formation of ice or penetration of frost at the bottom of excavation. Where the foundation is unstable or consists of rock, a stone or gravel foundation, at least six (6) inches thick, shall be placed and tamped to form an acceptable bed for the pipe.

Suitable tools and appliances for safe and convenient handling and laying of pipe and fittings shall be used. Extra care shall be exercised to prevent damage to pipe lining and coating.

At the end of each day the end of the pipe line shall be tightly closed with an expansion stopper to prevent dirt or other substances from entering the line.

A plastic warning tape shall be installed over all buried force main pipe. The tape shall have the warning "Caution - Sewer Line Buried Below" .The tape shall be positioned above the piping at a point 24 inches below finished grade. A magnetic location tape shall also be installed over all non-ferrous force main pipes.

Buried piping which passes above or beneath storm or sanitary sewer piping, water mains, or other utilities shall have a vertical separation of at least 18 inches.

Buried piping which passes beneath streams shall have a vertical separation of at least 1.0 feet in rock and 3 feet in other materials, including concrete encasement.

Sanitary sewer force main under storm drain pipe or stream culvert shall be laid as near to horizontal as possible. The length of the sanitary sewer force main shall be centered at the point of the crossing so that the joints shall be equidistant and as far as possible from the storm sewer or stream culvert. In addition, should 12" vertical separation not be maintained the sanitary sewer force main shall be encased in concrete for the full width of the trench (12" minimum encasement on each side), with at least 12 inches of concrete beneath the pipe and 12 inches over top of the pipe. The length of the encasement shall be 10 feet each side of the storm sewer or stream culvert.

There shall be at least a 10-foot horizontal separation between water mains and sanitary sewer force mains. Force mains crossing water mains shall be laid to provide a minimum vertical distance of 12 inches between the outside of the force main and the outside of the water main. This shall be the case where the water main is either above or below the force main. At crossings, one full length of force main pipe shall be located so both joints will be as far from the water main as possible.

Set, align, position and properly connect new valves and operators for proper operation and to allow maximum access for maintenance. Provide proper and adequate clearance for valve operation. When operated, valves shall operate smoothly and operators shall not bind. Valves and valve operators shall be installed in accordance with the manufacturer's instructions. Thoroughly clean and remove all shipping materials prior to setting valves. Operate all valves from fully opened to totally closed before setting. Provide support and anchorage as required. Buried valves shall be provided with special supports such as crushed stone, concrete pads or a sufficiently tamped trench bottom so that the pipe will not be required to support the weight of the valve. Valve boxes and curb boxes shall not transmit shock or stress to the valve or curb stop and shall be centered over the operating nut of the valve or curb stop. Provide a 24" x 24" x 6" thick concrete collar at each valve box and curb box in unpaved areas. The pad and box cover shall be flush with the surface of the finished area.

All pipe laid at a depth of 11 feet or greater shall be ductile iron, Class 52 double cement lined or epoxy coated.

3.14 JOINT RESTRAINT

Cast-in-place concrete thrust blocks shall be placed at all points of potential thrust as required in accordance with the standards included in these specifications and drawings. Thrust blocks shall be placed so that joints on mains will be accessible for repair. Thrust blocks shall be poured against undisturbed earth and shall be of a sufficient size to resist the thrust resulting from the specified hydrostatic test pressure.

Contractor shall use restrained joint ductile iron pipe and restraining elbows, tees, hydrants and plugs where indicated. Restrained joint pipe shall be used when one or more of the following conditions exist:

1. Where indicated
2. Unsuitable trench conditions
3. Unsuitable soil conditions.
4. Interference with, or close proximity to buried structures, pipelines or utility lines.

Restrained Joint Pipe: When thrust blocks cannot be used, restrained joints shall be placed at all points of potential thrust. The number of joints to be restrained on each side of a fitting shall be determined by the pipe manufacturer and submitted to AQUA for

review and approval. The length of restrained pipe shall be sufficient to resist the specified hydrostatic test pressures and shall also take into account such factors as the burial depth, soil types and backfill material used. Restrained joint ductile iron pipe shall be of the restrained mechanical or push-on joint type. Mechanical joint retainer glands are not acceptable. Restrained joint piping shall sustain the indicated test pressures, as a minimum.

3.15 TESTING

Before being tested, force mains shall be backfilled between joints to a safe level and thrust restraint suitable to withstand the hydrostatic test pressure shall be in place. Pipe lines shall be thoroughly flushed to remove all foreign materials which may have entered during construction.

Force mains shall be tested between the pump discharge valves and a test plug at the end. Test pressures shall be as specified in the paragraphs which follow.

Before applying the specified test pressure, air shall be expelled completely from the pipe. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be left in place.

Hydrostatic Test

1. The trench shall be backfilled between joints before testing to prevent movement of pipe.
2. The length of force main under test shall be slowly filled with water and brought to test pressure by means of a pump connected to the pipe in a manner satisfactory to AQUA, so as to obtain the specified hydrostatic test pressure at the highest point in the section of main under test. The water, pump, pipe connection and all necessary apparatus, shall be furnished and paid for by the Contractor. If desired, AQUA reserves the right to furnish gauges for the test, but all necessary assistance for conducting the test will be furnished and paid for by the Contractor. All air must be expelled from the pipe line prior to the test period. The test pressure shall be applied for a period of two (2) hours.
3. The specified test pressure shall be held within 5 psi for the duration of the test.

Leakage Test

1. After the hydrostatic test proves satisfactory, a leakage test shall be conducted. The pressure maintained during the leakage test shall be as specified in the following paragraphs. The test shall be conducted in the same manner as the pressure test except that suitable equipment, supplied and paid for by the

Contractor, shall be provided for measuring the amount of leakage. The duration of this test shall be twenty-four (24) hours.

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

    a. The amount of leakage in piping shall be measured at the specified test pressure by pumping from a calibrated container. For new pipe, no leakage shall be permitted.
    b. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi of the specified leakage test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by a drop in pressure in a test section over a period of time.

    Test pressures shall be as follows:

    Hydrostatic Test Pressure (psig): 2 X operating system pressure
    Leakage Test Pressure (psig): System operating pressure

Should any of these tests on a section of pipe line disclose an inability to hold the stipulated test pressure or leakage in an amount greater than that permitted, the Contractor shall, at his own expense, locate and correct any defects and retest same to the satisfaction of AQUA.

SECTION 4 - GRAVITY SANITARY SEWER SYSTEM

4.01 GRAVITY SEWER SYSTEM GENERAL

Gravity sanitary sewer main shall be constructed of the materials as specified herein.

The gravity sanitary sewer system shall include but not be limited to:

1. All gravity sanitary sewer systems.
2. Sanitary mains.
3. Sanitary manholes.
4. All excavating and backfill required for the gravity sanitary sewer system.

4.02 SUBMITTALS

Prior to commencing any work, the Builder and /or Contractor shall submit this following to AQUA for review and approval:

1. Product Data: Submit manufacturer's technical product data and installation instructions for sewer system materials and products. Certificates of conformance for all materials shall be submitted assuring conformance with these specifications. All pipe and appurtenances specified herein shall be covered by a guarantee certificate furnished by the Contractor and signed by an officer of the pipe manufacturer.

2. Shop Drawings: Submit shop drawings for sanitary sewer systems, showing piping materials. Include details of underground structures, connections, manholes, covers, castings, fittings and pipe.

3. Certificates of Conformance for all materials shall be submitted assuring conformance with these specifications. All pipe and appurtenances specified herein shall be covered by a guarantee certificate furnished by the Contractor and signed by an officer of the respective manufacturer.

4. Record Drawings: At project closeout, submit record drawings of installed gravity main and products. AQUA record drawings may be submitted along with Township(s) and Borough(s) record drawings.

5. Maintenance Data: Submit maintenance data and parts lists for sewer system materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual.

4.03 QUALITY ASSURANCE

It is recommended that the Builder and/or Contractor obtain materials from firms regularly engaged in manufacture of sanitary sewer system's products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

The Builder and/or Contractor shall comply with applicable portions of National Standard Plumbing Code pertaining to selection and installation of sanitary sewage system materials and products as well as with all local codes and ordinances.

4.04 MATERIALS

The use of PVC Sewer Pipe shall be permitted. However, ductile iron pipe must be used where crossing a State Highway, at all stream crossings, and all sewer installation greater than 11 feet. Pipe fittings and accessories of same material and weight/class as pipes shall be provided, with joining method as indicated.

DUCTILE IRON PIPE

1. Ductile Iron Pipe shall be Class 52 with push-on or mechanical joints conforming to AWWA C111 and AWWA C151 unless indicated otherwise.

2. Ductile iron pipe fittings shall be push-on or mechanical joint, conforming to AWWA C110 and AWWA C111 Class 350. Fittings shall be furnished suitable for use with the type of pipe specified herein.

3. All buried ductile iron piping and fittings shall have standard bituminous coating applied to exterior surfaces. Interior surfaces of all ductile iron pipe and fittings shall have a double cement-mortar lining conforming to AWWA C104, seal coated inside, or ceramic epoxy coating as specified by U.S. Pipe.

PVC PIPE

1. Polyvinyl Chloride (PVC) Sewer Pipe and Fittings Shall conform to ASTM D 3034 SDR 35 sewer pipe and fittings. PVC material shall conform to ASTM D1784, Cell Class 12454B.

2. PVC elastomeric joints shall comply with ASTM D3212 using elastomeric seals complying with ASTM F477. Elastomeric gasket shall be rubber and shall comply with the physical requirements of ASTM F477.

WYE BRANCHES

1. Wherever necessary, the Contractor shall lay "Y" branches of the same materials and strength as the sewer main for the purpose of making building connections. The "Y" branches shall be laid at an angle as shown on the construction details.

2. The spur of the "Y" branch shall be supported by Class "B" concrete as shown on the Sanitary Sewer Details. "Y" branches shall not be backfilled until location has been made by the Contractor in the presence of AQUA.

4.05 CONNECTIONS TO EXISTING MANHOLES

Connections to existing manholes: core drill existing manhole and install Kor-N-Seal, or equal.

4.06 SANITARY SEWER MANHOLES

Provide precast reinforced concrete sanitary manholes as indicated, and complying with ASTM C478.

The sections shall conform to the requirements of "Specifications for Precast Reinforced Concrete Manhole Sections" (ASTM C478), except that the joints shall be sealed with a Preformed Plastic Gasket that meets or exceeds all requirements of Fed. Spec. SS-S-00210, "Sealing Compound Preformed Plastic for Pipe Joints", Type 1, Rope Form.

The Sealing Compound shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler, and shall contain no solvents, irritating fumes or obnoxious odors. The compound shall not depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive strength. It shall be supplied in extruded rope-form of suitable cross-section and of such sizes as to seal the joint space when the sections are set in place. The sealing compound shall be protected by a suitable removable two-piece wrapper. The two-piece wrapper shall be so designed that one-half may be removed longitudinally without disturbing the other half to facilitate application of the sealing compound.

The top of base walls, the ends of reinforced concrete risers and the bottom ends of precast tops shall be so formed that when risers and tops are assembled with the base, they will make a continuous manhole. Joints shall be of such design as will permit effective joining and placement without irregularities in the interior wall surface of the manhole.

Manhole barrels shall consist of riser and top sections with a minimum wall thickness of 5 inches. The top section shall be an eccentric conical section with thickened upper walls with the smallest inside diameter equal to 30 inches, to receive the manhole frame and cover. No more than 2 lift holes shall be cast in each barrel or top section.

Manhole riser and top sections shall be designed, manufactured, tested, finished and marked in accordance with this specification and ASTM C478.

MANHOLE TOP: Precast concrete, of concentric cone, eccentric cone, or flat slab top type, as indicated.

MANHOLE BASE: Precast concrete, with base riser section and separate base slab, or base riser section with integral floor, as indicated.

MANHOLE STEPS: Aluminum for manhole steps not permitted. Use polypropylene. Steps shall be located a minimum of 6 inches from the ends of riser and top sections.

PIPE CONNECTORS: Resilient, complying with ASTM C923.

MANHOLE FRAM AND COVER:

1. Shall conform to the Sanitary Sewer Details.
2. Castings shall be tough gray iron, free from cracks, holes, swells and cold shuts. All manhole castings shall be made accurately to the pattern and to the dimensions shown on plans, and shall be planed where marked, or where otherwise necessary to secure perfectly flat and true surfaces. All lids which "rock" and do not lie solid after construction is finished will be condemned and must be replaced by perfect lids.
3. No plugging, burning in or filling will be allowed. Covers must fit the frames in any position. All castings shall be carefully coated, both inside and out, with coal-tar pitch varnish. The varnish shall be made from a good quality of coal-tar, with sufficient oil added to make a smooth coating, tough and tenacious when cold, and not brittle nor with any tendency to scale off.
4. Anchor bolts for bolting manhole frame to the precast manhole shall be 3/4" diameter stainless steel cinch anchor with 5" for embedment in the manhole top and a minimum 2-inch projection through the bars of the frame.

4.07 BRICK AND MORTAR

1. Brick shall conform to ASTM C32 Grade SM.

2. Mortar:

a. Aggregate: ASTM C144.
b. Portland Cement: ASTM C150, Type I, of natural color - or white to produce required color.
c. Hydrated Lime: ASTM C207, Type S.
d. Water: Clean and potable.

Mortar Applications: One part portland cement and two parts sand with hydrated lime added not to exceed 20% of the "cement by weight.

4.08 CONCRETE AND REINFORCING

1. Concrete shall conform to Section 03300 - Concrete of these specifications.

2. Reinforcing mesh and bars shall conform to ASTM A185 and ASTM A615, Grade 60.

4.09 STONE AGGREGATES

Crushed stone shall conform to the requirements for Coarse Aggregate in accordance with PennDOT Specification section 703.2, Size Number 57, Type C or better, as approved.

4.10 INSTALLATION OF GRAVITY MAIN FITTINGS

Install piping in accordance with governing authorities having jurisdiction, except where more stringent requirements are indicated.

Inspect piping before installation to detect apparent defects. Mark defective materials with paint and promptly remove from site.

Install gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements.

PVC and Ductile Iron Pipe shall be installed in accordance with manufacturer's installation recommendations, and in accordance with ASTM D2321.

CLEANING PIPING:

Clear the interior of piping of dirt and other superfluous material as work progresses. Maintain swab or drag in line and pull past each joint as it is completed. In large, accessible piping, brushes and brooms may be used for cleaning.

Place plugs in ends of uncompleted conduit at end of day or whenever work stops.

Flush lines between manholes if required to remove collected debris.

JOINT ADAPTERS:

Make joints between different types of pipe with standard manufactured adapters and fittings intended for that purpose.

CLOSING ABANDONED UTILITIES:

Close open ends of abandoned underground utilities which are indicated to remain in place. Provide sufficiently strong closures to withstand hydrostatic or earth pressure which may result after ends of abandoned utilities have been closed.

Close open ends of concrete or masonry utilities with not less than 8" thick brick masonry bulkheads.

. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Wood plugs are not acceptable.

LAYING PIPE:

Pipes shall be laid true to the lines and grades shown on the plans. The grade shown on the profile is the invert to which the work must conform. Work not conforming to the grade shall be corrected by the Contractor at his own expense. The locations of the proposed lines are shown on the plans. Approximate depths are shown on the plans.

The Contractor shall use a laser to control alignment and grade. The laser shall be set up and operated according to the manufacturer's instructions and the Contractor shall possess all required licenses and permits for laser operation. After the trench has been brought to the proper grade as heretofore specified, the pipe and fittings shall be laid. Care shall be taken to lay the pipe to true lines and grades. Every pipe laid shall be tested as to grade and alignment. Care must be taken to fit the joints together properly so that the centers of the pipes shall be in one and the same straight line, and so as to give an opening of even thickness, all around between spigot end of pipe and the socket end of specials and fittings.

Carefully handle and lower pipe into the trench. Take special care in laying pipe, to ensure that each length abuts against the next in such a manner that there shall be no shoulder or unevenness of any kind along the inside of the bottom half of the pipe line. No wedging or blocking will be permitted in laying any pipe unless by written order or prior approval from AQUA.

Bed each pipe section on a solid foundation before making successive joints. Bring no pipe section into position until the preceding length has been thoroughly embedded and secured in place. Correct any defects due to settlement at Contractor's own expense. Dig bell holes sufficiently large to ensure that the pipe is firmly bedded on the full length of the barrel. All pipe bedding shall be as shown on the drawings.

Use proper and suitable tools and appliances for the safe and convenient handling and laying of pipes.

Thoroughly clean each pipe section before placement and clean until the acceptance of the completed work. Provide and install carefully fitted strong stoppers in the open ends of all pipe lines so as to keep dirt and other substances from entering. Keep stoppers in the ends of the pipe lines at all times when laying is not in actual progress.

Whenever a pipe requires cutting to fit into the line or to bring it to the required location, cut the pipe in a satisfactory manner so as to leave a smooth end.

Keep the excavation in which pipe is being laid free from water and make no joint under water. Do not allow water to rise in the excavation until the joint material has received its set. Use the greatest care to secure water tightness and to prevent damage to, or disturbance of the joints during the refilling process, or at any time. After pipes have been laid and the joints have been made, allow no walking on or working over them, except such as may be necessary in tamping, until there is a covering at least two feet in depth, over their top.

Field cut short pieces of lateral sewer to locate laterals at the proper location. Keep on the work site, at all times, factory approved equipment to machine and adapt the field cut end of short pieces of pipe to standard couplings and jointing materials.

No pipe shall be laid upon a foundation into which frost has penetrated or there is a danger of formation of ice or penetration of frost at the bottom of excavation. Where the foundation is unstable or consists of rock, a stone or gravel foundation, at least six (6) inches thick, shall be placed and tamped to form an acceptable bed for the pipe.

The connection of a pipe to an existing manhole shall be completed with a flexible, watertight connection such as "Kor-N-Seal", or equal. All new connections shall be cored.

INTERIOR INSPECTION:

Inspect piping to determine whether line displacement or other damage has occurred.

Make inspections after lines between manholes or manhole locations, have been installed and approximately 2 feet of backfill is in place, and again at completion of project.
If inspection indicated poor alignment, debris, displaced pipe, infiltration or other defects, correct such defects, and re-inspect.

INSTALLING SANITARY MANHOLES

Place precast concrete sections as indicated on the Sanitary Sewer Details. Where manholes occur in pavements, set tops of frames and covers flush with finish surface. Elsewhere, set tops one foot above finish surface, unless otherwise indicated by AQUA.

Install in accordance with ASTM C891.

Provide preformed joint sealing compound as specified on the drawings.

Construct masonry for manholes and for adjusting existing manholes in accordance with the requirements of PENNDOT Specifications, Publication 408, latest revision, Section 663.3.

All precast manhole components shall be lifted and moved by use of suitable lifting slings and plugs that will not damage the precast manhole lip.

All damage to precast sections shall be thoroughly repaired in the presence of AQUA. Repair and patching of minor breaks shall be done by chipping and scarifying the defective area before application of grout. Sufficient time shall be allowed for curing before the precast sections are put together. Concrete cast-in-place bases shall be specially formed and keyed to accommodate the bottom precast section.

Manhole bases shall rest upon a 12-inch base of sound, level, AASHTO No. 57 compacted stone.

Manhole sections shall not be set by wedging or placing shims to secure proper level and manholes shall not be backfilled without the permission of AQUA.

The top of all precast manholes may be brought to proper grade for receiving manhole frames by use of precast grade rings. Masonry construction shall be performed by experienced and qualified workmen only. All work shall be laid plumb, straight, level, square and true. All joints shall be full and not more than one-half inch in thickness. The Contractor shall set in place and bond in the masonry all necessary steps and miscellaneous items specified elsewhere. The masonry walls shall be parged on the inside and outside with a one-half inch coat of Portland Cement mortar.

The flow channels and bench walls shall be monolithically constructed with the base.

The minimum depth of flow channel shall be equal to 3/4 the diameter of the largest sewer in the manhole to which it connects. The channel shall be graded to give a smooth, uninterrupted flow through the manhole.

Bench walls shall be pitched a minimum of 1 inch per foot from the inside periphery of the manhole to the edge of the flow channel.

Prior to delivery, the entire exterior manhole surface shall be coated with two (2) coats, producing a dry film thickness of .016 inches (16 mils) per coat of Bitumastic Super Service Black, as manufactured by Koppers Co., Inc., equivalent of Mobil Chemical Co., or approved equal. Prior to backfill, any damaged coating shall be repaired/reapplied to the exterior of the manhole.

Provide A-lok seals, or approved equal for all pipe penetrations cast in manholes.

Use "Kor-n-Seal", or approved equal to seal all pipe penetrations cored through manhole wall.

MANHOLE FRAMES AND COVERS

Manhole frames and covers shall be brought to proper grade as previously noted, set in 1/4" bed of mastic, and anchored in place with the four (4) 3/4" diameter anchor bolts which shall be securely embedded in the top of the manhole.

Manhole frames and covers to be the self-sealing type, complete with continuous gasket glued to a continuous groove in the bottom of the manhole cover, as manufactured by Neenah Foundry, or approved equal.

Bolt down Watertight manhole covers must be used for all manholes not located in paved areas. Rims shall be set 1 foot above finished grade.

Only terminal manholes shall be provided with vented covers, unless specifically noted by AQUA.

CONCRETE ENCASEMENT

All concrete encasing shall be in accordance with the requirements of the PENNDOT.

4.11 ACCEPTANCE TESTING:

After the gravity sewers have been laid and backfill placed to two (2) feet above the pipe, a light will be flashed between manholes, or, if the manhole has not yet been constructed, between the location of manholes, by means of a flashlight or mirrored light, to determine whether the alignment of the main is true and whether any pipe has been displaced subsequent to laying. If alignment is correct and no other defects are disclosed, backfilling may be continued. If the test shows poor alignment of the main, misplaced pipe or other defects, such defects shall be remedied by the Contractor, as required by AQUA, before the work of backfilling proceeds.

After backfilling, the Contractor shall make tests to ascertain if joints are tight. Leaking or poor joints shall be repaired, or removed at once by the Contractor to the satisfaction of AQUA.

No section of gravity sewer lines shall be tested for leakage before backfilling in that section has been completed. If this condition has been fulfilled, the sewer lines shall be tested for leakage between manholes as the work progresses.

The Contractor shall perform the tests and he shall furnish all apparatus and materials required for the tests.

The tests will be witnessed by AQUA.

The following tests shall be made:

1. Low pressure air test
2. Mandrel test for PVC pipe
3. Manhole vacuum test
4. Television Inspection

AIR TEST

1. The sewer mains and/or laterals shall be tested for leakage by the use of low pressure air as specified hereinafter and as approved by AQUA. Each manhole run will be tested separately as the construction progresses, before trench surface restoration.

2. Equipment shall be as manufactured by Cherne Industrial, Inc. of Edina, Minnesota; N.B. Products of New Britain, PA or equal. Equipment used shall meet the following minimum requirements:

    a. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected.
    b. Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.
    c. All air used shall pass through a single control panel.
    d. Three individual hoses shall be used for the following connections:

        i. From the control panel to pneumatic plugs for inflation
        ii. From the control panel to sealed line for introducing the low pressure air.
        iii. From the sealed line to the control panel for continually monitoring the air pressure rise in the sealed line.

3. All pneumatic plugs shall be seal tested before being used in the actual test installation. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 25 psig. The sealed pipe shall be pressurized to 5 psig. The plugs must hold against this pressure without having to be braced.

    After a manhole reach of pipe has been backfilled and cleaned, and the pneumatic plugs are checked by the above procedure, the plugs shall be placed in the line at each manhole and inflated to 25 psig. Low pressure

air shall be introduced into this sealed line until the internal air pressure reaches 4 psig greater than the average back pressure of any groundwater than may be over the pipe (3.5 psig minimum pressure in the pipe). At least two (2) minutes shall be allowed for the air pressure to stabilize.

After the stabilization period, the air hose from the control panel to the air supply shall be disconnected. The portion of line being tested shall be termed "Acceptable" if the time required in minutes for the pressure to decrease from 3.5 to 2.5 psig (greater than the average back pressure of any groundwater that may be over the pipe) shall not be less than the time shown for the given diameters:

8" Pipe = 4.0 minutes
10" Pipe = 5.0 minutes
12" Pipe = 6.0 minutes
15" Pipe = 7.0 minutes
16" Pipe = 7.0 minutes
18" Pipe = 9.0 minutes

MANDREL TEST

1. Deflection tests shall be successfully performed on the complete installation of PVC pipe by means of a mandrel test.

2. The Contractor shall utilize a 5% deflection mandrel to ensure that PVC pipe deflection during installation has not been exceeded. Mandrel test shall be conducted no earlier than 30 days after compaction of backfill.

3. Mandrel Test Procedure:

    a. Completely flush the line making sure the pipe is clean of any mud or debris that would hinder the passage of the mandrel.
    b. During the final flushing of the line, attach a floating block or ball to the end of the mandrel pull rope and float the rope through the line. (A nylon ski rope is recommended).
    c. After the rope is threaded through the line, connect the pull rope to the mandrel and place the mandrel in the entrance of the pipe.
    d. Connect a retrieval rope to the back of the mandrel to pull it back if necessary.
    e. Remove all the slack in the pull rope and place a tape marker on the rope at the ends of the pipe.
    f. Draw mandrel through the sewer line. If any irregularities or obstructions are encountered in the line, corrective action shall be taken as required.
    g. If a section with excessive deflection is found, it shall be located and excavated. The pipe shall be inspected for damage; if any damaged pipe is

found, it shall be replaced at the Builder's and/or Contractor's expense; if pipe is not damaged, replace and thoroughly tamp the haunching and initial backfill; replace remainder of backfill.

h. Re-test this section for deflection.

MANHOLE VACUUM TEST

1. Contractor shall supply all equipment and materials to vacuum test each manhole. Equipment and material shall be approved by AQUA.

2. Each Manhole shall be tested after backfilling and binder is placed if in roadway.

3. Prior to testing all lift holes shall be plugged with an approved non-shrink grout.

4. All pipes entering the manhole shall be plugged, taking care to securely brace the plug from being drawn into the manhole.

5. The test head shall be placed inside of the casting and the seal inflated in accordance with the manufacturer's recommendations.

6. A vacuum of 10 inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 9 inches. The manhole shall pass if time is greater than 60 seconds for 48" diameter, 75 seconds for 60", and 90 seconds for 72" diameter manholes.

7. If the manhole fails the initial test, necessary repairs shall be made with a non-shrink grout while the vacuum is still being drawn. Retesting shall proceed until a satisfactory test is obtained.

CLOSED CIRCUIT TELEVISION INSPECTION

The Contractor shall furnish all equipment and labor as required, including all electronic equipment and technicians, to televise sewers. The Contractor shall provide monitoring of closed circuit televised sewers in a manner which shall provide clean and visible pictures of the work being performed.

All video tapes shall be of a high quality DVD Discette capable of viewing in play, fast forward, rewind and still modes of DVD machines. Contractor shall provide the following audio and display information on all video tapes:

1. **Audio Information**

   a. No offensive language.
   b. Day, month, year and time.

c. Location of manholes by AQUA Numbering System and nearest street intersection.
d. Direction camera is viewing and manhole number at destination point.
e. Audio shall be used to describe the location and condition of all manholes, laterals, leaking joints, breaks, and other problem areas.

2. **Screen Display Information**

Standard Display on all DVD's shall be:

Date (month, date, and year)
Job Number
M.H. Number (#) to Number (#)
Linear Foot

This shall be located on the screen where it will not obstruct the view. Color T.V. camera shall be used for all televising.

SECTION 5 - HOUSE LATERALS

5.01 HOUSE SERVICES GENERAL

This section deals with the installation of sanitary sewer laterals. Contractor shall install wye, 45^{o} bend, piping, cap, joint materials and accessories and all other items incidental thereto and required for a complete and operational installation.

5.02 SUBMITTALS

Prior to commencing any work, the Builder and /or Contractor shall submit this following to AQUA for review and approval:

1. Shop Drawings: Submit shop drawings for house laterals showing piping materials including details of connections, fittings, pipe and appurtenances.

2. Record Drawings: At project closeout, submit to AQUA the station location of the lateral connections and the elevations of the laterals at the right-of-way or easement line.

5.03 MATERIALS FOR LATERALS AND FITTINGS

Sanitary sewer laterals shall be PVC or Ductile Iron Pipe in accordance with these specifications and as indicated on the sanitary sewer details. Laterals shall be 4 inch diameter minimum. Laterals for multiple dwellings and commercial buildings shall be sized for the maximum daily flow.

Polyvinyl Chloride (PVC) Pipe and Fittings: As specified in Section 4.04 - Gravity Sanitary Sewer System.

Ductile Iron Pipe (DIP) and Fittings: As specified in Section 4.04 - Gravity Sanitary Sewer System.

5.04 CONNECTIONS TO EXISTING MAIN

Lateral connections to existing mains shall be made with a sanitary sewer saddle connection specifically designed for connection of the existing pipe type and the proposed lateral. Saddle shall be a Scaltite Type "E" wye sewer pipe saddle, or approved equal.

5.05 LATERAL LOCATION

The station and elevation of all laterals must be recorded.

5.06 LATERAL INSTALLATION

The Contractor must adhere to all local and state plumbing codes and the applicable sections of the National Standard Plumbing Code.

The pipe and fittings shall be installed in accordance with manufacturer's installation recommendations and in accordance with ASTM D2321.

Pipe and fittings shall be installed as specified in Section 4.04 - Gravity Sanitary Sewer System.

The end of each lateral shall be capped prior to backfilling.

SECTION 6 - WASTEWATER PUMPING STATIONS SPECIFICATIONS

6.01 GENERAL

1. The intent of this section of the specifications is to provide the Developer and Contractor with **General Guidelines** for the design and construction of sanitary sewage pump stations.

2. This section includes wet well, packaged pumping stations with submersible grinder sewage pumps.

3. Nothing in these specifications shall preclude the Developer and/or Contractor from conformance with the PADEP Domestic Wastewater Facilities Manual. Where conflicts occur, DEP's manual shall govern.

6.02 PERFORMANCE REQUIREMENTS

1. Pressure Rating of Sewage Pumps and Discharge Piping Components: At least equal to sewage pump discharge pressure, but not less than 125 psig

2. Pressure Rating of Other Piping Components: At least equal to system operating pressure.

6.03 SUBMITTALS

1. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

2. Shop Drawings: Show fabrication and installation details for each packaged pumping station. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

    a. Wiring Diagrams: Power, signal, and control wiring.

3. Product Certificates: For sewage pumps, signed by product manufacturer.

4. Field quality-control test reports.

5. Maintenance Data: For packaged pumping stations to include in maintenance manuals.

6. Warranties: Special warranties specified in this Section.

6.04 QUALITY ASSURANCE

1. Installer Qualifications: An authorized representative of packaged pumping station manufacturer for installation and maintenance of units required for this Project.

2. Manufacturer Qualifications: A qualified manufacturer.

3. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7.

4. Product Options: Drawings indicate size, profiles, and dimensional requirements of packaged pumping stations and are based on the specific system indicated.

5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.

6. HI Compliance: Comply with HI 1.1-1.5 for sewage grinder pumps.

7. NEMA Compliance: Comply with NEMA MG 1 for electric motors.

8. UL Compliance: Comply with UL 778 for sewage grinder pumps.

6.05 WARRANTY

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged pumping stations that fail in materials or workmanship within specified warranty period.

2. Verify available warranties for units and components and retain or insert number below. Warranty Period: [Two] years from date of Substantial Completion.

6.06 PRODUCTS

1. Manufacturers

   In other Paragraph 6.06 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
   b. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2. Pumps:

a. Sewage pumps shall be submersible grinder-type sewage pumps, with guide rail, quick-disconnect system, controls, and piping, as manufactured by ITT Flygt Corporation or approved equal. Pumps shall be vertically mounted centrifugal, volute-type, single-suction, non-clog, submersible pumps with close-coupled submersible electric motors. Pumps shall be installed per the manufacturer's recommendations. Include stainless-steel grinder impeller and hermetically sealed motor with moisture-sensing probe, mechanical seals, and waterproof power cable. Pumps shall have rated capacity (GPM) at total dynamic head (feet) as noted on the construction drawings. Pumps shall be capable of handling unscreened raw sewage consisting of fibrous materials and spherical solids up to 3" diameter. Provide two pumps for each pump station.

b. One pump shall be fitted with the ITT Flygt mix flush valve assembly consisting of the ITT Flygt mix flush valve, impeller and volute. The valve shall be intrinsically safe and suitable for pumps used in hazardous locations. The system shall be based on the ejector principle with a ball closing the valve in a period of 20 to 50 seconds. A means of adjustment shall be provided on the valve to obtain the desired flushing period. The second pump shall be fitted with the mix flush valve adapter only.

c. Pumps, mechanical seals and motor units provided shall be from the same manufacturer in order to achieve standardization of operation, maintenance, spare parts, service and warranty.

3. Pump Accessories

a.. GUIDE RAIL SYSTEM: Each Pump to be furnished with a guide rail system consisting of a dual rail system connected to the discharge head and to an upper guide bar holder mounted to the access frame. The guide rail system shall consist of stainless steel guide bar brackets and schedule 40 Type 304 stainless steel pipe.

b. Pump removal system:

i. Each pump shall be equipped with complete attachments necessary for lifting the pump and motor from the wet well by means of the Flygt Grip Eye system. The working load of the lifting system shall be a minimum of 50% greater than the pump/motor unit weight.

ii. Pump Lift Cord: Furnish one (1) lift system. System shall consist of stainless steel cable, a short length of high tensile strength proof

tested chain and forged steel grip eye for use with portable hoist. Stainless steel chord shall be provided in a length that is 10-feet deeper than the wet well depth.

c. Discharge Elbow: Each pump shall be furnished with a discharge elbow specifically matched to the pump, and be manufactured by Flygt.

6.07 PUMP CONTROL SYSTEM

1. Control Sequence of Operation: Cycle each sewage pump on and off automatically to maintain wet-well sewage level. Automatic control operates both pumps in parallel if wet-well level rises above starting point of low-level pump, until shutoff level is reached. Automatic alternator, with manual disconnect switch, changes sequence of lead-lag sewage pumps at completion of each pumping cycle.

2. Level Controller and Probe: Level control system shall be Multitrode probe system comprising a multi-sensored probe in conjunction with a Multitrode controller. Discrete level setpoints will be as indicated on the construction drawings. The system shall be connected to the pump control panel for pump to level control operation. Controller and probe to be manufactured by ITT Flygt Corp., or approved equal.

3. Alarm Light:

   a. An external mounted alarm light shall be provided. Light shall be 100W, enclosed in a vapor proof fixture with metal guard and be provided with a solid state flasher and push button. Light shall be capable of being set to automatic mode, manual or OFF position. Light to normally be off, but will flash at a rapid frequency during all alarm conditions.

   b. Alarm conditions:

      i. High liquid level in wet well (as detected by primary or backup level probes)
      ii. Seal failure, either pump
      iii. High temperature, either pump
      iv. Pump failure, either pump
      v. Power failure (Emergency Generator Running)
      vi. Emergency generator failure
      vii. Emergency Generator High Temperature
      viii. Low generator fuel

4. Redundant High Level Probe: High level probe to be a single float level probe, freely suspended at the required height. Float and cable shall be contained within a protective polypropylene casing. The probe shall be connected to the pump station control panel and signal the alarm light and auto-telephone dialer upon activation. Probe shall be manufactured by ITT Flygt, or approved equal.

5. Automatic Telephone Dialer: Dialer shall consist of a field programmable, solid state electronic unit with surge protection housed within a weatherproof metal enclosure, shall plug into a standard line telephone jack and continuously monitor presence of AC power and 8 dry-contact alarm units, with voice-synthesized message output capability. Dialer shall be energized by the same alarm conditions as described above for the alarm light.

6.08 PUMP DISCHARGE PIPING

1. Interior Piping: Piping within valve chamber and wet well shall be flanged joint D.I.P. (ANSI A21.15), thickness class 53 (ANSI A21.51). Fittings shall be ductile iron or grey-iron flat faced with pressure rating of 250 PSI (ANSI A21.10). Gaskets shall be full faced, rubber and 1/8" thick (ANSI B16.21). All bolts and nuts used within wet well and valve chamber shall be 304 stainless steel.

2. In lieu of Ductile Iron, schedule 40 type 316 stainless steel piping may be used for all piping in the pump station wet well. All bends within the wet well structure shall be welded construction.

3. Force Main Pipe and Fittings (downstream of valve chamber): DIP CL52.

4. DIP/PVC Adapter: Dresser style 162 or approved equal.

5. Flanged Adapters: Dresser Style 127 (restrained joint) or approved equal.

6.09 WET WELL SYSTEM

1. The wet well structure shall be designed to resist all soil and hydraulic pressures, including both lateral pressures and hydraulic uplift.

2. Pre-cast wet well base slabs, top slabs, and barrel section rings shall conform to the requirements of ASTM C478 unless otherwise specified herein.

3. All pre-cast concrete shall be 4000psi at 28 days. All reinforcing steel shall be grade 60 deformed bars conforming to ASTM A-615 or ASTM A-616.

4. Pre-cast wet well shall be manufactured by Atlantic Precast Corp., Terre Hill Concrete Products, Rotondo Penncast, A.C Miller Concrete Products, or approved equal.

5. Course Aggregate: PADOT No. 2A or AASHTO No. 8 in accordance with Table C, Section 703.2, Publication 408 Specs.

6. Wet Well Access Doors: Hatch arrangement shall be Flygt FLED model, double leaf, hinged, as shown on the drawings. Size shall be as shown on the drawings. Unless otherwise noted, all hardware to be stainless steel. Hatch shall be self locking and designed to withstand a live load of 300 PSF.

7. Davit Crane: A portable hoist which can be seated in recessed sockets cast into the top slab of the wet well shall be provided. Hoist system shall include mast, boom, crane base, winch and drive assembly, wire rope and hook. Hoist system to have capacity to lift 150% of the weight of the pump and motor and shall be capable of lifting the sewage pumps without entering the wet well. Davit Crane to be provided with telescopic boom capable of being adjusted vertically while under load. The mast and boom assembly shall be capable of being rotated 360 degrees while under load. Mounting sockets shall be recessed into the wet well top slab, with covers and drain hole through bottom of socket and concrete slab to prevent freezing. Davit Crane System shall be Thern 5124M2GAL with a 524WGAL base, or approved equivalent.

8. Penetration Seals: Wet well and manhole-gravity sewer penetrations shall be integrally cast "A-lok" type seals. All other penetrations shall be "link-seal" by Thunderline Corp., or approved equal.

9. A bituminous protective coating shall be applied to all underground exterior surfaces of the wet well and valve chamber (the top and uppermost 12-inches of the sides shall not be coated). The coating shall consist of two (2) coats each 8 mils thick of Koppers Bitumastic No. 300-M or approved equal.

10. A protective epoxy coating (white) shall be applied to the entire interior concrete surface of the wet well. The coating shall consist of two (2) coats, each 6 mils thick of Pennchem coating No. 54-w-23 BY Pennsbury Coatings or approved equal.

11. All aluminum in contact with concrete and/or other metals is to receive two (2) coats of coal tar epoxy, 16 mils DFT minimum.

12. Contractor shall coordinate the location of the pipe openings with manhole section joints. No pipe shall be within one (1) foot of manhole joints.

13. Safety Grate: A safety grate shall be provided for the wet well access hatch. The grate shall provide fall-through protection per OSHA standard 1910 and shall be a Flygt Safe-Hatch as manufactured by ITT Flygt or approved equal.

6.10 VALVE VAULT SYSTEM

1. The valve vault structure shall be designed to resist all soil and hydraulic pressures, including both lateral pressures and hydraulic uplift.

2. Pre-cast valve vault base slabs, top slabs, and side walls shall conform to the requirements of ASTM C857 unless otherwise specified herein.

3. All pre-cast concrete shall be 4000psi at 28 days. All reinforcing steel shall be grade 60 deformed bars conforming to ASTM A-615 or ASTM A-616.

4. Pre-cast valve vault shall be manufactured by Atlantic Precast Corp., Terre Hill Concrete Products, Rotondo Penncast, A.C Miller Concrete Products, or approved equal.

4. Course Aggregate: PADOT No. 2A or AASHTO No. 8 in accordance with Table C, Section 703.2, Publication 408 Specs.

5. Valve Vault Access Doors: Hatch arrangement shall be Flygt FLED model, double leaf, hinged, as shown on the drawings. Size shall be as shown on the drawings. Unless otherwise noted, all hardware to be stainless steel. Hatch shall be self locking and designed to withstand a live load of 300 PSF.

6. Valve vault piping shall include an emergency bypass connection.

7. Valves:

    a. Check Valves: Unless otherwise noted, discharge line check valves shall be APCO Series 100 rubber flapper swing check valve with ductile iron body and cover. The body shall be long body design with integrally cast-on 125 pound, full faced end flanges, drilled per ANSI B16.1.

    b. Flap Valve: Flap valve shall be iron body, bronze mounted with flanged end, manufactured by Clow Valve Co., or approved equal.

    c. Shutoff Valves:

        i. Discharge line isolation valves shall be DeZurik Series 100 non-lubricated eccentric plug valves. Plug valves shall be resilient faced plug style and include bi-directional eccentric seating so that the opening movement of the plug results in the plug rising off of the body seat contact.
        ii. Gate Valves: Gate valves shall conform to the AWWA C509 standard and shall be of the resilient seated type with a 200 PSI working pressure rating. Valve shall be of iron body and cover construction with an elastomeric bonded cast iron disc and a non-

rising bronze stem and bronze stem nut. The valve stem shall be sealed with a double "o" ring assembly. All valves shall be equipped with a handwheel that shall cause the valve to be opened by turning in a counterclockwise direction (valves shall be mounted vertically in a horizontal flow alignment). Gate vales shall be manufactured by ITT Kennedy Valve, Mueller Company, or approved equal

8. Flowmeter: Magnetic Flowmeter shall be Tigermag EP, model FM657, flanged connection, with flow totalizer, as manufactured by Sparling Instruments, Inc.

9. Flow Transmitter: Provide a flow rate indicator and totalizer, remotely mounted in the control building. The totalizer shall be configured for digital display of flow rate and totalized flow, and shall be model 787 indicator totalizer, as manufactured by Sparling Instruments, Inc.

10. Chart Recorder: Provide Chart recorder mounted in control building. Recorder shall be capable of charting the instantaneous flow on a 12-inch circular paper chart. Recorder shall be model RR770 manufactured by Sparling Instruments, Inc.

11. Pressure Sensor Unit: Each pump or set of pumps shall be equipped with at least one pressure sensor unit and pressure gauge. The gauge shall have a pressure range adequate to indicate anticipated discharge pressures without exceeding 75% of the maximum scale. Unless otherwise specified or shown on the drawings, the anticipated maximum discharge pressure shall be 125% of the highest design point on the pump curve.

12. Valve Vault Ladder: Vertical stainless steel ladder, minimum width of 18" shall be provided, capable of being fastened to concrete using stainless steel anchor bolts.

14. Valve Vault Drain & Vents: Cast iron, service weight, ASTM A74, unless otherwise noted.

6.11 PERMANENT AUXILLIARY POWER GENERATOR

1. Generator shall be sized to adequately supply starting current and continuous operation for all connected loads. Generator to be located in a separate room within the control building, having adequate ventilation as required by the manufacturer. Engine shall have protective equipment capable of shutting down the unit and activate an alarm under conditions which may damage the engine. Supplier shall recommend amount and type of vibration isolation and anchor bolt necessary to mount the generator to the generator slab. With one pump running and all other loads on, the voltage drop, upon starting the second pump, shall not exceed 35%. Emergency generator shall be manufactured by Cummins/Onan.

Generator shall be supplied with natural gas feed from gas distribution system within development, if available. Otherwise, generator to be diesel powered.

2. Automatic Transfer switch (ATS): ATS shall be provided to automatically start the emergency generator when power failures are detected and to switch back over when power is restored. ATS shall be fully rated to protect all types of loads, inductive and resistive, from loss of continuity in power. Adjustable solid state time delays for starting, transfer, retransfer, and stopping the generator shall be provided. A seven day exerciser clock and standard indicating lights shall be provided. ATS shall be manufactured by Cummins/Onan and shall come integral with level 1 power command control with exerciser clock and programmed transition. ATS shall also contain a 2A (integral) battery charger mounted and wired within the ATS.

6.12 CONTROL BUILDING

1. Structure: Building to be of masonry construction and sized to house electric and control panels, emergency generator, and chemical treatment (if needed), all in separate rooms.

2. Chemical treatment (if applicable):

    a. Hydrogen Peroxide – Provide the following:

        i. Chemical Metering Pump: one (1) peristaltic chemical metering pump, 3 RPM, gear motor, powered by 120V electrical. Metering pump shall be capable of pumping in a range of ½ gpm and 5 gpm, or as specified by AQUA. Chemical metering pump and shall be model SP10, manufactured by Watson/Marlow or approved equal.
        ii. Polypropylene shelf for pump with stainless steel mounting hardware.
        iii. Hose and fittings capable of handling chemical.
        iv. 30 gallon plastic day tank for holding chemical solution
        v. Two (2) stainless steel ejectors one on discharge side of each pumps' discharge header, in locations directed by AQUA.
        vi. 24-hour timer with 15-minute interval pre-timed control of chemical feed pump.

3. Accessories:

    a. Lighting: Provide adequate lighting for each room in the control building.

b. Control Building Space Heater: Provide a unit space heater capable of maintaining the control building at an ambient temperature of 65°F. The space heater shall be ceiling or wall mounted with integral thermostat capable of controlling between 60°F and 90°F, and be manufactured by Chromalox, or approved equal.

c. Ventilation: (In all rooms except the emergency generator room) Exhaust fan shall be manufactured by New York Blower Company, or approved equal, and shall include 8" diameter fan with motor capable of producing 400 CFM of flow at 0" S.P. Fan shall include gravity louvers and shall mount directly in wall. Louvers shall be shielded on the exterior with an insect/bird screen. NOTE: Ventilation for the emergency generator room shall be installed exactly as specified by Cummins/Onan to be adequate for the generator to be used.

d. Hose Bibs: All hose bibs must have backflow protection and must be frost-proof.

e. Hose: Contractor shall furnish a 50-feet length of 3/4" heavy duty rubber hose for connection to the 2" yard hydrant.

6.13 SITE IMPROVEMENTS

1. Chain Link Fence: Nominal 8-foot height with 12-foot wide double section gate as shown on plans. Framework shall be constructed of schedule 40 steel, standard weight, one piece without joints. Fabric shall be 2-inch diamond mesh steel wire, interwoven 9 gage thick, top selvage twisted tight, bottom selvage knuckle end closed.

2. Access Drive: Driveway to be bituminous, minimum 10-foot wide providing access directly adjacent to the wet well, valve vault, and control building. Provide vehicle turnaround and parking area for one vehicle.

3. Exterior Lighting: A single exterior light shall be mounted 12' above ground on an aluminum pole set on a concrete base. Floodlight shall be a heavy-duty aluminum fixture with motion detector and manual override activation switches, impact resistant glass and a 500-watt quartz lamp. Light shall be equipped with manually operated toggle switch to override the motion detector.

4. Freeze-Proof Yard Hydrant: Provide a two-inch automatic draining hydrant with schedule 40 stainless steel casing and operating rod, bury depth of three feet with locking feature. All buried fittings must be constructed of brass. Hydrant shall be equipped with backflow protection. Hydrant seat must be repairable without excavation, manufactured by Woodford Manufacturing Company, or approved equal. Hydrant location to be chosen by AQUA.

SECTION 7 - STANDARD DETAILS

Exhibit 3

Certification Form for Final Project Cost

***** ACTUAL COSTS MUST BE SUBMITTED WITHIN ONE MONTH OF PROJECT COMPLETION AND PRIOR TO CONTRIBUTION*****

Exhibit 2 - Specifications for Builder Wastewater Extension Pipeline

DIVISION 01
GENERAL REQUIREMENTS

SECTION 01010 – GENERAL CONDITIONS

PART 1 - GENERAL

1.1 INTRODUCTION

A. The Builder shall comply with all regulations and requirements of AQUA, Local ordinances, these Specifications, plus applicable regulations of the Pennsylvania Department of Environmental Protection, Pennsylvania Department of Transportation, and all other Federal, State and Regulatory Agencies.

B. The Builder is the party who is ultimately accountable to AQUA for all work and responsible for all work, regardless if the work is performed by the Builder's Contractor. This condition is implied throughout these Specifications.

C. Before any work is started at the construction site, the Builder shall notify Aqua Pennsylvania Wastewater Company, Inc. (AQUA), local Police Departments, Public Works Departments, Fire Departments, School District, and the various utility companies serving the area and shall schedule a preconstruction meeting with AQUA. At the preconstruction meeting, the escrow amount may be modified as necessary to cover construction and inspection costs based on a bona fide construction proposal.

D. It shall be understood that AQUA, at their discretion, reserves the right to visit the construction site(s) and inspect the installation of the sewer mains and require corrective actions to assure compliance with these Standards.

E. All work is subject to the inspection and final acceptance by AQUA's Engineer or designated representatives.

1.2 DEFINITIONS

A. The following definitions shall be applicable in these Specifications:

1. AQUA shall mean the Aqua Pennsylvania Wastewater Company, a public utility of the Commonwealth.
2. Builder shall mean any landowner, agent of such landowner, or tenant with the permission of such landowner, who makes or who causes to make a subdivision of land or a land development, or who constructs or causes to be constructed a sanitary sewer extension or sewerage facilities.
3. Contractor shall mean any individual, partnership, or corporation performing sewer construction work for the Builder.
4. AQUA Representative shall mean a construction observer either employed by AQUA or a Consulting Engineer that represents AQUA.
5. Equal shall mean equal as approved by AQUA.
6. Construction Details shall mean those drawings which are approved by AQUA as AQUA's "Standard Details", and included in this project manual to show general and typical construction details.
7. Municipality shall mean Township(s) or Borough(s) that the work is being performed in.

8. Building Sewer shall mean the extension from any structure to the public sewer lateral.
9. Builder's Construction Drawings shall mean those drawings prepared by the Builder or his engineer and approved by AQUA to show the detailed design of the specific project including plan layout and design details.
10. Subdivision shall mean the division or subdivision of a lot, tract, or parcel of land by any means into two or more lots, tracts, parcels, or other divisions of land.
11. Work shall mean labor, services, materials, and equipment as required for the successful completion of the project.
12. Lateral shall mean that part of the sewer system extending from a sewer, located in the street right-of-way to the structure side of the building sewer serving an improved property. If there shall be no improvement on the project, the "lateral" shall mean that part of the sewer system extending from said sewer to the right-of-way or easement boundary to a point of future connection to the building sewer, if and when said property is improved.

1.3 INSTALLATION OF MAINS

A. All sewer mains shall be installed in accordance with the Standard Specifications of AQUA.

B. The layout and alignment of all sewer mains shall be reviewed and approved by AQUA.

C. All sewer mains shall not be less than 8-inches, with the possible exception of deadends, where the pipe may be 6-inches in size. Allowance for 6-inch lines on deadends shall be at the discretion of AQUA.

D. All sewer mains shall be laid with a minimum depth of cover of 4 feet, properly bedded, backfilled, blocked, subjected to testing in accordance with these Specifications.

1.4 INSTALLATION OF SEWER BUILDING SEWERS AND LATERALS

A. General: The building sewer extending from the property line to the premises shall be installed by the Builder or customer and subject to the detailed requirements and Standard Specifications of AQUA.

B. Cleanouts may be required on all building sewers extensions of 100 feet in length or greater at the discretion of AQUA. The cleanout shall be in complete accordance with the Standard Specifications of AQUA with respect to such work. All pipe passing through foundation or bearing walls shall be provided with suitable sleeves and the annular space between the sleeve and the pipe made watertight.

C. Inspection: AQUA shall be notified when the installation of the building sewer is completed and prior to backfilling, so that the building sewer can be tested in the presence of a representative of AQUA and an inspection made of both workmanship and materials. The notice shall include such data as the location, the name of the owner and tenant and the time the work will be ready for inspection.

D. Sewage will not be permitted through the building sewer which has not been inspected in the open trench and approved by AQUA. These requirements apply to both original installation and repairs.

1.5 PERFORMANCE

A. The Builder shall perform his work in such a manner as to interfere as little as possible with the use of intersecting roads or adjoining property. No excavation shall be left open or other obstruction allowed to remain longer than is absolutely necessary; and the Builder shall provide all safeguards and temporary passageways that may be necessary for the convenience and protection of all persons using said property either day or night.

PART 2 - REQUIREMENTS

2.1 DOCUMENTS TO BE SUBMITTED TO OBTAIN INITIAL PLAN APPROVAL

A. The Builder shall, in order to obtain initial approval of plans, submit their proposed plans and data to AQUA with sufficient information to enable AQUA's Engineer to review same for compliance with sound engineering practices and legal requirements and all AQUA rules and regulations and these Standard Specifications. AQUA's review of the Builder's plans is for the purpose of determining general conformance with AQUA's Standard Specifications, requirements and details of AQUA. The Builder remains responsible for implementation of AQUA's Specifications, requirements and details. The Builder is also responsible for the accuracy of the Accepted Plans and for the designed facility to function as intended. The Builder is also responsible for determining the size and location of all existing utilities. The Builder is hereby notified that any purchase of material and/or equipment etc., prior to AQUA's approval thereof, is at the Builder’s risk.

B. When AQUA, through its Engineer, indicates its general acceptance of the proposed plans, the Builder shall provide an estimate of the construction of the proposed facilities in sufficient detail for AQUA's Engineer to establish an escrow amount for the proposed work. Standard estimating procedure shall be used. In general, sewer main installation shall be classified by linear footage and pipe size for estimating. An estimate for rock excavation shall also be included. It is preferred that the estimate be done by the Builder competent in the work to be performed. AQUA’s Engineer will have the right to adjust the estimate to reflect their understanding of the cost to perform this work.

2.2 SUBMITTALS AFTER PLAN APPROVAL

A. Upon general acceptance of the proposed plans, but prior to initiating any work, the Builder shall submit copies of all required permits and other various requirements as itemized herein.

B. All submittals shall be made in accordance with Section 01300 - Submittals of these Specifications.

C. The Builder shall, in accordance with the following schedule, transmit to AQUA, two (2) copies or sets of the following data, unless otherwise noted.

1. Two (2) weeks prior to construction:

a. Three (3) sets of the Accepted Plans signed and sealed by a Professional Engineer licensed to practice in the Commonwealth of Pennsylvania. The drawings shall be clear and legible. The plans prepared utilizing AutoCAD shall be prepared at a scale of not less than 1 inch equals 50 feet. Each drawing shall contain a North arrow. Each drawing shall name the legal Owner of the land on which the construction is to occur and the legal name of the Builder.
b. Pennsylvania State Highway Occupancy Permit (when required).
c. Borough and Township Road Opening Permit (when required).
d. Erosion and Sediment Control Plan.
e. Any and all other permits that may be required to undertake the installation of the sewer facilities.
f. Executed easements or rights-of-way obtained from private landowners (when required) to be conveyed to AQUA upon acceptance of the completed facilities.
g. Shop Drawings of all the materials and systems to be installed under this Work. See Section 01300, Submittals for copies required.
h. Blasting Report, if required.

2. During construction:

a. Letters of certification as to compliance with the Specifications including but not limited to:

(1) Paving material
(2) Select backfill - Type No. 2A (PennDOT)
(3) Concrete

3. After construction:

a. Blasting Records
b. Record Drawings
c. Warranties and Guarantees shall be turned over to AQUA.
d. A Maintenance Bond equal to fifteen percent (15%) of the construction cost of the proposed work is required. The Builder shall also purchase and maintain such insurance as will protect AQUA from any claims. The said insurance shall be as required under the laws of Pennsylvania.

2.3 ROCK EXCAVATION

A. Builder shall obtain approval from AQUA prior to any blasting. All blasting shall be performed under the supervision of a Professional Engineer licensed to practice in the Commonwealth of Pennsylvania.

B. Excavation in rock shall be carefully performed and where blasting is necessary, care shall be taken to prevent damage of any kind to persons or property. Blasting shall be done in accordance with Federal, State, and Municipal ordinances by qualified Operators licensed to practice in Pennsylvania and shall be done in accordance with present day standards of good practice. Builder, at its sole expense, shall secure all permits and shall meet all Federal, State, and Municipal requirements regulating the transportation, storage, and use of explosives.

C. Trenches excavated in rock shall be excavated to a depth of six (6) inches below the grade prescribed for the bottom of the pipe and shall be re-filled to the proper grade with bedding materials, such as sand or highway screenings, that will provide an adequate cushion for the pipe.

D. In no case will excavated rock materials be acceptable for use in any portion of the backfill.

2.4 SOILS TESTING

A. All soils testing as described in these Specifications shall be performed by a reputable testing and control firm when required by AQUA.

2.5 ACCESS TO WORK

A. Representatives of AQUA shall have access to the work. The Builder shall provide proper and safe facilities for such access and observation of the work and also for any inspection or testing thereof by others.

2.6 AQUA MAY STOP THE WORK

A. If the work is defective, or the Builder fails to supply suitable materials, AQUA may order the Builder to stop the work, or any portion thereof, until the cause for such order has been eliminated.

2.7 WARRANTY AND GUARANTEE

A. The Builder warrants and guarantees to AQUA that all work will be of good quality and free from faults or defects. All unsatisfactory work, all faulty or defective work, and all work not conforming to the Accepted Plans and these Specifications shall be considered defective. AQUA will give timely notice of all defects to Builder. At the option of AQUA, all defective work, whether or not in place, may be rejected or accepted with or without requiring corrections from Builder.

2.8 TESTS AND INSPECTIONS

A. Where so indicated in these Specifications, or if the laws, ordinances, rules, regulations, or orders of any public entity having jurisdiction, require any work to specifically be inspected, tested, or approved by some public body, the Builder shall assume full responsibility thereof, pay all cost in connection therewith, and furnish AQUA the required certificates of inspection, testing, or approval.

B. The Builder shall give timely notice of readiness of the work for all inspections or approvals.

C. All analysis will be run by an approved commercial or any AQUA approved laboratory and paid by AQUA/Builder. A copy of all the test results to be submitted to AQUA prior to final inspection.

2.9 FINAL INSPECTION

A. Upon written notice from the Builder that the project is complete, AQUA will make a final inspection with the Builder and will notify the Builder in writing of all particulars in which this inspection reveals that the work is incomplete or defective. The Builder shall take such measures as are necessary to remedy such deficiencies.

2.10 FINAL APPLICATION FOR ACCEPTANCE

A. After the Builder has completed all such corrections to the satisfaction of AQUA, and delivered all schedules, guarantees, bonds, certificates of inspection, and other documents, AQUA shall issue a letter of final acceptance.

2.11 RECORD DRAWINGS

A. The as built information for the extension project will accurately represent actual construction of the sewer main and appurtenances, be sufficient to permit AQUA to obtain the full benefit of the protections of the Pennsylvania Underground Public Utility Protection Law upon and after contribution, and contain the following legible information, documented in detail in a project construction log and noted on a copy of the drawings:

1. Variations from the final Plan
2. Limits of any rock encountered in the excavation
3. Locations of manholes, wyes, connections, valves, etc. relative to fixed points (e.g., edge of curb, existing manholes or valve boxes, telephones poles, etc.)
4. Final elevation information including rim, invert, and outfall elevations including revised profile plans.

B. At completion of the Work, Builder shall provide AQUA with two (2) sets of reproducible plans, in a neat and clean condition showing the "As-Built Conditions."

C. Plans shall be marked "Record Drawings" and maintained at the project site. The Builder shall record on the prints all deviations from their Accepted Plans and these Specifications, at the time that such deviations are made.

1. Record Drawings for sewer mains shall show all vertical and horizontal changes as shown on the Accepted Plans. The location of all service laterals (lengths and depths) shall be dimensional from the main. Record Drawings shall indicate a profile showing the depths where rock was encountered and all other changes made to the Accepted Plans and these Specifications.

D. A complete file of accepted field sketches, diagrams, and other changes as may become necessary during the progress of the work shall also be maintained and attached to the set of marked-up prints.

E. At completion of the work, the Builder shall provide, for the information of AQUA, each sheet of marked prints and all accepted field sketches and diagrams.

F. When this data has been reviewed and returned by AQUA, the Builder shall record all field changes and conditions on the Record Drawings clearly noting all field changes and conditions and providing plots on reproducible mylars. Each sheet shall be clearly marked “Record Drawing” and shall be signed by an officer of the company of the Builder certifying that each sheet/drawing reflect the actual as-built conditions.

G. Provide one (1) set of printed drawings in addition to the Record Drawings. Deliver printed drawings to AQUA.

PART 3 – EXECUTION (NOT USED)

END OF SECTION 01010

SECTION 01030 - LOCATIONS OF EXISTING LINES

PART 1 - GENERAL

1.1 SCOPE

A. Construction Requirements:

1. In accordance with the Commonwealth of Pennsylvania Act No. 287, PA One Call System, 1-800-242-1776, the Builder, prior to performing excavation or demolition work on the job site shall obtain all recorded locations of existing lines as outlined herein.
2. Attention is directed to the fact that there may be other lines in certain locations in addition to the recorded locations.

B. Related Requirements Specified Elsewhere:

1. Act No. 287
2. Excavation, Section 02221 - Trenching, Backfilling and Compaction

1.2 SUBMITTALS

A. The Builder shall furnish AQUA a certification listing the names of the Users whom he has contacted prior to starting their work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. It is the duty of the Builder, prior to performing excavation or demolition work at their site within a political subdivision, to ascertain the exact location and type of Users' lines which are located within the limits of their work area.

3.2 OBTAINING LOCATION OF EXISTING USERS' LINES

A. Not less than three (3) working days prior to the day the excavation or demolition work shall begin, the Builder shall request that each of the Users with facilities within the limits of the work area locate these facilities in the field. Generally, this will include determining and locating the number and horizontal position of all lines. (Also see Paragraph 3.3 of this Section, "Locating Lines.")

B. The following are cooperative steps which the Builder shall take, either at or off the excavation or demolition site:

1. Before the Builder starts any demolition work in the area of a particular User's line, the Builder shall ascertain from the User if the User wants to have a representative present during the work within this area. Additionally, the Builder shall comply with all standard regulations and necessary precautions as may be required by the User.
2. Inform each operator, employed by the Builders at the site of such work, of the information obtained by him as noted above.
3. Report immediately to the User any break or leak on its lines, or dent, gouge, groove, or other damage to such lines or to their coating or cathodic protection, made or discovered in the course of the excavation or demolition work.
4. Alert immediately the occupants of premises as to any emergency that he may create or discover at or near such premises.
5. The requirements of paragraphs A and B above apply to a User or Builder performing excavation or demolition work in an emergency.

3.3 LOCATING LINES

A. All recorded or unrecorded lines shall be located on the ground with pipe-locating equipment well ahead of the work at all times. All such locations shall be plainly marked by coded paint symbols on pavement or marked stakes in the ground. Such locations shall be established at least 50 feet in advance of all trench excavation. All such location work shall be provided by the Builder to the satisfaction of AQUA.

3.4 LINES, GRADES, AND CONSTRUCTION SURVEYING

A. The Builder shall be responsible for the stake-out for the construction of the project. The Builder shall provide all surveying required to layout the construction work from horizontal and vertical reference points. The Builder shall provide all engineering personnel, materials, equipment, and labor required to stake-out the baselines and/or centerlines and all offset lines and grades.

B. On jobs where the Builder intends to use a laser he shall either: provide offset stakes at a minimum of 100' intervals and use them to spot check his grades or provide a level, rod, and level operator to spot check his grades.

3.5 COORDINATION

A. The Builder shall be required to coordinate his activities with AQUA and in no way shall the Builder’s activities interfere with facility operations unless suitable arrangements are made five (5) days in advance to minimize the interference to the satisfaction of AQUA.

END OF SECTION 01030

SECTION 01300 - SUBMITTALS

PART 1 - GENERAL

1.1 SCHEDULES

A. Before any work is started at the job site, the Builder shall submit to AQUA's Engineer Shop Drawings in accordance with the following requirements.

B. The Builder shall be responsible for preparing a Progress or Work Schedule for the entire project.

C. The Builder shall submit for approval immediately after execution of the Contract a carefully prepared Progress Schedule showing the proposed dates of starting and completing each of the various sections of the work.

1.2 SHOP DRAWINGS AND SAMPLES

A. The Builder shall process the Shop Drawings required for the work to AQUA's Engineer and shall be responsible for their timely submission in accordance with the Shop Drawing Schedule which is included in the overall Progress or Work Schedule as described in Part 2 of this Section.

1. AQUA shall review submittals with reasonable promptness.
2. Affix stamp and initials or signature, and indicate requirements for resubmittal or approval of submittal.
3. Return submittals to Builder for distribution or resubmission.

B. Revised Shop Drawings submitted for review shall be marked "RESUBMISSION."

PART 2 - SCHEDULE

2.1 PREPARATION

A. The Builder shall prepare a Progress or Work Schedule for the entire project for any work anticipated to last longer than four weeks.

B. Each activity in the Progress or Work Schedule shall be identified and a time for the performance of such activity indicated. Each activity shall be preceded by all work that must be accomplished prior to that activity. All abbreviations, codes, and/or symbols used shall be described on the Schedule.

2.2 CHANGES IN EQUIPMENT AND/OR MATERIALS

A. In these specifications and on accompanying drawings, there are specified and shown certain pieces of equipment and/or materials which are deemed most suitable for service anticipated. This is not done to eliminate other equipment and material equally as good and efficient. Should Builder desire to use some other make of equipment or material, he shall submit to AQUA a written request for such change and in same shall state advantage to AQUA. Determination as to whether or not such change will be permitted rests solely with AQUA.

B. Unless otherwise specifically provided, all workmanship, equipment, materials, and articles incorporated in the work shall be new and the best grade of the respective kinds for this purpose. Where equipment, materials, articles, or workmanship are referred to in the Specifications as “Equal to” any particular standard, AQUA shall decide the question of equality.

C. Materials specified by reference to the number or symbols of a specific standard, such as ASTM Specification, a Federal Specification or other similar standard shall comply with requirements in the latest revision thereof and any amendment or supplement there to except as limited to type, class or grade, or modified in such reference. The standards referred to, except as modified in the Specifications, shall have full force and effect as though printed therein.

2.3 CATALOG SHEETS

A. For standard manufactured items considered by AQUA as not requiring special Shop Drawings, the Builder shall submit three (3) copies of manufacturer's catalog sheets showing illustrated cuts of the items to be furnished, scale details, sizes, dimensions, performance characteristics, capacities, wiring and control diagrams, and all other pertinent information.

B. AQUA will retain two (2) copies and return remainder to the Builder.

2.4 SHOP DRAWINGS

A. The Builder will submit for review a minimum three (3) white prints of Shop and Working Drawings of fabricated equipment and materials for which such drawings are specifically requested.

B. Prior to submitting drawings to AQUA’s Engineer, the Builder shall check thoroughly all such drawings to satisfy that the subject matter conforms to the Accepted Plans and Specifications in all respects. Drawings which are correct shall be marked with the date, checker's name, and certification of the Builder's approval, and then shall be submitted to AQUA. Any Shop Drawings submitted without the Builder's certification, will be returned without review.

C. AQUA will retain two (2) copies and return remainder to the Builder.

D. Shop Drawings shall show the principal dimensions, weight, structural and operating features, performance characteristics and wiring diagrams, space required, clearances, type and/or brand of finish or shop coat, grease fittings, etc., depending on the subject of the drawing. When it is customary to do so, when the dimensions are of particular importance, or when so specified, the drawings shall be certified by the manufacturer or fabricator as correct.

E. When so specified or if considered by AQUA to be acceptable, manufacturer's Specifications, catalog data, descriptive matter, illustrations, etc., may be submitted for review in place of Shop and Working Drawings. In such case the requirements shall be as specified for Shop and Working Drawings, insofar as applicable.

F. The Builder shall be responsible for the prompt submission of all Shop and Working Drawings in accordance with the Shop Drawing Schedule so that there shall be no delay to the work due to the absence of such drawings.

G. No material shall be purchased or fabricated until the required Shop and Working Drawings have been submitted and reviewed. All materials and work involved in the construction shall then be as represented by said drawings.

H. Only drawings which have been checked and corrected by the fabricator should be submitted to the Builder by the Builder’s Subcontractors and vendors. Prior to submitting drawings to AQUA, the Builder shall check thoroughly all such drawings to satisfy that the subject matter thereof conforms to the drawings and Specifications in all respects. Drawings which are correct shall be marked with the date, checker's name and indication of the Builder's approval, and then shall be submitted to AQUA; other drawings shall be returned for correction.

I. AQUA's review of Shop and Working Drawings will follow a general check made to ascertain conformance with the design concept and functional result of the project and compliance with the information given in the Accepted Plans and Specifications. The Builder is responsible for: details and accuracy; conforming and correlating all quantities and dimensions at the job site; information that pertains solely to the fabrication processes or to techniques of construction; and coordination of the work of all trades.

J. The Builder shall check and verify all field measurements and shall submit with such promptness as to cause no delay in his own work four copies, checked and approved by him, of all shop or setting drawings and schedules required for the work of the various trades. AQUA shall check and approve, with reasonable promptness, such schedules and drawings only for compliance with the information given in the Specifications. The Builder shall make any corrections required by AQUA, file with him two copies and furnish such other copies as may be needed. AQUA’s approval of such drawings or schedules shall not relieve the Builder from responsibility for deviations from Specifications, unless he has in writing called AQUA’s attention to such deviations at the time of submission, and secured his written approval, nor shall it relive him from responsibility for errors in shop drawings or schedules.

2.5 SAMPLES

A. When specified, the Builder shall provide samples in duplicate and identify each sample by an appropriate tag or label listing the names of the project, the Builder and/or Subcontractor as well as the exact identification of the sample. Tag or label shall be large enough to provide a blank space for review stamps.

B. Samples of items submitted for destruction tests or for use in testing mixture with other materials, will not be returned. Review of these items will be given by letter.

C. When reviewed, one sample of each item, not submitted for destruction, will be returned to the Builder and shall be kept and maintained in good condition in the submitting Builder's office at the project site for later use in comparison with material actually delivered for the work. When samples of large fabricated items or of costly items are required, reviewed samples may be installed in the work if the exact location of such samples is recorded on AQUA's set of Accepted Plans.

D. The Builder shall promptly submit all material or equipment samples, certificates, affidavits, etc. as called for in the contract documents or required by AQUA. No such material or equipment shall be manufactured or delivered to the site, except at the Builder’s own risk, until the required samples or certificates have been approved in writing by AQUA. Each sample submitted by the Builder shall carry a label giving the name of the Builder, the project for which it is intended, and the name of the producer. The accompanying certificates or letter from the Builder shall state that the sample complies with the Specifications, shall give the name and brand of the product, its place of origin, the name and address of the producer and all specifications or other detailed information which will assist AQUA in passing upon the acceptability of the sample promptly. It shall also include the statement that all materials or equipment furnished for use in the project will comply with the samples and/or certified statements.

E. After actual deliveries, AQUA will have such check tests made as it deems necessary in each instance and may reject materials and equipment and accessories for cause, even though such materials and articles have been given general approval. If materials, equipment or accessories which fail to meet check tests have been incorporated in the work, AQUA will have the right to cause their removal and replacement by proper materials or to demand and secure such reparation by the Builder as is equitable.

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

1. Functional characteristics of the product, with integrally related parts and attachment devices.
2. Full range of color, texture, and pattern.

2.6 CERTIFICATIONS AND TESTS

A. Two (2) copies of certifications and reports of tests when required under the various Sections of the Specifications, shall be submitted to AQUA.

2.7 CONSTRUCTION PHOTOGRAPHS

A. The Builder shall provide clear, sharp, color progress photographs monthly, starting when the work begins and continuing as long as the work is in progress.

B. The number of views required shall be from three to six, depending on the progress of work. Views shall be provided of the general construction area before any work begins. Photographs shall be 4" x 6" in size and shall be submitted in duplicate.

2.8 VIDEOTAPING

A. A narrated videotape shall be provided by the Builder prepared describing and showing the condition of adjoining and nearby sidewalks, curbs, roadways, foundations, other utilities, and structures which may be damaged as a result of the blasting. The videotape shall be submitted to AQUA prior to commencing work.

2.9 RECORD DRAWINGS

A. Do not use record documents for construction purposes. Protect record documents from deterioration and loss in a secure, fire-resistant location. Provide access to record documents for the Engineer's reference during normal working hours.

B. Maintain a clean, undamaged set of white prints of Accepted Plans and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the work as originally shown. Mark which drawing is most capable of showing conditions fully and accurately. Where Shop Drawings are used, record a cross-reference at the corresponding location on the Accepted Plans. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

1. Mark record sets with red erasable pencil. Use other colors to distinguish between variations in separate categories of the work.
2. Mark new information that is important to AQUA but was not shown on Accepted Plans or Shop Drawings (i.e. location, type and depth of adjacent or crossing utilities such as gas, electric, sewer, storm water, telephone, etc.)
3. Note related change order numbers where applicable.
4. Organize Record Drawings sheets into manageable sets. Bind sets with durable paper cover sheets; print suitable titles, dates, and other identification on the cover of each set.
5. Upon completion of the work, submit Record Drawings to the Engineer for review prior to revising the Record Drawing required by the Builder’s Agreement.

PART 3 - EXECUTION

3.1 GENERAL

A. Shop Drawings are defined as drawings, diagrams, illustrations, schedules, performance charts, brochures, and other data prepared by the Builder or any subcontractor, manufacturer, supplier or distributor, which illustrate how specific portions of the work shall be fabricated and/or installed.

B. Shop Drawings are a supplementary means of communications to assist in the understanding of what the Builder is providing and doing, and that whatever he puts in speaks for itself and either meets or does not meet the Accepted Plans and Specifications.

C. In the instance of a substituted item, the Builder shall verify that it will fit into the space allocated to the originally required item giving due to all other trades' requirements. Where modifications to the Accepted Plans and Specifications are proposed, the Builder must indicate such deviation in writing in their submittal.

3.2 SUBMITTAL PROCEDURES

A. Make submittals promptly in accordance with approved schedule and in such sequence as to cause no delay in the work or in the work of any other contractor. Number of Submittals required:

1. Shop Drawings: Submit four (4) copies
2. Product Data: Submit four (4) copies
3. Samples: Submit the number stated in each Specification Section
4. Instruction Manuals: See Paragraph 1.5

B. Submittals shall contain:

1. The date of submission and the dates of any previous submissions
2. The Project title
3. The names of:

    a. Builder
    b. Supplier
    c. Manufacturer

4. Identification of the product with the Specification Section number
5. Field dimensions, clearly identified as such
6. Relation to adjacent or critical features of the work or materials
7. Applicable standards, such as ASTM or Federal Specification numbers
8. Identification of deviations from Contract Documents
9. Identification of revisions on re-submittals
10. An 8-inch x 3-inch blank space for Builder and AQUA stamps
11. Builder’s stamp, initialed or signed, certifying to review of submittal, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.

C. Builder shall make any corrections or changes in the submittals required by AQUA and resubmit until approved. For Shop Drawings and Product Data:

1. Revise initial drawings or data and resubmit as specified for the initial submittal.
2. Indicate any changes which have been made other than those requested by AQUA.
3. For Samples: submit new samples as required for initial submittal.

3.3 FIELD DISTRIBUTION

A. The Builder shall be responsible for the required number of processed drawings or catalog cuts for field distribution.

B. The Builder shall be responsible for the prompt distribution of processed Shop Drawings.

C. The Builder shall have the overall responsibility for coordinating the necessary information to properly coordinate the work.

D. Builder shall distribute reproductions (if necessary) of Shop Drawings and copies of Product Data which carry AQUA's stamp of approval to:

1. Job site file
2. Record documents file
3. Other affected contractors
4. Subcontractors
5. Supplier or fabricator

END OF SECTION 01300

SECTION 01500 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SCOPE

A. The Builder is referred to conditions and requirements given in various Sections of the Specifications.

1.2 OCCUPYING PRIVATE LAND

A. Written consent from the proper parties shall be obtained by the Builder to enter or occupy with personnel, tools, materials or equipment any land other than the secured property for any purpose related to the performance of the work.

1.3 PROTECTION OF EXISTING UTILITIES

A. The Builder shall conduct operations and take all special precautions necessary to protect equipment, utility lines, roadways and subsurface, submerged and overhead facilities which are to remain in place and undisturbed by operations. The Builder shall immediately notify AQUA of the facilities or areas which are disturbed, damaged or injured as a result of the Builder's operations, and determine the proper method of replacing or repairing the affected facilities at least to the conditions which existed prior to the Builder's operations. The Builder shall, at their own expense, replace, repair or restore the affected facilities or areas to their original condition or shall reimburse AQUA of said facilities or areas for such expenses as AQUA may accrue in performing the work.

1.4 STORAGE AND PROTECTION OF MATERIALS

A. Materials stored in the open at the project site shall be stored on planks or other dunnage as necessary to keep materials from contact with the ground and shall be covered with tarpaulins for protection from weather.

B. Care shall be exercised in the installation of material to avoid damage or disfiguration of any kind. All equipment shall be protected from dust and moisture prior to and after installation.

C. Failure of the Builder to protect material furnished, as outlined herein, shall be grounds for rejection of the material.

D. The Builder shall confine his equipment, storage of materials, and construction operations to the projects limit as prescribed by ordinances or permits and shall not unreasonably encumber the site or public rights of way with his materials and construction equipment.

1.5 PROTECTION OF PROPERTY AND STRUCTURES

A. The Builder shall sustain in their places and protect from direct or indirect injury all pipes, conduits, poles, tracks, walls, buildings, pavement, guide rails, driveways, curb, street signs, sidewalks, lawns fields, mailboxes, shrubs, bushes, plantings, and other structures or property in vicinity of his work, whether above or below ground. He shall replace any pipe if it is a functioning pipe. Builder shall restore any existing property damaged by construction activity. Restoration, when complete, shall render the disturbed area equal to or better than its original condition prior to construction.

B. The Builder shall have sufficient sheeting or shoring available for supporting his excavations and for sustaining or supporting any structures that are uncovered, undermined, endangers, threatened or weakened.

1.6 INTERFERENCE WITH/AND PROTECTION OF STREETS

A. The Builder shall not close or obstruct any portion of a street, road, or private way without obtaining permits therefore from the proper authorities including any local authority, PADOT, the School District and PA State Police, as appropriate. If any street or private way shall be rendered unsafe by the Builder's operations, the Builder shall make such repairs or provide such temporary ways or guards as shall be acceptable to AQUA.

B. Streets, roads, private ways and walks not closed shall be maintained passable by the Builder at the Builder’s expense and the Builder shall assume full responsibility for the adequacy and safety of provisions made.

C. The Builder shall, no less than 24 and preferably 48 hours in advance of closing any street, notify the appropriate authorities, in writing, with a copy to AQUA. The Builder shall cooperate with the Police Department in the establishment of alternate routes and, at the Builder’s expense, shall provide adequate, plainly marked detour signs.

D. For control of moderate traffic or when required by a permitting agency, the Builder shall provide an adequate number of flagmen or uniformed special officers.

E. Whenever and wherever traffic is sufficiently congested or public safety is endangered, the Builder, as required, shall furnish uniformed special officers to direct traffic and to keep traffic off the highway area affected by construction operations. Such officers shall be in addition to the watchmen required. Traffic control shall be in accordance with PennDOT Publication 203, Work Zone Traffic Control.

F. The Builder shall, where required, maintain roads open for traffic with satisfactory barricades, warning signs, and lights. Where permission for detouring traffic is granted, the Builder shall post detour signs and maintain such detour routes. During progress of the work, sidewalks and crossings shall be kept open for passage of pedestrians unless otherwise authorized.

G. The Builder shall furnish, place, and maintain safety fence around all excavations and other areas during non-work hours. Safety fencing shall be the product of Tenax Corporation, bright orange, no less than five feet in height, or approved equal.

H. The Builder shall construct and maintain, without compensation, adequate and approved bridges over excavations as may be necessary for purpose of accommodating pedestrians or vehicles.

I. All fire hydrants, water valves, and fire alarm boxes shall be left uncovered and readily accessible for use.

1.7 SAFETY PRECAUTIONS

A. Until final acceptance of the work, the Builder shall continuously maintain adequate protection of the work and work in progress from damage. The Builder shall adequately protect adjacent private and public property as provided by law and these Specifications.

B. The Builder shall take all necessary precautions for the safety of employees doing the work, and shall comply with all applicable provisions of federal, state, and local safety laws and building codes to prevent accidents or injury to person on, about or adjacent to the premises where the work is being performed. The Builder shall erect and properly maintain at all times as required by the conditions and progress of the work, all necessary safeguards and barricades for the protection of the work, all necessary safeguards and barricades for the protection of employees on the work and the safety of others employed near the work and public, and shall post danger signs and warning lights warning against the hazards created by such features of the construction as protruding nails, hoists, excavations, scaffolding, stairways and falling materials.

C. The Builder shall designate a responsible member of its organization on the work, whose duty shall be the prevention of accidents. The name and position of the person so designated shall be reported in writing to AQUA.

D. The Builder shall immediately report in writing, giving full details, to AQUA all serious accidents which arise out of or in connection with the performance of the work, whether on or adjacent to the site, which cause death, serious personal injury or substantial property damage. In addition, if death or serious injury or substantial property damage is caused, the accident shall be reported immediately by telephone or messenger to AQUA. If a claim is made or suit is filed by anyone against the Builder, or any Subcontractor on account of any accident, the Builder shall promptly report the facts in writing to AQUA, giving full details of the claim.

E. The Builder shall assume all risks of loss or damage of any kind to any vehicles, machinery, equipment, materials or supplies which it shall provide in doing the work.

F. The Builder shall adequately protect property owned by others from damage by the construction operations.

1.8 DUST AND LITTER CONTROL

A. During the progress of the work, the Builder shall conduct operations and maintain the area of their activities so as to minimize the creation and dispersion of dust, litter, and other debris. Proper containers for litter shall be provided, and they shall be emptied when full.

1.9 SANITARY

A. The Builder shall provide, maintain, and remove when no longer required, an adequate number of temporary, prefabricated, chemical-type toilets with proper enclosures for the use of workmen during construction. When connected to water and sewer, meet all code requirements and take precautions to prevent freezing.

B. Keep toilets clean and supplied with toilet paper at all times. Comply with all local and state health requirements and sanitary regulations.

1.10 HEAT

A. At all times during the placing, curing and setting of concrete, provide sufficient heat to ensure heating of spaces involved to not less than 40 degrees F.

1.11 AQUA REPRESENTATIVE

A. AQUA reserves the right, but is not obligated, to assign a Representative to witness the construction activity. The Representative will make periodic visits to the site to familiarize themselves generally with the progress and quality of the work and to determine in general if the work is proceeding in accordance with the specifications. They will not be required to make exhaustive or continuous onsite inspections to check the quality or quantity of the work and they will not be responsible for the Builders failure to carry out the construction work in accordance with the specifications and construction drawings. During such visits and on the basis of their observations while at the site, they will keep AQUA informed of the progress of the work of Builders and they may condemn work as failing to adhere to the specifications and/or construction drawings. They shall request that AQUA reject the work whenever such rejection may be necessary in their reasonable opinion to ensure the proper completion of the project.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 01500

DIVISION 02
SITEWORK

SECTION 02221 - TRENCHING, BACKFILLING AND COMPACTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Trench Excavation.

B. Bedding and backfilling.

C. Surface Restoration.

1.2 DEFINITIONS

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

B. Bedding: That stone material placed under the pipe.

C. Haunching: That stone material placed from pipe bottom to the pipe centerline.

D. Initial Backfill: That stone material from the pipe centerline to twelve (12) inches above top of pipe.

E. Engineer: AQUA's Engineer, or designated representative of AQUA who is responsible for observing and accepting the Work.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO T99 - Moisture-Density Relations of Soils, Using a 5.5 lb. Rammer and a 12 in. Drop.
2. AASHTO T191 - Standard Method of Test for Density of Soil In-Place by the Sand Cone Method.

B. The "PennDOT Sections" noted herein refer to sections contained in the Commonwealth of Pennsylvania Department of Transportation Specifications Publication 408 latest version. The references pertain only to materials, construction equipment, methods and labor. The payment provisions do not apply to work to be performed under this Contract.

C. All workmanship, materials and Builder's responsibility for all work in and adjacent to PennDOT right-of-way shall be in compliance with PennDOT regulations, specifications and requirements. Where information in the specification is contradictory to current PennDOT requirements, PA requirements shall govern. No additional compensation will be considered for claims of misleading or contradictory requirements.

D. Commonwealth of Pennsylvania Department of Transportation Specifications.

1. PennDOT 408, Section 703 Aggregates.

E. State Code: Commonwealth of Pennsylvania, Pennsylvania Code, Title 67. Transportation, Department of Transportation, Chapter 459, Occupancy of Highways by Utilities, July 1989 (PennDOT Chapter 459).

F. State Publication: Commonwealth of Pennsylvania, Pennsylvania Code, Title 67, Transportation, Department of Transportation, Chapter 203, Work Zone Traffic Control (PennDOT Chapter 203).

PART 2 - PRODUCTS

2.1 MATERIALS

A. Select Backfill: Excavated material free of cinders, ashes, refuse, vegetable or organic material, boulders larger than 6", rocks, stone, or other material which, in the opinion of the Professional, is unsuitable. If the excavated material is found to be unsuitable, the Builder is required to backfill with suitable material at their expense. The Builder may use suitable material from other project areas at no additional cost to AQUA.

B. Aggregate Backfill, Bedding and Haunching: Fine aggregates and coarse aggregates conforming to AASHTO and PennDOT requirements, see plan for dimensions.

C. Classification of Backfill, Bedding and Haunching Materials:

1. Aggregate Backfill of trench bottoms over-excavated at direction of Professional to correct unstable trench bottom conditions: PennDOT 2A or as directed.
2. Pipe Bedding and Haunching:

a. AASHTO M43 Gradation No. 7 or 8.

3. Initial Backfill:

a. AASHTO M43 Gradation No. 7 or 8.

4. Final Backfill:

a. Select Backfill: Unless otherwise noted on drawings.

D. Underground Warning Tape:

1. Printed polyethylene tape, three inches minimum width, color coded, one inch minimum lettering, printed with name of utility buried below, and suitable for installation in all soil types.
2. Non-magnetic for ductile iron pipe.
3. Magnetic for PVC and HDPE pipe.

4. Provide for:

    a. Electric Power Lines, Cables, Conduit and Lighting Cables – RED
    b. Gas, Oil, Steam, Petroleum, or Gaseous Materials – YELLOW
    c. Communications, Alarm or Signal Lines, Cables or Conduit – ORANGE
    d. Potable Water – BLUE
    e. Reclaimed Water, irrigation, and Slurry Lines – PURPLE
    f. Sewers and Drain Lines – GREEN
    g. Sludge – BROWN

PART 3 - EXECUTION

3.1 TRENCH PREPARATION AND EXCAVATION

A. The Builder shall notify PA One Call (1-800-242-1776) in accordance with the regulations of the Act.

B. General: Excavation of every description and of whatever substances encountered shall be performed to the lines and grades indicated on the drawings and specified herein, or as directed by the Professional.

1. Excavation shall be made by open cut, unless written permission to tunnel or bore is given by the Professional or is specifically outlined in the Specifications or shown on the Drawings.
2. Trenches may be excavated and backfilled either by machinery or by hand as the Builder may elect, provided the Builder shall use hand excavation where necessary to protect existing structures, utilities, or private or public properties and that backfilling shall be done by hand to the extent hereinafter specified.
3. The Builder shall have no claim for extra compensation due to the fact that hand excavation, instead of machine excavation, may be made necessary from any cause whatsoever.
4. All work by the Builder shall be done in accordance with all Federal, State, Municipal, including OSHA regulations, governing work of this nature.

C. Stripping, Storing and Restoring Surface Items: The Builder shall remove all topsoil, paving, sub-paving, curbing, gutters, brick, paving block, granite curing, flagging or other similar materials, and grub and clear the surface over the area to be excavated. The Builder shall properly store and preserve such materials that may be required for future use in restoring the surface. The Builder shall be responsible for any loss or damage to said materials because of careless removal or neglectful or wasteful storage, disposal, or use of the materials. Any excavated materials not required for backfill or restoration shall be disposed of by the Builder at their expense.

1. All materials which may be removed, including rock, earth and sand taken from the excavation, shall be stored, if practical, in the roadway or right-of-way or such other suitable place and in such manner as the Professional will approve.
2. If more materials are removed from any trench than can be backfilled over the completed pipe or stored in the street, leaving space for traffic, the excess materials shall be removed and stored at a suitable site provided by the Builder.

3. The Builder shall, at their own expense, bring back as much of the approved materials so removed as may be required to properly refill the trench or excavation.
4. When directed by the Professional, the Builder shall furnish such other suitable materials as may be necessary to properly refill the trench at no additional cost to AQUA.
5. The Builder shall restore all shrubbery, fences, poles or other property and surface structures, removed or disturbed as a part of the Work, to a condition equal to that before the Work began, furnishing all labor and materials incidental thereto, without any additional cost to AQUA.
6. The Professional may mark certain trees, shrubs, or other items that are not to be disturbed or damaged. In the event such items are disturbed or damaged, they shall be replaced or compensated for at the Builder's expense.
7. Any tree which is approved by the Professional for removal shall be cut into four foot lengths and become the property of the Builder and shall be removed from the site.

D. The Builder must work around existing utilities at no additional cost to AQUA for this work. If the Builder must repair or replace any damaged utilities. The Builder must do this at their own expense.

E. Width of Trench: Pipe trenches shall be sufficiently true in alignment to permit the pipe to be laid in the approximate center of the trench. The trench shall be wide enough to provide a free working space on each side of the pipe.

F. Length of Trench:

1. No trench shall be opened more than 100 feet in advance of the pipe lines laid. Builder shall provide all safety items such as sheeting, shoring and bracing.
2. The Builder shall limit all trench openings to a distance commensurate with all rules of safety and the Erosion and Sedimentation Control Plan.
3. If the Work is stopped either totally or partially by their own accord or the direction of others, the Builder shall refill the trench and temporarily repave or restore over the same at their own expense and the trench shall not be opened until the Builder is ready to proceed with the construction of the pipeline.
4. Dimensions for excavation will be according to the depth and width specified for the pipe size. Except at locations where rock or unsuitable material is encountered, extra care should be taken not to exceed the depth specified. If the excavation does exceed the proposed depth, the bottom of the trench should be back-filled in six-inch lifts and properly compacted until the desired level is reached to lay the pipe.

G. Pumping and Draining: The Builder shall remove by pumping, draining, or otherwise, any water which may accumulate in the trenches and other excavations and shall build all dams and do all other work necessary to keep the trenches or other excavations as free from water as possible. All pumping operations are subject to Erosion and Sedimentation Control measures.

1. Where it is impractical to completely drain the trench, special pipe of jointing materials may be authorized at no additional expense to AQUA.
2. While the pipelines are being laid, the Builder shall have sufficient pumping machinery ready for immediate use.
3. All surface waters shall be prevented from entering the open ditches or excavations by proper grading of the surface in the vicinity of the excavation.

4. Sediment laden water will be pumped to an appropriately located “Dirtbag” as shown on Erosion and Sedimentation Control Drawing.

H. Accommodations of Drainage: The Builder shall keep gutters, sewers, drains and ditches open at all times so that the flow of storm or other waters shall not be obstructed. If the material excavated from the trenches must temporarily extend over gutters or other waterways, it shall be the duty of the Builder to plank or bridge over the gutters, without extra compensation, so that the flow of water is not impeded.

I. Protection of Utilities, Property and Structures: The existence and location of underground utilities as indicated on the Drawings is presented merely to serve as a notification that such utilities do exist in the general proximity of the work. Any utilities not shown, or not located as shown, shall not be cause of the Builder to deny responsibility for their protection and/or repair during construction.

1. The Builder shall notify all utility companies in advance of construction, to include requesting the companies to establish location of their utilities, in accordance with Pennsylvania Act 287/172, as amended. Cooperate with agents of these companies during the progress of the work. Procedures for emergency action and repairs to utilities shall be established with the utility company prior to commencement of the work. During the course of their work, if the Builder damages any of the aforementioned utilities, he shall immediately follow the procedure of emergency action and repair as established at their own expense. The Builder shall determine the location of all utility lines on private property, with the assistance of the utility owner when on private property.
2. Whenever the Builder, during the progress of the excavation, shall uncover service pipes or mains, which because of injury or age are in poor condition, they shall immediately notify the proper utility owner in order that steps may be taken for replacement or repair. Locations of repairs, and the procedures of repairs that have been made shall be recorded by the Builder.
3. The Builder shall, at their own expense, sustain in their places, and protect from direct or indirect injury, all pipes, conduits, existing sewerage systems, septic tanks, tile fields, and other structures or property in the vicinity of the work, whether above or below the ground, or that may appear in the trench. The Builder shall at all times have a sufficient quantity of repair pipe, timber and plank, chains, ropes, etc., on the ground and shall use them as necessary for sheeting excavations and for sustaining or supporting any structures that are uncovered, undermined, endangered, threatened, or weakened, whether such structures are or are not shown on the Drawings.
4. Pipes and underground conduits exposed as a result of the Builder's operations shall be adequately supported along their entire exposed length by timber or planking, installed in such manner that the anchorage of the supporting members will not be disturbed or weakened during the backfilling operation. Backfill of selected material shall be carefully rammed and tamped under and around the supports and all supports shall be left in place as a guard against breakage of the supported structure due to trench settlement. No additional payment will be due to the Builder for material left in place nor for the labor of installing and maintaining supports.
5. The cost of all work related to utility protection and repair shall be included in the price of pipe installed. No separate payment will be made for utility relocation or repairs.

J. Where mains are to be constructed on rights-of-way or easements in open areas, the maximum width of trench at the top specified hereinbefore may be exceeded only if the construction is kept entirely within the limits of the right-of-way or easements and can be carried on without damage to adjoining property. The angle of slope shall be the angle at which the trench bank will stand without sliding.

K. In locations other than rights-of-way or easements, the Professional may, as warranted by working conditions, and where permitted by the Pennsylvania Department of Labor and Industry requirements, waive the requirements that the maximum width of trench at the top shall not exceed the dimensions specified hereinbefore.

3.2 PIPE BEDDING AND TRENCH BACKFILL

A. Bedding and Haunching: The trench shall be excavated to a depth of six inches below the outside diameter of the pipe barrel, or deeper if so specified. The resultant subgrade shall be undisturbed, or compacted as approved by the Professional if disturbed. The bedding and haunching shall then be prepared by placing thoroughly compacted aggregate, shaped to conform to the bottom portion of the pipe or compacted against the bottom portion of the pipe, to a vertical distance of three inches above the lowest outside surface of the pipe. The Builder is required to properly haunch the pipe before any additional backfilling is allowed.

B. Special Bedding:

1. Concrete Cradle and Concrete Encasement: If concrete cradle and/or encasement is indicated on the Drawings or required by the Professional, the trench shall be excavated to a depth of twelve inches below the outside of the barrel of pipes.
2. Unstable Subgrade: Where the bottom of the trench at subgrade is found to be unstable or to include ashes, cinders, any type or refuse, vegetable, or other organic material, or large pieces or fragments of inorganic material, which, in the opinion of the Professional, should be removed, the Builder shall excavate and remove such unsuitable material to the width and depth recommended by the Professional.

    a. Before pipe is laid, the subgrade shall be made by backfilling with aggregate material, as directed by the Professional, in six inch (compacted thickness) layers thoroughly tamped and the bedding prepared as hereinbefore specified.
    b. Aggregate Backfill when used at the direction of the Professional to stabilize trench subgrade will be paid for in accordance with the unit price Bid for Miscellaneous Aggregate Backfill per the actual dimensions of the area backfilled in accordance with Section 02221, exclusive of the pipe bedding.

3. Special Foundations: Where the bottom of the trench at the subgrade is found to consist of material which is unstable to such a degree that, in the opinion of the Professional, it cannot be removed and replaced with an approved material thoroughly compacted in place to support the pipe properly, the Builder shall construct a foundation for the pipe, consisting of piling, timbers or other materials, in accordance with plans prepared by the Professional.

C. Backfilling Methods:

1. General: Backfilling shall not be done in freezing weather except by permission of the Professional, and it shall not be done with frozen material. The Builder may not backfill when the material already in the trench is frozen.

a. Where Aggregate Backfill is not indicated on the Drawings or specified herein, and in the opinion of the Professional should be used in any part of the Work, the Builder shall furnish and backfill with aggregate as directed.

2. In or adjacent to state highways, all backfill shall be in accordance with PennDOT requirements.

D. Initial Backfill: Following placement of bedding and haunching material, initial backfill shall be placed to a depth of twelve (12) inches over the crown of the pipe. The Builder shall compact the initial backfill in maximum twelve (12) inch (compacted thickness) layers using vibratory compactors of such size that will not damage the pipe or manual compaction methods as approved by the Professional. Bring the backfill up both sides of the pipe simultaneously to prevent displacement of the pipe.

E. Aggregate Backfill to Restoration Depth (within all roads and State Highway or as directed by the Professional): From six inches above the top of the pipe to Restoration Depth, the trench shall be backfilled by hand or by approved mechanical methods. Backfill in this section of the trench shall be aggregate backfill material subject to limitations specified and consolidated by compacting in eight (8) inch layers. Any consolidation method utilizing water such as jetting or puddling will not be permitted. Consolidation shall proceed from the center of the trench to the sides to prevent arching.

F. Select Backfill to Restoration Depth: From twelve (12) inches above the top of the pipe to restoration depth, the trench shall be backfilled by hand or by approved mechanical methods. Backfill in this section of the trench shall be excavated material subject to limitations specified and consolidated by tamping in eight inch layers or other approved mechanical methods. Any consolidation method utilizing water, such as jetting or puddling will not be permitted. Consolidation shall proceed from the center of the trench to the sides to prevent arching. If the backfill contains too much moisture for optimum compaction, the Builder shall dry the common backfill or provide aggregate backfill at no additional cost to AQUA.

1. Compacted layers may exceed eight (8) inches provided the Builder can demonstrate that the compaction results as described in the follow sub-section (Compacting and Compaction Tests) are being obtained throughout the lifts of backfill.

G. Underground Warning Tape: For the purpose of early warning and identification of buried pipes during future trenching or other excavation, the Builder shall provide continuous identification tapes in trenches. Install the tapes in accordance with printed recommendations of the tape manufacturer, and as modified herein. Bury tape at a depth of 12 inches below grade; in pavements, measure 12 inches down from subgrade of pavement. Tape to be installed along all mains, and laterals.

H. Compacting and Compaction Tests:

1. The Builder shall perform a sample backfilling of a pipe segment early on in the construction, adequately justifying to the Professional that the backfill and compaction operations are adequate to obtain the desired compaction results.
2. Use mechanical tampers to compact backfill materials in trench refill operations to produce a density of backfill in each layer of not less than those specified below as a percentage of maximum standard density determined in accordance with AASHTO T99 or PennDOT requirements.

    a. Areas subject to vehicular traffic: 100%.
    b. Grassed areas: 95%.

3. During the course of backfilling and compacting work, the Professional or AQUA may, at any location or depth of trench, require the Builder to perform tests to determine whether the Builder's compaction operations are sufficient to meet specified requirements, at the Builder's expense. The Builder shall retain the services of an independent agency approved by AQUA for all compaction tests. Builder shall repair all backfill that does not conform to the compaction requirements at no additional cost to AQUA. The Builder shall provide ample notice to assure all soil testing is done.

3.3 RESTORATION AND CLEAN-UP OF SURFACE

A. Restoration by Builder:

1. The Builder shall restore all driveways, parking lots, sidewalks, curbing, gutters, shrubbery, guiderail, fences, mailboxes, coachlight standards, poles, sod or other property and surface structures removed or disturbed as a part of the Work to a condition equal to that before the Work began, furnishing all labor and materials incidental thereto. Cost of such restoration will be considered part of the price bid and no additional compensation will be made for such work.

B. Clean-up and Maintenance of Surfaces:

1. General: During construction, the surfaces of all areas including, but not limited to, roads, streets, and driveways shall be maintained by the Builder on a daily basis to produce a safe, desirable, and convenient condition. Streets shall be swept and flushed after backfilling, and recleaned as dust, mud, stones and debris caused by the Work, or related to the Work accumulates. Failure of the Builder to perform this work may be cause for AQUA to order the work by others, and backcharge all costs to the Builder.

    a. All surplus materials furnished by the Builder and temporary structures shall be removed from the site by the Builder.
    b. All dirt, rubbish and excess earth from the excavation shall be disposed of by the Builder in a manner and place acceptable to all governing agencies.
    c. The construction site shall be left clean at the end of each working day to the satisfaction of AQUA and Professional.
    d. All surplus materials furnished and delivered by the Builder will be removed by the Builder.

2. Repair or Correction of Unsatisfactory Conditions: All unsatisfactory conditions resulting from the work shall be corrected.

    a. Any hazardous condition caused by the Work, on any surface, shall be repaired or corrected within two hours of observance or notification of its existence. If repairs or corrections are not made within this period, AQUA will have the work completed with the resulting cost subtracted from the Builder's next monthly Application for Payment. Any such costs shall be deemed a reduction in the total amount due to the Builder under the Contract and no subsequent reimbursement shall be made to the Builder by AQUA for these costs.
    b. The Builder shall maintain all backfilled excavations in proper conditions as specified. All depressions appearing in backfilled excavations shall be promptly repaired by the Builder. If the Builder fails to make repairs within forty eight (48) hours after receipt of written notice from AQUA, AQUA may backfill said depression and, in an emergency, AQUA may backfill or protect any dangerous depression wherever necessary without giving previous notice to the Builder, and AQUA shall charge expense thereof to the Builder.
    c. There will be no additional payment made for maintenance work.

C. Restoration of Meadows and Cultivated Fields:

1. General: Final restoration of all areas shall be performed by the Builder in accordance with the Specifications for the particular land use as herein defined.

    a. Final restoration shall be performed no later than the start of the next planting season following construction. The planting season shall be as established by the U.S. Agricultural Service for the area of construction for pasture and meadows.
    b. Topsoil shall be free from subsoil, brush, weeds, or other litter, clay lumps and stones, but may contain decaying vegetable matter as is present in good topsoil.
    c. Precautions shall be exercised as necessary to conform with laws relating to erosion and sedimentation control.
    d. Seed shall be labeled for the current growing season. Germination tests of seeds shall be made not more than six months prior to seeding. Seed which has become wet, moldy or otherwise damaged shall not be used.
    e. All seed mixtures formulas shall be submitted to the Professional for approval prior to seeding.
    f. The Builder shall be responsible to produce a stand of grass in all seeded or sodded areas. Erosion, drought, or any other condition encountered shall not relieve the Builder of this requirement.

2. Lawns: Finish grade and sodding in accordance with applicable sections of these specifications.

3. Pasture Grass, and Meadow Grass: Prior to construction, the full depth of the existing topsoil, but no less than 12 inches, shall be stripped from all areas anticipated to be disturbed, and shall be stockpiled during construction. Upon completion of the construction, all topsoil removed shall be replaced. As the final class of material is applied, bringing the area to finished grade, the depth of topsoil replaced shall not be less than the depth removed.

    a. The sod and/or seed mixture shall be as stated in other specification sections.
    b. If the topsoil thickness is less than twelve (12) inches, the Builder shall import suitable topsoil so that a good stand of grass can be established at no additional cost to AQUA.

END OF SECTION 02221

SECTION 02510 - ASPHALTIC CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provision of Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.

1.2 SUMMARY

A. Asphaltic concrete paving to include Superpave Base and Wearing Course.

B. Aggregate base course.

C. Proofrolling of prepared subbase is included in this Section.

D. Installation of Tack Coats.

E. Sealing is included in this Section.

F. The work required by this section includes roadway paving, walkway paving, and installation of line striping and signage.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division I Specification Sections.

B. Material Certificates shall be signed by material producer and Builder, and certify that each material item complies with or exceeds specified requirements.

1.4 QUALITY ASSURANCE

A. Perform work in accordance with Pennsylvania Department of Transportation (PennDOT) Publication 408 latest revision.

B. Obtain materials from same source throughout.

1.5 SITE CONDITIONS

A. Weather Limitations: Apply tack coats and asphalt when ambient temperature is above 50 deg. F and when temperature has not been below 35 deg. F for 12 hours immediately prior to application. Do not apply when base is wet or contains an excess of moisture, nor when base is frozen.

B. Construct hot-mixed asphalt surface course when atmospheric temperature is above 40 deg. F and when base is dry. Do not construct asphalt courses between October 31 and April 1.

C. Grade Control: Establish and maintain required lines and elevations.

1.6 REGULATORY REQUIREMENTS

A. Conform to applicable code for paving work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Use locally available materials and gradations that exhibit a satisfactory record of previous installations.

B. Coarse Aggregate: Sound, angular crushed stone, or crushed gravel, complying with (PennDOT) Section 703.2 Type 2A.

C. Fine Aggregate: Sharp-edged natural sand or sand prepared from stone, gravel, or combinations thereof, complying with PennDOT Section 703.1

D. Herbicide Treatment: Commercial chemical for weed control, registered by Environmental Protection Agency. Provide granular, liquid, or wettable powder form.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to the following:

a. Ciba-Geigy Corp.
b. Dow Chemical U.S.A.
c. E.I. DuPont de Nemours & Co., Inc.
d. FMC Corp.
e. Thompson-Hayward Chemical Co.
f. U.S. Borax and Chemical Corp.

E. Joint sealant conforming to PG 64-22.

F. Tack Coat in accordance with PennDOT Section 460.

G. Superpave 9.5 mm Wearing Course PennDOT Section 409.

H. Superpave 19.0 mm Wearing/Binder Course PennDOT Section 409.

I. Bituminous joint sealing material: CRAFCO Asphalt Rubber Type 2 or CRAFCO Superflex.

J. Superpave 25 mm Base Course PennDOT Section 309.

K. Signage and line striping per PennDOT requirements.

PART 3 - EXECUTION

3.1 MISCELLANEOUS ASPHALTIC CONCRETE GUIDELINES

A. For those paving areas that are to be paved:

1. All existing material shall be removed to subgrade elevation. Where the paving is to remain, the edges of the reconstructed areas shall be sawcut.
2. Install paving to indicated thicknesses.
3. Adjust the elevation of all manhole covers, valve tops, catch basin grates and similar structures, so that the top elevation is below the finished paving surface by 1/2-inch.
4. Provide all line striping and symbols on the completed paving.
5. Seal edges of paving.
6. Reset street signage that was removed for the project. Provide new signage for any signage that was damaged.

3.2 SURFACE PREPARATION

A. Sawcut existing paving as required. Remove and dispose of existing paving down to the aggregate base course level. Paving shall be taken to an approved disposal facility by the Builder.

B. Remove loose material from compacted subbase surface immediately before applying herbicide treatment.

C. Proof-roll prepared subbase surface to check for unstable areas and areas requiring additional compaction. Remove all soft and yielding subbase and subgrade and replace with new subbase and subgrade.

D. Maintain proper roadway cross sections and an adequate ditch line where applicable. Pull suitable material from the ditch line toward the center of the roadway. Level all high spots and ruts and remove all unsuitable material during this operation.

E. Apply tack coat to contact surfaces of previously constructed asphalt and surfaces abutting or projecting into hot-mixed asphalt pavement. Distribute at a rate as recommended in PennDOT documents.

F. Allow to dry until at proper condition to receive paving.

G. Exercise care in applying bituminous materials to avoid smearing of adjoining concrete surfaces. Remove and clean damaged surfaces.

3.3 PLACING MIX

A. General: Place hot-mixed asphalt mixture on prepared surface, spread, and strike off. All material shall be placed in accordance with PennDOT Publication 408. Place areas inaccessible to equipment by hand. Place each course to required grade, cross-section, and compacted thickness.

B. Place bituminous mix in strips not less than 10 feet wide, unless otherwise acceptable to Engineer. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips.

C. Complete the Superpave concrete base course for a section before placing wearing course.

D. Immediately correct surface irregularities in course behind paver. Remove excess material forming high spots with shovel.

E. Joints: Make joints between old and new pavements, or between successive days' work, to ensure continuous bond between adjoining work. Construct joints to have the same texture density, and smoothness as other sections of hot-mixed asphalt course. Clean contact surfaces and apply tack coat.

F. Use spade bits or saws to neatly remove existing paving from areas where new paving is to meet existing paving. All such joints shall be butt joints. Feathered joints will not be permitted. Square up existing paving edges to a depth of one and one half inches (1-1/2") and in straight lines where practical, where it abuts new paving.

G. Take ownership of and haul from the site all materials and debris resulting from milling and cutting.

H. Place asphalt courses within 24 hours of applying tack coat.

I. Place Superpave base course to compacted thicknesses as shown on the drawings.

J. Place Superpave wearing course to compacted thickness as shown on the drawings.

K. Remove splashes of bituminous materials from all surfaces exposed to general view, including manhole and valve box covers.

L. Make the thicknesses of the various paving courses equal to the thickness after compaction. All bituminous paving courses shall be compacted. Heat and roll (iron) seams between adjacent passes of surface course.

M. Slope all finished paving to drain toward gutters, inlets and other storm water facilities. Fill low spots, pot holes, bird baths, etc. Slope paving away from buildings.

N. Do not block downspouts with new paving.

3.4 ROLLING

A. General: Begin rolling when mixture will bear roller weight without excessive displacement.

B. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.

C. Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling and repair displaced areas by loosening and filling, if required, with hot material.

D. Follow breakdown rolling with second rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been evenly compacted.

E. Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained 95 percent laboratory density.

F. Patch by removing and replacing paving areas mixed with foreign materials and defective areas. Cut out such areas and fill with fresh, hot, hot-mixed asphalt. Compact by rolling to specified surface density and smoothness.

G. Protect after final rolling by not permitting vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.5 JOINT SEALING

A. Joints shall be sealed between old and new pavement or successive day's pour and between paving and concrete.

B. Place sealant 6" each side of joints (12" width).

C. Cover sealant with a coating of sand.

3.6 TOLERANCES

A. Flatness: Maximum variation of 1/4 inch measured with 10-foot straight edge.

B. Scheduled Compacted Thickness: Within 1/4 inch.

C. Variation from True Elevation: Within 1/2 inch.

3.7 PROTECTION OF NEWLY COMPLETED SURFACES

A. The Builder shall protect the newly completed bituminous surfaces from vehicular traffic or other damaging loads until adequate stability and adhesion have been attained and the materials have sufficiently cured to prevent distortion, flushing of the bituminous material to the surface or excessive loss of aggregate.

3.8 LINE STRIPING, MARKINGS AND SIGNAGE

A. Install all line striping and traffic markings in accordance with PennDOT Publication 408, Section 962.

END OF SECTION 02510

SECTION 02605 - MANHOLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Precast concrete manholes.

1.2 RELATED SECTIONS

A. Gravity Wastewater Sewer: Section 02731.

B. Cast-in-Place Concrete: Section 03300.

1.3 REFERENCES

A. American Society for Testing and Materials:

1. ASTM A48 - Gray Iron Castings.
2. ASTM A307 - Carbon Steel Externally Threaded Standard Fasteners.
3. ASTM A615 - Deformed and Plain Billet-steel Bars for Concrete Reinforcement.
4. ASTM C139 - Concrete Masonry Units for Construction of Catch Basins and Manholes.
5. ASTM C270 - Mortar for Unit Masonry.
6. ASTM C361 - Reinforced Concrete Low Head Pressure Pipe.
7. ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
8. ASTM C478 - Precast Reinforced Concrete Manhole Sections.
9. ASTM C923 - Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.
10. ASTM D2146 - Propylene Plastic Molding 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 C302, AWWA Standard for Reinforced Concrete Water Pipe-Noncylinder Type, Not Prestressed.

D. Federal Specifications:

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

1.4 SUBMITTALS

A. Shop Drawings and Product Data:

1. Manufacturer's published detail drawings, modified to suit design conditions if required, and Builder prepared drawings as applicable.
2. Manufacturer's descriptive literature and specifications covering the product specified. Include installation information.

B. Certificates:

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

1.5 QUALITY ASSURANCE

A. Shop Inspection:

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

B. Field Inspection:

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

C. Source Quality Control:

1. Maintain uniform quality of products and component compatibility by using the products of one manufacturer in the case of precast reinforced concrete manholes.
2. Obtain certificate of construction compliance with ASTM C478 from the precast reinforced concrete manhole manufacturer. Submit same certificate as part of required submittals.

D. Initial Manholes: Construct the first manhole in the Project to demonstrate the following, and serve as the minimum acceptable conditions of construction through the Project. No additional compensation will be allowed for initial manhole requirement.

1. Demonstrate manhole base construction methods.
2. Demonstrate manhole component sealing in the case of precast reinforced concrete manholes.
3. Demonstrate manhole stop 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.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

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

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

1.7 SITE CONDITIONS

A. Environmental Requirements: In no instance may the Builder set or construct manhole base on subgrade containing frost.

PART 2 - PRODUCTS

2.1 BASIC MATERIALS

A. Cast-in-Place Concrete to meet requirements of Section 03300.

B. Waterproofed Mortar: Material composition meeting requirements of ASTM C270, Type M with waterproofing admixture included.

C. Concrete Masonry Units for Manholes: Commercially manufactured solid precast segmental concrete masonry units meeting requirements of ASTM C139.

D. Manhole Steps:

1. Material: Aluminum alloy 6061-T6, with standard mill finish or, polypropylene coated.
2. Type: Drop-front design with non-slip serrated step surface.
3. Coating: Coat portion of step which will be embedded in concrete with high-build bituminous paint.

E. Manhole Frame and Cover: Gray iron castings conforming to ASTM A48, Class No. 30, designed for AASHTO Highway Loading Class HS-20. Provide castings of uniform quality, free from blowholes, porosity, hard spots, shrinkage distortion or other defects. Covers to be self-sealing. Frame and cover design, dimensions and weight equal to MHR 701 as manufactured by Quirin.

1. Finish: Bearing surfaces shall be machined to prevent rocking and rattling under traffic. Casting surfaces shall be shotblast cleaned and coated with asphalt paint, non-tacky drying.
2. Identification: Cast the word DANGER SEWER – DO NOT REMOVE COVER integrally on cover in two inch size raised letters.
3. Frame hold-down bolts: ASTM A307.
4. Anchor Bolts: J or L shape with standard coarse thread ends, ASTM A307.

F. Watertight Manhole Frame and Cover: Gray iron castings conforming to previously specified requirements for Manhole Frame and Cover and equal to MHR 701 I.C. as manufactured by Quirin. The cover shall have a built in O-ring and a non-penetrating pickhole.

G. Preformed Plastic Sealing Compound: FS SS-S-210A, type 1, Rope Form, of either bitumastic base compound or butyl rubber base compound, and shipped protected in a removable two piece wrapper. Size cross-section of rope form to provide squeeze-out of material around entire interior and exterior circumference when joint is completed.

H. PVC Waterstop for Cast-in-Place Base: Gasket Type waterstop composed of virgin polyvinyl chloride (PVC) such as manufactured by Fernco Joint Sealer Co.; CMA Concrete Manhole Adapter.

I. Manhole Inserts: HDPE construction as manufactured by Parson.

J. Heat Shrinkable Wrap: Wrap to cover riser rings and joints in their entirety as equal to wrapid seal as manufactured by CANUSA.

2.2 PRECAST REINFORCED CONCRETE MANHOLE COMPONENTS

A. Materials and Construction shall conform to requirements specified in ASTM C478 except as follows:

1. Concrete: Composition and compressive strength conforming to ASTM C478 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 C302.
3. Manhole Steps: Factory installed in manhole components, prealigned vertically, spaced on equal centers, and located the minimum distance from ends of risers and top sections as indicated on drawings.
4. Manhole Component Seals: Manhole component joints factory formed for self-centering concrete to concrete bearing employing either a rubber compression gasket or preformed plastic sealing compound.

    a. Rubber Compression Gasket: Composition conforming to ASTM C361 or ASTM C443.
    b. Preformed Plastic Sealing Compound: As specified in 2.1 6.
    c. Heat Shrinkable Wrap: Wrap to cover all joints in their entirety as equal to Wrapid Seal as manufactured by CANUSA.

5. Manhole Component Design: Base, tapered and straight riser section, and top section dimensions and diameters, not consistent with ASTM C478, are as indicated on drawings.

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

1. Pipe Opening Seals: Resilient gasket type, cast integrally with manhole component conforming to requirements specified in ASTM C923 and of the following acceptable pipe seals:

a. A-LOK Products Corporation; A-LOK Manhole Pipe Seal.
b. Scales Manufacturing Corporation; RES-SEAL.
c. Thunderline Corporation; LOCK-SEAL Modular Wall and Casing Seal.
d. Dual Seal Gaskets, Inc.; DUAL SEAL II.

C. Precast Top Sections: Of materials and construction as specified previously except additional and differing requirements as follows:

1. Hold Down Bolt Inserts: Factory cast in top section no less than two 3/4 inch threaded inserts or slotted inserts to accommodate manhole frame hold down bolts. Threaded inserts of three inches depth. Both insert types designed for an ultimate load in tension of 12,500 pounds. Inserts factory plugged for shipping. Coordinate insert location with manhole component manufacturer to assure proper location in top sections.
2. Flat Slab Tops: Tops factory formed to properly accept and support required manhole frame and cover and formed to join riser section in a matching joint.
3. Eccentric Cone Tops: Manufacture to same minimum wall thickness and with same area of circumferential steel reinforcement as riser sections.

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

E. Coatings:

1. Prepare surfaces to be coated in accordance with the written instructions of the coating manufacturer, including cleaning, sandblasting or acid etching as necessary.
2. Factory coat entire exterior of precast manhole components with two coats of Pennsbury 32-B-4 PENNOXY-TAR, or equal, to dry film thickness of 7 or 8 mils per coat, coating to be repaired in the field as warranted.

PART 3 - EXECUTION

3.1 LOCATING & INSPECTION

A. All manholes will be field located and verified for depth and alignment by the Builder and Engineer. **No manholes shall be ordered until the actual location of such is determined in the field.**

B. Inspect precast reinforced concrete manhole components in accordance with requirements of ASTM C478 regarding repairable defects and defects subject to rejection by the Engineer.

C. All material found during the progress of the work, either before or after installation, to have cracks, flaws or other defects will be rejected by the Engineer. All defective materials furnished by the Builder shall be promptly removed from the site.

D. Unless noted on the drawings or otherwise directed by the Engineer, all manholes shall be set such that top of rim is flush with existing or final grade.

3.2 PREPARATION

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

3.3 MANHOLE CONSTRUCTION METHODS

A. Cast-In-Place Concrete Manhole Base (if required):

1. Form and pour concrete in accordance with requirements of Section 03300. 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.
    c. Do not place precast riser sections on cast-in-place bases for a minimum of 48 hours after pour.

2. Install sewer piping in cast-in-place manhole bases prior to pouring the concrete.
3. Install PVC Waterstop on pipes entering and leaving manhole base prior to pouring concrete. Install PVC Waterstop in accordance with manufacturer's written instructions.
4. Use 4,500 psi concrete as specified in Section 03300.
5. Coat bases in accordance with the requirements for precast manhole components.

B. Precast Concrete Bases: Install bases on a six inch deep compacted layer of same material used for pipe bedding.

1. When using prefabricated pipe opening seals for connecting pipes into manhole, and such seals create an annular space on interior and exterior of manhole wall after pipe connection is made, fill such annular spaces with preformed plastic sealing compound.

    a. Tightly caulk sealing compound into annual spaces, completely filling the spaces, and render the installation watertight.

b. Follow sealing compound installation, trowel compound surface smooth and flush with interior face of manhole.

C. Concrete Channel Fill: Field pour concrete channel fill for each manhole base or provide and install precast channels:

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. Make slopes gradual outside the invert channels.
6. Use 3,000 psi concrete as specified in Section 03300.

D. 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. Use preformed plastic sealing compound between all sections, installed in accordance with manufacturer's recommendations, and join sections also in accordance with written instructions of manhole component manufacturer.

a. Prime joint surfaces if required by preformed sealing compound manufacturer.
b. If sealing compound is installed in advance of section joining, leave exposed half of two piece protective wrapper in place until just prior to section joining.
c. Use preformed sealing compound as the sole element utilized in sealing section joints from internal and external hydrostatic pressure.
d. Following manhole section installation, trowel sealing compound surface smooth and flush with interior face of manhole.
e. Make pipe connections into manhole walls as specified previously for pipes connecting into manhole bases.

E. Lifting Hole Sealing: Seal with properly designed tapered rubber plugs. Drive plugs into holes in such a manner to render holes completely water and air tight. Sealing of lifting holes with grout not permitted.

F. Frame and Cover Installation: Where required, make final adjustment of frame to elevation using the following materials:

1. Precast Grade Rings:

a. Set precast grade rings in Water-Proof Mortar. Mortar thickness is not to exceed 3/4 inch maximum and 3/8 inch minimum. Wet, but do not saturate precast grade rings immediately before laying.

b. Pre-set grade rings to proper plane and elevation using wedges or blocks of cementitious material not exceeding one square inch wide on all sides.

1) No more than four wedges or blocks per grade ring is permitted.
2) Incorporate wedges or blocks in fresh mortar in a manner to completely encase each. Crown fresh mortar to produce squeeze-out between grade rings.
3) Tool exposed joints with appropriately shaped tool and compact mortar edge into joints.
4) Clean off excess mortar prior to initial mortar set.

2. Concrete Masonry Leveling Units: Lay segmental concrete masonry units to line and in radial course with completely filled mortar joints. Flush cut exposed horizontal and vertical joints on manhole interior and exterior. Leave exterior surface ready for parging.
3. Use concrete masonry units upon written approval of Engineer. Primary leveling unit shall be precast grade rings.
4. Parge the outside of finished concrete masonry leveling units with a minimum of 1/2 inch thick waterproof mortar.
5. 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.
6. Use bolts of sufficient length to properly pass through leveling units, if any, engage full depth of manhole top section inverts and allow enough threaded end to pass through manhole frame to properly tighten nut and washer. Tighten manhole frame bolts after mortar has cured.

G. Plugging Pipe Openings: Plug pipe openings in manholes where such openings are required for future pipe connections.

1. Use masonry units and waterproofed mortar laid up to prevent deterioration.
2. Install such materials to meet exfiltration limits and to allow future removal without damage to manhole.

H. Manhole Insert: The manhole frame rim shall be clean from all debris. Once insert is installed and manhole cover is re-installed, there shall be a flush surface from frame lip to cover.

1. Adjustments of inserts shall be the Builder’s responsibility.

I. Heat Shrinkable Wrap: As per manufacturer’s instructions.

3.4 TESTING MANHOLES

A. General:

1. Conduct tests in presence of and to complete satisfaction of the Engineer.
2. Should a manhole not satisfactorily pass testing, discontinue manhole construction in the Project until such manhole does test satisfactorily.

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

    a. Vacuum Testing Equipment:

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

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

B. Vacuum Test Procedure:

1. Perform vacuum testing in accordance with the testing equipment manufacturer's written instructions.
2. Draw a vacuum of ten inches of mercury and close the valves.
3. Consider manhole acceptable when vacuum does not drop below nine inches of mercury for the following manhole sizes and times:

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

C. Exfiltration Test Procedure:

1. Completely fill manhole to top of frame with water.
2. Allow water filled manhole to stand four hours prior to testing to allow absorbing in materials.
3. At commencement of test, fill manhole to top lip of manhole frame.
4. During a consecutive four hour period, keep an accurate record of the amount of water to be added because of exfiltration.
5. Consider manhole acceptable when exfiltration rate does not exceed a rate of 0.038 gallons a day per inch of manhole diameter per vertical foot of manhole.

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

1. Repair or replace defective materials and workmanship, as is the case, before conducting such additional Manhole Acceptance Tests and such subsequent repairs and retesting as required until manholes meet test requirements.
2. Materials and methods used to make manhole repairs must meet with Engineer's approval prior to use.
3. Make repairs, replacements and retests at no additional expense to AQUA.

END OF SECTION 02605

SECTION 02606 - PRE-CAST VAULTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections apply to this Section.

1.2 STIPULATIONS

A. The Specification Sections “General Conditions”, “Special Requirements”, and “General Requirements” form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.3 REFERENCES

A. American Society for Testing and Materials:

1.	ASTM A307	Carbon Steel Externally Threaded Standard Fasteners
2.	ASTM A615	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
3.	ASTM C139	Concrete Masonry Units for Construction of Catch Basins and Manholes
4.	ASTM C361	Reinforced Concrete Low Head Pressure Pipe
5.	ASTM C478	Precast Reinforced Concrete Manhole Sections
6.	ASTM C923	Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes

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

C. Federal Specifications:

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

1.4 SUBMITTALS

A. Submit detailed drawings modified to suite site conditions.

1.5 QUALITY ASSURANCE

A. Shop Inspection:

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

B. Field Inspection:

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

C. Source Quality Control:

1. Maintain uniform quality of products and component compatibility by using the products of one manufacturer in the case of precast reinforced concrete valve vaults.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Transport and handle precast reinforced concrete vaults and other products specified herein in a manner recommended by the respective manufacturers of such to prevent damage and defects.

1.7 SITE CONDITIONS

A. Environmental Requirements: In no instance may the Builder set or construct vaults on subgrade containing frost.

PART 2 - PRODUCTS

2.1 BASIC MATERIALS

A. Cast-in-Place Concrete: Meeting requirements of Section 03300.

B. Waterproofed Mortar: Material composition meeting requirements of ASTM C270, Type M with waterproofing admixture included.

C. Concrete Masonry Units for Manholes and Vaults: Commercially manufactured solid precast segmental concrete masonry units meeting requirements of ASTM C139.

D. Preformed Plastic Sealing Compound: FS SS-S-210A, Type 1, Rope Form, of either bituminastic-base compound or butyl-rubber base compound (CS-102), and shipped protected in a removable two-piece wrapper. Size cross-section of rope form to provide squeeze-out of material around entire interior and exterior circumference when joint is completed.

2.2 PRECAST REINFORCED CONCRETE VAULT COMPONENTS

A. Materials and Construction: Conforming to requirements specified in ASTM C478 except as follows:

1. Concrete: Composition and compressive strength conforming to ASTM C478 except use Type II or Type III cement in vault components and increase compressive strength to 4,500 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 C302.
3. Component Seals: Vault component joints factory formed for self-centering concrete to concrete bearing employing either a rubber compression gasket or preformed plastic sealing compound.

    a. Rubber Compression Gasket: Composition conforming to ASTM C361 or ASTM C443.
    b. Preformed Plastic Sealing Compound: As specified previously.
    c. Heat Shrinkable Wrap: Wrap to cover all joints in their entirety as equal to Wrapid Seal as manufactured by CANUSA.

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

1. Pipe Opening Seals: Resilient gasket type, cast integrally with manhole component conforming to requirements specified in ASTM C923 and of the following acceptable pipe seals:

    a. A-LOK Products Corporation; A-LOK Manhole Pipe Seal.
    b. Scales Manufacturing Corporation; RES-SEAL.
    c. Thunderline Corporation; LOCK-SEAL Modular Wall and Casing Seal.
    d. Dual Seal Gaskets, Inc.; DUAL SEAL II.

C. Vault Coatings:

1. Prepare surfaces to be coated in accordance with the written instructions of the coating manufacturer, including cleaning, sandblasting or acid etching as necessary.
2. Factory coat entire exterior locate below grade of precast manhole components with 2 coats of Pennsbury 32-B-4 PENNOXY-TAR, or equal, to dry-film thickness of 7- or 8-mils per coat, coating to be repaired in the field as warranted.

D. Aluminum Access Hatch: 300#/SF loading, 316 stainless steel hardware with spring assist locking hold open arm, 1.5-inch frame drain coupling, and slam lock. Holliday Series W1S.

E. OSHA Safety Grate: Aluminum “I” bar construction with fusion epoxy orange coating and stainless steel hardware. Haliday Series X

F. Aluminum Access Ladder: Aluminum construction with slip resistant ribbed rungs, flat wall mounting stand-offs. Haliday Series L1B.

G. Aluminum Ladder Extension: Aluminum and stainless steel construction with locking pins Haliday Series L1E.

H. Precast vaults shown with watertight manhole covers shall also meet the frame and cover standards within the “Manholes” section.

PART 3 - EXECUTION

3.1 LOCATING AND INSPECTION

A. All vaults will be field located by the Builder and Engineer. No vaults shall be ordered until the actual location of such is determined in the field.

B. The precast reinforced concrete vault components shall be inspected in accordance with requirements of ASTM C478 regarding repairable defects and defects subject to rejection by the Engineer.

C. All material found during the progress of the work, either before or after installation, to have cracks, flaws or other defects will be rejected by the Engineer. All defective materials furnished by the Builder shall be promptly removed from the site.

3.2 CONSTRUCTION METHODS

A. Precast Concrete Bases: Install bases on a 6-inch-deep compacted layer of same material used for pipe bedding.

1. Vault base shall be installed in a level position.
2. When using prefabricated pipe opening seals for connecting pipes into vault, and such seals create an annular space on interior and exterior of vault wall after pipe connection is made, fill such annular spaces with:

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

3. Concrete Fill: Field pour concrete floor for each vault base as indicated.

    a. Accurately shape invert to a semi-circular bottom conforming to inside of connecting pipes, and steel trowel finish to a smooth dense surface.
    b. Make changes in direction of entering sewer and branches to a true curve of as large a radius as vault size will permit.
    c. Make slopes gradual outside the invert channels.
    d. Use 3,000 psi concrete as specified in Section 03300.

B. Lifting Hole Sealing: Seal with properly designed tapered rubber plugs. Drive plugs into holes in such a manner to render holes completely water and air tight. Sealing of lifting holes with grout not permitted.

C. Riser Section: Pre-cast or cast-in-place riser sections shall be constructed and/or installed to match the existing grade. The riser section shall include the hatch, ladder or steps, and ladder-up extension device.

END OF SECTION 02606

SECTION 02610 - PRE-CAST MANHOLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Precast Concrete Manholes

1.2 RELATED SECTIONS

A. Gravity Wastewater Sewer — Section 02731

B. Cast-in-Place Concrete — Section 03300

1.3 REFERENCES

A. American Society for Testing and Materials:

1. ASTM A48 — Gray Iron Castings
2. ASTM A307 — Carbon Steel, Externally-Threaded Standard Fasteners
3. ASTM A615 — Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
4. ASTM C139 — Concrete Masonry Units for Construction of Catch Basins and Manholes
5. ASTM C270 — Mortar for Unit Masonry
6. ASTM C361 — Reinforced Concrete Low-Head Pressure Pipe
7. ASTM C443 — Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
8. ASTM C478 — Precast Reinforced Concrete Manhole Sections
9. ASTM C923 — Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes
10. ASTM D2146 — Propylene Plastic Molding 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 C302 — Standard for Reinforced Concrete Water Pipe-Noncylinder Type, Not Prestressed

D. Federal Specifications:

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

1.4 SUBMITTALS

A. Make submittals under provisions of Section 01300 — Submittals.

B. Shop Drawings and Product Data:

1. Manufacturer's published detail drawings, modified to suit design conditions if required, and Builder prepared drawings as applicable.
2. Manufacturer's descriptive literature and specifications covering the product specified. Include installation information.

C. Certificates:

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

1.5 QUALITY ASSURANCE

A. Shop Inspection:

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

B. Field Inspection:

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

C. Source Quality Control:

1. Maintain uniform quality of products and component compatibility by using the products of one manufacturer in the case of precast, reinforced concrete manholes.
2. Obtain Certificate of Construction Compliance with ASTM C478 from the precast reinforced concrete manhole manufacturer. Submit same Certificate as part of required submittals.

D. Initial Manholes: Construct first manhole to demonstrate the following, and serve as the minimum acceptable conditions of construction through the project.

1. Demonstrate manhole base construction methods and channel formation.
2. Demonstrate manhole component sealing in the case of precast, reinforced concrete manholes.
3. Demonstrate manhole step alignment.
4. Demonstrate pipe opening sealing.
5. When pavement is installed, demonstrate method of adjustment of manhole frame and cover to grade, and manhole frame and cover attachment.
6. Upon completion, demonstrate successful manhole acceptance test.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

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

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

1.7 SITE CONDITIONS

A. Environmental Requirements: In no instance, set or construct manhole based on subgrade containing frost.

PART 2 - PRODUCTS

2.1 BASIC MATERIALS

A. Cast-in-Place Concrete: Meet requirements of Section 03300.

B. Waterproofed Mortar: Material composition meeting requirements of ASTM C270, Type M with waterproofing admixture included.

C. Concrete Masonry Units for Manholes: Commercially-manufactured, solid precast segmental, concrete masonry units meeting requirements of ASTM C139.

D. Manhole Steps:

1. Aluminum for manhole steps not permitted. Use polypropylene.
2. Steps shall be located a minimum of 6 inches from the ends of riser and top sections.

E. Manhole Frame and Cover: Gray iron castings conforming to ASTM A48, Class No. 30, designed for AASHTO Highway Loading Class HS-20. Provide castings of uniform quality, free from blowholes, porosity, hard spots, shrinkage distortion, or other defects. Covers to be self-sealing. Frame and cover design and dimensions equal to No. R-1642, as manufactured by Neenah Foundry Company or as shown on Drawing S-4 in Construction Details Section of Specifications.

1. Finish: Bearing surfaces machined to prevent rocking and rattling under traffic. Casting surfaces shotblast cleaned and coated with asphalt paint, non-tacky drying.
2. Identification: Cast the words integrally on the cover in 2-inch raised letters.
3. Frame Hold-Down Bolts: ASTM A307.
4. Anchor Bolts: J or L shape with standard coarse thread ends, ASTM A307, or as shown on Drawing S-5 in Construction Details Section of Specifications.

5. Manhole frames and covers to be the self-sealing type, complete with continuous gasket glued to a continuous groove in the bottom of the manhole cover, as manufactured by Neenah Foundry or approved equal.

F. Watertight Manhole Frame and Cover: Gray iron castings conforming to previously specified requirements for manhole frame and cover. Bolt down watertight manhole covers must be used for all manholes not located in paved areas. Rims shall be set 1 foot above finished grade.

G. Preformed Plastic Sealing Compound: FS SS-S-210A, Type 1, Rope Form, of either bituminous-base compound or butyl rubber-base compound, and shipped protected in a removable two-piece wrapper. Size cross-section of rope form to provide squeeze-out of material around entire interior and exterior circumference when joint is completed.

H. PVC Waterstop for Cast-in-Place Base: Gasket-type waterstop composed of virgin polyvinyl chloride (PVC) such as manufactured by Fernco Joint Sealer Co.; CMA Concrete Manhole Adapter.

2.2 PRECAST, REINFORCED, CONCRETE MANHOLE COMPONENTS

A. Provide precast reinforced concrete sanitary manholes as indicated and complying with ASTM C478.

1. The sections shall conform to the requirements of “Specifications for Precast Reinforced Concrete Manhole Sections” (ASTM C478) except that the joints shall be sealed with a Preformed Plastic Gasket that meets or exceeds all requirements of Fed. Spec. SS-S-00210, “Sealing Compound Preformed Plastic for Pipe Joints”, Type 1, Rope Form.
2. The Sealing Compound shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler and shall contain no solvents, irritating fumes, or obnoxious odors. The compound shall not depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive strength. It shall be supplied in extruded rope-form of suitable cross-section and of such sizes as to seal the joint space when the sections are set in place. The sealing compound shall be protected by a suitable removable two-piece wrapper. The two-piece wrapper shall be so designed that one-half may be removed longitudinally without disturbing the other half to facilitate application of the sealing compound.
3. The top of base walls, the ends of reinforced concrete risers and the bottom ends of precast tops shall be so formed that when risers and tops are assembled with the base, they will make a continuous manhole. Joints shall be of such design as will permit effective joining and placement without irregularities in the interior wall surface of the manhole.
4. Manhole barrels shall consist of riser and top sections with a minimum wall thickness of 5 inches. The top section shall be an eccentric conical section with thickened upper walls with the smallest inside diameter equal to 30 inches, to receive the manhole frame and cover. No more than 2 lift holes shall be cast in each barrel or top section.

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

1. Pipe Opening Seals: Resilient gasket type, cast integrally with manhole component conforming to requirements specified in ASTM C923 and of the following acceptable pipe seals:

a. A Lok Products Corporation; A Lok Manhole Pipe Seal.
b. Scales Manufacturing Corporation; RES-SEAL.
c. Thunderline Corporation; LOCK-SEAL Modular Wall and Casing Seal.
d. Dual Seal Gaskets, Inc.; DUAL SEAL II.

2. Connections to existing manholes: core drill existing manhole and install Kor-N-Seal, or equal.

C. Precast Top Sections: Of materials and construction, as specified previously, except additional and differing requirements as follows:

1. Hold-Down Bolt Inserts: Factory cast in top section no less than two (2) 3/4-inch threaded inserts or slotted inserts to accommodate manhole frame hold-down bolts. Threaded inserts of 3-inch depth. Both insert types designed for an ultimate load in tension of 12,500 pounds. Inserts factory plugged for shipping. Coordinate insert location with manhole component manufacturer to assure proper location in top sections.
2. Flat Slab Tops: Tops factory formed to properly accept and support required manhole frame and cover and formed to join riser section in a matching joint.
3. Eccentric Cone Tops: Manufacture to same minimum wall thickness and with same area of circumferential steel reinforcement as riser sections.

D. Grade Rings: Leveling and grade adjusting rings of concrete or HDPE. Material and thicknesses of grade rings shall provide a smooth transition to surrounding grade. Hold down bolt holds to match frame. Design must provide for full bearing of manhole frame assembly.

E. Precast Grade Rings: Leveling and adjusting units of 3- or 4-inch-thickness of materials and constructions as specified previously. Factory cast grade rings with hold-down bolt holes matching location of same in manhole frame. Design must provide for full bearing of manhole frame.

F. Coatings:

1. Prepare surfaces to be coated in accordance with the written instructions of the coating manufacturer, including cleaning, sandblasting, or acid etching as necessary.
2. Prior to delivery, the entire exterior manhole surface shall be coated with two (2) coats, producing a dry film thickness of .016 inches per coat of Bitumastic Super Service Black, as manufactured by Koppers Company, Inc., equivalent of Mobil Chemical Company, or approved equal. Prior to backfill, any damaged coating shall be repaired/reapplied to the exterior of the manhole.

PART 3 - EXECUTION

3.1 LOCATING AND INSPECTION

A. All manholes will be field located by the Builder and Engineer. No manholes shall be ordered until the actual location of such is determined in the field.

B. Inspect precast, reinforced, concrete manhole components in accordance with requirements of ASTM C478 regarding repairable defects and defects subject to rejection by the Engineer.

C. All material found during the progress of the work, either before or after installation, to have cracks, flaws or other defects will be rejected by the Engineer. All defective materials furnished by the Builder shall be promptly removed from the site.

3.2 PREPARATION

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

3.3 MANHOLE CONSTRUCTION METHODS

A. Cast-In-Place Concrete Manhole Base (if required):

1. Form and pour concrete in accordance with requirements of Section 03300 — Cast-in-Place 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.
    c. Do not place precast riser sections on cast-in-place bases for a minimum of forty-eight hours after pour.

2. Install sewer piping in cast-in-place manhole bases prior to pouring the concrete. 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 4,500 psi concrete as specified in Section 03300 — Cast-in-Place Concrete.
4. Coat bases in accordance with the requirements for precast manhole components.

B. Precast Concrete Bases: Install bases on a 6-inch-deep compacted layer of same material used for pipe bedding.

1. When using prefabricated pipe opening seals for connecting pipes into manhole, and such seals create an annular space on interior and exterior of manhole wall after pipe connection is made, fill such annular spaces with preformed plastic sealing compound.

    a. Tightly caulk sealing compound into annual spaces, completely filling the spaces, and render the installation watertight.
    b. Following sealing compound installation, trowel compound surface smooth and flush with interior face of manhole.

C. Concrete Channel Fill: Field pour concrete channel fill for each manhole base or provide and install precast channels:

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. Make slopes gradual outside the invert channels.
6. Use 3,000 psi concrete as specified in Section 03300 - Cast-in-Place Concrete.

D. 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. Preformed plastic sealing compound must be used between all sections, installed in accordance with manufacturer's recommendations, and join sections also in accordance with written instructions of manhole component manufacturer.

    a. Prime joint surfaces, if required, by preformed sealing compound manufacturer.
    b. If sealing compound is installed in advance of section joining, leave exposed half of the two-piece protective wrapper in place until just prior to section joining.
    c. Use preformed sealing compound as the sole element utilized in sealing section joints from internal and external hydrostatic pressure.
    d. Following manhole section installation, trowel sealing compound surface smooth and flush with interior face of manhole.
    e. Make pipe connections into manhole walls as specified previously for pipes connecting into manhole bases.

E. Lifting Hole Sealing: Seal with properly designed tapered rubber plugs. Drive plugs into holes in such a manner to render holes completely water and air tight. Sealing of lifting holes with grout not permitted.

F. Frame and Cover Installation: Where required, make final adjustment of frame to elevation using the following materials:

1. Precast Grade Rings:

   a. Set precast grade rings in waterproof mortar. Mortar thickness not to exceed 3/4-inch maximum and 3/8-inch minimum. Wet, but do not saturate precast grade rings immediately before laying.
   b. Pre-set grade rings to proper plane and elevation using wedges or blocks of cementitious material not exceeding 1-square-inch-wide on all sides. No more than four (4) 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. Concrete Masonry Leveling Units: Lay segmental concrete masonry units to line and in radial course with completely filled mortar joints. Flush cut exposed horizontal and vertical joints on manhole interior and exterior. Leave exterior surface ready for parging.
3. Place precast concrete sections as indicated on the Sanitary Sewer Details. Where manholes occur in pavements, set tops of frames and covers flush with finish surface. Elsewhere, set tops one foot above finish surface, unless otherwise indicated by AQUA.
4. Use concrete masonry units upon written approval of Engineer. Primary leveling unit shall be precast grade rings.
5. Parge the outside of finished concrete masonry leveling units with a minimum of 1/2-inch-thick waterproof mortar.
6. 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.
7. Use bolts of sufficient length to properly pass through leveling units, if any, engage full depth of manhole top section inverts and allowing enough threaded end to pass through manhole frame to properly tighten nut and washer. Tighten manhole frame bolts after mortar has cured.
8. All precast manhole components shall be lifted and moved by use of suitable lifting slings and plugs that will not damage the precast manhole lip.
9. All damage to precast sections shall be thoroughly repaired in the presence of AQUA. Repair and patching of minor breaks shall be done by chipping and scarifying the defective area before application of grout. Sufficient time shall be allowed for curing before the precast sections are put together. Concrete cast-in-place bases shall be specially formed and keyed to accommodate the bottom precast section.
10. Manhole bases shall rest upon a 12-inch base of sound, level, AASHTO No. 57 compacted stone.

11. Manhole sections shall not be set by wedging or placing shims to secure proper level and manholes shall not be backfilled without the permission of AQUA.
12. The top of all precast manholes may be brought to proper grade for receiving manhole frames by use of precast grade rings. Masonry construction shall be performed by experienced and qualified workmen only. All work shall be laid plumb, straight, level, square, and true. All joints shall be full and not more than one-half inch in thickness. The Builder shall set in place and bond in the masonry all necessary steps and miscellaneous items specified elsewhere. The masonry walls shall be parged on the inside and outside with a one-half inch coat of Portland Cement mortar.
13. The minimum depth of flow channel shall be equal to ¾ the diameter of the largest sewer in the manhole to which it connects. The channel shall be graded to give a smooth, uninterrupted flow through the manhole.
14. Bench walls shall be pitched a minimum of 1-inch per foot form the inside periphery of the manhole to the edge of the flow channel.

G. Plugging Pipe Openings: Plug pipe openings in manholes where such openings are required for future pipe connections.

1. Use masonry units and waterproofed mortar placed to prevent deterioration.
2. Install such materials to meet exfiltration limits and to allow future removal without damage to manhole.

H. Drop Connections: Make drop connections in all manholes where the drop invert is 2 feet or more, or as required by the Engineer. Use the same pipe material, as used to construct the main, from which the drop connection is made. Construct drop connection as shown on the Drawings.

3.4 FIELD QUALITY CONTROL

A. General:

1. Conduct tests in presence of and to complete satisfaction of the Engineer.
2. Provide tools, materials (including water), equipment, and instruments necessary to conduct manhole testing specified herein.
3. Prior to testing manholes, thoroughly clean such and seal openings, both to complete satisfaction of the Engineer. Seal openings using properly sized plugs.
4. Perform testing with frames installed. The joint between the manhole and the manhole frame shall be included in the test.
5. The Builder may elect to make a test prior to backfilling for his own purposes; however, the tests of the manholes for acceptance shall be conducted after the backfilling has been completed.

B. Vacuum Test Procedure: See Section 02731 - Gravity Wastewater Sewer.

END OF SECTION 02610

SECTION 02731 - GRAVITY WASTEWATER SEWER

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wastewater Gravity Sewer Pipelines.

B. Service Connection Piping.

C. Pipeline Testing.

D. Manhole Vacuum Testing.

1.2 RELATED SECTIONS

A. Trenching, Backfilling, and Compacting: Section 02221.

B. Cast-in-Place Concrete: Section 03300.

1.3 QUALITY ASSURANCE

A. Source Quality Control:

1. Shop Tests and Inspection:

a. All material furnished by the Builder shall be certified by the Builder for compliance with the pertinent specifications. Shop inspections and testing may be required. The cost of shop testing shall be borne by the Builder.

B. Disposition of Defective Material: All material found during the progress of the work, either before or after installation, to have cracks, flaws or other defects will be rejected by the Engineer. All defective materials furnished by the Builder shall be promptly removed by the Builder from the site at their own expense.

1.4 REFERENCES

A. American Society for Testing and Materials:

1. ASTM D2321 - Underground Installation of Flexible Thermoplastic Sewer Pipe.
2. ASTM D3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
3. ASTM D3212 - Joints for drain and sewer plastic pipes using flexible elastomeric seals.
4. ASTM F477 - Elastomeric seals (Gaskets) for joining plastic pipe.

1.5 SUBMITTALS

A. Shop Drawings and Product Data: Furnish completely dimensioned shop drawings, catalog cuts or other data as required to provide a complete description of piping and piping specialties.

B. Certificates:

1. Certified records or reports of results of shop tests, such records or reports to contain a sworn statement that shop tests have been made as specified.
2. Manufacturer's sworn certification that pipe will be manufactured in accordance with specified reference standards for each pipe type.

1.6 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.

1.7 SITE CONDITIONS

A. Environmental Requirements:

1. Trenches shall be kept dewatered until pipe joints have been made and concrete cradle or encasement, if any, have cured.
2. Under no circumstances may pipe be laid in water or on bedding containing frost.
3. Pipe may not be laid when weather conditions are unsuitable, as determined by the Engineer, for pipe laying work.

PART 2 - PRODUCTS

2.1 SEWER PIPE AND FITTINGS

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

B. Polyvinyl Chloride Pipe (PVC):

1. Pipe: Type PSM SDR-35, ASTM D3034 unless specified otherwise in the Drawings.
2. Fittings: Conforming to same ASTM standard requirements for pipe.
3. Joints: Push-on with elastomeric gasket, ASTM D3212; and ASTM F477 for gasket specifications.

C. Ductile Iron Pipe (DIP):

1. Pipe: ANSI A21.50 and ANSI A 21.51, AWWA C111 and AWWA C151.
2. Wall Thickness Class (Buried): Class 52.
3. Fittings: Gray iron or ductile iron ANSI A21.10, AWWA C1110 and AWWA C111, Class 350.

4. Joints:

    a. Rubber Gasket Joints (Buried): ANSI A 21.11

        1) 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.

5. Cement Lining: Ductile Iron pipe and fittings shall be coated inside with double thickness cement mortar lining (1/8") and seal coated, all in conformance with ANSI A21.4 and AWWA C104.
6. Pipe and Fittings Coating: Factory coated inside and out with bituminous material; minimum 1 mil dry thickness. Bituminous material and finished coat conforming to seal coat requirements in ANSI A21.4.
7. Ductile iron pipe must be used where crossing a State Highway, at all stream crossings, and all sewer installation greater than 11 feet. Pipe fittings and accessories of same material and weight/class as pipes shall be provided with joining method as indicated.

2.2 SERVICE CONNECTION PIPE AND FITTINGS

A. Polyvinyl Chloride Pipe (PVC): As specified for sewer pipe and fittings; six-inch diameter.

B. Pipe Plugs from the pipe manufacturer designed for permanent installation and removable.

C. Wherever necessary, the Builder shall lay “Y” branches of the same materials and strength as the sewer main for the purpose of making building connections. The “Y” branches shall be laid at an angle as shown on the construction details. Builder shall install wye, 45^{o} bend, piping, cap, joint materials, and accessories and all other items incidental thereto and required for a complete and operational installation.

D. Lateral connections to existing mains shall be made with a sanitary sewer saddle connection specifically designed for connection of the existing pipe type and the proposed lateral. Saddle shall be a Scaltite Type “E” wye sewer pipe saddle or approved equal.

PART 3 - EXECUTION

3.1 PREPARATION

A. Earthwork: Perform earthwork for sewer installation as specified in Trenching, Backfilling, and Compacting: Section 02221.

3.2 PIPE LAYING

A. General: All pipe shall be laid to a uniform line and grade between manholes, socket ends upgrade, with a firm and even bearing along the barrel of the pipe, close joints and smooth invert. The spigot end of the pipe is to be centered in, shoved tight and secured against the bell or socket of the previously laid pipe. The interior of each pipe shall be cleaned of all excess joint and foreign material before the next pipe is laid. The pipe shall be laid in the bedding materials as specified in Section 02221. Pipe-laying shall commence at the lowest point and proceed upgrade. At the close of each day's work, and at such other times when pipe is not being laid, the open end of the pipe shall be protected with a close fitting stopper.

B. Joints: Make joints in strict accordance with manufacturer's installation instructions.

C. Laying Specified Types of Plastic Pipe: Installation and joint assembly according to ASTM D 2321.

D. Construction Control:

1. Pipes shall be laid true to the lines and grades shown on the plans. The grade shown on the profile is the invert to which the work must conform. Work not conforming to the grade shall be corrected by the Contractor at his own expense. The locations of the proposed lines are shown on the plans. Approximate depths are shown on the plans.
2. The Builder shall use a laser to control alignment and grade. The laser shall be set up and operated according to the manufacturer’s instructions and the Builder shall possess all required licenses and permits for laser operation. After the trench has been brought to the proper grade as heretofore specified, the pipe and fittings shall be laid. Care shall be taken to lay the pipe to true lines and grades. Every pipe laid shall be tested as to grade and alignment. Care must be taken to fit the joints together properly so that the centers of the pipes shall be in one and the same straight line, and so as to give an opening of even thickness all around between spigot end of pipe and the socket end of specials and fittings.
3. Whenever a pipe requires cutting to fit into the line or to bring it to the required location, cut the pipe in a satisfactory manner so as to leave a smooth end.
4. Keep the excavation in which pipe is being laid free from water and make no joint under water. Do not allow water to rise in the excavation until the joint material has received its set. Use the greatest care to secure water tightness and to prevent damage to, or disturbance of the joints during the refilling process, or at any time. After pipes have been laid, the joints have been made, allow no walking on or working over them, except such as may be necessary in tamping, until there is a covering at least two feet in depth over this top.
5. Field cut short pieces of lateral sewer to locate laterals at the proper location. Keep on the work site, at all times, factory approved equipment to machine and adapt the field cut end of short pieces of pipe to standard couplings and jointing material.
6. No pipe shall be laid upon a foundation into which frost has penetrated or there is a danger of formation of ice or penetration of frost at the bottom of excavation. Where the foundation is unstable or consists of rock, a stone or gravel foundation, at least six (6) inches thick, shall be placed and tamped to form an acceptable bed for the pipe.

E. Variations: The Engineer reserves the right to vary the line and/or grade from that shown on the drawings for pipe lines and manholes when such changes may be necessary or advantageous. No claims will be allowed for changes in location or grade except as such changes are made after trenching has been done. Payment for all variances shall be in accordance with the unit pricing as indicated in the bid and all excavation shall be unclassified.

F. Sanitary Sewer near Water Mains. The Engineer may vary the location of sanitary sewers in close proximity to water mains. No variations on location will be permitted without approval of the Engineer.

1. Horizontal Separation - Sewers should be laid at least 10 feet horizontally from any existing or proposed water main. Should local conditions prevent a lateral separation of 10 feet, a sewer main may be laid closer to the 10 feet to a water main if (1) it is laid in a separate trench, or if (2) it is laid in the same trench with the water mains located at one side of the bench of undisturbed earth and if in either case the elevation of the crown of the sewer is at least 18 inches below the invert of the water main.
2. Vertical Separation - Whenever sewers must cross under water mains, the sewer shall be laid at such an elevation that the top of the sewer is at least 18 inches below the bottom of the water main. When the elevation of the sewer cannot be varied to meet the above requirement, the water main shall be relocated to provide this separation or reconstruct it with mechanical joint pipe for a distance of 10 feet on each side of the sewer. One full length of water main should be centered over the sewer so that joints will be as far from the sewer as possible.

   When it is impossible to obtain proper horizontal and vertical separation as stipulated above, both the water main and sewer shall be constructed of mechanical joint cast iron pipe or ductile iron pipe and shall be pressure tested to assure water tightness; or, the sewer shall be concrete encased for a distance of 10 feet on either side of the water main in accordance with the details shown on the contract drawings or as ordered by the Engineer.

G. Handling of Sewer Line Materials into Trench: Proper implements, tools and facilities satisfactory to the Engineer shall be provided and used by the Builder for the safe and convenient prosecution of the work. All pipe, fittings, jointing materials, etc. shall be carefully lowered into the trench piece-by-piece by means of a derrick, ropes, or other suitable tools or equipment, in such a manner as to prevent damage to sewer line materials and/or workmen. Under no circumstances shall such materials be dropped or dumped into the trench. Take special care in laying pipe to ensure that each length abuts against the next in such a manner that there shall be no shoulder or unevenness of any kind along the inside of the bottom half of the pipe line. No wedging or blocking will be permitted in laying any pipe unless by written order of prior approval from AQUA.

1. Bed each pipe section on a solid foundation before making successive joints. Bring no pipe section into position until the preceding length has been thoroughly embedded and secured in place. Correct any defects due to settlement at Builder's own expense. Dig bell holes sufficiently large to ensure that the pipe is firmly bedded on the full length of the barrel. All pipe bedding shall be as shown on the drawings.

2. Use proper and suitable tools and appliances for the safe and convenient handling and laying of pipes.

H. Pipe Clearance in Rocks: Ledge rock, boulders and large stones shall be removed to provide a clearance of at least six inches below and on each side of all pipe and fittings.

1. The specified minimum clearances are the minimum clear distances which will be permitted between any part of the pipe and/or fitting being laid and any part, projection or point of such rock, boulder or stone.

I. Culverts: Sanitary sewer shall be furnished and installed under culverts to the dimensions shown on the drawings.

J. Concrete Cradle and Encasement:

1. Preparation: Prior to the formation of cradle or encasement, if any, temporary supports consisting of timber wedges and solid concrete bricks or cap blocks shall be used to support the pipe in place. Temporary supports shall have minimum dimensions and shall support the pipe at not more than two locations, one at the bottom of the barrel of the pipe adjacent to the shoulder of the socket and the other near the spigot end.
2. Placing: After jointing of the pipe has been completed, concrete shall be uniformly poured beneath and on both sides of the pipe. Placement shall be done by the use of suitable equipment. The concrete shall be wet enough during placement to permit its flow, without excessive prodding, to all required points around the pipe surface. The width of cradle shall be such as to fill completely the trench width. In case of extremely wide trenches, concrete encasement may be confined above the top of the pipe to a narrower width but in no case shall it be less than the width of trench required for the size of pipe being used. Before depositing concrete, the space within the limits of the pour shall have been cleared of all debris and water. Water shall not be allowed to rise adjacent to, or flow over, concrete deposited for less than 24 hours. Concrete shall be protected from the direct rays of the sun and kept moist, by a method acceptable to the Engineer, for a period of seven days or until backfilling is begun. In no case shall backfilling begin within 24 hours of the time of placing and the Engineer shall have strict control of the rate of backfilling.
3. Concrete shall have a strength of 3000 psi per requirements of Section 03300.

K. Cleaning Piping:

1. Clear the interior of piping of dirt and other superfluous material as work progresses. Maintain swab or drag in line and pull past each joint as it is completed. In large, accessible piping, brushes, and brooms may be used for cleaning.
2. Place plugs in ends of uncompleted conduit at end of day or whenever work stops.
3. Flush lines between manholes if required to remove collected debris.

L. Joint Adapters:

1. Make joints between different types of pipe with standard manufactured adapters and fittings intended for that purpose.

M. Closing Abandoned Utilities:

1. Close open ends of abandoned underground utilities which are indicated to remain in place. Provide sufficiently strong closures to withstand hydrostatic or earth pressure which may result after ends of abandoned utilities have been closed.
2. Close open ends of concrete or masonry utilities with not less than 8-inch thick brick masonry bulkheads.
3. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Wood plugs are not acceptable.

3.3 SERVICE CONNECTIONS

A. Fittings, (Wye branches, risers and bends) and service pipe shall be provided in strict accordance with these specifications and any and all practices and precautions required for the sewer main are equally applicable to the service connections from the sewer to one foot behind the curbline, right-of-way line, or edge of paved surface, or to a location designated by the Engineer. The Builder shall place a 2" x 2" wooden marker at the end of each sewer lateral. The marker shall be one piece and may not be constructed from two or more smaller pieces. The marker shall extend from the lateral invert to 12" above grade.

B. Service connections are to be installed at a grade of quarter inch per foot from the main line to the termination of the lateral.

C. The Builder shall submit to the Engineer, on a monthly basis, all as-built information which shall include: manhole run, station, length from centerline of sewer, invert elevation at the termination point of lateral and the address or property owner's name for whom the lateral and the address or property owner's name for whom the lateral is provided.

D. If rock is encountered during the installation of the lateral, the Builder shall extend the lateral to the required distance as specified elsewhere in these specifications, and they shall provide a minimum "rock-free" distance of one foot beyond the end of the lateral. No lateral shall be "butted" against rock.

E. Plugs: Close free ends of branches and service connections with a carefully fitted plug. Type of plug used and method of installation shall meet Engineer's approval. Installed plugs shall successfully pass line acceptance tests.

F. Install warning tape as described in Section 02221.

3.4 PIPELINE TESTING PREPARATION

A. Backfill trenches in accordance with detail on Drawings.

B. Provide pressure pipeline with concrete reaction support blocking.

C. Flush pipeline to remove debris. Collect and dispose of flushing water and debris.

D. Clean pipelines by propelling a snug fitting rubber ball through the pipeline with water from the upstream manhole to the downstream manhole. Investigate and correct any stoppage of the cleaning ball. Collect and dispose of cleaning water and debris.

E. Lamping:

1. After flushing and cleaning, lamp gravity pipeline in the presence of the Engineer.
2. Assist the Engineer in the lamping operation by shining a light at one end of each pipeline section between manholes. The Engineer will observe the light at the other end. Pipeline that has not been installed with uniform line and grade will be rejected. Remove and re-lay rejected pipeline sections. Reclean and lamp until pipeline section achieves a uniform line and grade to the satisfaction of the Engineer.

F. Plug outlets, wye-branches and laterals. Brace plugs to offset thrust.

G. Conduct all testing for pipes and manholes with an AQUA/Engineer representative on site.

3.5 TESTING GRAVITY SEWER PIPELINES

A. Low Pressure Air Test:

1. Test each newly installed section of gravity sewer line between manholes.
2. Slowly introduce air pressure to approximately 5.0 psig.
3. The sewer mains and/or laterals shall be tested for leakage by the use of low pressure air as specified hereinafter and as approved by AQUA. Each manhole run will be tested separately as the construction progresses, before trench surface restoration.
4. Equipment shall be as manufactured by Cherne Industrial, Inc. of Edina, Minnesota; N.B. products of New Britain, PA or equal. Equipment used shall meet the following minimum requirements:

    a. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected.
    b. Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.
    c. All air used shall pass through a single control panel.
    d. Three individual hoses shall be used for the following connections:

        1) From the control panel to pneumatic plugs for inflation.
        2) From the control panel to sealed line for introducing the low pressure air.
        3) From the sealed line to the control panel for continually monitoring the air pressure rise in the sealed line.

5. All pneumatic plugs shall be seal tested before being used in the actual test installation. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 25 psig. The sealed pipe shall be pressurized to 5 psig. The plugs must hold against this pressure without having to be braced.

After a manhole reach of pipe has been backfilled and cleaned, and the pneumatic plugs are checked by the above procedure, the plugs shall be placed in the line at each manhole and inflated to 25 psig.

6. Allow pressure to stabilize for at least five minutes. Adjust pressure to 3.5 psig or the increased test pressure as determined below if groundwater is present. Start the test.
7. Test:

   a. Determine the test duration for a sewer section with a single pipe size from the table below:

Nominal Pipe Size	T (Time) Min/100 Ft.	
4	.3	3 minutes minimum
6	.7	3 minutes minimum
8	1.2	4 minutes minimum
10	1.5	5 minutes minimum
12	1.8	6 minutes minimum
15	2.0	7 minutes minimum
16	2.0	7 minutes minimum
18	2.0	9 minutes minimum

   b. Record the drop in pressure during the test period. If the air pressure has dropped more than 1.0 psig during the test period, the line is presumed to have failed. If the 1.0 psig air pressure drop has not occurred during the test period, the test shall be discontinued and the line will be accepted
   c. If the line fails, determine the source of the air leakage, make corrections and retest. The Builder has the option to test the section in incremental stages until the leaks are isolated. After the leaks are repaired, retest the entire section between manholes.

B. Infiltration Test:

1. Use only when gravity pipeline is submerged in groundwater. Obtain prior approval of the Engineer.
2. Maximum Allowable Infiltration: 100-gallons per inch of pipe diameter per mile per day for any one section under test, including the allowances for leakage from manholes.

C. Infiltration:

1. After the air testing described in the preceding paragraph has been completed by the Builder, regardless of any indications of the test results made by the Engineer or AQUA, the Engineer and AQUA reserve the right to perform field investigations, prior to final written acceptance of each sewer run by AQUA and/or during the one-year correction period specified elsewhere in the Contract Documents, to establish the leakage of groundwater into the sewer and laterals constructed under this contract. The cost of these investigations shall be borne by AQUA.
2. Should the leakage exceed 100 gallons per day per inch diameter per mile of pipe for any section, the Builder shall, at the direction of the Engineer or AQUA, and at no cost to AQUA, perform any additional testing or corrective work required to reduce the infiltration in each manhole run from those lines installed by the Builder to less than 100 gallons per day per inch diameter per mile of pipe. This leakage applies to each manhole run separately and should not be construed to mean total leakage in the total system. The scope of this corrective work shall include, but not be limited to, cleaning, televising and testing the sewer and laterals to the limits installed by the Builder, to include testing and grouting of joints, excavation and replacement of faulty or damaged portions of the work, and all final restoration.

3.6 DEFLECTION TESTING OF PLASTIC SEWER PIPE

A. At the direction of the Engineer, perform vertical ring deflection testing on suspect portions of PVC sewer piping, in the presence of the Engineer, after backfilling has been in place for at least 30 days but not longer than 12 months.

B. The maximum allowable deflection for installed plastic sewer pipe shall be limited to 5% of the original vertical internal diameter.

C. Perform deflection testing with a deflectometer, calibrated television, or a properly sized "Go, No-Go" mandrel. The mandrel(s) shall be constructed at the Builder's expense and subject to the approval of the Engineer.

D. Pipe exceeding the allowable deflection shall be located, excavated, replaced, and retested at the sole expense of the Builder.

E. Mandrel Test Procedure:

1. Completely flush the line making sure the pipe is clean of any mud or debris that would hinder the passage of the mandrel.
2. During the final flushing of the line, attach a floating block or ball to the end of the mandrel pull rope and float the rope through the line. (A nylon ski rope is recommended.)
3. After the rope is threaded through the line, connect the pull rope to the mandrel and place the mandrel in the entrance of the pipe.
4. Connect a retrieval rope to the back of the mandrel to pull it back if necessary.
5. Remove all the slack in the pull rope and place a tape marker on the rope at the ends of the pipe.
6. Draw mandrel through the sewer line. If any irregularities or obstructions are encountered in the line, corrective action shall be taken as required.

7. If a section with excessive deflection is found, it shall be located and excavated. The pipe shall be inspected for damage; if any damaged pipe is found, it shall be replaced at the Builder's and/or Contractor's expense; if pipe is not damaged, replace and thoroughly tamp the haunching and initial backfill; replace remainder of backfill.
8. Re-test this section for deflection.

3.7 MANHOLE VACUUM TEST

A. Builder shall supply all equipment and materials to vacuum test each manhole. Equipment and material shall be approved by AQUA.

B. Each manhole shall be tested after backfilling and binder is placed if in roadway.

C. Prior to testing, all lift holes shall be plugged with an approved non-shrink grout.

D. All pipes entering the manhole shall be plugged, taking care to securely brace the plug from being drawn into the manhole.

E. The test head shall be placed inside of the casting and the seal inflated in accordance with the manufacturer's recommendations.

F. A vacuum of 10 inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 9 inches. The manhole shall pass if time is greater than 60 seconds for 48" diameter, 75 seconds for 60", and 90 seconds for 72" diameter manholes.

G. If the manhole fails the initial test, necessary repairs shall be made with a non-shrink grout while the vacuum is still being drawn. Retesting shall proceed until a satisfactory test is obtained.

3.8 CLOSED CIRCUIT TELEVISION INSPECTION

A. The Builder shall furnish all equipment and labor as required, including all electronic equipment and technicians, to televise sewers. The Builder shall provide monitoring of closed circuit televised sewers in a manner which shall provide clean and visible pictures of the work being performed.

B. All video tapes shall be of a high quality DVD Diskette capable of viewing in play, fast forward, rewind, and still modes of DVD machines. Builder shall provide the following audio and display information on all video tapes.

1. Audio Information:

    a. No offensive language
    b. Day, month, year, and time
    c. Location of manholes by AQUA numbering system and nearest street intersection
    d. Direction camera is viewing and manhole number at destination point

e. Audio shall be used to describe the location and condition of all manholes, laterals, leaking joints, breaks, and other problem areas.

2. Screen Display Information:

a. Standard Display on all DVD's shall be:

1) Date (month, date, and year)
2) Job Number
3) M.H. Number (#) to Number (#)
4) Linear Foot

b. This shall be located on the screen where it will not obstruct the view. Color T.V. camera shall be used for all televising.

3.9 TEST REPORTS

A. The Builder shall submit a written, certified report which includes the detailed testing log with times and results for all pipe segments and manholes.

3.10 ACCEPTANCE

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

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

END OF SECTION 02731

SECTION 02732 - FORCE MAINS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Force Main Pipe and Fittings.

B. Site Conditions.

C. Excavation, Bedding & Backfill.

D. Anchorage.

E. Tests.

F. Submittals.

G. Product Delivery, Storage and Handling.

1.2 RELATED SECTIONS

A. Trenching, Backfilling, and Compacting, Section 02221.

B. Cast-in-Place Concrete, Section 03300.

PART 2 - PRODUCTS

2.1 FORCE MAIN PIPE AND FITTINGS

All work shall be performed in accordance with UNI-B-3-92 "Recommended Practice for the Installation of Polyvinyl Chloride (PVC) Pressure Pipe".

A. Polyvinyl Chloride Pipe (PVC):

1. Polyvinyl Chloride (PVC) Pipe for force mains and pressure lines shall be of the bell and spigot type or the coupling type and shall be manufactured in accordance with ASTM D 2241, SDR21, Class 200. PVC material for pipe shall conform to ASTM D1784, Cell Class 124554B. Gaskets for pipe shall conform to ASTM F477, joints shall conform to ASTM D3139.

    a. Suggested Suppliers: Certain Teed Corp.; J-M Manufacturing Company, Inc.

2. The pipe shall be made of PVC compounds having a cell classification of 12454-B (or type 1, grade 1 or type 1120) or 12454-C (or type 1, grade 11, or type 1220) as defined in ASTM D 1784.

3. Fittings shall be manufactured in one piece of injection molded PVC compound meeting ASTM D1784. Fittings shall be Class 200, designed to withstand a minimum of 630 psi quick burst pressure at 73 degrees F tested in accordance with ASTM D1599. Bell shall be a gasket joint conforming to ASTM 3139 with gaskets conforming to ASTM F477.
4. The joint shall be a rubber ring gasket meeting the requirements of ASTM D 1869, C 361 and C 443, and shall provide an adequate compressive force against the bell and spigot or the coupling to affect a positive seal and to provide for expansion and contraction while preventing displacement. The rubber ring gasket shall be the only element depended upon to make the joint flexible and watertight. Solvent cement joints are not acceptable.
5. PVC pipe shall be furnished in standard lengths of 18-22 feet. All pipe shall be marked clearly at intervals of five feet or less with the manufacturer's name, cell classification, SDR rating, and ASTM Designation D 2241.
6. Pipe shall meet the dimensional requirements of SDR 21 with a pressure rating of not less than 200 psi.
7. Fittings for PVC pipe shall be compatible PVC fittings as recommended by the pipe manufacturers, and of same class as the pipe.

B. Ductile Iron Pipe:

1. ANSI A21.51, AWWA C151, Ductile Iron Pipe, Thickness Class 52 with mechanical joint fittings for underground installation, Class 53 for Flanged piping.
2. Cement lining - double thickness cement mortar lining (1/8") with seal coat, in conformance with ANSI A21.4 and AWWA C104.
3. Exterior Coating:

    a. bituminous coating, minimum 1.0 mil thickness for underground piping.
    b. shop prime with primer compatible with finish coat for piping inside structures.

4. Joints:

    a. Use rubber gasket joints for pipe and fittings installed underground.

        1) Mechanical Joint: ANSI A21.11
        2) Push-on Joint: ANSI A21.11

    b. Use flanged joints for pipe and fittings installed inside of structures, unless indicated otherwise. Mechanical pipe couplings with self-centering gaskets designed to mechanically engage grooved or shouldered piping and lock in a positive watertight couple may be used in lieu of flanged joints, except where indicated otherwise.

        1) Flanged joint: ANSI A21.15
        2) Mechanical coupling: Victaulic Style 31 or equal.
        3) Gaskets: 1/16 inch thick, one piece cloth insertion rubber gaskets suitable for wastewater service.

5. Ductile Iron Fittings: Fittings for buried ductile iron pipe shall be mechanical joint, conforming to AWWA C110 and AWWA C111 Class 350. Fittings shall be furnished suitable for use with the type of pipe specified herein.

6. Gaskets and Bolting Materials:

    a. All bolting shall conform to the appropriate standards: ASTM A307 Grade B for bolts and ASTM A194 Grade 2 for nuts. All bolting shall be cadmium plated except for submerged conditions where stainless steel shall be provided.
    b. Dimensions shall conform to ANSI B18.2.1 for bolts and ANSI B18.2.2 for nuts. Threading shall conform to ANSI B1.1 Class 2A fit for bolts and Class 2B fit for nuts.
    c. Bolts shall extend completely through the nuts and may have reduced shanks of a diameter not less than the diameter at the root of threads.
    d. Washers shall be steel, cadmium plated, to fit within the bolt facing on the flange. Stainless steel washers shall be used for submerged conditions.
    e. Gaskets shall be 1/8 inch thick cloth inserted synthetic rubber full face gaskets and holes punched for flanges conforming to AWWA C111. Gaskets for ductile iron flanged pipe and fittings 12 inch and smaller shall have “nominal” inside diameters, not the larger inside diameters per ANSI B16.21.
    f. Gaskets and bolts for other than flanged joints shall be as required for mechanical joints and/or push-on joints as applicable in accordance with AWWA requirements.

C. Stainless Steel Pipe:

1. Type 304 stainless steel pipe shall be used.

PART 3 - EXECUTION

3.1 SITE CONDITIONS

A. Environmental Requirements:

1. Keep trenches dewatered until pipe joints have been made and concrete cradle or 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.

3.2 EXCAVATION, BEDDING & BACKFILL

A. Non-metallic force mains to be installed with magnetic underground warning tape.

B. Where force main is benched into a sewer trench, the sewer backfill shall be installed to the elevation of the force main prior to the force main installation and backfill.

3.3 ANCHORAGE

A. Concrete Thrust Blocks: Provide concrete thrust blocks for all fittings, and at all locations where horizontal or vertical deflections are made in the joints of the piping.

1. Reaction Backing: Concrete of a mix not leaner than 1 cement: 2□ sand: 5 stone and having a compressive strength of not less than 2,000 psi, at 28 days. Place backing between solid ground and the fitting to be anchored; the area of bearing on the pipe and on the ground in each instance shall be as indicated on the Drawings or directed by the Engineer. Unless otherwise indicated or directed, place backing so that the pipe and fitting joints will be accessible for repair.
2. Metal Harness: Where indicated, use metal harness of tie rods of adequate strength to prevent movement. Steel rods or clamps shall be galvanized and painted with two coats of asphalt type paint.

B. Anchorage for Bends: Provide thrust restraint system for all bends deflected 11.25 degrees or more on mains six inches in diameter or greater.

1. Use only a thrust block system for PVC pipe.
2. Use metal rods only as indicated on the Drawings or directed by the Engineer.
3. Do not use split retainer flanges on PVC pipe to obtain a restrained joint.

3.4 IDENTIFICATION

A. Underground Type Plastic Line Markers: Manufacturer's standard permanent, bright colored, continuous printed plastic tape, intended for direct burial service; not less than 6" wide x 4 mils thick. Provide green tape with black printing reading "CAUTION – SEWER LINE BURIED BELOW".

1. Suggested Suppliers: Allen Systems, Inc.; Emed Company, Inc.; Seton Name Plate Corp.

3.5 VALVES AND APPURTENANCES

A. Valves: Cast iron ball or plug valves shall be installed on service and force main lines at the locations required by the Project Drawings. Valves installed in valve/cleanout pits shall be actuated with a quarter turn type hand lever. Buried valves shall be actuated with an underground actuator through a cast iron valve box. Ball valves on individual properties shall be oriented with the seat in place for pressure.

B. Painting: All surfaces of each valve body assembly shall be clean, dry, and free from grease before painting. All unmachined surfaces of the valve body assembly shall be wire brushed down to clean metal. Two coats of an asphalt varnish shall be applied in accordance with AWWA C500.

C. Spare Parts and Tools: Repair or service parts for one of each type and size of valve used in this work shall be furnished and stored as directed by the Engineer. The equipment shall include, in general, the following items: special tools required for maintenance or operation of valves, gaskets, rings, seals, lubricants, bolts, washers, and miscellaneous accessories required to maintain valves in proper operating service.

D. Flanges: All flanged valves shall be drilled and faced to the ASA 125 pound standard template and in accordance with ANSI B16.1.

E. Non-Lubricated Plug Valves (Eccentric-Type):

1. Designed for a minimum working water pressure of 175 psi for valves through 12-inch, 150 psi for valves 14-inch through 36-inch, and 125 psi for valve sizes 42-inch through 54-inch.
2. Provide non-lubricated eccentric-type plug valve with valve bodies of cast iron conforming to ASTM A126 Grade B or valve bodies of semi-steel with coated plug suitable for wastewater and nickel or stainless steel seats.
3. Provide full-pressure, drip-tight shutoff with rated pressure from either direction.
4. Provide straight-through, round-port configuration or rectangular-style design; however, part area shall be a minimum of 80% of corresponding pipe area.
5. Valves 8-inch and larger operated by enclosed worm and gear.
6. Provide enclosed worm and gear operator for valves less than 8-inch that must be chain operated.
7. Acceptable Manufacturers:

    a. DeZurik; Series 100 Eccentric Valves
    b. Keystone, USA Valve Division; Ballcentric
    c. Clow
    d. Victaulic Series 365
    e. Or equal

F. Valve Boxes: Standard 7-inch cast iron extension roadway type valve boxes shall be installed over buried valves and service line cleanouts. Screw threads shall be cast integrally with box wall. Welded screw threads are not acceptable.

3.6 SLEEVES AND COUPLINGS

A. Shall be provided for joining buried ductile iron pipe where approved by AQUA. Sleeves for buried piping shall be gray iron ASTM A-126 Class B.A.

1. Suggested Suppliers: Rockwell International (Smith-Blair Type 431); Dresser Industries, Inc. (Dresser Style 53); Ford Meter Box Company, Inc.

3.7 FORCE MAIN FLUSHING STATIONS

A. Provide two-way sanitary sewer flushing connections on all sewer force mains as shown on the details.

B. Distances: The maximum distance between the two-way flushing stations, or between the force main beginning or terminus and a flushing station, is 1,000 feet.

3.8 FORCE MAIN CLEANOUTS

A. In lieu of putting two-way flushing stations along the force main as described in the preceding paragraph, one-way force main cleanouts can be provided as shown on the details.

B. Distances: The maximum distance between the one-way cleanouts, or between the force main beginning or terminus and a cleanout, is 1,000 feet.

3.9 ACCESSORIES

A. Provide anchorages for tees, wyes, crosses, plugs, caps, bends, and valves. After installation, apply full coat of asphalt or other approved corrosion-retarding material to surfaces of ferrous anchorages.

1. Clamps, Straps, and Washers: Steel, ASTM A506.
2. Rods: Steel, ASTM A575.
3. Rod Couplings: Malleable-iron, ASTM A197.
4. Bolts: Steel, ASTM A307.
5. Cast-Iron Washers: Gray-iron, ASTM A126.
6. Thrust Blocks: Concrete, minimum 28 day compressive strength of 3,000 psi in accordance with the Sanitary Sewer Details.
7. Crushed Stone: AASHTO No. 57 or PennDOT No. 2A coarse aggregate in accordance with the requirements of PennDOT Specifications Section 703.2.

3.10 PIPE LAYING

A. Pipe laying shall conform to AWWA C600 with excavation and backfill in accordance with Section 02221. Adequate and suitable equipment and appliances for safe and convenient handling and laying of pipes shall be used.

B. Prior to being lowered into the trench, each pipe and fitting shall be carefully inspected and those not meeting specifications or are otherwise defective shall be rejected and removed from the project.

C. Pipes shall be thoroughly cleaned before they are laid and shall be kept clean until acceptance of complete work. Open ends shall be provided with a stopper carefully fitted so as to keep dirt and other substances from entering the main. Unless approved otherwise, a stopper shall be kept in the end of the line when work is not in progress. Pipe shall be laid so that when completed, the interior bore will conform accurately to grades and alignment indicated by the plans.

D. Before joints are made, each pipe shall be well bedded and no pipe shall be brought into position until the preceding length has been thoroughly secured in place. Coupling or bell holes shall be dug sufficiently large to insure the making of a proper joint. All joints shall be made in strict conformance with the manufacturer's instructions.

E. The excavation into which the pipe is being laid shall be kept free from water and no joints shall be made under water. Water shall not be allowed to rise in excavation until joint is complete. Care shall be used to secure water tightness and to prevent damage to joints during backfilling. All pipe joints shall be watertight within allowances established by these specifications.

F. No pipe shall be laid upon a foundation into which frost has penetrated or there is a danger of formation of ice or penetration of frost at the bottom of excavation. Where the foundation is unstable or consists of rock, a stone or gravel foundation, at least six (6) inches thick, shall be placed and tamped to form an acceptable bed for the pipe.

G. Suitable tools and appliances for safe and convenient handling and laying of pipe and fittings shall be used. Extra care shall be exercised to prevent damage to pipe lining and coating.

H. At the end of each day the end of the pipe line shall be tightly closed with an expansion stopper to prevent dirt or other substances from entering the line.

I. A plastic warning tape shall be installed over all buried force main pipe. The tape shall have the warning "Caution - Sewer Line Buried Below" .The tape shall be positioned above the piping at a point 24 inches below finished grade. A magnetic location tape shall also be installed over all non-ferrous force main pipes.

J. Buried piping which passes above or beneath storm or sanitary sewer piping, water mains, or other utilities shall have a vertical separation of at least 18 inches.

K. Buried piping which passes beneath streams shall have a vertical separation of at least 1.0 feet in rock and 3 feet in other materials, including concrete encasement.

L. Sanitary sewer force main under storm drain pipe or stream culvert shall be laid as near to horizontal as possible. The length of the sanitary sewer force main shall be centered at the point of the crossing so that the joints shall be equidistant and as far as possible from the storm sewer or stream culvert. In addition, should 12" vertical separation not be maintained the sanitary sewer force main shall be encased in concrete for the full width of the trench (12" minimum encasement on each side), with at least 12 inches of concrete beneath the pipe and 12 inches over top of the pipe. The length of the encasement shall be 10 feet each side of the storm sewer or stream culvert.

M. There shall be at least a 10-foot horizontal separation between water mains and sanitary sewer force mains. Force mains crossing water mains shall be laid to provide a minimum vertical distance of 12 inches between the outside of the force main and the outside of the water main. This shall be the case where the water main is either above or below the force main. At crossings, one full length of force main pipe shall be located so both joints will be as far from the water main as possible.

N. Set, align, position and properly connect new valves and operators for proper operation and to allow maximum access for maintenance. Provide proper and adequate clearance for valve operation. When operated, valves shall operate smoothly and operators shall not bind. Valves and valve operators shall be installed in accordance with the manufacturer's instructions. Thoroughly clean and remove all shipping materials prior to setting valves. Operate all valves from fully opened to totally closed before setting. Provide support and anchorage as required. Buried valves shall be provided with special supports such as crushed stone, concrete pads or a sufficiently tamped trench bottom so that the pipe will not be required to support the weight of the valve. Valve boxes and curb boxes shall not transmit shock or stress to the valve or curb stop and shall be centered over the operating nut of the valve or curb stop. Provide a 24" x 24" x 6" thick concrete collar at each valve box and curb box in unpaved areas. The pad and box cover shall be flush with the surface of the finished area.

O. All pipe laid at a depth of 11 feet or greater shall be ductile iron, Class 52 double cement lined or epoxy coated.

3.11 JOINT RESTRAINT

A. Cast-in-place concrete thrust blocks shall be placed at all points of potential thrust as required in accordance with the standards included in these specifications and drawings. Thrust blocks shall be placed so that joints on mains will be accessible for repair. Thrust blocks shall be poured against undisturbed earth and shall be of a sufficient size to resist the thrust resulting from the specified hydrostatic test pressure.

B. Builder shall use restrained joint ductile iron pipe and restraining elbows, tees, hydrants and plugs where indicated. Restrained joint pipe shall be used when one or more of the following conditions exist:

1. Where indicated
2. Unsuitable trench conditions
3. Unsuitable soil conditions
4. Interference with, or close proximity to, buried structures, pipelines, or utility lines

C. Restrained Joint Pipe: When thrust blocks cannot be used, restrained joints shall be placed at all points of potential thrust. The number of joints to be restrained on each side of a fitting shall be determined by the pipe manufacturer and submitted to AQUA for review and approval. The length of restrained pipe shall be sufficient to resist the specified hydrostatic test pressures and shall also take into account such factors as the burial depth, soil types and backfill material used. Restrained joint ductile iron pipe shall be of the restrained mechanical or push-on joint type. Mechanical joint retainer glands are not acceptable. Restrained joint piping shall sustain the indicated test pressures, as a minimum.

3.12 TESTING

A. Before being tested, force mains shall be backfilled between joints to a safe level and thrust restraint suitable to withstand the hydrostatic test pressure shall be in place. Pipe lines shall be thoroughly flushed to remove all foreign materials which may have entered during construction.

B. Force mains shall be tested between the pump discharge valves and a test plug at the end. Test pressures shall be as specified in the paragraphs which follow.

C. Before applying the specified test pressure, air shall be expelled completely from the pipe. If permanent air vents are not located at all high points, the Builder shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be left in place.

D. Hydrostatic Test:

1. The trench shall be backfilled between joints before testing to prevent movement of pipe.
2. The length of force main under test shall be slowly filled with water and brought to test pressure by means of a pump connected to the pipe in a manner satisfactory to AQUA, so as to obtain the specified hydrostatic test pressure at the highest point in the section of main under test. The water, pump, pipe connection and all necessary apparatus, shall be furnished and paid for by the Builder. If desired, AQUA reserves the right to furnish gauges for the test, but all necessary assistance for conducting the test will be furnished and paid for by the Builder. All air must be expelled from the pipe line prior to the test period. The test pressure shall be applied for a period of two (2) hours.
3. The specified test pressure shall be held within 5 psi for the duration of the test.

E. Leakage Test:

1. After the hydrostatic test proves satisfactory, a leakage test shall be conducted. The pressure maintained during the leakage test shall be as specified in the following paragraphs. The test shall be conducted in the same manner as the pressure test except that suitable equipment, supplied and paid for by the Builder, shall be provided for measuring the amount of leakage. The duration of this test shall be twenty-four (24) hours.
2. No pipe installation will be accepted if the leakage is greater than that determined by the following:

    a. The amount of leakage in piping shall be measured at the specified test pressure by pumping from a calibrated container. For new pipe, no leakage shall be permitted.
    b. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi of the specified leakage test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by a drop in pressure in a test section over a period of time.

3. Test pressures shall be as follows:

   a. Hydrostatic Test Pressure (psig): 2 X operating system pressure
   b. Leakage Test Pressure (psig): System operating pressure

4. Should any of these tests on a section of pipe line disclose an inability to hold the stipulated test pressure or leakage in an amount greater than that permitted, the Builder shall, at his own expense, locate and correct any defects and retest same to the satisfaction of AQUA.

3.13 SUBMITTALS

A. Shop Drawings and Product Data: Furnish completely dimensioned shop drawings, catalog cuts or other data as required, to provide a complete description of piping and piping specialties.

B. Certificates:

1. Certified records or reports of results of shop tests, such records or reports to contain a sworn statement that shop tests have been made as specified.
2. Manufacturer's sworn certification that pipe will be manufactured in accordance with specified reference standards for each pipe type.

3.14 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.

END OF SECTION 02732

SECTION 02733 – LOW PRESSURE SEWER PIPE (FORCE MAIN)

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Low Pressure Sewer Pipe and Fittings.

B. Site Conditions.

C. Excavation, Bedding & Backfill.

D. Anchorage.

E. Tests.

F. Submittals.

G. Product Delivery, Storage and Handling.

1.2 RELATED SECTIONS

A. Trenching, Backfilling, and Compacting, Section 02221.

B. Manholes, Section 2605

C. Cast-in-Place Concrete, Section 03300.

PART 2 - PRODUCTS

2.1 HIGH DENSITY POLYETHYLENE PIPE (HDPE)

A. The pipe and fittings shall be made of High Density, Extra High Molecular Weight (EHMW) polyethylene with a standard thermoplastic material designation code of PE3408 and having a cell classification of 345464E per ASTM D3350. The molecular weight category shall be extra high (250,000 to 1,500,000) as per the Gel Permeation Chromatography determination procedure with a typical value of 300,000 to 330,000. The pipe shall be manufactured in accordance with ASTM F714 and/or ASTM D3035.

B. The manufacturer shall provide certification that the stress regression testing has been performed on the specific product in accordance with ASTM D2837 “Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials”. The certification shall also state the specific resin used and its source.

C. HDPE pipe manufactured from materials meeting the specifications of this section shall have an Environmental Stress Crack Resistance of no failures in 10,000 hrs. (ESCR: F_O>10,000) when tested in accordance with ASTM F1248.

D. The pipe and fittings shall have product traceability. The manufacturer shall include a printline on the pipe. This shall notate the manufacturer's name, date of manufacture, the lot and supplier of raw material, plant location, and production shift. The ASTM standard shall also appear as ASTM F714 with the material designation as PE3408.

E. Both pipe and fittings shall carry the same pressure rating. All fittings shall be pressure rated to match the system piping to which they are joined. At the point of fusion, the outside diameter and minimum wall thickness of the fitting shall match the outside diameter and minimum wall thickness specifications of ASTM F714 for the same size pipe. Fittings shall be manufactured by the pipe manufacturers or be compatible fittings as recommended by the pipe manufacturers. Elbows, tees, and wyes shall be manufactured by mitered fabrication. All fittings shall be derated according to the manufacturer's written specifications, and clearly labeled on the fitting as such.

F. Force main and lateral HDPE pipe shall meet the dimensional requirements of SDR 11 and SDR 11.5 with a pressure rating of not less than 160 psi.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with ANSI/ASTM F585, "Standard Practice for Insertion of Flexible Polyethylene Pipe into Existing Sewers".

B. The system shall be complete, including special equipment for transport and fusion joining of HDPE pipe. The Builder shall be familiar with the procedures of installation and joining of pipe sections.

C. Pipe shall be installed in such a way as not to create tension or compression forces in the pipe. Concrete encasement thrust blocking shall be placed at curvatures greater than forty-five degrees, or where pipe movement is likely to occur, at the direction of the Engineer.

3.2 SITE CONDITIONS

A. Environmental Requirements:

1. Keep trenches dewatered until pipe joints have been made and concrete cradle or 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.

3.3 EXCAVATION, BEDDING & BACKFILL

A. Non-metallic force mains shall be installed with magnetic underground warning tape.

B. Where the force main is to be benched into a sewer trench, the sewer backfill shall be installed to the elevation of the force main prior to the force main installation and backfill.

3.4 JOINING

A. Heat Fusion Joining Systems: Pipe and fittings shall be thermal butt fusion, saddle fusion, or socket fusion according to manufacturer recommended procedures.

B. The manufacturer shall provide fusion training. The Contactor (actual installers) and the onsite joint inspector shall be trained by the manufacturer or manufacturer's authorized representative.

C. It will not be permitted to join unlike SDR's to one another. Transition from unlike SDR's shall be accomplished by mechanical couplings capable of identical pressure ratings or machined polyethylene nipples where a thicker wall polyethylene has been matched to the companion pipe wall.

D. Mechanical Joining Systems: HDPE pipe and fittings shall be connected by means of a polyethylene flange adapter and backup ring. The polyethylene flange adapter will be of the same specifications as the LightView except will be made from black plate stock. This method is also approved to join to another piping system or valves. Mechanical compression couplings or full circle encasement clamps may be used depending on the test specification.

E. Mechanical couplings shall be installed in accordance with the mechanical coupling manufacturer's recommended procedures.

F. Equipment: The fusion equipment and operator shall be required to demonstrate successful field experience.

3.5 TESTS

A. Pressure/Leakage Test of Force Mains. Upon completion of the installation and backfilling of each portion of the force main, a formal pressure leakage test will be required of the force mains, valves and fittings in the system constructed. Where any section of a main is provided with concrete thrust blocks, the test shall not be made until at least five (5) days have elapsed after the concrete was installed. If high-early-strength cement is used in the concrete thrust blocks, the test shall not be made until at least two (2) days have elapsed. Prior to the formal test, the main to be tested shall be thoroughly flushed. The force main shall then be tested as per Unibell Standard Test #UNB-3. See standard for leakage requirements.

B. The Engineer shall be furnished with a written report of the results of the hydrostatic test that identifies the specified length of pipe testing, the pressures (minimum 1.5 times working pressure), the duration of the test, and the amount of leakage.

C. If any test of pipe laid discloses leakage greater than specified in Unibell UNB-3, the Builder shall at their own expense locate and repair the defective pipe or joints until the leakage is within the specified allowance.

D. The Builder shall furnish all labor, materials, tools and equipment necessary for or incidental to satisfactory testing, and shall be responsible for any damage to the pipe line or to adjoining property, due to this work.

3.6 WARRANTY

A. The manufacturer shall provide evidence that their standard Terms and Conditions of Sales for warranty and guarantee have been one year from date of manufacture for a period of at least five years. It will not be permitted for a manufacturer to waive the date for the period of warranty and guarantee for this project to meet this specification. The one year date of manufacture shall be covered under the standard Terms and Conditions of Sale.

3.7 SUBMITTALS

A. Shop Drawings and Product Data: Furnish completely dimensioned shop drawings, catalog cuts or other data as required, to provide a complete description of piping and piping specialties.

B. Certificates:

1. Certified records or reports of results of shop tests, such records or reports to contain a sworn statement that shop tests have been made as specified.
2. Manufacturer's sworn certification that pipe will be manufactured in accordance with specified reference standards for each pipe type.

3.8 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.

END OF SECTION 02732

SECTION 02767 – VALVE BOXES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to details.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Type 1: Roadway Style – 5-1/4" inside diameter, cast iron, asphaltic coated 3-piece adjustable valve box, round head, with the word "**SEWER**" printed on top.

1. Manufacturers: Bringham & Taylor, Mueller or Tyler.

B. Type 2: Curb Stop Box: 1" inside diameter upper section, asphaltic coated 2-piece cast iron with operating rod and lid with brass head plug.

1. Manufacturer: Ford Model EA2-40-40-24R or Mueller.

C. Adjustable Pipe Supports: Provide Standon S92 saddle support for 2- and 3-inch pipes and C92 saddle clamp support for 2-inch pipe with ASTM A36 saddle strap, threaded stud, base plate and ASTM A53 collar/base cups with MIG welding and a corrosion resistant galvanized finish.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install Type 1 valve boxes at every distribution valve, blow-off valve, and hydrant isolation valve.

B. Provide valve box length as required to accommodate valve depth.

C. Provide Type 2 valve boxes with extended rods for curb stops.

D. Support valve boxes in accordance with details.

E. Valve boxes shall be flush with the finish grade.

F. Locate curb stop valve box in concrete sidewalk. If area does not specify for the installation of sidewalk, provide 4” thick concrete pad a minimum of 12” square as noted on the standard details.

END OF SECTION 02767

SECTION 02768 – VALVES AND FLUSHING CONNECTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Contractor shall provide the equipment and materials listed herein as part of Contract.

1.2 SUBMITTALS

A. Shop drawings and product data.

1.3 RELATED SECTIONS

A. Precast Vaults, Section 02606.

B. Valve Boxes, Section 02767.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Sewage Combination Air Valve: Provide APCO Model 443WA.1 (2-inch inlet and 1-inch outlet) air release valve where shown on the drawings. Valves shall be provided with shutoff valve, blowoff valve, flush valve and minimum 5-feet rubber hose with quick disconnect coupling for back flushing.

B. Ball Valve: Provide Nordstrom poly-water HDPE valves for flushing connections as shown on the Drawings. Valves shall be of drop-light shutoff, multiple elastomeric steam seals, smooth full bore, EPDM seat, flanged ends, and 200 psi rated pressure.

C. Adjustable Pipe Supports: Provide Standon S92 saddle support for 2- and 3-inch pipes and C92 saddle clamp support for 2-inch pipe with ASTM A36 saddle strap, threaded stud, base plate and ASTM A53 collar/base cups with MIG welding and a corrosion resistant galvanized finish.

D. Flushing Hydrants: Provide 2" Flushing hydrants for the intermediate and terminal cleanout assemblies. The 2" flushing hydrants are to be hidden underground within a heavy duty precast concrete junction box with cover. Provide a 2-1/2" brass NSFT discharge with cap and chain on top of the pipe riser and is exposed within the junction well box. Also exposed in the well is the top of the valve stem for the integral bronze body ball valve with automatic weep that allow for the hydrant barrel to drain. Basis of design is Gil Industries or an approved equal. Utilize two (2) 45^{o} elbows in lieu of a 90^{o} elbow. Refer to the drawings for more information.

PART 3 - EXECUTION

3.1 EQUIPMENT

A. Equipment described in this Section to be installed at the location shown on the drawings, as applicable. Where equipment is not shown, or where equipment is a portable item, deliver to Owner prior to completion of Contract.

END OF SECTION 02768

DIVISION 03
CONCRETE

SECTION 03300 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Concrete materials and mixes for the following:

1. Concrete Cradle and/or Encasement.
2. Reaction Backing (Thrust Blocks).
3. Manhole Base Channel Fill.
4. Manhole Bases.
5. Anti-Flotation Rings.
6. Concrete Footings, Equipment Foundations, Slabs on Grade.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials, AASHTO M182 Burlap cloth made from Jute or Kenaf.

B. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete for Buildings.
2. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
3. ACI 305R - Hot Weather Concreting.
4. ACI 306R - Cold Weather Concreting.
5. ACI 308 - Standard Practice for Curing Concrete.
6. ACI 309 - Standard Practice for Consolidation of Concrete.
7. ACI 318 - Building Code Requirements for Reinforced Concrete.

C. American Society for Testing and Materials:

1. ASTM C33 - Concrete Aggregates.
2. ASTM C39 - Compressive Strength of Cylindrical Concrete Specimens.
3. ASTM C94 - Ready Mixed Concrete.
4. ASTM C143 - Slump of Portland Cement Concrete.
5. ASTM C150 - Portland Cement.
6. ASTM C171 - Sheet Materials for Curing Concrete.
7. ASTM C171 - Sampling Freshly Mixed Concrete.
8. ASTM C173 - Air Content of Freshly Mixed Concrete by the Volumetric Method.
9. ASTM C231 - Air Content of Freshly Mixed Concrete by the Pressure Method.
10. ASTM C260 - Air Entraining Admixtures for Concrete.
11. ASTM C309 - Liquid Membrane - Forming Compounds for Curing Concrete.
12. ASTM C494 - Chemical Admixtures for Concrete.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portland Cement: ASTM C150 of the following type:

1. For concrete which will be in contact with sewage: Type II, Moderate Sulfate Resistance.
2. For all other uses: Type I, Normal.

B. Aggregates: Meeting requirements of ASTM C33.

C. Water: Potable quality, clean and free of injurious amounts of oil, acid, alkali, organic matter, suspended matter, and other deleterious substances.

D. Concrete Admixtures:

1. Air-Entraining Admixture: Use a product conforming to ASTM C260, certified by manufacturer to be compatible with other required admixtures.
2. Water-Reducing Admixture: ASTM C494, Type A, and containing not more than 0.1 percent chloride ions.
3. High-Range Water-Reducing Admixture (Super Plasticizer): ASTM C494, Type F or Type G and containing not more than 0.1 percent chloride ions.
4. Water-Reducing, Non-Chloride Accelerator Admixture: ASTM C494, Type E, and containing not more than 0.1 percent chloride ions.
5. Water-Reducing, Retarding Admixture: ASTM C494, Type D, and containing not more than 0.1 percent chloride ions.
6. Prohibited Admixtures: Calcium chloride thyocyanates or admixtures containing more than 0.1 percent chloride ions are not permitted.

E. Moisture-Retaining Cover: One of the following, complying with ASTM C171.

1. Waterproof paper.
2. Polyethylene film.
3. Polyethylene-coated burlap.

F. Liquid Membrane-Forming Curing Compound: Liquid type membrane-forming curing compound complying with ASTM C309, type I, Class A. Moisture loss not more than 0.055 gr/sq cm when applied at 200 sq ft/gal.

1. Acceptable Manufacturers:

a. Masterseal; Master Builders.
b. L&M Cure; L&M Construction Chemicals.
c. Substitutions: Under provisions of Section 01600.

2.2 PROPORTIONING AND DESIGN OF MIXES

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301.

B. Compressive Strength:

1. Provide concrete with 28 day compressive strength as specified in other Specification Sections.
2. Where no compressive strength is specified, use 3,000 psi concrete.

C. Admixtures:

1. Use water-reducing admixture or high range water-reducing admixture (super plasticizer) in concrete as required for placement and workability.
2. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50°F.
3. Use high-range water-reducing admixture in pumped concrete, concrete required to be watertight, and concrete with water/cement ratios below 0.50.
4. Use air-entraining admixture in exterior exposed concrete, unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus-or-minus 1-1/2 percent within following limits:

a. Concrete exposed to freezing and thawing, deicer chemicals, or subjected to hydraulic pressure:

Maximum Aggregate Size (inches)	Air Content (% by Volume)
1/2	5-9
3/4	4-8
1	3.5-6.5
1-1/2	3-6
2	2.5-5.5
3	1.5-4.5

D. Water-Cement Ratio: Provide concrete for following conditions with maximum water-cement (W.C.) ratios as follows:

1. Concrete with 28 day compressive strength required to be 3,000 or higher: 0.58 maximum (non air-entrained), 0.40 maximum (air-entrained).

E. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:

1. Slump: Not less than 1" nor more than 4", except when super plasticizer is used, slump may be as high as eight inches.

2.3 CONCRETE MIXES

A. Job-Site Mixing will not be permitted.

B. Ready-Mix Concrete: Comply with requirements of ASTM C94, and as herein specified.

1. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C94 may be required.
2. When air temperature is between 85°F and 90°F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90°F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 CONCRETE PLACEMENT

A. General: comply with ACI 304 "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete", and as herein specified.

B. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306.

C. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305.

3.2 CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than seven days.
2. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least seven days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.

B. Curing Methods: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, in accordance with ACI 308.

3.3 FINISHES

A. Provide a steel troweled floor finish on the floors of the generator stations.

3.4 QUALITY CONTROL

A. Sampling and testing for quality control during placement of concrete may include the following, as directed by Engineer.

1. Sampling Fresh Concrete: ASTM C172, except modified for slump to comply with ASTM C94.
2. Slump: ASTM C143; one test at point of discharge for each day's pour of each type of concrete; additional tests shall be performed when concrete consistency seems to have changed.
3. Air Content: ASTM C173, volumetric method; ASTM C231 pressure method; one for each day's pour of each type of air-entrained concrete.
4. Concrete Temperature: Test hourly when air temperature is 40° F and below, and when 80°F and above; and each time a set of compression test specimens made.
5. Compressive Strength Tests: ASTM C39; one set for each day's pour exceeding 5 cubic yards plus additional sets for each 50 cubic yards over and above the first 25 cubic yards of each concrete class placed in any one day; one specimen tested at seven days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required. The average compressive strength for the two 28 day specimens will be used to determine compliance with the compressive strength requirements.

END OF SECTION 03300

DIVISION 11
EQUIPMENT

SECTION 11100 - SEWAGE PUMPING STATIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Concrete Wet Well.

B. Valve Chamber.

C. Submersible Pumps:

1. Pump Motor
2. Motor Starter
3. Pump Controls

D. Sewage Grinder.

E. Emergency Generator.

1.2 RELATED SECTIONS

A. Trenching, Backfilling, and Compacting, Section 02221.

B. Force Mains, Section 02732

C. Valves and Flushing Connection, Section 02768

D. Cast-in-Place Concrete, Section 03300.

1.3 GENERAL GUIDELINES

A. The intent of this section of the specifications is to provide the Developer / Builder with **General Guidelines** for the design and construction of sewage pumping stations. Each pumping station is unique and will need to be designed and constructed as such.

B. Nothing in these specifications shall preclude the Developer / Builder from conformance with the PADEP Domestic Wastewater Facilities Manual. Where conflicts occur the more stringent requirement shall govern.

1.4 PERFORMANCE REQUIREMENTS

A. Pressure ratings of sewage pumps and discharge piping components shall be at least 150% of the sewage pump discharge pressure but not less than 150 psig.

B. Force main velocities shall be a minimum of 2 ft/sec with 3 to 3.5 ft/sec preferred. Maximum velocity shall be 6 ft/sec.

1.5 SUBMITTALS

A. Shop Drawings and Product Data:

1. Manufacturer's published detail drawings showing the wiring diagrams, pipe, joints, fittings, connection details, equipment, materials, procedures for fabrication and erection, adapters, appurtenances, procedures for earthwork, shoring, bracing, procedure of dewatering, methods of installation and testing, and other relevant details of the complete installation, modified to suit design conditions if required, and Builder prepared drawings as applicable.
2. Manufacturer's descriptive literature and specifications covering the product specified. Include installation information.

B. Certificates:

1. Submit test certificates for each consignment or shipment to indicate all materials and equipment required by the Specifications are satisfactorily tested by the manufacturer and found to comply with specified requirements.

C. Design Engineer’s Report:

1. Design Engineer’s report identifies pump capacities detailing pump selection method and calculations. Manufacturer's data on pumps shall include pump characteristic curves showing head, capacity, efficiency, and brake horsepower.

D. Operation and Maintenance Manual:

1. The Developer / Builder shall furnish for submission with each unit or set of identical mechanical units copies of printed instruction books. These books shall include operation, maintenance and repair information, location and telephone number where spare parts may be ordered, plus a parts list. The parts list shall indicate the various parts by their name, number, and diagram.

1.6 QUALITY ASSURANCE

A. Workmanship and Guarantee:

1. The manufacturer of the pumping station shall have a minimum of five years experience in the design and manufacture of submersible pumping stations and shall guarantee the structure and all equipment to be free from defects in materials and workmanship for a period of up to one year from date of start-up.
2. Warranties and guarantees by the suppliers of various components in lieu of a single-source responsibility by the manufacturer will not be accepted. The manufacturer shall be solely responsible for the guarantee of the station and all components, with the exception of the flow metering and remote monitoring system. These shall be warranted by their respective manufacturers. Verify available warranties for units and components and retain or insert number below. Warranty Period: [Two] years from date of Substantial Completion.

3. In the event a component fails to perform as specified or is proven defective in service during the guarantee period, the manufacturer shall provide a replacement part without cost to AQUA. The manufacturer shall further provide, without cost, such labor as may be required to replace, repair, or modify major components such as the pumps, pump motors, and sewage piping manifold.
4. Installer Qualifications: An authorized representative of packaged pumping station manufacture for installation and maintenance of units required for this Project.
5. Manufacturer Qualifications: A qualified manufacturer.
6. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7.
7. Product Options: Drawings indicate size, profiles, and dimensional requirements of packaged pumping stations and are based on the specific system indicated.
8. Electrical Components, Devices, and Accessories: listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
9. HI Compliance: Comply with HI 1.1-1.5 for sewage grinder pumps.
10. NEMA Compliance: Comply with NEMA MG 1 for electric motors.
11. UL Compliance: Comply with UL 778 for sewage grinder pumps.

B. Factory Tests:

1. All components of the pumping station shall be given an operational test of all equipment at the factory to check for excessive vibration, for leaks in all piping or seals, for correct operation of the control systems and all auxiliary equipment. Pumps shall take suction in a manner to simulate actual service conditions. The control panel shall undergo a full operational test with all systems operating.
2. Each pump shall be factory tested by the manufacturer for capacity, power requirements, and efficiency at the specified minimum operating head, rated heat, shut-off head, and at three points as necessary to provide a certified pump performance curves. Certified curves will be provided for each serial number pump being supplied to the project and be performed to Hydraulic Institute test level A standards for engineer's review prior to shipment.

1.7 PRODUCT STORAGE AND HANDLING

A. General:

1. The Builder shall at all time take necessary steps to protect and preserve all materials, supplies, equipment and all work which has been performed.
2. Should work be suspended temporarily because of inclement weather or other causes, the Builder shall take such steps as are necessary to protect materials, supplies, equipment and work performed against damage and injury. Any damaged materials, supplies, equipment, or work performed shall be removed and replaced at the expense of the Builder.

B. Storage and Handling:

1. In all cases, equipment and materials shall be stored per manufacturer instructions so that equipment and materials shall remain undamaged and in suitable condition for installation. Damaged equipment and materials shall be replaced at the expense of the Builder.

2. All materials shall be so handled that the coating and/or linings shall not be damaged. If any part of the coating or lining is damaged, it shall be repaired or replaced by the Builder at no cost to AQUA.

PART 2 - PRODUCTS

2.1 DESCRIPTION OF EQUIPMENT

A. The Builder shall furnish and install a pumping station within a concrete wet well and valve chamber. Each pump shall be capable of handling raw, unscreened domestic sewage consisting of water, fibrous materials, and 3”inch diameter spherical solids. The pump (s) shall be capable of handling liquids with temperatures to 104 degrees F continuous, 160 degrees F intermittent, and shall be capable of running dry for extended periods.

B. The station will be provided with a portable hoist rated to lift the pumps within the station, and remove them from the wet well.

2.2 SEWAGE PUMPS AND MOTOR

A. Pumps General:

1. A minimum of two submersible non clog or grinder type pumps, ITT Flygt Corporation or approved equal, shall be furnished and installed to meet specified operating conditions with at least one pump fitted with the ITT Flygt mix flush valve assembly and the other pump fitted with the mix flush valve adapter only.
2. The pump(s) shall be manufactured by a company regularly engaged in the manufacture and assembly of similar units for a minimum of five (5) years.
3. Pumps, mechanical seals and motor units provided shall be from the same manufacturer in order to achieve standardization of operation, maintenance, spare parts, service and warranty.

B. Pump Construction:

1. A minimum of two submersible non clog or grinder type pumps, ITT Flygt Corporation or approved equal, shall be furnished and installed to meet specified operating conditions with at least one pump fitted with the ITT Flygt mix flush valve assembly and the other pump fitted with the mix flush valve adapter only.
2. The volute, seal plates, impeller and motor housing shall be constructed of high quality ASTM A-48 class 30 cast iron. Pump (s) shall be painted with a water based air dry enamel of 2.0 mil minimum thickness. All exposed hardware shall be 300 series stainless steel. The pump construction shall contain no points of critical clearance nor require periodic adjustment or replacement to maintain operating efficiency. Discharge connection shall be a standard 125 pound 4” inch flange. All gaskets shall be of the compression square ring type eliminating critical slip fits and the possibility of damage during service associated with sliding o-ring sealing arrangements.

3. The impeller shall be of the non-clog design with pump out vanes on the back side. The impeller shall be dynamically balanced to ISO G6.3 specifications. The double mechanical shaft seal shall be of the single spring design operating in an oil-filled seal cavity. Pump-out vanes in the back of the impeller shroud shall develop a radially increasing pressure differential from the impeller hub outward. This pressure differential shall be transmitted by means of a Buna-N elastomer diaphragm to the oil in the seal cavity, thus producing a higher pressure inside the seal cavity than immediately adjacent to the seal face in the pump case forcing the oil in the seal cavity to be the seal face lubricant. The materials of construction shall be silicon carbide for the rotating faces and silicon carbide for the stationary faces, lapped and polished to a tolerance of one light band, 300 series stainless steel hardware, and all elastomer parts to be of Buna-N.
4. The seal shall be commercially available and not a manufacturer's proprietary design. A moisture sensor detection system consisting of two probes utilized as a positive/negative pole shall be integrated within the oil-filled seal chamber. Units utilizing one probe and grounding through the pump case or a float device are not acceptable.

C. Pump Accessories:

1. Guide Rail System: Each pump to be furnished with a guide rail system consisting of a dual rail system connected to the discharge head and to an upper guide bar holder mounted to the access frame. The guide rail system shall consist of stainless steel guide bar brackets and Schedule 40 Type 304 stainless steel pipe.
2. Pump Removal System:

   a. Each pump shall be equipped with complete attachments necessary for lifting the pump and motor from the wet well by means of the Flygt Grip Eye system. The working load of the lifting system shall be a minimum of 50% greater than the pump/motor unit weight.
   b. Pump Lift Cord: Furnish one (1) lift system. System shall consist of stainless steel cable, a short length of high tensile strength proof

D. Electric Motor:

1. The motor shall be designed to be non-overloading throughout the entire intended hydraulic operating range. The pump and motor shall be UL Listed with Underwriters Laboratories as Class I, Division I, Groups C & D, explosion proof, for installation in water and sewage. All electrical parts shall be housed in an air filled, cast iron, watertight enclosure. The enclosure shall be sealed by the use of o-rings and shall have rabbit joints with a large overlap. The motor shaft extension and all external hardware shall be stainless steel. The motor windings shall have class F insulation system minimum and a 1.15 service factor. The shaft seals shall be a tandem design and operate in an oil filled enclosure. The shaft sealing system shall run in an oil bath. The lower, primary seal shall consist of one stationary silicone carbide ring and one positively driven (rotating) silicon carbide ring; while the upper seal between the motor and the oil housing shall consist of one stationary stainless steel ring and one positively driven rotating carbon ring. Each interface shall be held in place by its own independent spring system. The seal shall be commercially available and not a manufacturer's proprietary design.

Thermal sensors shall be used to monitor stator temperatures. The stator shall be equipped with a thermal switch embedded in the end coil of the stator winding. This shall be used in conjunction with and supplemental to external motor overload protection and wired to the control panel.

The pump shall be equipped with type 6/4 SOW-A power cable and sensor cable type 18/5 SOW. The cable entry design shall be such that it precludes specific torque requirements to insure a watertight and submersible seal. All incoming lead wires shall be spliced in the motor terminal housing. After splicing, the terminal housing shall be filled with epoxy to seal the outer cable jacket and the individual strands to prevent water from entering the motor housing. A secondary rubber pressure grommet shall be provided as an additional sealing point and strain relief at the point of cable entry. Cable entry designs utilizing terminal boards to connect power cord leads with motor leads shall not be acceptable. The pump cord(s) shall be equipped with a properly sized meltric fitting to connect to pump disconnect box.

2.3 PUMP DISCONNECT PANEL AND STAND

A. An appropriately rated stainless steel junction box shall be provided and mounted on the top slab of the system. The enclosure shall be lockable single door and carry an IP rating of 66 minimum. The disconnect panel shall be mounted on a stainless steel pedestal with stainless steel mesh that provides atmospheric separation per NEC requirements. The wires shall be surrounded by stainless steel wire mesh of which one side can be removed to access the wiring. Meltric fitting sized for pump amperage shall be installed for quick removal and replacement of pump units. The precast concrete slab shall include an aluminum cable trough with bolt down cover to allow pump control wires to reach into disconnect box without any splicing.

2.4 SWITCH RATED PLUGS AND RECEPTACLES

A. Meltric DSN Decontactor Series switch rated plugs and receptacles should be used for connecting the pump power cords into the bottom of the junction box. Hazardous location models suitable for Class 1, Division 2, Group D location shall be provided. The plugs and receptacles shall include the following features.

1. Features:

a. Spring-Loaded Butt Contacts – Butt style contacts ensure a very positive and consistent connection. The spring loading of these contacts, which is accomplished with coil springs, provides a desirably high contact force that remains constant over thousands of operations. In addition, it should automatically compensate for any wear and/or deviations in contact length resulting from manufacturing tolerances.

b. Silver-Nickel Contact Material – Solid silver-nickel (85%/15%) contacts should be used. Brass contacts will not be considered acceptable. The silver-nickel combination is used for the excellent electrical and mechanical properties.

c. Dead Front Construction – When used in submersible pump applications the dead front construction should be used to enhance safety by eliminating unintended access to live parts. Dead front should be able to be opened only by an appropriate mating plug.
d. Enclosed Arc Chambers – The contacts should make and break within enclosed arc chambers. By containing arcing in the chamber, safety is greatly enhanced.
e. Push Button Load Breaking – To disconnect the switch the user needs to depress the pawl, which will cause the circuit to be disconnected and the plug to be ejected to its off position.
f. Automatic Watertightness – The DSN contactor shall have a NEMA 4X rating, while the DS and DB models shall have a NEMA 3R rating.
g. Spring Assisted Terminals – A spring ring shall surround the conductor terminal, which applies constant pressure as the terminal screw is tightened.
h. Stainless Steel Springs & Screws – All hardware shall be made of stainless steel.
i. The DS, DSN, and DB product lines shall be UL, CSA, and IEC switch rated plugs and receptacles.
j. Optional Auxiliary Contacts – Integral pilot contacts shall be an option. These pilot contacts shall be able to control auxiliary equipment, monitor parameters, or communicate alarms through the same plug as the power supply.

B. Pump Retrieval Chain Sling for Each Pump - Stainless steel chain attaches to pump lifting handle and smarty lift grasps chain for pump lifting and installation.

2.5 CORD STRAIN RELIEF

A. Each pump cord shall be fitted with a stainless steel Kellems cord grip to help support the weight of the pump power and control cables. Kellems support grips are used to hold the weight of electrical cable as it hangs in a vertical, sloping or horizontal position. Electrical cable must be supported, or its dead weight can cause excessive strain or pullout at the connections resulting in pump failure.

2.6 WET WELL

A. The wet well shall be as indicated on the drawings with a monolithically poured base and riser section. The unit shall have minimum 8" thick walls and a flotation collar and precast hopper bottom, 4,000 PSI reinforced concrete conforming to ASTM specific C-478. All joints shall be sealed with Ram-Nek sealant. The top cover slab shall be a minimum of 8" thick concrete with a U.S.F. Fabrication lockable aluminum cover inserted to size written in the specifications below. The junction box shall be mounted to a stainless steel frame, and the wires shall be surrounded by stainless steel wire mesh of which one side can be removed to access the wiring. The entire structure shall be mounted to the concrete wet well slab to allow maintenance personnel to disconnect wiring without entering or reaching into the wet well.

1. Manufacturer: AC Miller Concrete Products or approved equal.

B. Piping in the station shall be minimum 4" cement lined ductile iron with threaded flanges. No "uniflanges", slip on flanges, or flexible couplings will be allowed in the pumping station. The station shall also be equipped with an inlet gasket, minimum 2.00" stainless steel guide rails, and a stainless steel level control switch-mounting bracket with a compression grommet that allows for level setting adjustment. A galvanized vent with bird screen of size shown shall be mounted through the top slab of the wet well. The vent shall have a confined space warning sign attached with stainless steel U-bolts.

C. The station shall also be equipped with an inlet gasket(s) as per the station drawing, stainless steel guide rails, pump and control and a level control switch mounting bracket for floats and transducer and a cable rack to hang pump cords with stainless steel Kellems cord support grips.

D. A white epoxy coating shall be applied to the entire interior concrete surface of the wet well. The coating shall consist of minimum two (2) coats, each six (6) mils thick, applied as recommended by the manufacturer under controlled conditions at concrete manufacturer's plant.

1. Manufacturer: Penn-Chem Coating #54-W-23 by MAB Coatings or approved equal.

E. Bitumastic coating shall be applied to the below grade exterior concrete surface of the wet well.

F. Pipe Gaskets:

1. All pipe penetrations in the manhole shall be sealed watertight using flexible rubber gaskets conforming to ASTM C923 specifications. The use of caulking or epoxy type liner systems at the pipe penetrations shall not be acceptable.

a. Manufacturer: Kor-N-Seal as manufactured by NPC, or approved equal.

2.7 VALVES

A. Air Cushioned Swing Check Valve:

1. Horizontal swing check valves, sized as shown on the plans shall be installed in the discharge piping. The swing check valve shall be constructed with heavy cast iron or cast steel body with a bronze or stainless steel seat ring, a non-corrosive shaft for attachment of weight and lever, and complete non-corrosive trim cushion chamber. It shall absolutely prevent the return of water, oil or gas back through the valve when the inlet pressure decreases below the deliver pressure. The valve must be tight seating, and must be cushioned in operation. The seat ring must be renewable. The cushion chamber shall be attached to the side of the valve body externally and so constructed with a piston operating in a chamber that will effectively permit the valve to be operated without any hammering action. The cushion chamber shall be arranged that the closing will be adjustable to meet the service requirements. The valve disc shall be convex and of cast iron or cast steel and shall be suspended from a non-corrosive shaft which will pass through a stuffing box and be connected to the cushion chamber on the outside of the valve. All material and workmanship shall be first class throughout and the purchaser reserves the right to inspect this valve before shipment. The valve shall be the GA Industries, Inc. Fig. No. 250-D, or APCO Series 6004 or approved equal.

B. Resilient Seat Gate Valves:

1. Resilient Seat Gate Valves 12 Inches and Under for Buried Service Installation: Resilient wedge, iron body, bronze trim, resilient seat for zero leakage, mechanical joint ends, non-rising stem, 0-Ring packing, 2-inch operating nut, epoxy coating inside and outside applied before valve assembly. Valves shall meet or exceed AWWA Standard C504, C509 and C550 (current edition). Valves shall be rated for 200 psi minimum with no leakage. Valves shall be line size in accordance with the diameters shown on the drawings. Manufacturer: Mueller A-2360, US Metroseal or equal.

C. Valve Chamber:

1. Provide a separate concrete valve chamber for discharge, gate valves and swing check valves. Valve chambers shall be constructed of concrete as specified for pump station with minimum 6" walls and 10" bottom, white epoxy coating interior, bitumastic coating exterior (below grade only). The top cover slab shall be concrete with a U.S.F. Fabrication lockable aluminum cover inserted to size written in the specifications below. Piping shall be sealed with boot gaskets and waterstops where it penetrates the wall. Aluminum ladder with safety extension shall be provided in the chamber. The valve chamber floor shall be sloped toward the drain line to provide sufficient drainage. A 2 " PVC drain line sloped at 3% with flap valve or Tide Flex valve shall be installed from valve chamber to wet well. The valve chamber shall incorporate precast concrete piers with stainless steel straps or “Standon” pipe supports to support and stabilize piping.
2. Manufacturer: AC Miller Concrete Products or approved equal.

D. Piping and Valves:

1. The station sewage piping shall be class 53 ductile iron pipe that will extend down through the common base plate terminating in plain ends exterior to the pump chamber. Steel or PVC pipe will not be accepted as an “or equal” substitute to the ductile iron pipe specified. The pipes shall be sealed where they penetrate the concrete with link seal or a gasket to form a gas tight seal between the pump valve chamber and wet well. Each discharge line shall be fitted with a gate valve and check valve as specified herein and sized as shown on the plans. All piping shall be field coated with two coats of gray epoxy to a DFT of 10 – 12 mils. Valve vault piping shall also include an emergency bypass connection.

2.8 PRESSURE GAUGES

A. Provide a filled sleeve pressure sensor assembly on each of the pump discharge lines. Provide ample space for gauge assembly, valve operation and process sampling. Each pressure gauge shall be an all welded assembly. The diaphragm shall be recessed within the all-welded body, and the pressure gauge is back-welded to the seal upper housing to eliminate another potential leak path. No threaded seal fill port should be included to ensure tamper resistant design.

1. Suitable Pressure Ranges: 0 psi to 100 psi
2. Operating Temperature: 0^{o}F to 200^{o}F
3. Ambient Temperature: -40^{o}F to 150^{o}F
4. Dial Size: 2 1/2" process gauge
5. Process Connection: 1/4" NPT female

6. Process materials: Carbon steel body; Class 150 flanges; Neoprene sleeve; ethylene glycol and water fill fluid
7. Manufacturer: Red Valve Series 40 or approved equivalent

2.9 WET WELL HATCH

A. The hatch shall have a clear opening as indicated on the Drawings. Door leaf shall be 1/4 inch thick aluminum diamond plate reinforced for a 300 p.s.f. live load. The frame shall be extruded aluminum channel section with an integral anchor flange on all four (4) sides. The frame shall include an EPDM odor reduction gasket that reduces the amount of odor that escapes from below the door and a 1-1/2 inch threaded drain coupling. The floor access door shall be equipped with a flush drop handle that does not protrude above the cover, and a stainless steel hold open arm with red vinyl grip that automatically locks the cover in the 90 degree open position. The door shall have stainless steel hinges and stainless steel tamper resistant bolts/locknuts. A staple for a padlock shall be supplied for security. All stainless steel components shall be type 316 alloy. An adhesive backed vinyl material that protects the product during shipping and installation shall cover the entire top of the frame and cover. Installation shall be in accordance with the manufacturer's attached instructions. Manufacturer shall guarantee the door against defects in materials and workmanship for a period of ten (10) years.

B. Additional Features:

1. Bituminous Coating – A bituminous coating shall be applied to any part of the aluminum frame that comes in contact with the concrete.
2. Slamlock – The hatch shall be equipped with a watertight stainless steel slamlock with threaded plug, removable outside key, and fixed inside handle. The slamlock must latch onto a stainless steel catch that is bolted to the frame.
3. Hinged on Opposite Short Sides – The doors of the hatch shall be hinged on opposing short sides.
4. Hinged Aluminum Safety Grate – The hatch shall have a fall through prevention system capable of withstanding a load of 300 pounds per square foot. The hatch should not rely on the safety grate to achieve its 300 pounds per square foot. Instead both the hatch and safety grate should independently achieve a rating of 300 pounds per square foot. It will consist of an aluminum grate with 5" x 5" openings that rotates on hinges that are welded to the hatch frame. When the grate is lifted to its open position, it will lock in place and serve as a barrier. The door cannot be closed until the Hinged Aluminum Safety Grate is completely closed. (Will reduce clear opening.)

C. Manufacturer: The floor access door shall be Model TPD as manufactured by U.S.F. Fabrication, Inc. or approved equal.

2.10 VALVE CHAMBER HATCH

A. The hatch shall be as indicated on the Drawings. Door leaf shall be ¼-inch thick aluminum diamond plate reinforced for a 300 p.s.f. live load. The frame shall be extruded aluminum channel section with an integral anchor flange on all four (4) sides. The frame shall include an EPDM odor reduction gasket that reduces the amount of odor that escapes from below the door and a 1-1/2 inch threaded drain coupling. The floor access door shall be equipped with a flush drop handle that does not protrude above the cover, and a stainless steel hold open arm with red vinyl grip that automatically locks the cover in the 90 degree open position. The door shall have stainless steel hinges and stainless steel tamper resistant bolts/locknuts. A staple for a padlock shall be supplied for security. All stainless steel components shall be type 316 alloy. An adhesive backed vinyl material that protects the product during shipping and installation shall cover the entire top of the frame and cover. Installation shall be in accordance with the manufacturer's attached instructions. The door shall be manufactured and assembled in the United States. Manufacturer shall guarantee the door against defects in materials and workmanship for a period of ten (10) years.

B. Additional Features:

1. Bituminous Coating – A bituminous coating shall be applied to any part of the aluminum frame that comes in contact with the concrete.
2. Slamlock – The hatch shall be equipped with a watertight stainless steel slamlock with threaded plug, removable outside key, and fixed inside handle. The slamlock must latch onto a stainless steel catch that is bolted to the frame.

C. Manufacturer: Model TPS as manufactured by U.S.F. Fabrication, Inc. or approved equal.

2.11 PORTABLE HOIST

A. A portable adjustable stainless steel hoist which has an integral base that is mounted to the top slab shall be provided. The hoist shall have a 2000 lb. maximum capacity and shall be capable of lifting the pumps without entering the wet well. The portable hoist shall be manufactured by Thern or approved equal. The hoist base shall be mounted so the hoist can reach both pumps.

2.12 APPURTENANCES

A. Pump Guide Rails: Non-sparking stainless steel.

B. Pump Mounting Plates and Guide Rail Braces: Stainless steel.

C. Guide Rail Supports: Stainless steel.

D. Pump Lifting Cable: Stainless steel (stainless steel lift cable shall incorporate enough length to reach into portable hoist assembly).

E. Fasteners and Hardware: Stainless steel.

F. Pump/Control Cable: Cable shall be supplied by the manufacturer for the entire circuit, starting at the pumps and terminating in the pump control panel. Provide junction boxes and conduit seals as required.

G. Vent Pipes: Provide 4" galvanized iron vents with return bends and No. 8 bronze mesh insect between two flanges. Confined space warning sign should be affixed to wet well vent pipe.

2.13 ELECTRICAL

A. Wiring:

1. All wiring shall be minimum 600 volt (UL) type MTW or AWM and have a current carrying capacity of not less than 125% of the full load current.
2. The conductors shall be in complete conformity with the National Electric Code, state, local and NEMA electrical standards.
3. To ensure the safety of all personnel working with this equipment, as well as providing a simple means of tracing wires when troubleshooting, all wiring shall be color coded in strict accordance with the wiring diagrams furnished by the equipment supplier.

B. UL Approval:

1. The control panel shall be constructed in compliance with Underwriter's Laboratories Industrial Control Panels listing and follow-up service, utilizing UL listed recognized components where applicable.

C. Enclosure:

1. The described equipment shall be housed in appropriate stainless steel enclosure as shown on the drawings. Controls should be mounted on a deadfront door of the enclosure for easy access by operators.
2. All major components and sub-assemblies shall be identified as to function with laminated, engraved Bakelite nameplates or similar approved means.
3. The following described equipment shall be furnished as the control systems required and matched to the specific pumping station equipment.

D. Power Supply and Metering:

1. Main Circuit Breaker: A properly sized molded case circuit breaker shall be provided as the main power disconnecting device for the control panel. The circuit breaker must have a minimum ampere interrupting capacity of 25,000 @ 480 volt symmetrical RMS amps.

E. Lightning Arrestor:

1. A lightning arrestor shall be supplied in the control and connected to each line of the incoming side of the power input terminals. The arrestor shall protect the control against damage due to lightning strikes on the incoming power line.

F. Phase Monitor:

1. A solid state, phase sequence/failure and under voltage release relay shall be provided to ensure additional running protection for the pump motors. The relay shall be complete with an LED to indicate proper phase sequence, all phases in operation and voltage within limits. The relay shall also include an adjustable voltage monitor, be UL and CSA certified and be complete with automatic reset feature.

G. Pump Circuit Breaker:

1. A thermal magnetic circuit breaker shall be supplied as branch circuit protection for each pump motor. The circuit breaker must have a minimum ampere interrupting capacity of 10,000 @ 480 volt symmetrical RMS amps. The circuit breakers shall be operable through the operator's door of the enclosure and include provision for padlocking in open position.
2. The circuit breaker shall be properly sized to protect the control circuit conductors, motor starter and the motor against overcurrent due to short circuit or grounds.

H. Motor Starters (Reduced Voltage Soft Starter):

Provide a microprocessor-controlled starter for three-phase induction motors as manufactured by Benshaw type RediStart Digital motor starter or equivalent.

1. Starter shall include the following :

a. NEMA (National Electrical Manufacturers Association) specified frame size.
b. Solid state design.
c. Current limited reduced voltage starting.
d. Closed-loop motor current control.
e. Programmable motor protection.
f. Programmable operating parameters.
g. Programmable metering options.
h. Variable voltage control.
i. 120 VAC Control Voltage

2. Starter shall operate within applied voltage and frequency values of 480VAC and 60Hz.
3. The starter shall be programmed for a motor FLA and the motor service factor. The starter shall continually monitor the amount of current being delivered to the motor.
4. Starter shall include the following standard features:

a. Adjustable ramp time (0 - 120s)
b. Adjustable initial current
c. Adjustable maximum current
d. Adjustable full-voltage kick start (0.1 to 5 seconds or Off)
e. Selectable motor deceleration control for Pumps (0 - 60s)
f. Variable voltage control input (0 to 5 volts, 0 to 10 volts, 4 to 20mA)
g. Extreme current imbalance/line phase loss detection
h. Adjustable line current imbalance protection (5 - 40%)
i. General fault, motor power and up to speed form "C" contacts
j. Line phase sequence sensitivity or insensitivity
k. Phase loss and phase reversal protection

l. Selectable solid state overload class (10, 20, 30, or None)
m. Negative sequence overload biasing
n. Adjustable motor full load amps (1 - 1600A)
o. Adjustable motor service factor (1.00 - 1.40)
p. Adjustable current transformer ratio
q. Adjustable stalled motor detection (0 - 210s)
r. Line frequency tracking (23Hz through 72Hz)
s. 120VAC external trip input (fault detection active on start or UTS)
t. 800% FLA instantaneous overcurrent detection
u. Overcurrent (jam) protection (50 - 400%, 1 to 15 seconds or disabled)
v. Undercurrent protection (25 - 100%, 1 to 15 seconds or disabled)
w. Shorted SCR detection and SCR condition indication
x. 3-digit 7-segment LED Display
y. Programmable metering

5. LED Display - A three character, alphanumeric LED display located on the control card shall display:

a. Starter status information.
b. Operating parameters.
c. Condition codes.
d. Fault codes.
e. Thermal Overload Content.
f. Metering.
g. Remote display active.

6. LED indicators - Each starter shall have indicating LEDs for:

a. Power On
b. SCR Condition

7. Control Relays:

The starter shall have four control relays as follows:

a. Start/Stop input relay: (This contact shall energize whenever the SCRs are conducting as a direct command from the starter).
b. Fault output relay: (The relay shall energize any motor or starter fault is detected)
c. UTS (up to speed) output relay. (The contact shall engage when a true motor Up to Speed condition is achieved)
d. Motor power output relay.

Each relay shall provide three Form “C” relay contacts capable of 250VAC, 16A Resistive and 8A Inductive. The fault contact shall be only capable of 125VAC 2A Resistive, 1A Inductive.

I. Receptacle: An inner door mounted ground fault interrupter (GFI) type convenience receptacle rated at 15 amperes shall be supplied for the operating of trouble lights, drill, etc. It shall be protected by a separate 15 ampere trip rated circuit breaker.

J. Condensation Protective Heater: A thermostatically controlled, fan driven heater shall be supplied in the control panel to maintain a stable temperature and protect the electrical and electronic equipment from the harmful effects of condensation, corrosion and low temperatures.

K. Motor Ground Fault: Motor Ground fault protection will be provided for each pump motor to ensure the integrity of the submersible pump cords.

L. Control Breaker – Door Mounted: The panel shall be supplied with a properly sized control power circuit breaker. The breaker shall be operator door mounted and shall supply power to all control wiring within the enclosure.

M. USEMCO "Sentry" or approved equivalent Pump Controller:

1. The control system shall utilize standard "off the shelf" equipment. Job specific, "one-of-a-kind" customized software and hardware components will not be accepted
2. The equipment shall be protected from transient voltages and surges induced into the signal lines. The Builder shall provide a permanent earth ground connection to the panel ground lug in order to insure proper operation of transient protectors.
3. A microprocessor-based automatic pump and alarm control system shall be provided for the pump station incorporating an industrial-grade, 16-bit CMOS microcomputer and associated elements suitable for achieving performance as hereinafter described. The controller shall incorporate the following:

    a. Internal diagnostics.
    b. Real time clock calendar.
    c. Floating-point math.
    d. Battery backup.
    e. Non-proprietary RTU communication.
    f. (4) PID loops.

4. The system shall incorporate UL 508 Industrial Control Panel approved elements as required of all components of the panel and shall be furnished with all necessary hardware and software to accomplish level-responsive pump and alarm operation with software specifically suited to this project.
5. All of the discrete I/O circuitry of the computer-based system shall be built to the IEEE 472 (1974) Surge Withstand Capability Standards. The automatic pump and alarm control system computer shall be the standard product of the control system manufacturer and specifically suited for this type of industrial control panel service. All job connections shall be a UL recognized clamp type barriered screw terminals.
6. The constant speed drive equipment shall be programmed to respond to variations in the wetwell in a manner wherein the hydraulic requirement will be accommodated in the pumping program using simple menu-related operator interface routines.
7. Upon power-up, the Controller shall go through a timing routine, which allows the analog signal and display to stabilize before any control, or alarm outputs are enabled. After the stabilization period, the control circuits of the Controller shall be sequentially enabled on a time-step arrangement. In addition to the time delay upon power-up, the differential-level control circuits shall each be forced to an off condition upon power up so that a level excursion will need to go past their turn-on elevation for them to operate.

8. An alternator shall operate the pumps in a First-on/First-off (FOFO) sequence and can be configured to sequence the pumps every start, every 24 hours, on the lowest run time or manually. The alternator shall be capable of accepting pump failure and/or advance inputs and shall automatically transfer to the next pump sequence when failure condition input is sensed. The alternator shall provide automatic transposing of the operating sequence of the control relays for the pumps on successive starts. The FOFO alternator sequencing shall operate such that the next load turned on is always the one that has had the longest opportunity to rest since its last operation.
9. Microprocessor based, programmable controller and operator interface shall provide all of the above controls and operations. A redundant back up float system shall be incorporated into the controller along with programmable automatic operation. Operator interface shall be a minimum of 3" x 4" LCD.
10. The automatic pump and alarm control shall employ an operator interface having a 240 x 80 pixel STN monochrome liquid crystal display. The operator interface shall have an IEC standard IP65F sealed housing. The display shall be rated for 50,000 hours and include an adjustable sleep mode to increase life. The unit shall support four levels of password protection.
11. The Operations Manual shall be included for the pump controller.

N. Controller Configuration:

1. The pump controller shall operate on a 4-20mA input via a submersible transducer, and shall be capable of being configured at the factory or jobsite to perform operating functions as described below. All configurations shall be password protected and shall be provided as a minimum as follows:

    a. Duplex Pump Operation.

        1) Clock hours (0-23) and minutes (0-59).
        2) Calendar day of week (0-6 for Monday - Sunday).
        3) Wetwell transducer rating (1.0-15.0 PSI).
        4) Wetwell transducer offset.
        5) Wetwell cross sectional area for Flow Monitor.
        6) Lag pump disable for non-additive systems.
        7) Pump Alternation method.
        8) Shut down, Alarm only or Lag pump designation upon Seal fail.
        9) On board or Redundant float back up with weekly test feature.
        10) Selectable pump fault for Low oil or Bearing overtemperature

    b. The pump controller shall include the field adjustable delay timers. All timer settings shall be password protected and shall be provided as follows:

        1) Pump 1 start fail delay (0-99 seconds).
        2) Pump 2 start fail delay (0-99 seconds).
        3) Lead pump start delay (0-99 seconds).
        4) Lag pump start delay (0-99 seconds).
        5) Lead pump stop delay (0-99 seconds).
        6) Lag pump stop delay (0-99 seconds).
        7) High Level alarm delay (0-99 seconds).
        8) Low Level alarm delay (0-99 seconds).
        9) Delay between calls (0.1-9.9 minutes).
        10) Back up float pump down timer (1-5 minutes).

11) Back up float lag call timer (0-99 seconds).

c. The pump controller shall include the field adjustable set points. Set points shall be password protected and provided as follows:

1) Lead pump start.
2) Lead pump stop.
3) Lag pump start.
4) Lag pump stop.
5) High Level Alarm.
6) Low Level Alarm.
7) Back up high float.

d. The menu driven screen shall display the following:

1) Wetwell Level.
2) Pump Run time values scaled to hours and tenths.
3) Pump Start counters.
4) Flow Rates.
5) Pumping Rates.
6) Alarm Messages.

O. Alarm Messages:

1. In the event of an alarm condition the operator interface shall display an alarm message. The following list of alarms shall be provided:

a. Low Level.
b. High Level.
c. Pump 1 Fail.
d. Pump 2 Fail.
e. Transducer Fail.
f. Seal 1 Fail.
g. Seal 2 Fail.
h. Motor 1 Overtemp.
i. Motor 2 Overtemp.
j. Pump 1 Fail (Configurable from external device).
k. Pump 2 Fail (Configurable from external device).
l. Backup Float Test Fail.

P. Flow Monitoring:

A flow-monitoring algorithm shall be included in the controller to measure influent flow. This algorithm shall calculate the incoming flow rate during periods of pump inactivity, detecting the change in level and using the configured wetwell area. Pumping rates shall be calculated during periods of pump activity, detecting the change in level and using the configured wetwell area and average incoming flow rate. The controller shall display incoming flow and totalized flow in gallons per minute. It also shall display each pump’s rate in gallons per minute.

Q. Pump Seal Fail:

A seal failure relay specifically designed to interface with a contact closure from each of the specified pumps shall be included. A Seal Fail alarm message shall be displayed on the controller. In addition the controller should be configured to shut down the pump or designate it to the lag position until the condition is corrected.

R. Over Temperature Pump Protection:

Over temperature protection relays shall be provided in the control panels to operate in conjunction with the over temperature switch in each pump motor. The controller shall provide an Overtemp Fail alarm message and pump lockout of operation upon occurrence of high temperature. The circuitry shall also include a reset push button on the controller for manual reset capability.

S. Ammeters:

A 3½" ammeter shall be provided for each pump motor. Each meter shall be connected to a current transformer. The meter and current transformer shall be sized such as to provide half scale readings when the pump motors are running at designed conditions. The ammeter shall meet ANSI specifications C-39.1. The ammeter shall be mounted on the operator's door of the control panel.

T. Selector Switches:

A 22 mm oil tight, three-position, "Hand-Off-Automatic" selector switch shall be flush-mounted on the operator's door of the control panel for the operation of each motor starter. This selector switch shall operate the starter when it is in either the "Hand" position or the "Automatic" position, and the automatic control system is calling for the operation of the equipment in the manner as herein described.

U. Status Indicators:

A 22 mm oil tight green "Pump Running" push-to-test pilot light shall be flush-mounted on the operator's door of the control panel. This pilot light shall be operated from a respective starter auxiliary contact. The pilot light shall have a replaceable bulb.

V. Weather Proof Alarm Light:

A weatherproof high water, 100-watt alarm light assembly including a high impact resistant lexan red lens and wire guard with mounting bracket shall be included, for panel or remote mounting. The alarm light will glow at half brilliance during normal operation. During alarm conditions, a solid-state flasher shall be included to strobe the alarm light from full brilliance to off 90 times per minute for any of the specified alarm conditions.

W. Power Fail Alarm:

A 120-Volt DPDT control relay powered from the load side of the control power circuit breaker shall be included.

X. Telemetry Contacts:

Dry contacts rated 10 amps shall be provided, and wired to a numbered terminal strip inside the panel, to interface with remote telemetry or dialing equipment for the following:

1. Motor Heat Sensor(s)
2. High Level Alarm
3. Low Level Alarm
4. Moisture Sensor(s)
5. Power Fail
6. Pump(s) Run
7. Pump Fail
8. Transducer Fail

2.14 SUBMERSIBLE WET WELL LEVEL SENSING TRANSDUCER

A. The submersible transducer shall be a piezoresistive type with optional ranges of 0-100 INWC to 0-100 psi. The device shall require a 10-30 VDC low voltage power supply. The response time of the transducer shall be less than one millisecond. Accuracy of the equipment should be #0.25% of the entire range and the repeatability shall be #0.05% of the entire range. The transducer shall be capable of being used in media from +15°F to +122°F, and the storage temperature for the unit shall be -22°F to 176°F. Shock resistance per IEC 770 for mechanical shock should be 1000g, and the vibration resistance per IEC 770 for vibration under resonance conditions should be 50g. Protection against reverse polarity, short circuit, and overvoltage should be included in the transducer. The transducer shall carry an IP68 (NEMA 6) rating and shall be submersible up to 350 ft. All wetted parts shall be 316 SS. The transducer shall have a vented polyurethane cable with a tensile strength of 220 lbs.

1. Manufacturer: WIKA model LS-10 or equal.

B. An optional anti-clog attachment shall be included for the above referenced submersible transducer. The anti-clog attachment shall be made of all 316 SS, and shall be silicone liquid filled. The anti-clog attachment shall also include a 2" diaphragm for performance. In case of transducer failure, the anti-clog attachment should be able to be removed and used with a new transducer. Transducers with anti-clog attachments that cannot be removed shall not be acceptable. The anti-clog attachment shall be able to be used with all models of WIKA transducers.

1. Manufacturer: WIKA LS-10 with a LevelGuard™ or equal.

2.15 WET WELL LEVEL SENSING FLOAT SWITCHES

A. The floats shall have a molded polyethylene body, internal redundant polyurethane foam floatation, potted switch/cable connections and fine stranded AWG #18 cable with heavy-duty synthetic rubber jacket in lengths as required to run unspliced to the control panel.

B. The Builder shall furnish, install and wire the float switches as shown on the drawings. The float switches shall be individually suspended in the wetwell with weight kits. The float switch cables shall be suspended from a cable rack mounted to the top of the wetwell.

C. The redundant back-up float controller shall connect to the float switch level sensors through an intrinsically safe module. The module shall provide an intrinsically safe interface for the sensors located in a hazardous area rated Class 1, Group D. The module shall contain an LED indicator providing visible indication of sensor actuation. The intrinsic safety barrier shall be UL listed.

2.16 ALARM DIALER

A. The automatic dialing alarm system shall be microprocessor based and have the capability to monitor from 4-48 dry contact or digital inputs, 8 to 48 analog inputs or energize from 4 to 24 relays in any combination. The dialer shall be field upgradeable to allow for future conditions. Each of these inputs shall monitor a set of dry contacts (normally-closed or normally-open). In addition, the dialer shall monitor the AC power and battery voltage continuously. Upon detecting an alarm on any of its inputs, a low battery condition or detecting loss of its AC power, the dialer shall begin dialing the first of up to 16 user programmed telephone numbers.

B. The dialer shall speak user-recorded messages to the called party describing its location and the alarm conditions that are present. The dialer shall then verbally request that an acknowledgment be given. The called party shall acknowledge the call by momentarily depressing the ‘8’, ‘9’ or ‘*’ key on their telephone keypad. If the dialer is not acknowledged during the call, it shall hang up, wait from 1 to 3600 seconds and then dial the next number in its phone list. If a successful acknowledgment occurs, the dialer shall give a sign-off message, hang up and then wait a user-programmed period of time for the alarm conditions to be corrected. If this period of time elapses and the alarm condition(s) still exist, the dialer shall begin the alarm notification cycle again. The dialer shall have relay outputs that shall remain energized as long as the dialer has any unacknowledged alarms.

   This output shall be available to allow for wiring to an external horn, buzzer, light or other local alarm device. Alternatively, the user shall be able to program the dialer to allow remote activation of this relay from a telephone keypad.

C. Construction:

   1. Enclosure: Minimum rating should be NEMA 4X
   2. Power Requirements: 115 VAC 10% 60 Hz; 25 watts
   3. Printer Port: Centronics parallel – DB25 (female)
   4. Serial Port: 38.4Kbaud – DB9 (male)
   5. Electrical Protection: Transient voltage/surge protection shall be provided on power line, telephone and all input channels. Solid state surge protection provided on digital input, analog input, serial port, parallel port, telephone and AC power circuitry.
   6. The alarm dialer shall be mounted in its own enclosure within the pump control panel. Alarm dialer shall have its own surge protection separate from any panel surge protection.

      a. Manufacturer: Antx Elite or RACO Verbatim or Equal

2.17 MAGNETIC FLOWMETER AND TRANSMITTER

A. A 4-inch magnetic flow tube with remote transmitter shall be provided. The flow tube shall be flanged and placed in the valve vault discharge piping. The transmitter shall be mounted remotely in the control building. Provide optional indicator, keypad and configure for totalizing flow.

B. Flow tube: ptfe liner; 316 ss electrodes; Foxboro 9300A.

C. Flow transmitter: Foxboro IMT25, remote mounted.

2.18 PERMANENT AUXILIARY POWER GENERATOR

A. Generator shall be sized to adequately supply starting current and continuous operation for all connected loads. Generator to be located in a separate room within the control building, having adequate ventilation as required by the manufacturer. Engine shall have protective equipment capable of shutting down the unit and activate an alarm under conditions which may damage the engine. Supplier shall recommend amount and type of vibration isolation and anchor bolt necessary to mount the generator to the generator slab. With one pump running and all other loads on, the voltage drop, upon starting the second pump, shall not exceed 35%. Emergency generator shall be manufactured by Cummins/Onan. Generator shall be supplied with natural gas feed from gas distribution system within development, if available. Otherwise, generator to be diesel powered.

B. Automatic Transfer switch (ATS): ATS shall be provided to automatically start the emergency generator when power failures are detected and to switch back over when power is restored. ATS shall be fully rated to protect all types of loads, inductive and resistive, from loss of continuity in power. Adjustable solid state time delays for starting, transfer, retransfer, and stopping the generator shall be provided. A seven day exerciser clock and standard indicating lights shall be provided. ATS shall be manufactured by Cummins/Onan and shall come integral with level 1 power command control with exerciser clock and programmed transition. ATS shall also contain a 2A (integral) battery charger mounted and wired within the ATS.

2.19 CONTROL BUILDING

A. Structure: Building to be of masonry construction and sized to house electric and control panels, emergency generator, and chemical treatment (if needed), all in separate rooms.

B. Chemical Treatment Odor Control:

1. Hydrogen Peroxide - Provide the following:

a. Chemical Metering Pump: one (1) peristaltic chemical metering pump, 3 RPM, gear motor, powered by 120V electrical. Metering pump shall be capable of pumping in a range of 1/z gpm and 5 gpm, or as specified. Chemical metering pump and shall be model SP10, manufactured by Watson/Marlow or approved equal.

1) Polypropylene shelf for pump with stainless steel mounting hardware.

2) Hose and fittings capable of handling chemical.
3) 30 gallon plastic day tank for holding chemical solution.
4) Two (2) stainless steel ejectors one on discharge side of each pump's discharge header.
5) 24-hour timer with 15-minute interval pre-timed control of chemical feed pump.

2. Other suitable methods of odor control shall be considered on a case by case basis.

C. Accessories:

1. Lighting: Provide adequate lighting for each room in the control building.
2. Control Building Space Heater: Provide a unit space heater capable of maintaining the control building at an ambient temperature of 65°F. The space heater shall be ceiling or wall mounted with integral thermostat capable of controlling between 60°F and 90°F, and be manufactured by Chromalox, or approved equal.
3. Ventilation: (In all rooms except the emergency generator room) Exhaust fan shall be manufactured by New York Blower Company, or approved equal, and shall include 8" diameter fan with motor capable of producing 400 CFM of flow at 0" S.P. Fan shall include gravity louvers and shall mount directly in wall. Louvers shall be shielded on the exterior with an insect/bird screen. NOTE: Ventilation for the emergency generator room shall be installed exactly as specified by Cummins/Onan to be adequate for the generator to be used.
4. Hose Bibs: All hose bibs must have backflow protection and must be frost-proof.
5. Hose: Builder shall furnish a 50-feet length of 3/4" heavy duty rubber hose for connection to the 2" yard hydrant.

2.20 SITE IMPROVEMENTS

A. Chain Link Fence: Nominal 8-foot height with 12-foot wide double section gate. Framework shall be constructed of schedule 40 steel, standard weight, one piece without joints. Fabric shall be 2-inch diamond mesh steel wire, interwoven 9 gage thick, top selvage twisted tight, bottom selvage knuckle end closed.

B. Access Drive: Driveway to be bituminous, minimum 10-foot wide providing access directly adjacent to the wet well, valve vault, and control building. Provide vehicle turnaround and parking area for one vehicle.

C. Exterior Lighting: A single exterior light shall be mounted 12' above ground on an aluminum pole set on a concrete base. Floodlight shall be a heavy-duty aluminum fixture with motion detector and manual override activation switches, impact resistant glass and a 500-watt quartz lamp, Light shall be equipped with manually operated toggle switch to override the motion detector.

D. Freeze-Proof Yard Hydrant: Provide a two-inch automatic draining hydrant with schedule 40 stainless steel casing and operating rod, bury depth of three feet with locking feature. All buried fittings must be constructed of brass. Hydrant shall be equipped with backflow protection. Hydrant seat must be repairable without excavation, manufactured by Woodford Manufacturing Company, or approved equal.

PART 3 – INSTALLATION

3.1 FABRICATION, INSTALLATION, AND FIELD TESTING

A. General: Fabrication and installation of all equipment and materials required for the sewage lift stations and Pumping stations shall be performed by the Builder as per manufacturer's instructions, drawings, cut sheets, and the Specifications and Drawings. Testing of all equipment and materials after installation shall be considered an integral portion of the construction process. The Builder shall repair any item not meeting testing criteria at their own expense. The Builder shall also furnish all necessary labor, equipment, and materials for testing and shall bear all the costs thereof.

B. Fabrication and Installation:

1. All anchorage steel required for the equipment shall be supplied by the equipment manufacturer. The Builder shall install the anchorages in the concrete structures in accordance with drawings and instructions furnished by the equipment manufacturer. Foundation anchor steel shall be grouted as shown on the plans.
2. The Builder shall furnish and install all sleeves and adapters in the wall required for process piping. The Builder shall install all piping and fittings and shall make all joints and connections, including wall sleeves, watertight by means acceptable to the Engineer.

C. Start-Up:

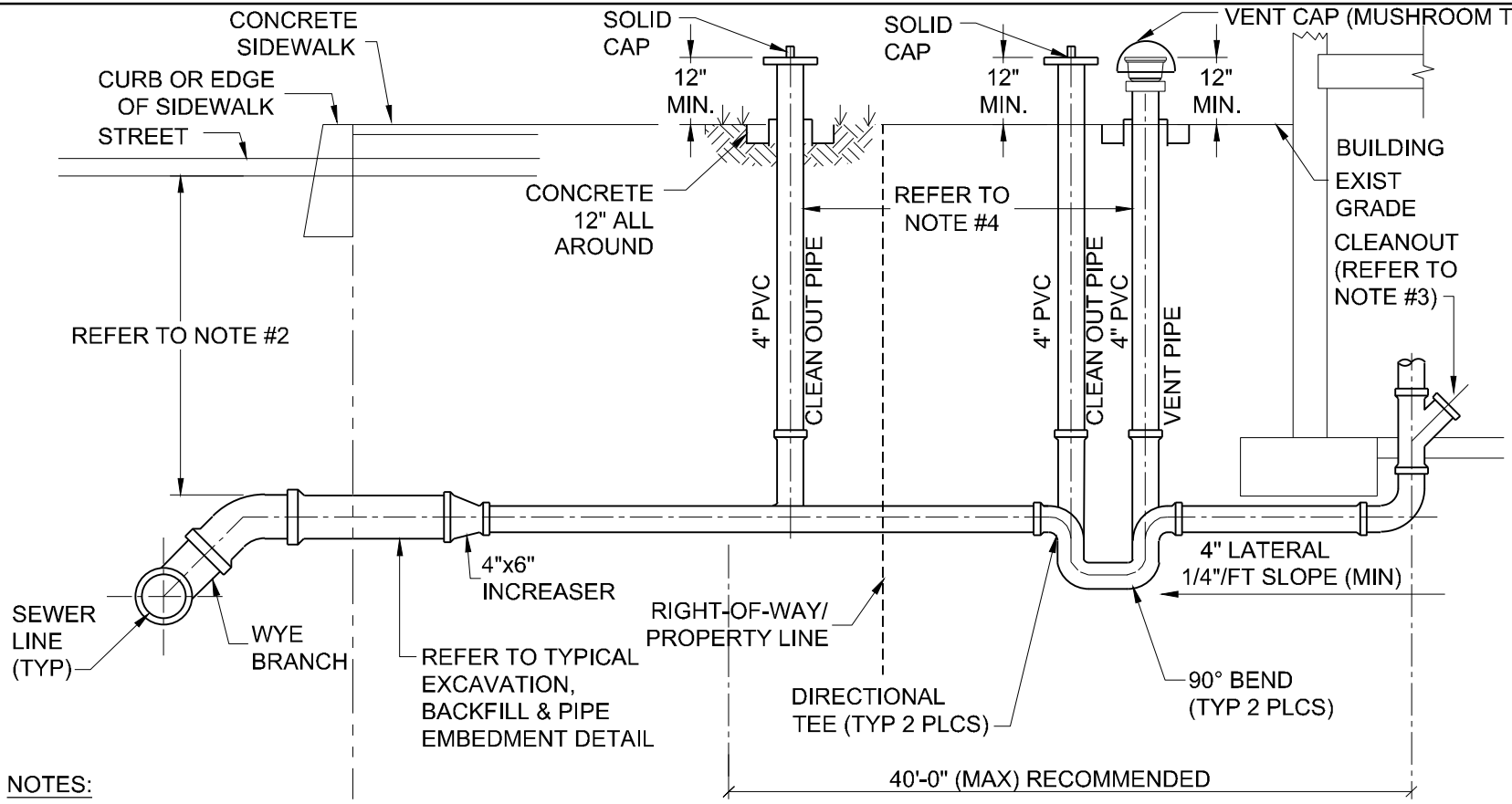
1. Prior to the start-up of any piece of mechanical equipment, the Builder shall have submitted to the Engineer four copies of printed instructions as specified herein.
2. Start-up of all mechanical equipment shall be conducted by the Builder, under the direction of the manufacturer's representative, and in the presence of the Engineer. Unless otherwise allowed by the Engineer, in writing, the manufacturer's representative shall be present during the start-up of the equipment.
3. As part of the start-up, the manufacturer's representative shall instruct the operating personnel of AQUA on the proper operation and maintenance of the equipment. Eight (8) hours and two (2) separate visits shall be included in the bid price.
4. The manufacturer's representative shall issue a written start-up report to the Engineer, the Builder, and the manufacturer containing the following information:

    a. A list of each piece of mechanical equipment which was started up.
    b. The manufacturer of the equipment.
    c. The date of the start-up.
    d. A list of persons present during the start-up.
    e. A list of persons present during the operation and maintenance instructions given by the manufacturer's representative.
    f. Any problems noted during the start-up.
    g. Any recommendations which would improve the operation.
    h. A statement that the equipment is or is not operating properly and why.
    i. The name of the person directing the start-up and the company the person represents.

D. The Builder shall be responsible for coordinating and making the necessary arrangements to schedule the start-up of the equipment. The Builder shall include all costs relating to equipment start-up in the bid price for the installation of the equipment.

END OF SECTION 11100

DETAIL DRAWINGS



NOTES:

1. 4" SINGLE RUNNING TRAP WILL BE INSTALLED WITHIN ONE PIPE LENGTH OF THE END OF THE 6" LATERAL.
2. MINIMUM DEPTH OF 4" LATERAL WILL BE 48" BELOW FINISHED GRADE UNLESS APPROVED BY ENGINEER.
3. IF THERE IS NOT A CLEANOUT LOCATED INSIDE OF DWELLING AN ADDITIONAL CLEANOUT SHALL BE INSTALLED IMMEDIATELY OUTSIDE OF THE BUILDING PRIOR TO RUNNING TRAP
4. LOCATE VENT CAP AND CLEANOUT IN LAWN AREA. MUSHROOM CAP SHALL BE USED ON VENT.
5. IN GENERAL, SANITARY SEWERS SHOULD BE LOCATED AT LEAST 100 FEET FROM PUBLIC WATER SUPPLY SOURCES AND 50 FEET FROM PRIVATE WATER SUPPLY SOURCES, UNLESS THE SANITARY LINES ARE ENCASED IN CONCRETE OR APPROVED EQUIVALENT.
6. REFER TO DRAWING S- 3 FOR LATERAL NOTES.

TYPICAL BUILDING SEWER

SCALE: NONE

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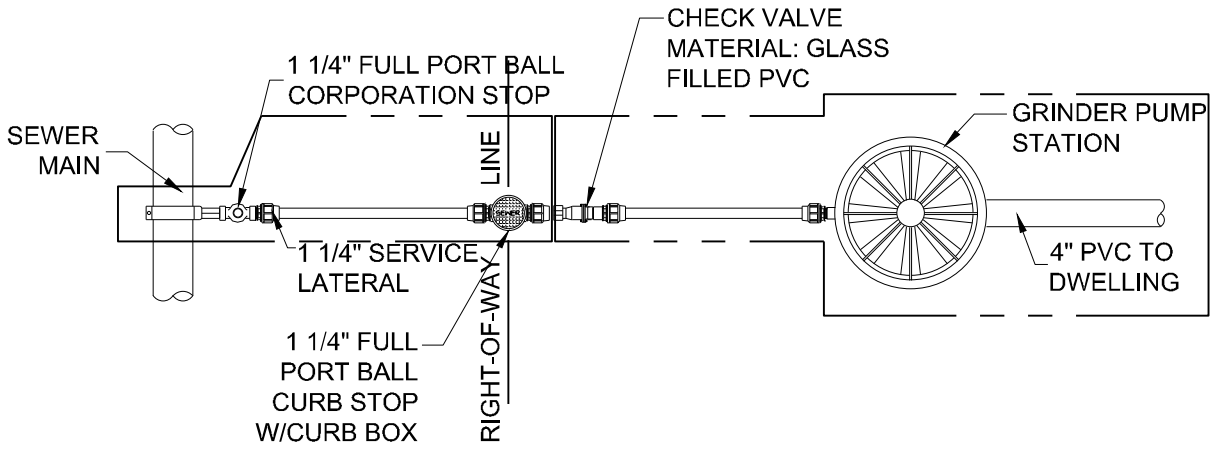
PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.
MAH	BAK	EJP	4111.89

DATE: 07/20/16

SCALE: NONE

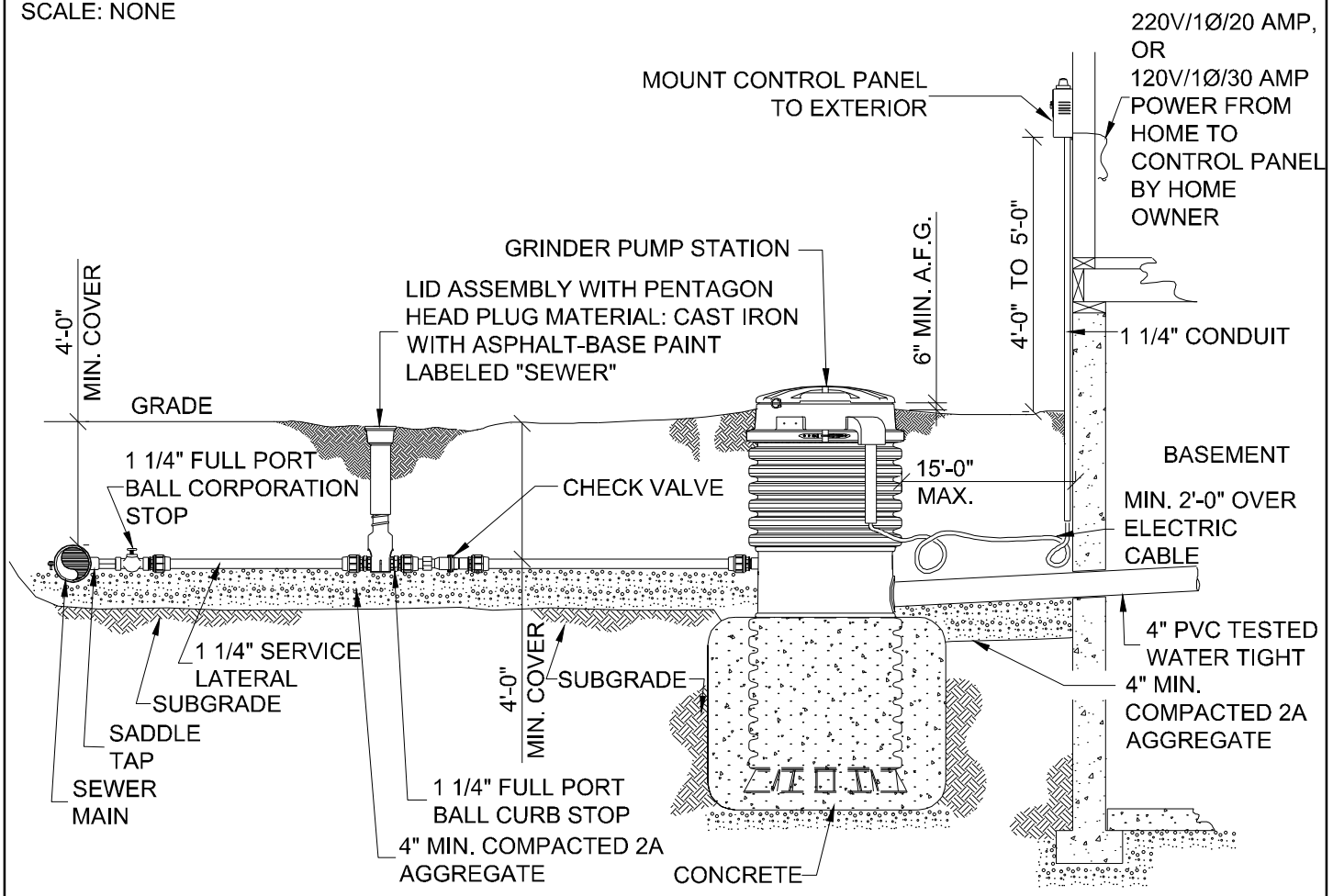
DRAWING NO. S-1

TYPICAL BUILDING SEWER



TYPICAL GRINDER PUMP LATERAL INSTALLATION - PLAN

SCALE: NONE



TYPICAL GRINDER PUMP INSTALLATION - ELEVATION

SCALE: NONE

NOTES: 1. REFER TO DRAWING S-3 FOR LATERAL NOTES.

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TYPICAL GRINDER PUMP INSTALLATION

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MAH	BAK	EJP	4111.89	07/20/16	NONE	S-2

LATERAL NOTES:

1. ALL MATERIAL USED FOR LATERAL INSTALLATIONS SHALL BE NEW, FREE FROM DEFECTS AND CONFORM TO ALL STANDARDS SET FORTH BY A.P.I.

2. ALL LATERALS MUST BE INSPECTED BEFORE BACKFILLING. COMPLETED DRAWINGS SHOWING THE EXACT LOCATION AND DEPTH OF LINE SHALL BE SUBMITTED TO A.P.I. DURING FINAL INSPECTION OR THE LATERAL WILL NOT BE AUTHORIZED TO USE.

3. ALL FEES MUST BE PAID IN PROPER AMOUNT BEFORE A CONNECTION PERMIT WILL BE ISSUED.

MATERIAL ALLOWED BY A.P.I. FOR BUILDING GRAVITY SEWERS

1. PVC BELL AND SPIGOT SEWER PIPE / SDR 35.

2. 4" @ 1/4" / FT. MIN. GRADE
   6" @ 1/8" / FT. MIN. GRADE

LOW PRESSURE:
1. HDPE OR PVC
2. MINIMUM DIAMETER: 1 1/4 INCH

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LATERAL NOTES

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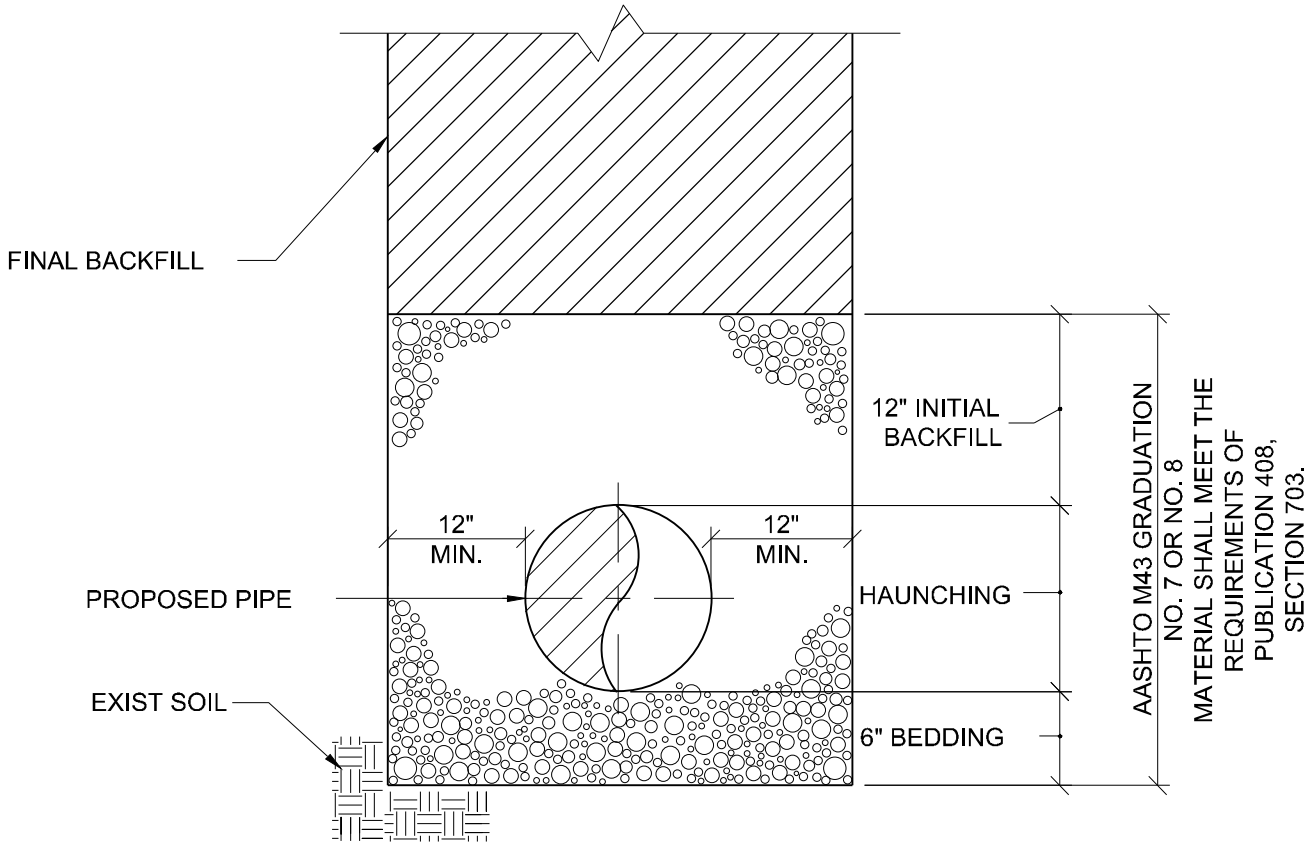
MAH	BAK	EJP	4111.89

DATE: 07/20/16

SCALE: NONE

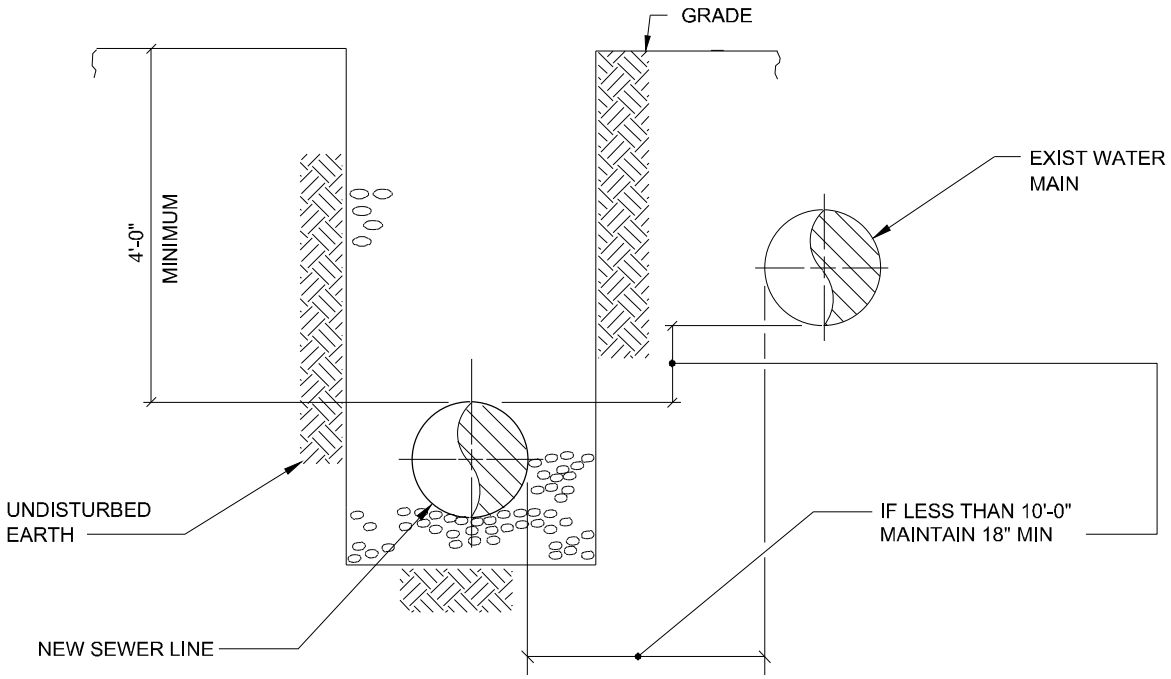
DRAWING NO. S-3



TYPICAL EXCAVATION, BACKFILL & PIPE EMBEDMENT DETAIL

SCALE: NONE

AQUA PENNSYLVANIA, INC. 762 WEST LANCASTER AVE, BRYN MAWR, PA. 19010				TYPICAL EXCAVATION, BACKFILL & PIPE EMBEDMENT DETAIL	
				DATE: 07/20/16	DRAWING NO. S-4
PREPARED BY: MAH	CHECKED BY: BAK	APPROVED BY: EJP	PROJECT NO.: 4111.89	SCALE: NONE	



NEW SEWER LINE PARALLEL TO EXISTING WATER MAIN DETAIL

SCALE: NONE

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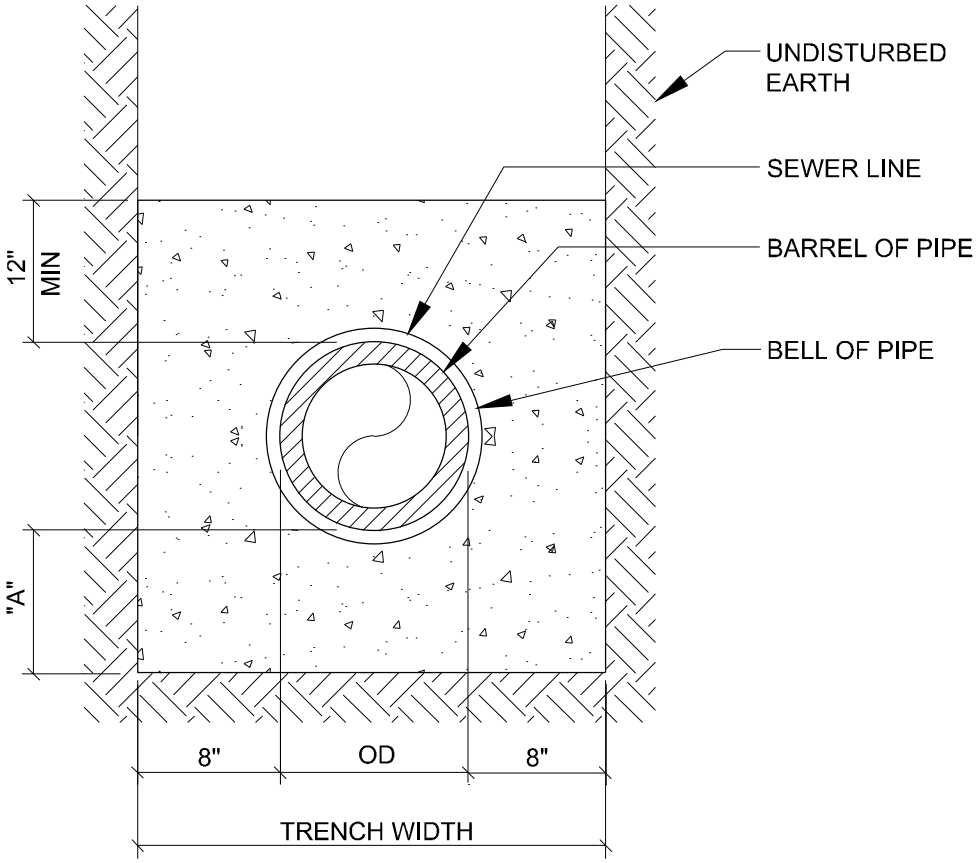
NEW SEWER LINE PARALLEL TO EXISTING WATER MAIN

PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.	DATE:	SCALE:	DRAWING NO.
MAH	BAK	EJP	4111.89	07/20/16	NONE	S-5



PIPE SIZE	"A"
4" - 16"	6"
18" - 48"	6"
54" - 84"	10"

NOTE: ALL CONCRETE SHALL HAVE MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE END OF 28 DAYS.

CONCRETE ENCASEMENT DETAIL

SCALE: NONE

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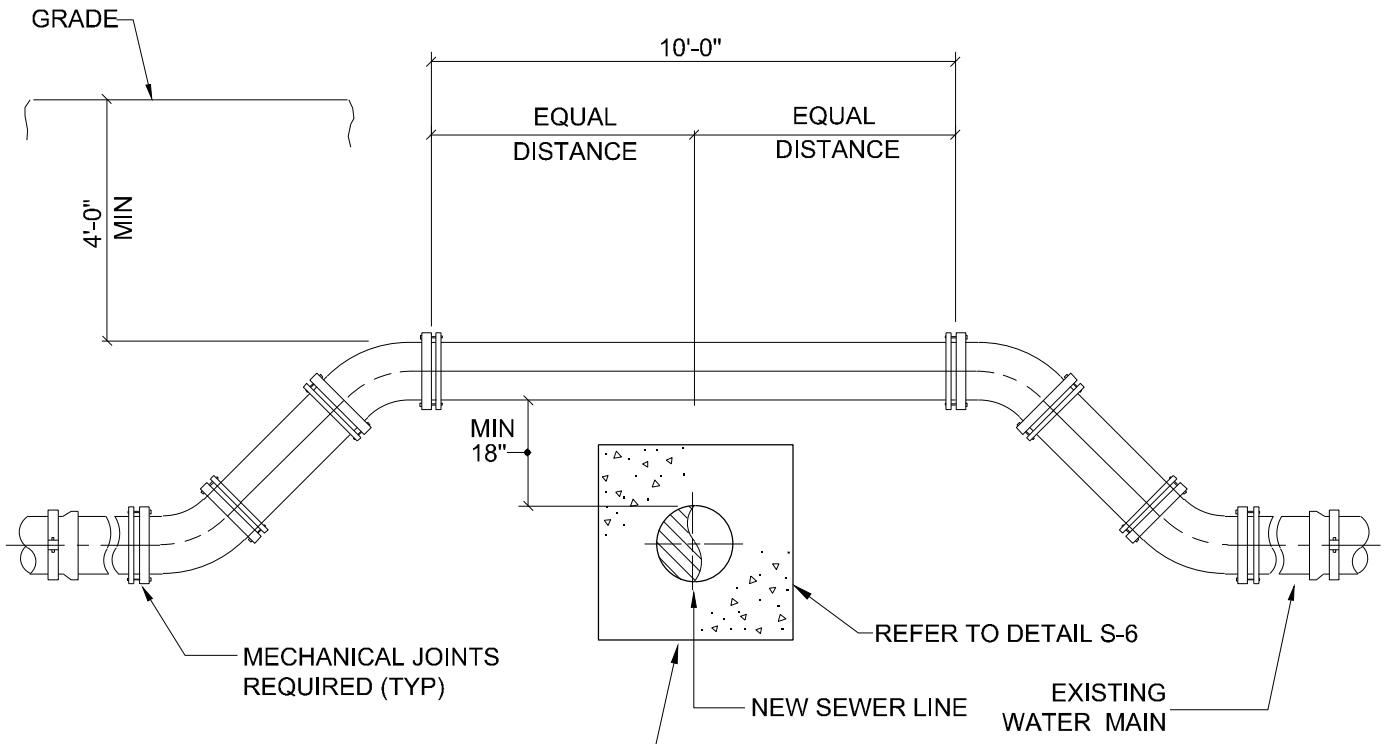
CONCRETE ENCASEMENT DETAIL

PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.	DATE:	DRAWING NO.
MAH	BAK	EJP	4111.89	07/20/16	S-6
				SCALE: NONE	



WHEN VERTICAL SEPARATION IS LESS THAN 18" PROVIDE CONCRETE ENCASEMENT ON UNDISTURBED GROUND. THE LENGTH OF THE ENCASEMENT SHALL BE EXTENDED A MINIMUM OF 10 FEET BEYOND THE CENTERLINE OF THE WATER MAIN IN BOTH DIRECTIONS.

NOTE: ALL CONCRETE SHALL HAVE MINIMUM COMPRESSIVE STRENGTH OF 3000 PSI AT THE END OF 28 DAYS.

NEW SEWER LINE CROSSING UNDER EXISTING WATER MAIN DETAIL

SCALE: NONE

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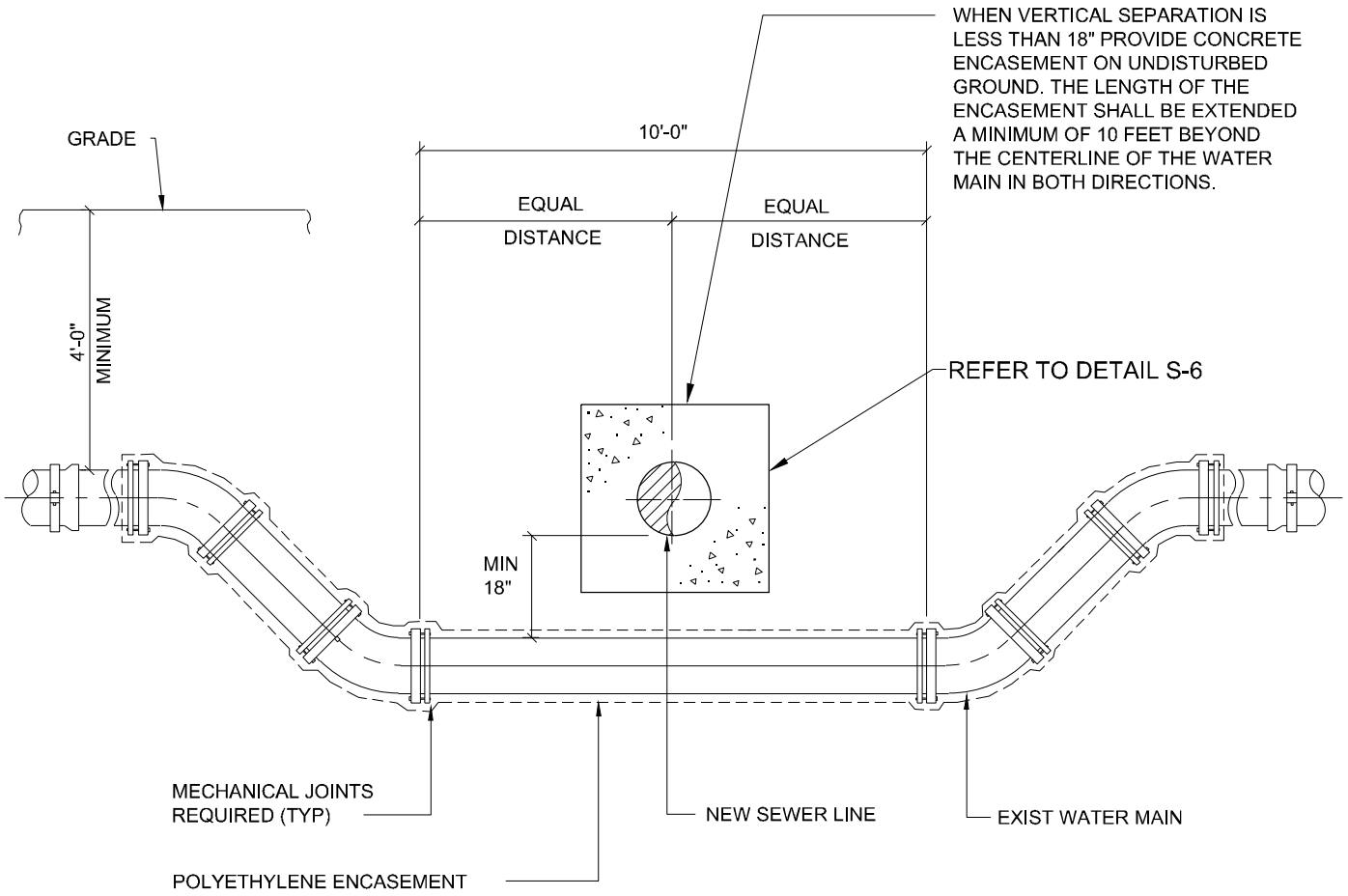
SEWER CROSSING UNDER EXISTING WATER MAIN DETAIL

PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.	DATE:	SCALE:	DRAWING NO.
MAH	BAK	EJP	4111.89	07/20/16	NONE	S-7



NOTE: ALL CONCRETE SHALL HAVE MINIMUM COMPRESSIVE STRENGTH OF 3000 PSI AT THE END OF 28 DAYS.

NEW SEWER LINE CROSSING OVER EXISTING WATER MAIN DETAIL

SCALE: NONE

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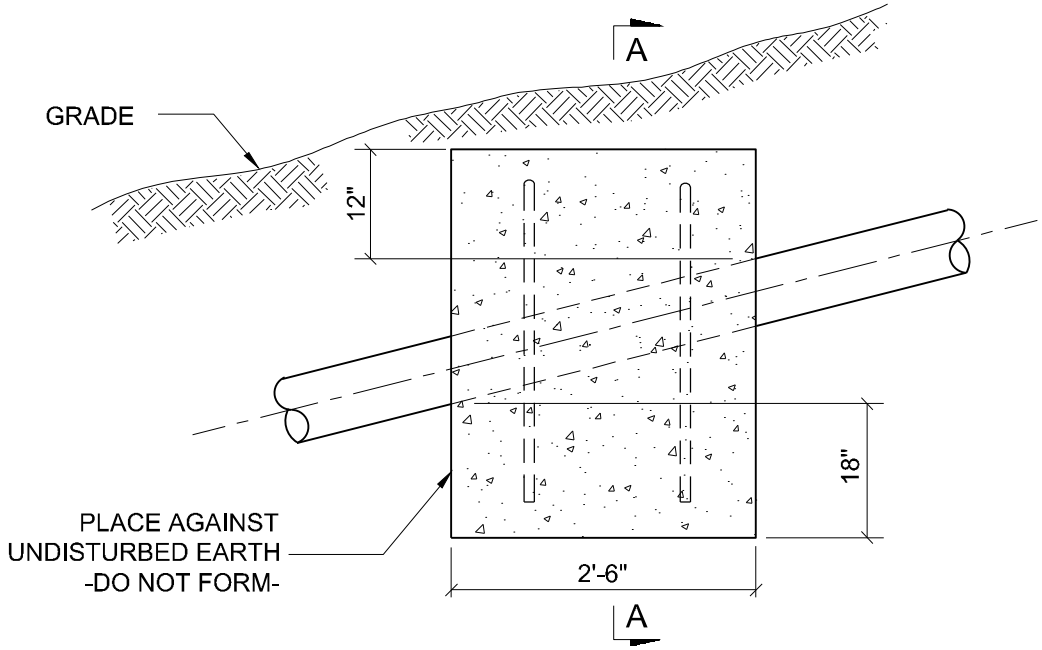
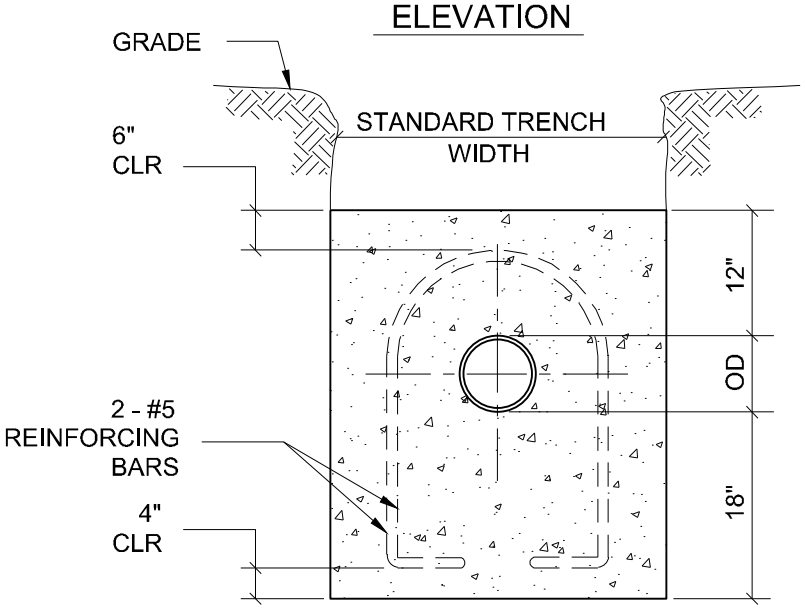
NEW SEWER CROSSING OVER EXISTING WATER MAIN

PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.	DATE:	DRAWING NO.
MAH	BAK	EJP	4111.89	07/20/16	S-8
				SCALE: NONE	



ELEVATION



SECTION A-A

CONCRETE ANCHOR NOTES:

1. ANCHORS ARE NOT REQUIRED ON SLOPES LESS THAN 20% UNLESS NOTED ON DRAWINGS.
2. PROVIDE ANCHORS ON 36' CENTERS FOR SLOPES BETWEEN 20% TO 34%.
3. PROVIDE ANCHORS ON 24' CENTERS FOR SLOPES BETWEEN 35% TO 50%.
4. PROVIDE ANCHORS ON 16' CENTERS FOR SLOPES BETWEEN 51% TO 70%.
5. ALL CONCRETE SHALL HAVE MINIMUM COMPRESSIVE STRENGTH OF 3000 PSI AT THE END OF 28 DAYS.

CONCRETE ANCHORS - SLOPE BREAKERS

SCALE: NONE

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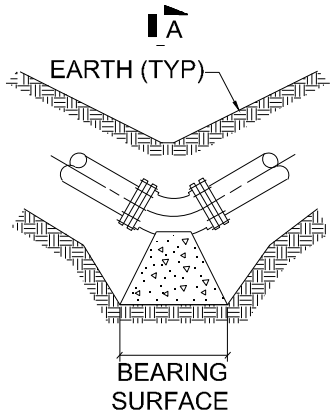
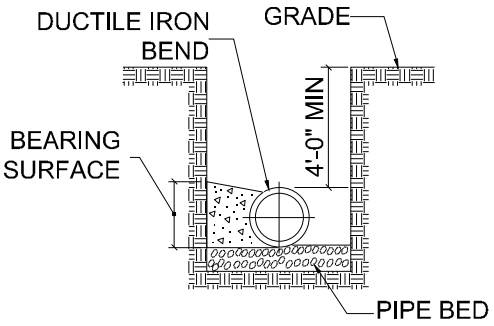
CONCRETE ANCHORS - SLOPE BREAKERS

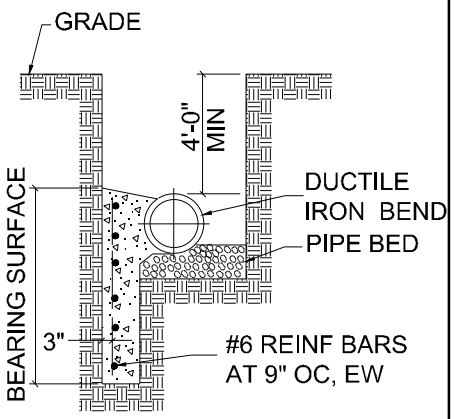
PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.	DATE:	SCALE:	DRAWING NO.
MAH	BAK	EJP	4111.89	07/20/16	NONE	S-9



PLAN

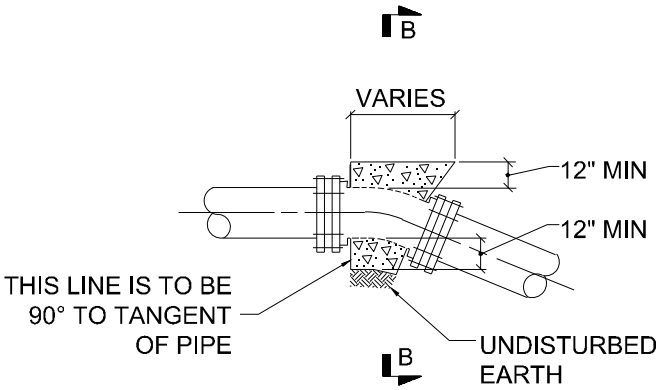


SECTION A-A

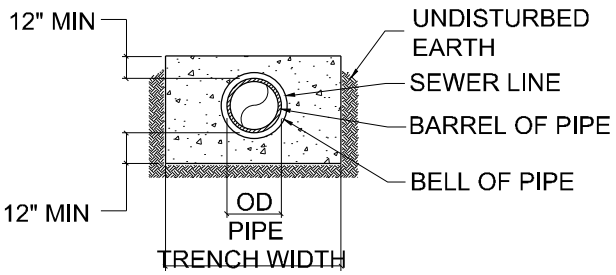


ALTERNATE SECTION A-A

THRUST BLOCKING FOR HORIZONTAL BENDS



ELEVATION



SECTION B-B

THRUST BLOCKING FOR VERTICAL BENDS

NOTES:
1. ALL CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 3000 PSI AT THE END OF 28 DAYS.
2. ALL REINFORCING STEEL SHALL BE DEFORMED BARS.
3. NO COUPLING OR JOINTS SHALL BE COVERED WITH CONCRETE.
4. INSTALL CONCRETE THRUST BLOCKS AT EACH ELBOW, TEE AND CAPPED END FITTINGS LOCATED IN THE HORIZONTAL PLANE.
5. HARNESS PIPE IF ORDERED BY ENGINEER.
6. SIZE OF THRUST BLOCKS TO BE DETERMINED INDIVIDUALLY AT THE TIME OF CONSTRUCTION BY ENGINEER.

THRUST BLOCKING DETAILS

SCALE: NONE

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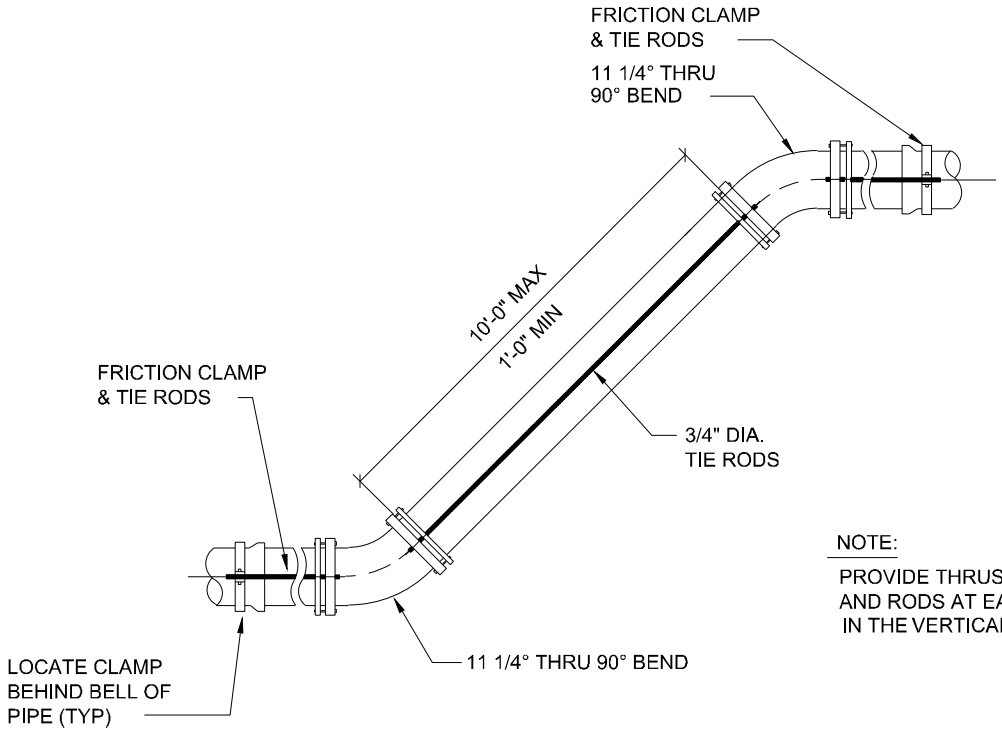
THRUST BLOCKING DETAILS

PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.	DATE:	SCALE:	DRAWING NO.
MAH	BAK	EJP	4111.89	07/20/16	NONE	S-10



NOTE:

PROVIDE THRUST CLAMPS WITH LUGS AND RODS AT EACH ELBOW LOCATED IN THE VERTICAL PLANE.

THRUST CLAMPING DETAIL

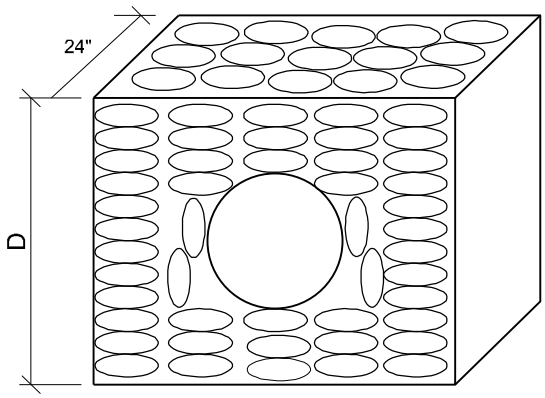
SCALE: NONE

AQUA PENNSYLVANIA, INC. AQUA 762 WEST LANCASTER AVE, BRYN MAWR, PA. 19010				THRUST CLAMPING DETAIL	
				DATE: 07/20/16	DRAWING NO. S-11
PREPARED BY: MAH	CHECKED BY: BAK	APPROVED BY: EJP	PROJECT NO.: 4111.89	SCALE: NONE	

REQUIRED SPACING AND MATERIALS FOR TRENCH PLUGS		
TRENCH SLOPE (%)	SPACING (FT)	PLUG MATERIAL
< 5	*	*
5-15	500	** EARTH FILLED SACKS
15-25	300	** EARTH FILLED SACKS
25-35	200	** EARTH FILLED SACKS
35-100	100	** EARTH FILLED SACKS
> 100	50	CEMENT FILLED BAGS (WETTED) OR MORTARED STONE

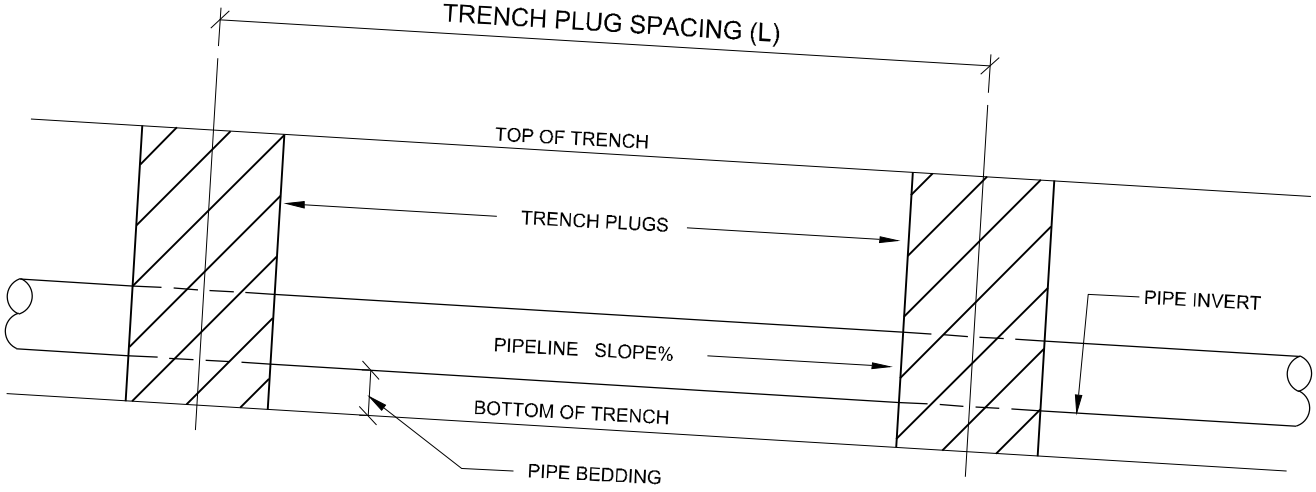
* TRENCH PLUGS ARE REQUIRED AT ALL STREAM, RIVER, OR WATER-BODY CROSSINGS REGARDLESS OF TRENCH SLOPE. OTHERWISE NOT REQUIRED.

** TOPSOIL MAY NOT BE USED TO FILL SACKS.



D = DEPTH TO BOTTOM OF TRENCH

SECTION VIEW



ELEVATION

TRENCH PLUG DETAIL

SCALE: NONE

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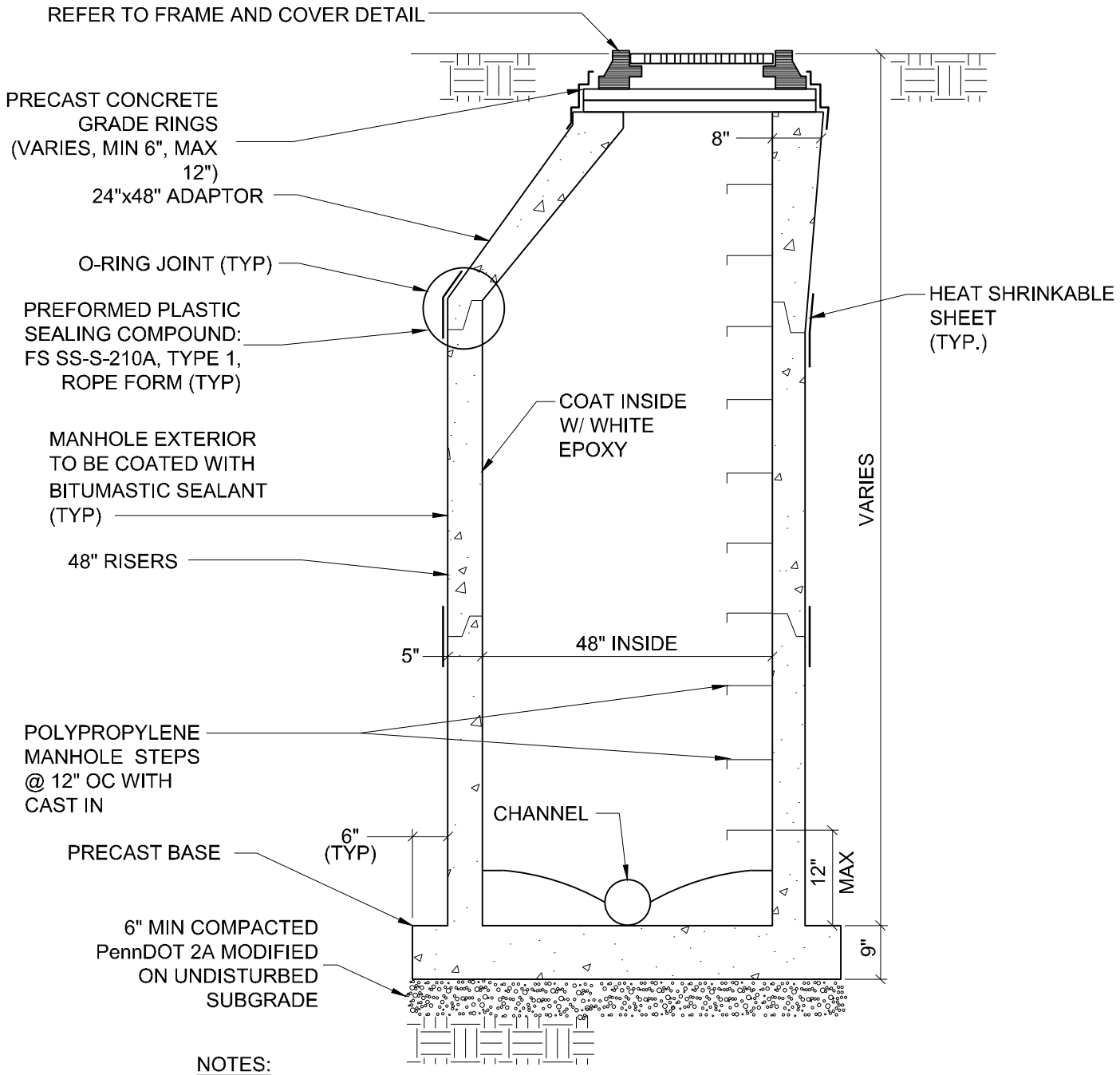
PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.
MAH	BAK	EJP	4111.89

TRENCH PLUG DETAIL

DATE: 07/20/16

SCALE: NONE

DRAWING NO. **S-12**



NOTES:

1. ALL PIPE TO MANHOLE CONNECTIONS SHALL BE MADE WITH A CAST-IN-PLACE GASKET. (TYP) (A-LOK OR APPROVED EQUAL)
2. MANHOLES EXCEEDING A DEPTH OF 16 FEET SHALL PROVIDE PRE-CAST LANDING PLATFORM.

TYPICAL MANHOLE DETAIL

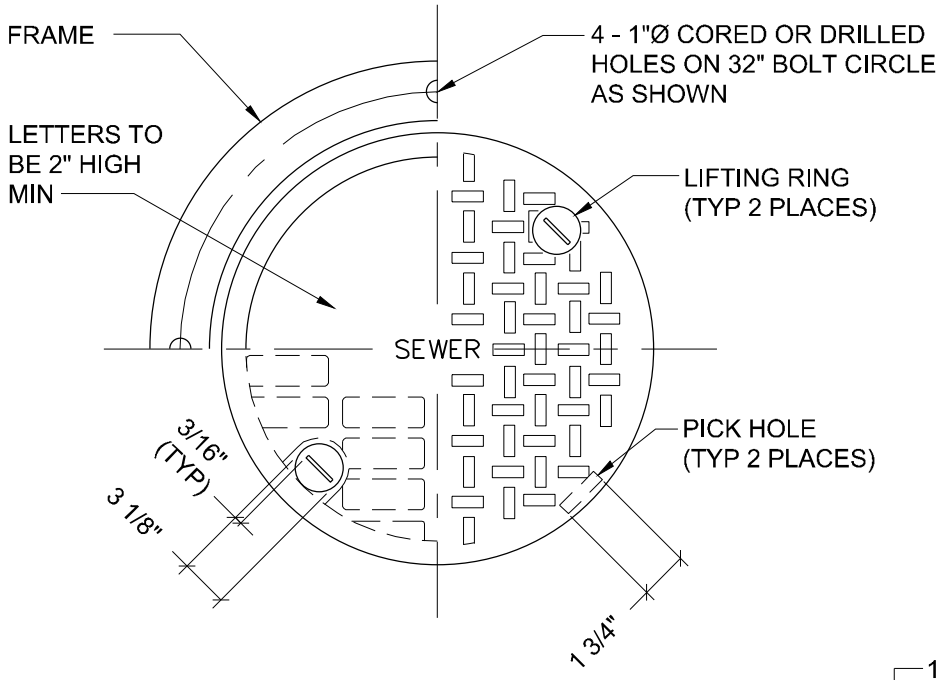
SCALE: NONE

AQUA PENNSYLVANIA, INC.

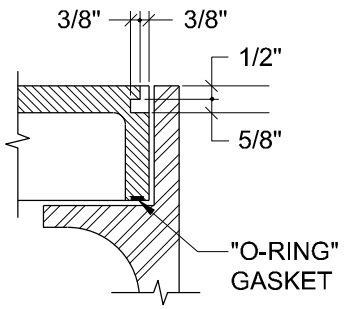
762 WEST LANCASTER AVE,
BRYN MAWR, PA. 19010

TYPICAL MANHOLE DETAIL

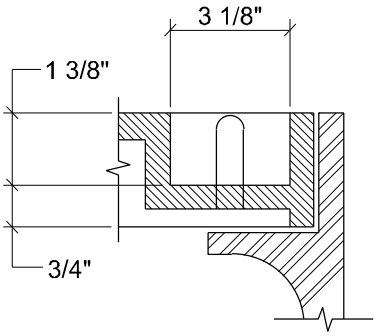
PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.	DATE:	SCALE:	DRAWING NO.
MAH	BAK	EJP	4111.89	07/20/16	NONE	S-13

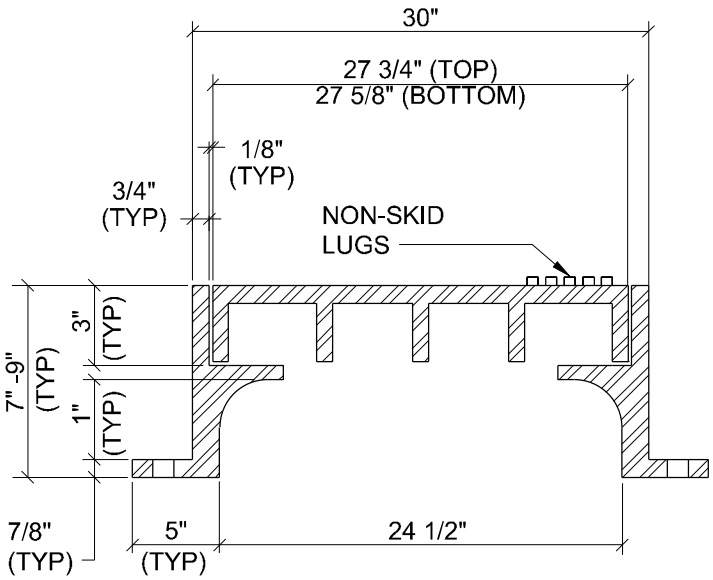


PLAN



PICK HOLE DETAIL





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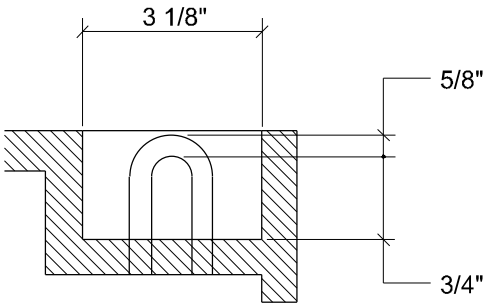


LIFT RING DETAILS

NOTE: APPROXIMATE WEIGHT 500#

CAST IRON REGULAR MANHOLE FRAME & COVER

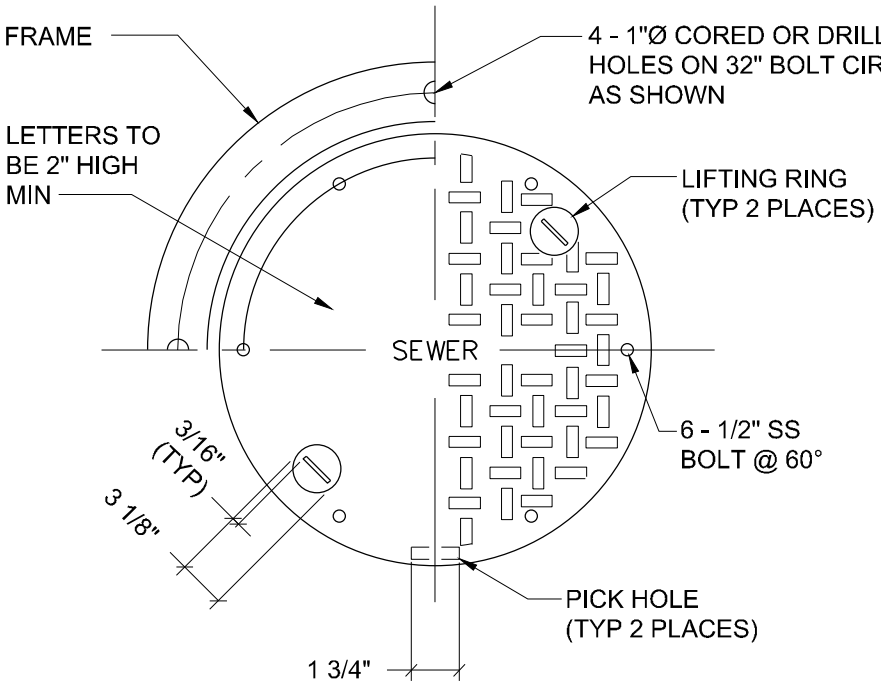
SCALE: NONE

AQUA PENNSYLVANIA, INC.

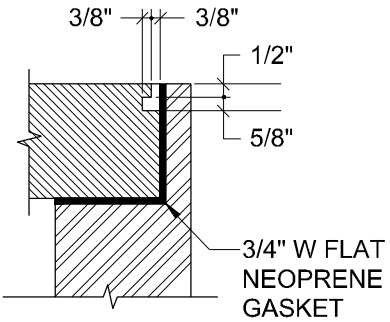
762 WEST LANCASTER AVE,
BRYN MAWR, PA. 19010

CAST IRON MANHOLE & COVER

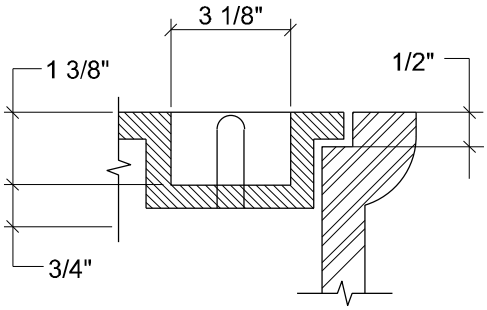
PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.	DATE:	SCALE:	DRAWING NO.
MAH	BAK	EJP	4111.89	07/20/16	NONE	S-14

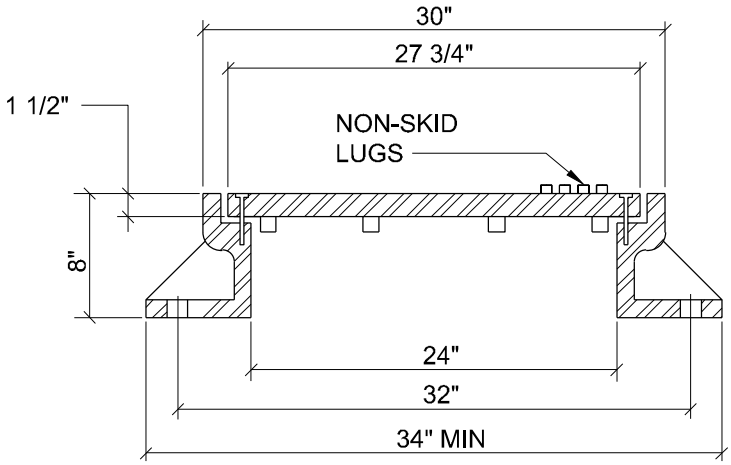


PLAN



PICK HOLE DETAIL





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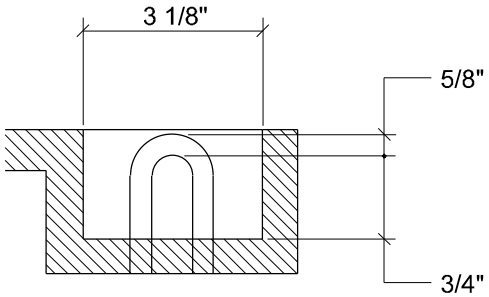


LIFT RING DETAILS

NOTES: CASTING TO BE SUPPLIED WITH BOLTED COVER AND MACHINED BEARING SURFACE.

BRIDGESTATE FOUNDARY CO, HADDONFIELD, NJ (PATTERN NO 1502 - TYPE "A" MODIFIED OR APPROVED EQUAL.

APPROXIMATE WEIGHT 500#

CAST IRON WATERTIGHT MANHOLE FRAME & COVER

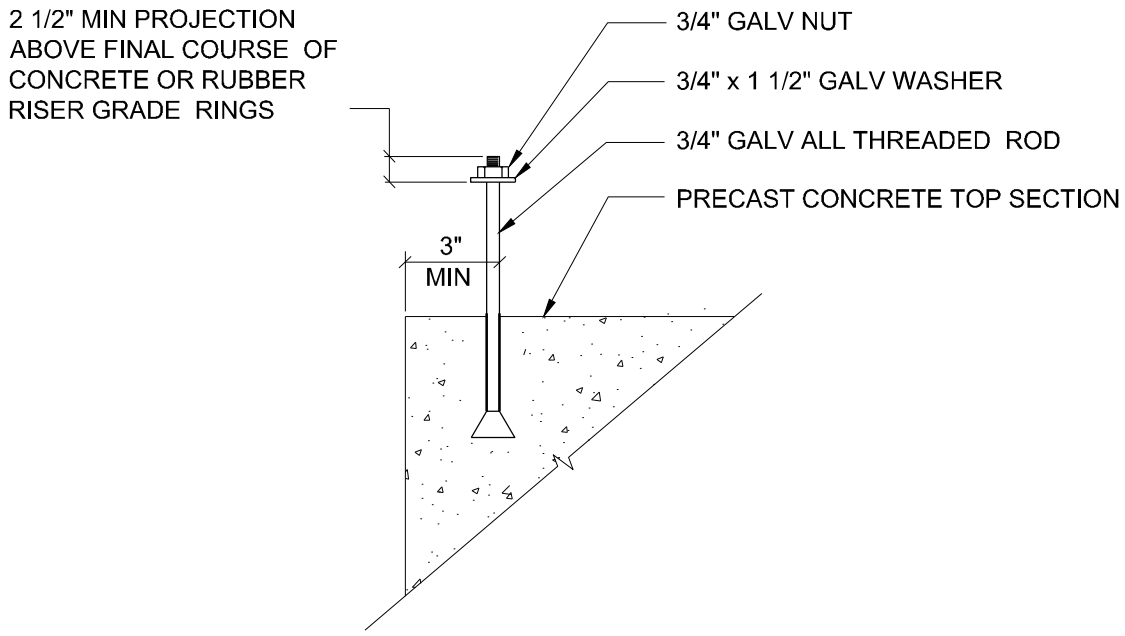
SCALE: NONE

AQUA PENNSYLVANIA, INC.

762 WEST LANCASTER AVE,
BRYN MAWR, PA. 19010

CAST IRON WATERTIGHT MANHOLE FRAME & COVER

PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.	DATE:	SCALE:	DRAWING NO.
MAH	BAK	EJP	4111.89	07/20/16	NONE	S-15



NOTE: FOUR (4) BOLTS REQUIRED PER MANHOLE.

MANHOLE FRAME - ANCHOR BOLT DETAIL

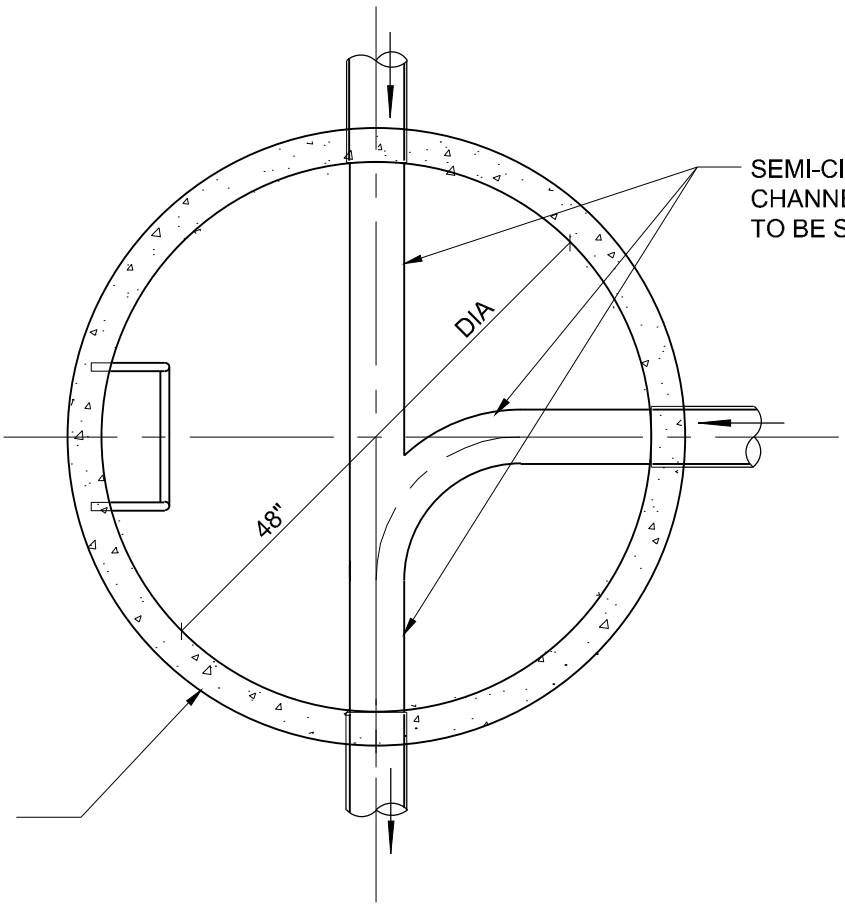
SCALE: NONE

AQUA PENNSYLVANIA, INC.

762 WEST LANCASTER AVE,
BRYN MAWR, PA. 19010

MANHOLE FRAME - ANCHOR BOLT

PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.	DATE:	SCALE:	DRAWING NO.
MAH	BAK	EJP	4111.89	07/20/16	NONE	S-16



NOTE:

1. ALL FLOW CHANNELS SHALL BE PRE-CAST BY MANUFACTURER UNLESS AUTHORIZED BY ENGINEER

MANHOLE BASE
TYPICAL CHANNEL CONFIGURATION

SCALE: NONE

AQUA PENNSYLVANIA, INC.

AQUA

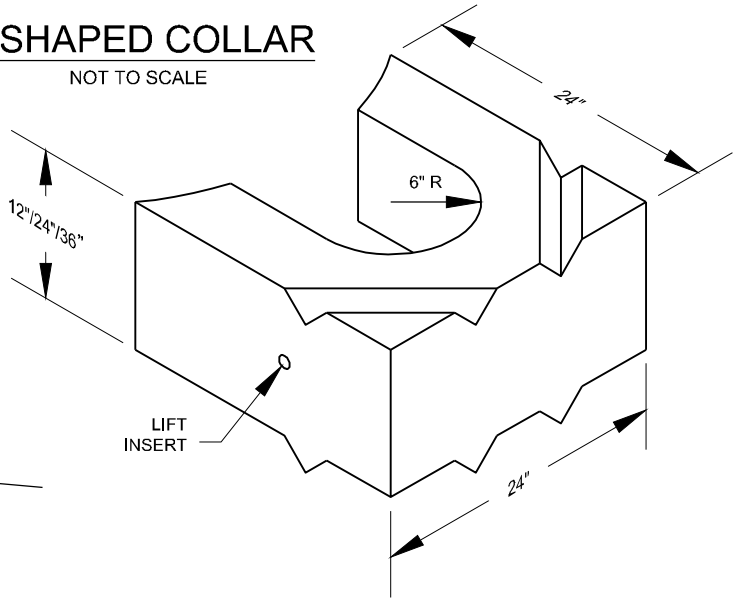
762 WEST LANCASTER AVE,
BRYN MAWR, PA. 19010

MANHOLE BASE TYPICAL CHANNEL CONFIGURATION

PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.	DATE:	SCALE:	DRAWING NO.
MAH	BAK	EJP	4111.89	07/20/16	NONE	S-17

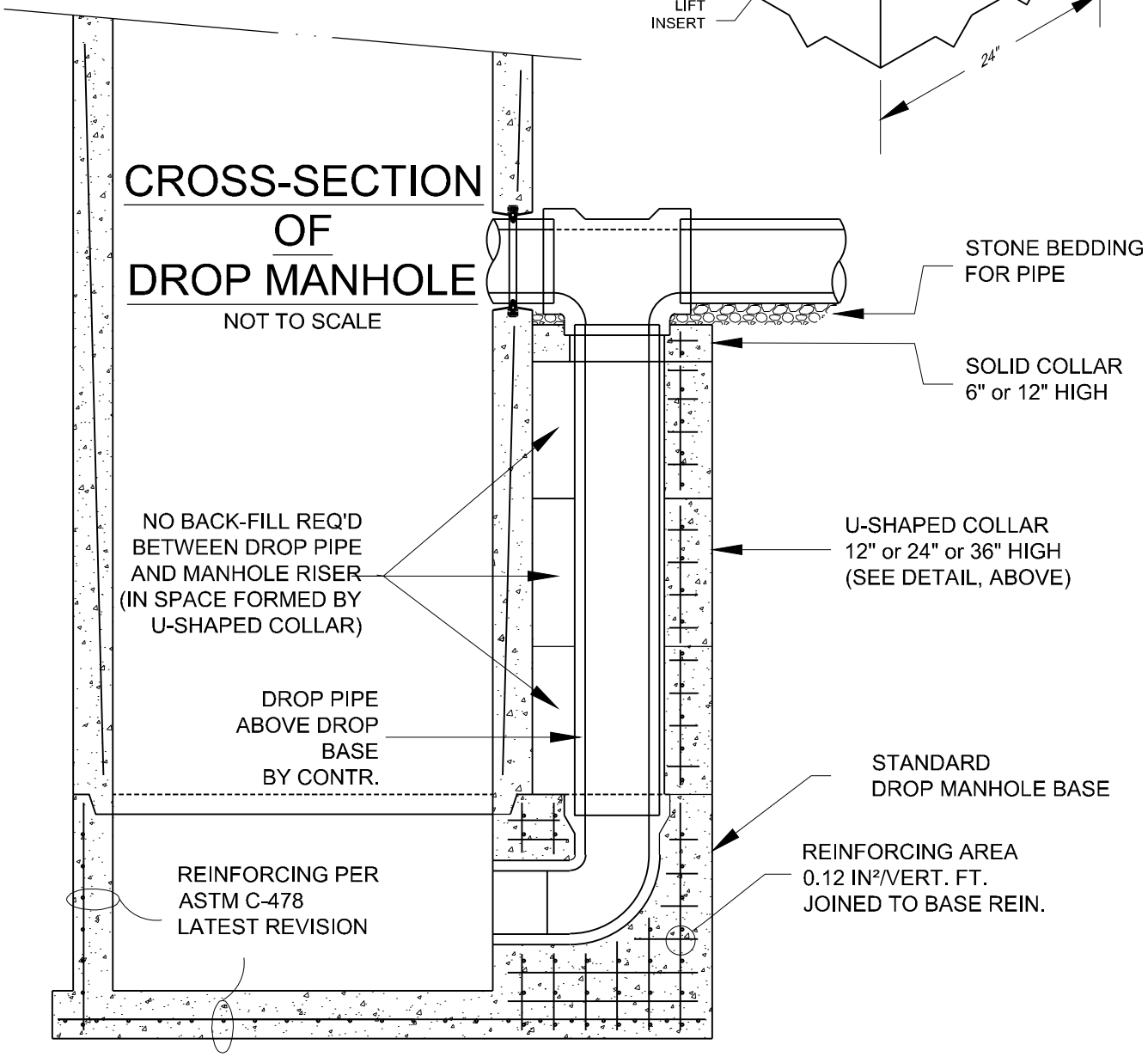
U-SHAPED COLLAR

NOT TO SCALE



CROSS-SECTION OF DROP MANHOLE

NOT TO SCALE



TYPICAL OUTSIDE DROP MANHOLE DETAIL

SCALE: NONE

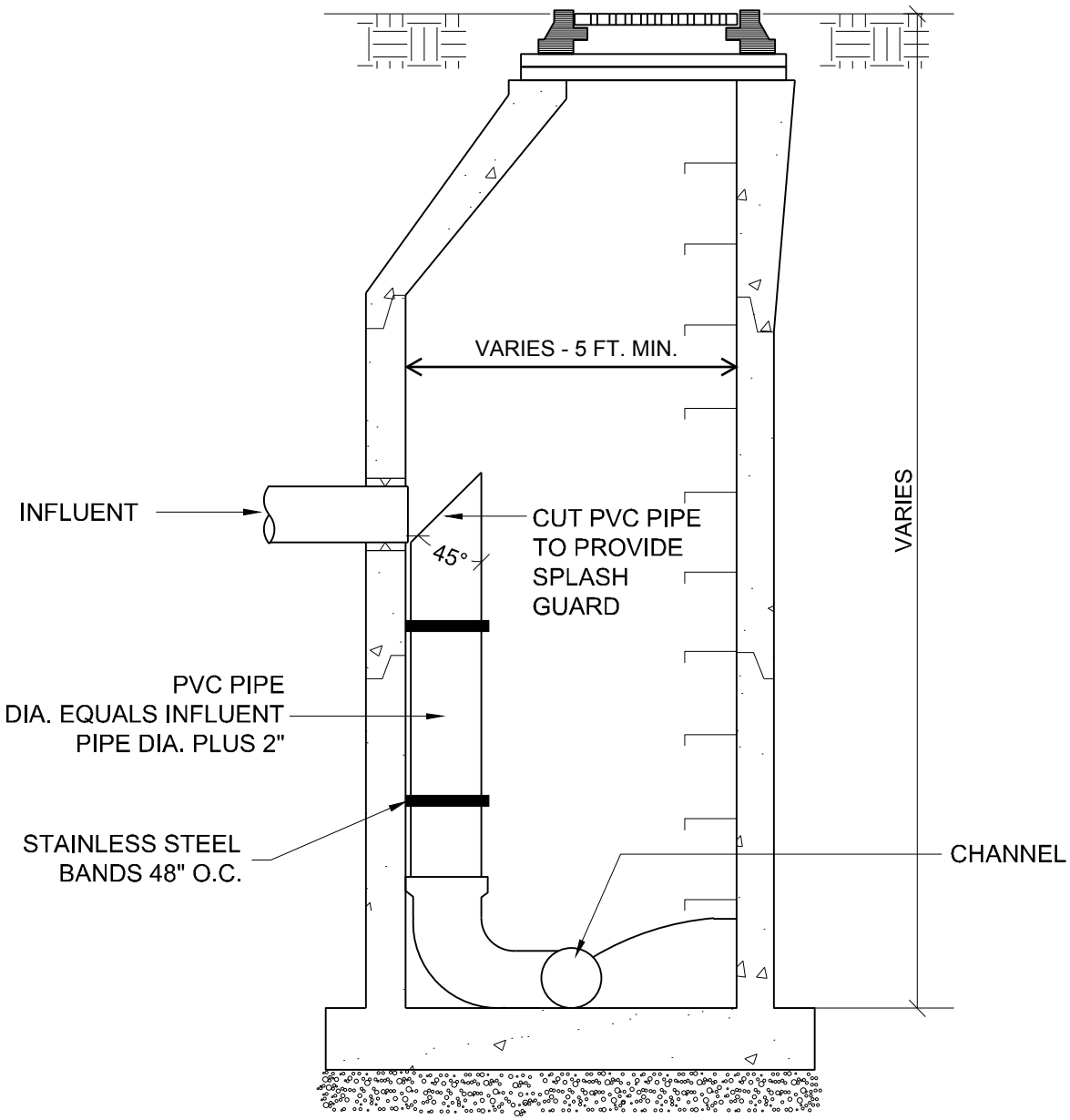
AQUA PENNSYLVANIA, INC.

AQUA

762 WEST LANCASTER AVE,
BRYN MAWR, PA. 19010

TYPICAL OUTSIDE DROP MANHOLE DETAIL

PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.	SCALE:	DATE:	DRAWING NO.
MAH	BAK	EJP	4111.89	NONE	07/20/16	S-18



TYPICAL INSIDE DROP MANHOLE DETAIL

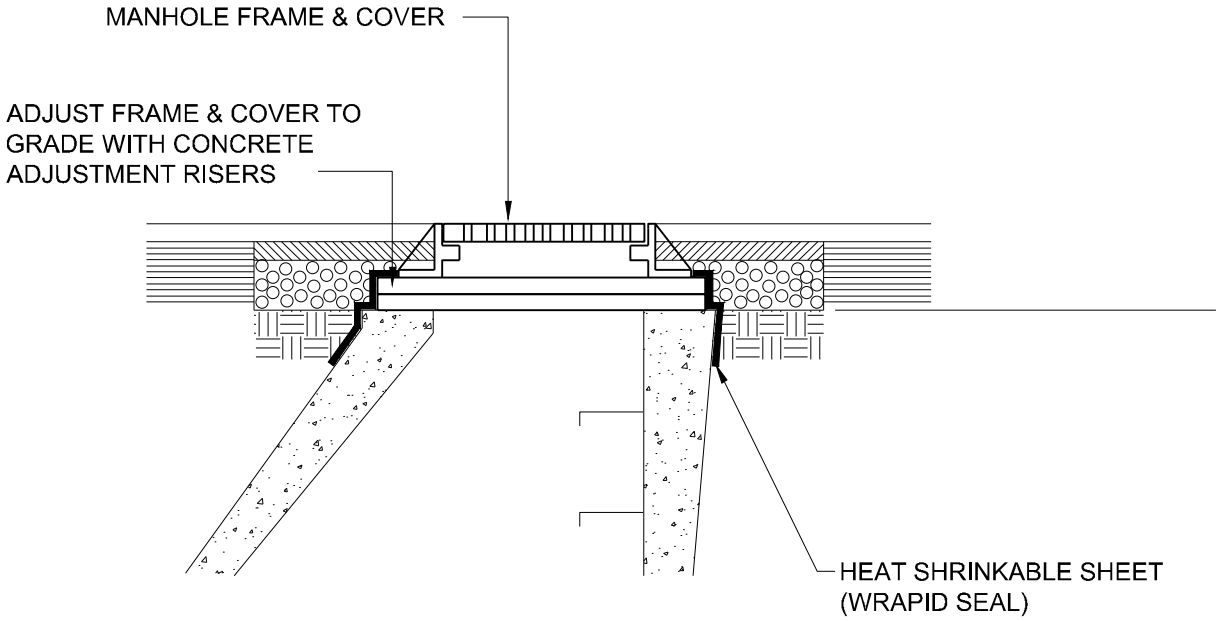
SCALE: NONE

AQUA PENNSYLVANIA, INC.

762 WEST LANCASTER AVE,
BRYN MAWR, PA. 19010

TYPICAL INSIDE DROP MANHOLE DETAIL

PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.	DATE:	SCALE:	DRAWING NO.
MAH	BAK	EJP	4111.89	07/20/16	NONE	S-19



MANHOLE FRAME AND COVER ADJUSTMENT DETAIL

SCALE: NONE

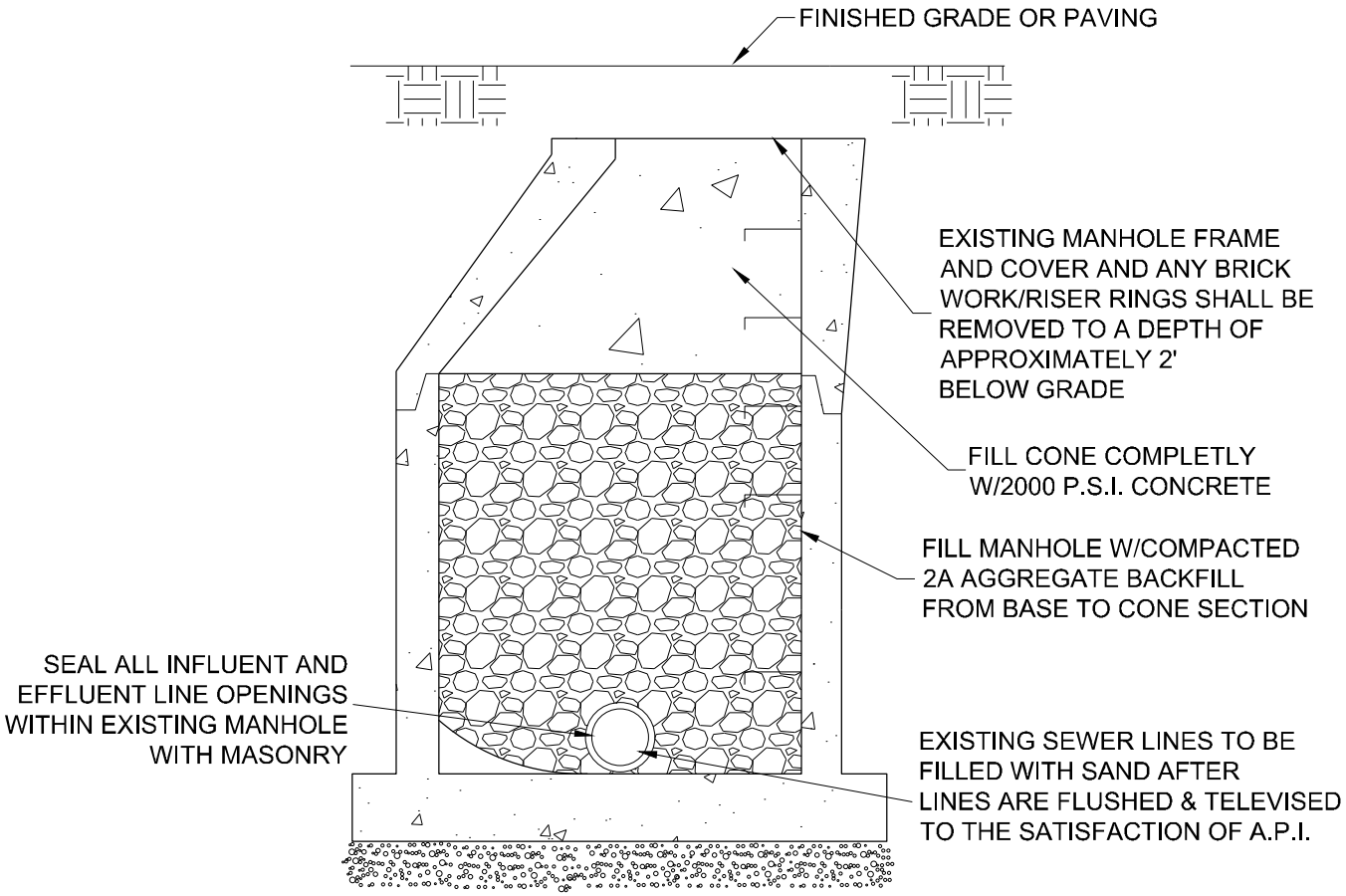
AQUA PENNSYLVANIA, INC.

AQUA

762 WEST LANCASTER AVE,
BRYN MAWR, PA. 19010

MANHOLE FRAME AND COVER ADJUSTMENT DETAIL

PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.	DATE:	SCALE:	DRAWING NO.
MAH	BAK	EJP	4111.89	07/20/16	NONE	S-20



MANHOLE ABANDONMENT DETAIL

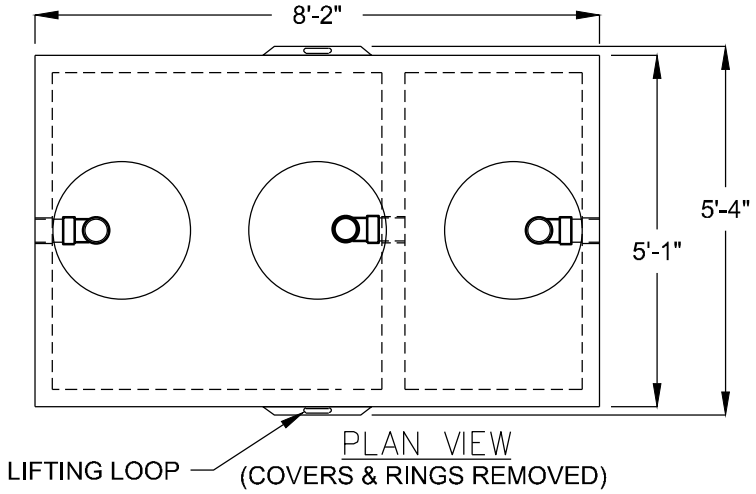
SCALE: NONE

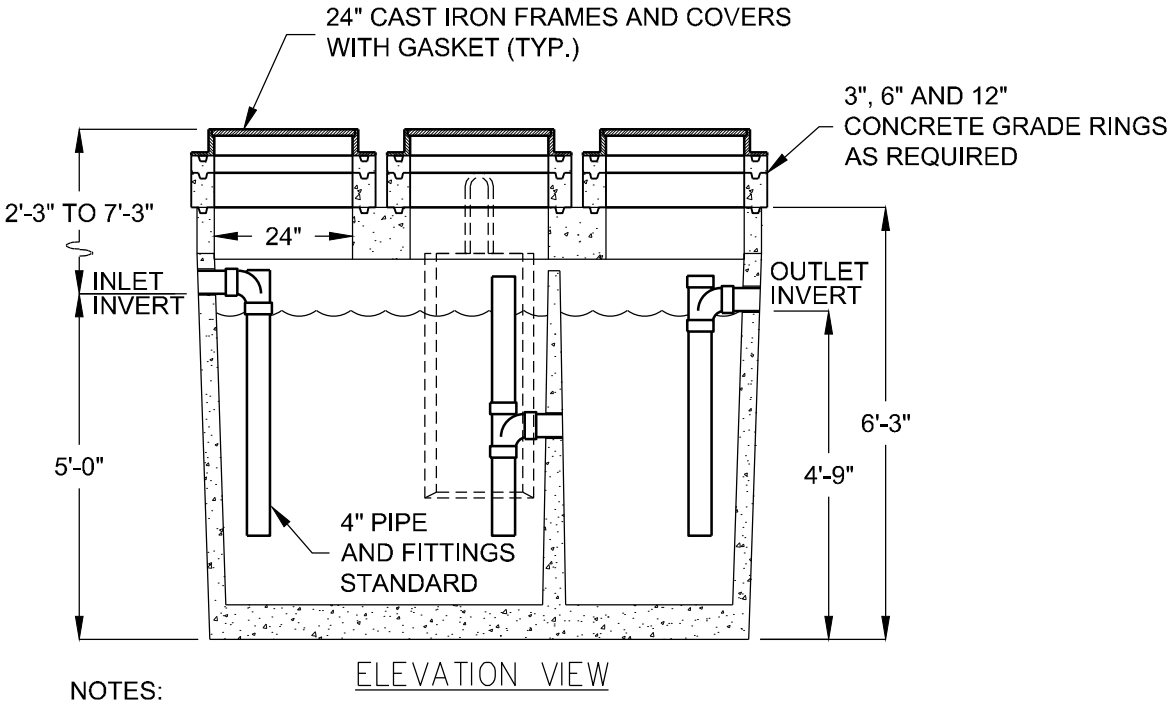
AQUA PENNSYLVANIA, INC.

762 WEST LANCASTER AVE,
BRYN MAWR, PA. 19010

MANHOLE ABANDONMENT DETAIL

PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.	DATE:	SCALE:	DRAWING NO.
MAH	BAK	EJP	4111.89	07/20/16	NONE	S-21





NOTES:

1. DETAIL DEPICTS A 1,000 GALLON OPERATING CAPACITY GREASE INTERCEPTOR. THE ACTUAL TYPE AND CAPACITY MUST BE DETERMINED BY OWNER AND APPROVED BY A.P.I.
2. DESIGN LOAD: H-20 TRAFFIC WITH DRY SOIL CONDITIONS (WATER LEVEL BELOW TANK) AND 1'-6' EARTH COVER.
3. SUITABLE SUB-BASE BEDDED WITH GRANULAR MATERIAL SHALL BE PREPARED TO HANDLE ANTICIPATED LOADS.
4. FOR KITCHEN USE ONLY NOT TO BE USED WITH SEWAGE SYSTEM.
5. INTERCEPTOR TO CONTAIN WATER TIGHT JOINTS.

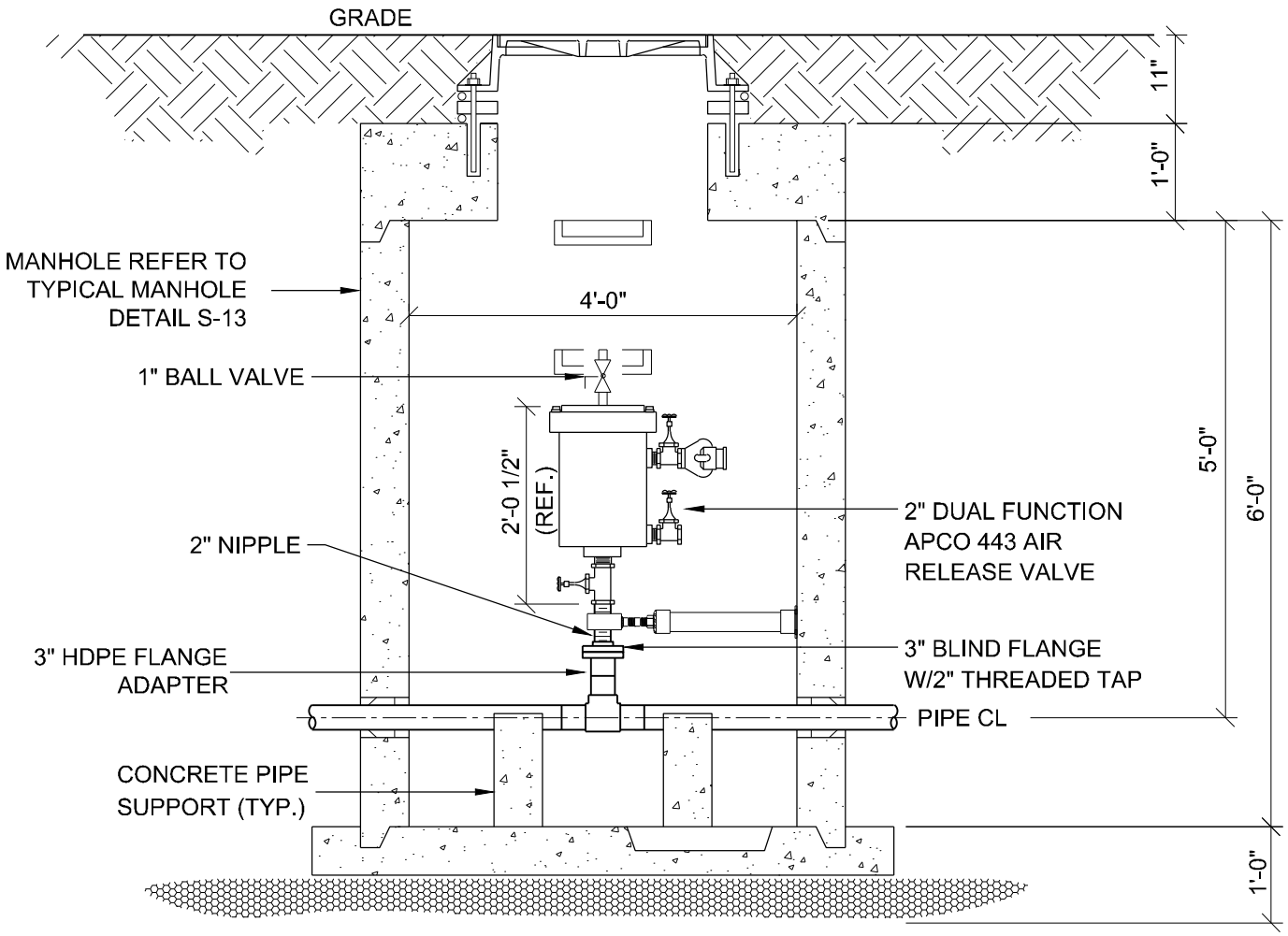
1000 GALLON GREASE INTERCEPTOR

SCALE: NONE

AQUA PENNSYLVANIA, INC.
AQUA
762 WEST LANCASTER AVE,
BRYN MAWR, PA. 19010

1000 GALLON GREASE INTERCEPTOR

PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.	DATE:	DRAWING NO.
MAH	BAK	EJP	4111.89	07/20/16	S-22
				SCALE: NONE	



AIR RELEASE VALVE MANHOLE

SCALE: NONE

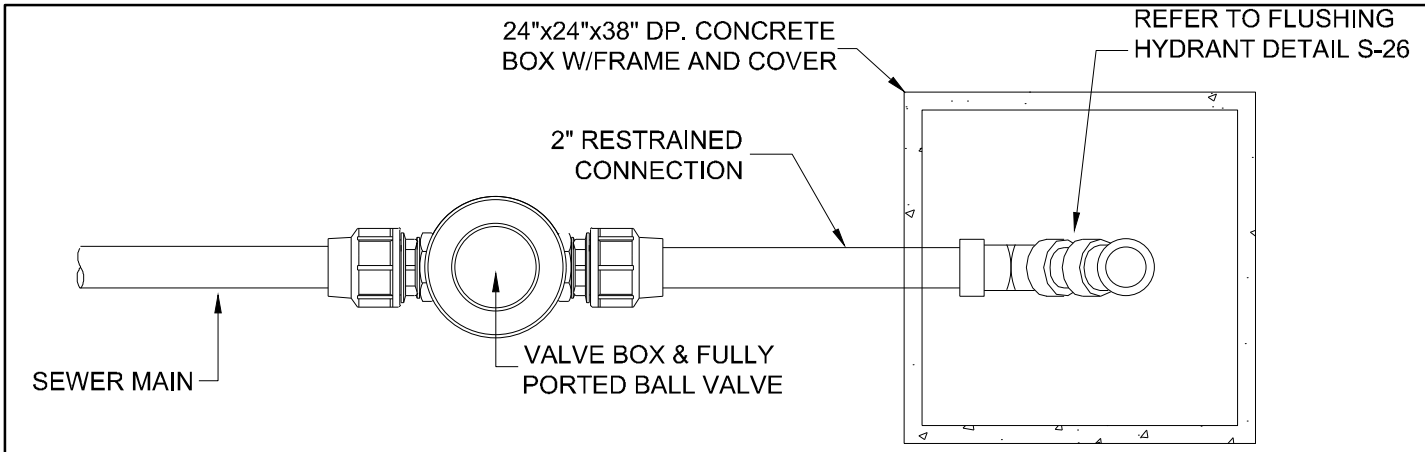
AQUA PENNSYLVANIA, INC.

AQUA

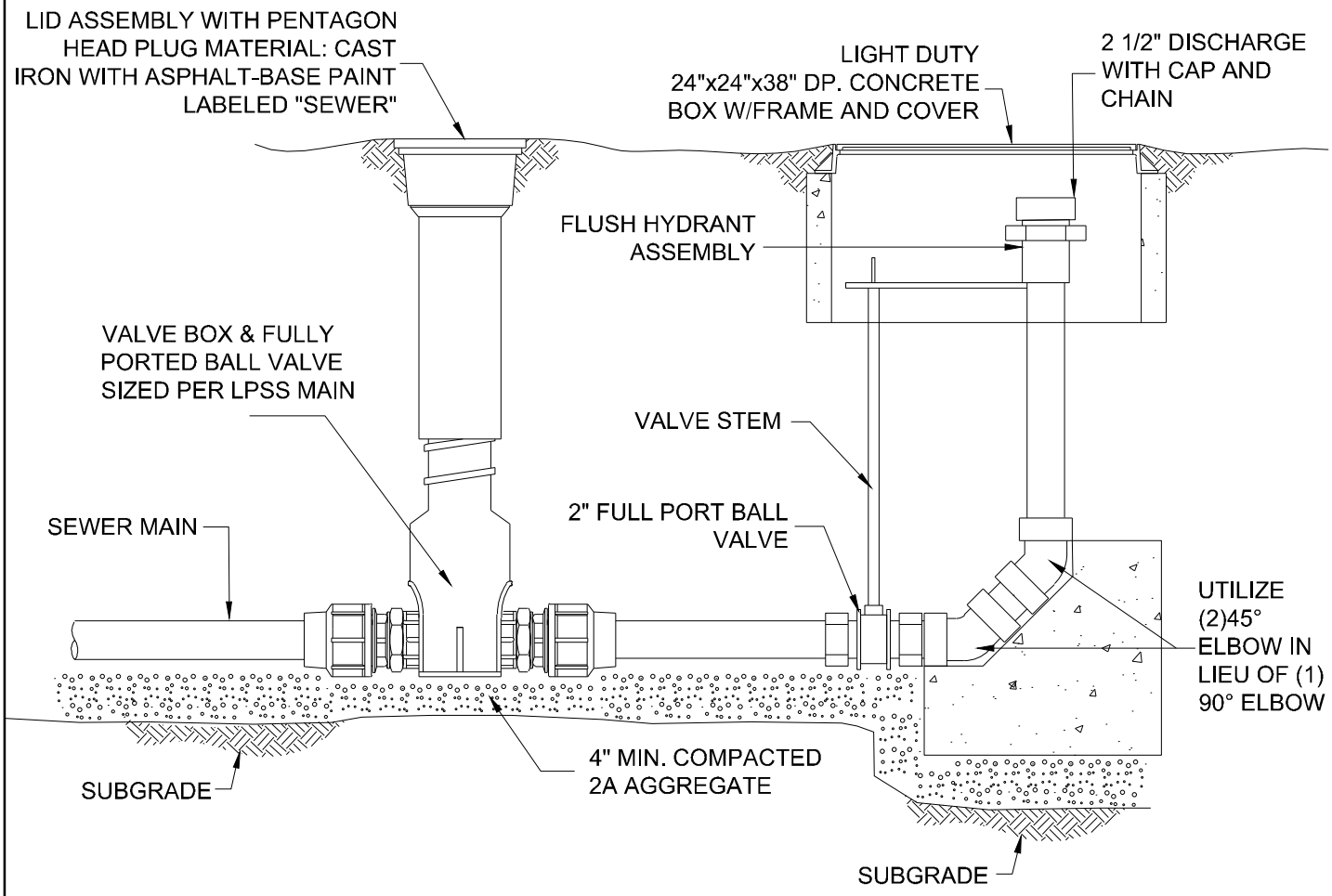
762 WEST LANCASTER AVE,
BRYN MAWR, PA. 19010

AIR RELEASE VALVE MANHOLE

PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.	DATE:	SCALE:	DRAWING NO.
MAH	BAK	EJP	4111.89	07/20/16	NONE	S-23



PLAN VIEW



ELEVATION VIEW

TERMINAL CLEANOUT ASSEMBLY

SCALE: NONE

AQUA PENNSYLVANIA, INC.

AQUA

762 WEST LANCASTER AVE,
BRYN MAWR, PA. 19010

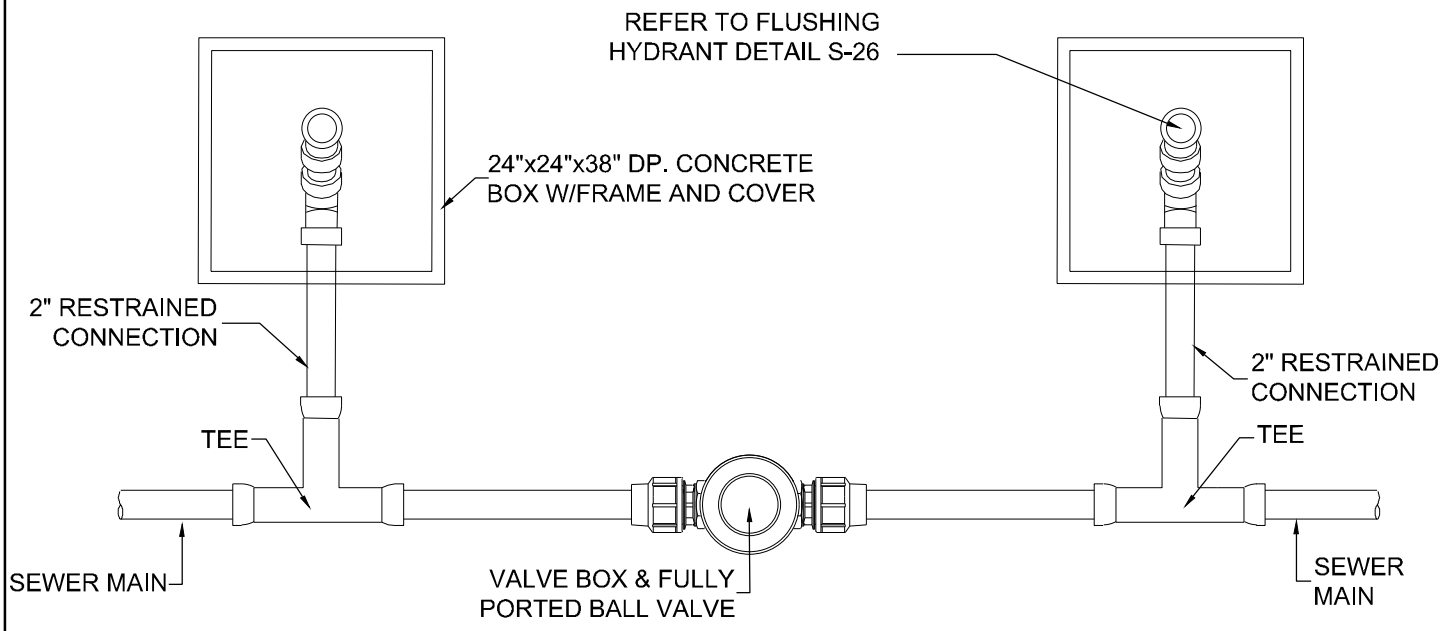
TERMINAL CLEANOUT ASSEMBLY

PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.
MAH	BAK	EJP	4111.89

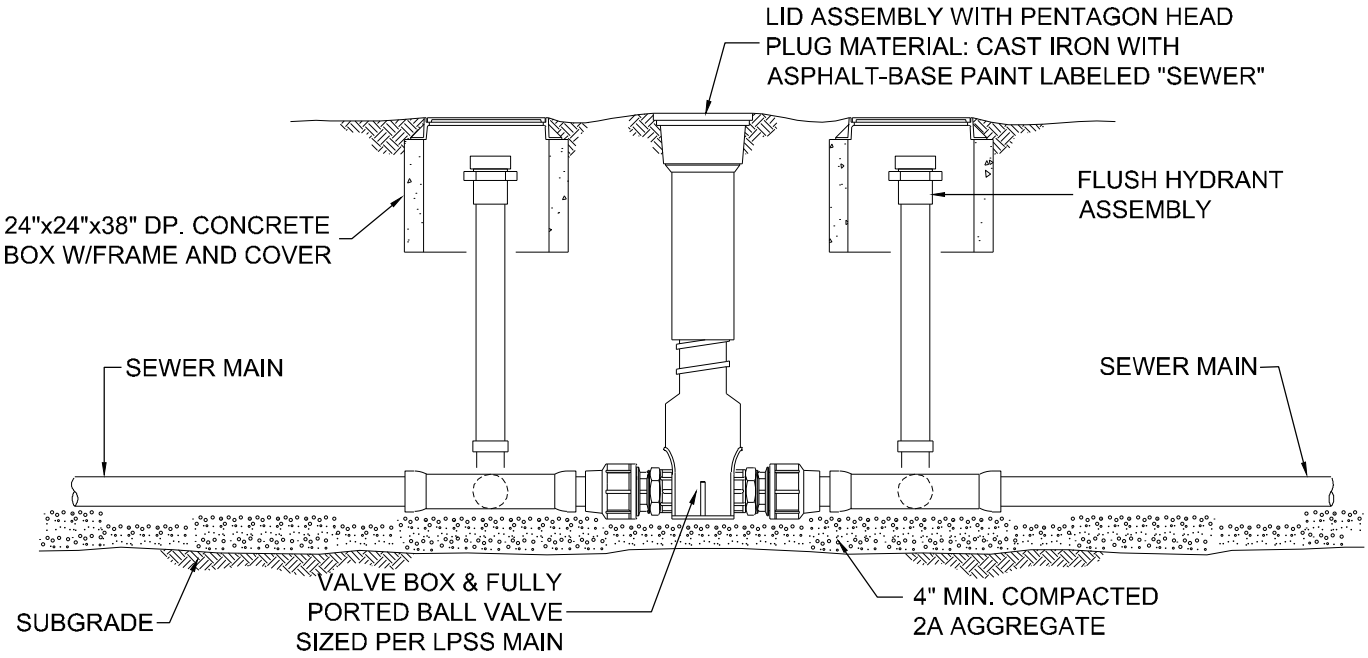
DATE: 07/20/16

SCALE: NONE

DRAWING NO. **S-24**



PLAN VIEW



ELEVATION VIEW

INTERMEDIATE CLEANOUT ASSEMBLY

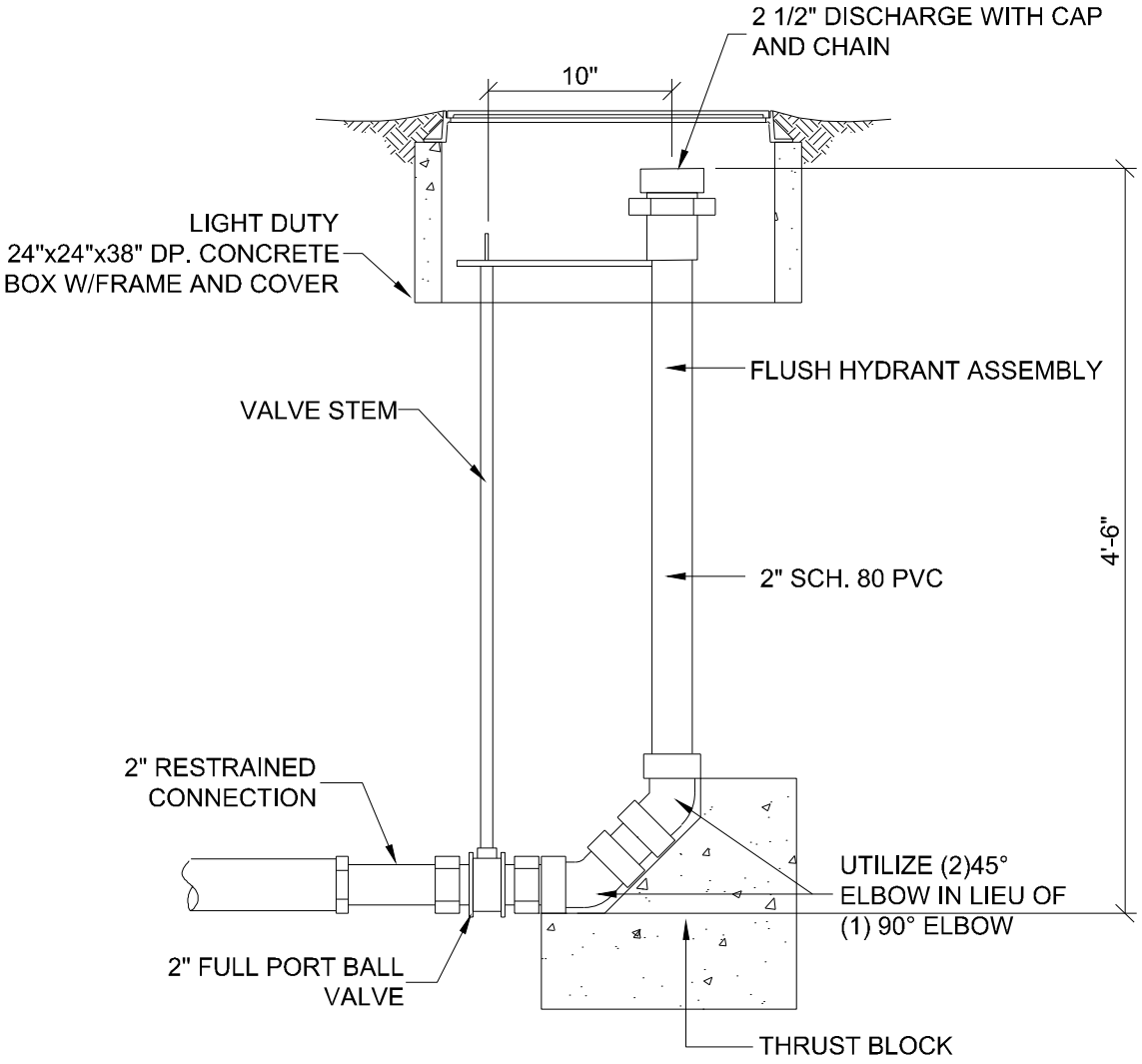
SCALE: NONE

AQUA PENNSYLVANIA, INC.

762 WEST LANCASTER AVE,
BRYN MAWR, PA. 19010

INTERMEDIATE CLEANOUT ASSEMBLY

PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.	DATE:	SCALE:	DRAWING NO.
MAH	BAK	EJP	4111.89	07/20/16	NONE	S-25



FLUSHING HYDRANT DETAIL

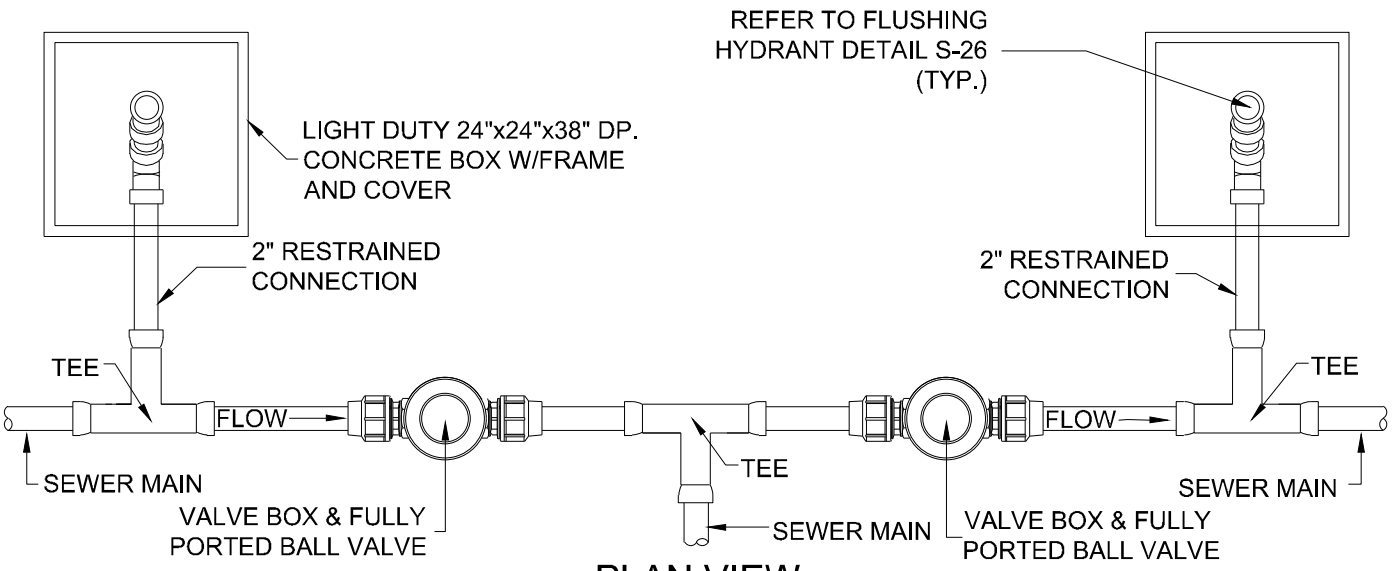
SCALE: NONE

AQUA PENNSYLVANIA, INC.

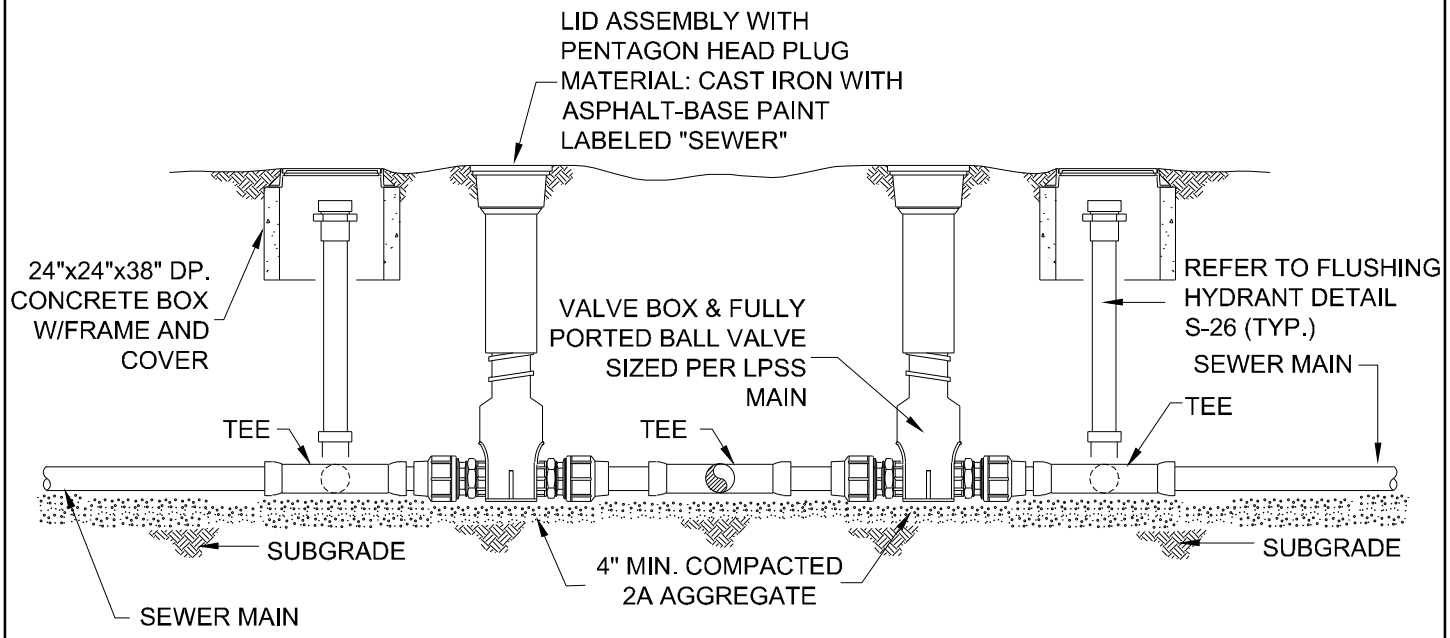
762 WEST LANCASTER AVE,
BRYN MAWR, PA. 19010

FLUSHING HYDRANT DETAIL

PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.	DATE:	SCALE:	DRAWING NO.
MAH	BAK	EJP	4111.89	07/20/16	NONE	S-26



PLAN VIEW



ELEVATION VIEW

2 WAY BRANCH CLEANOUT ASSEMBLY

SCALE: NONE

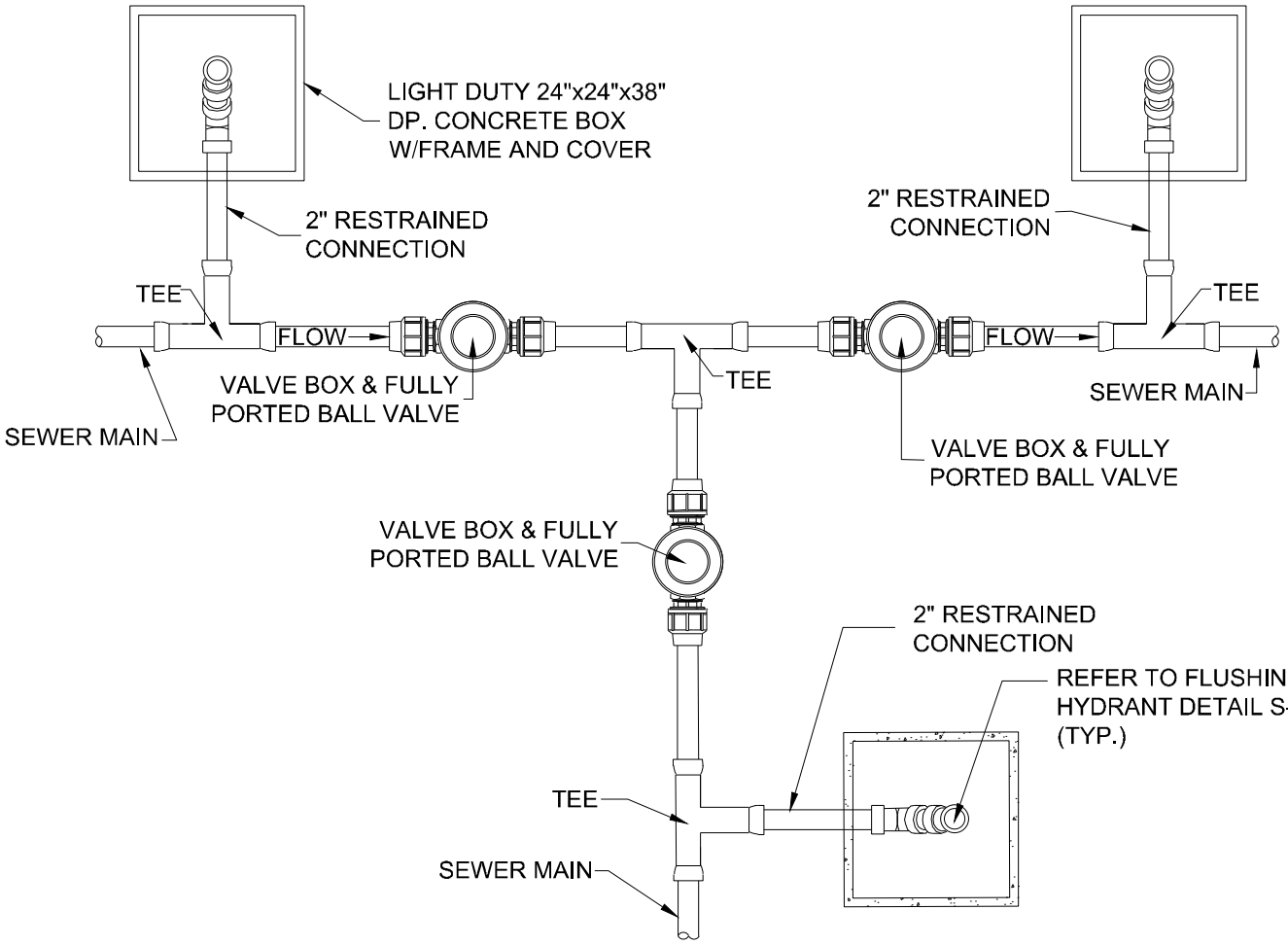
AQUA PENNSYLVANIA, INC.

762 WEST LANCASTER AVE,
BRYN MAWR, PA. 19010

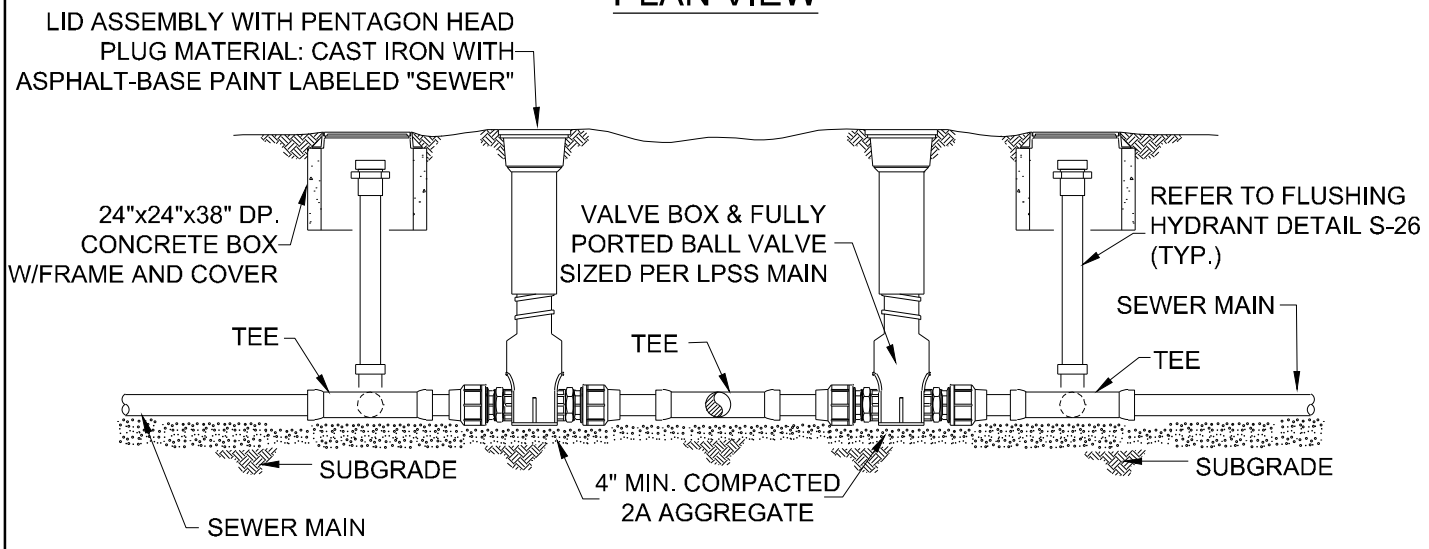
PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.
MAH	BAK	EJP	4111.89

2 WAY BRANCH CLEANOUT ASSEMBLY

DATE:	DRAWING NO.
07/20/16	S-27
SCALE: NONE	



PLAN VIEW



ELEVATION VIEW

3 WAY BRANCH CLEANOUT ASSEMBLY

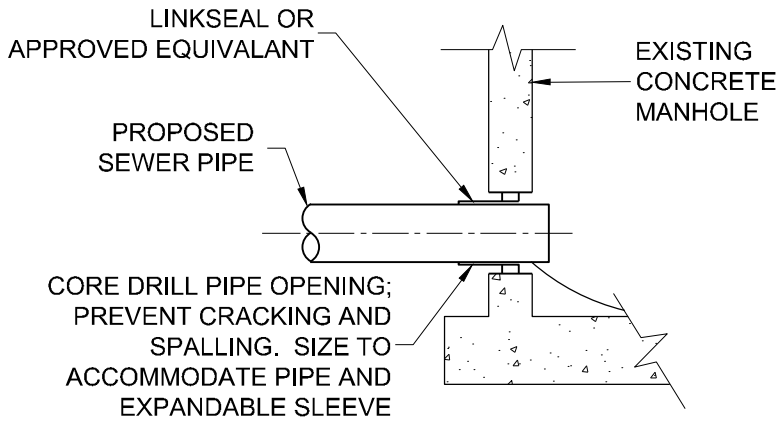
SCALE: NONE

AQUA PENNSYLVANIA, INC.

762 WEST LANCASTER AVE,
BRYN MAWR, PA. 19010

3 WAY BRANCH CLEANOUT ASSEMBLY

PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.	DATE:	SCALE:	DRAWING NO.
MAH	BAK	EJP	4111.89	07/20/16	NONE	S-28



NOTES:

1. PROPOSED SEWER PIPE INVERT ELEVATION SHALL NOT BE BELOW EXISTING SEWER INVERT ELEVATION.
2. PROPOSED SEWER PIPE SHALL BE LOCATED A MINIMUM OF 8" ABOVE OR BELOW EXISTING MANHOLE JOINT.
3. AFTER CONNECTION OF PIPE TO MANHOLE, REMOVE CONCRETE CHANNEL AS REQUIRED AND RECONSTRUCT CHANNEL.
4. KEEP GROUNDWATER, SURFACE WATER AND DEBRIS FROM ENTERING EXISTING FACILITIES.
5. MAINTAIN EXISTING FLOW DURING CONSTRUCTION.
6. DROPS OVER 2 FT WILL REQUIRE AN INSIDE DROP CONNECTION.

TYPICAL TIE-IN TO EXISTING MANHOLE DETAIL

SCALE: NONE

AQUA PENNSYLVANIA, INC.

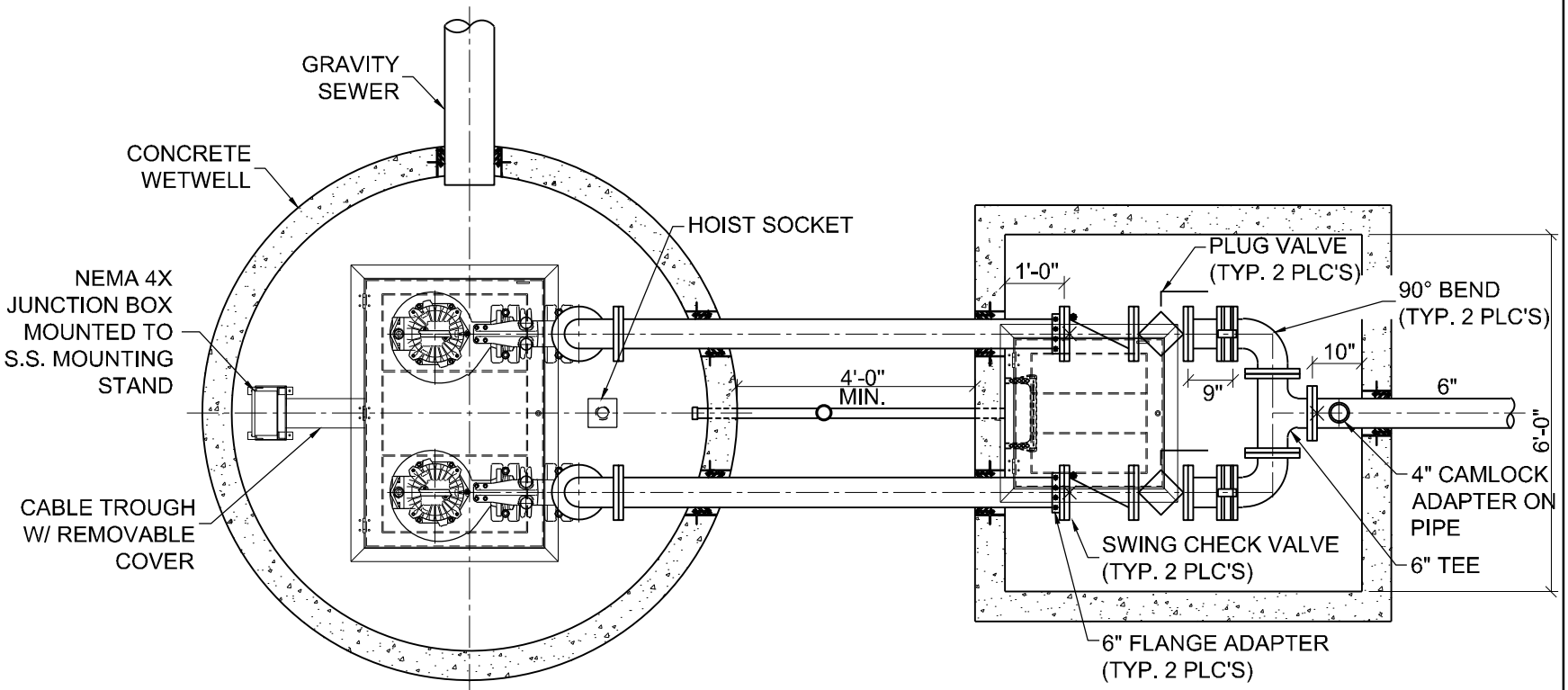
AQUA

762 WEST LANCASTER AVE,
BRYN MAWR, PA. 19010

TYPICAL TIE-IN TO EXISTING MANHOLE DETAIL

PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.	DATE:	SCALE:	DRAWING NO.
MAH	BAK	EJP	4111.89	07/20/16	NONE	S-29

FOR GENERAL ARRANGEMENT ONLY DETAIL PLANS TO BE SUBMITTED FOR REVIEW.



PLAN VIEW - PUMP STATION

SCALE: NONE

AQUA PENNSYLVANIA, INC.

762 WEST LANCASTER AVE,
BRYN MAWR, PA. 19010

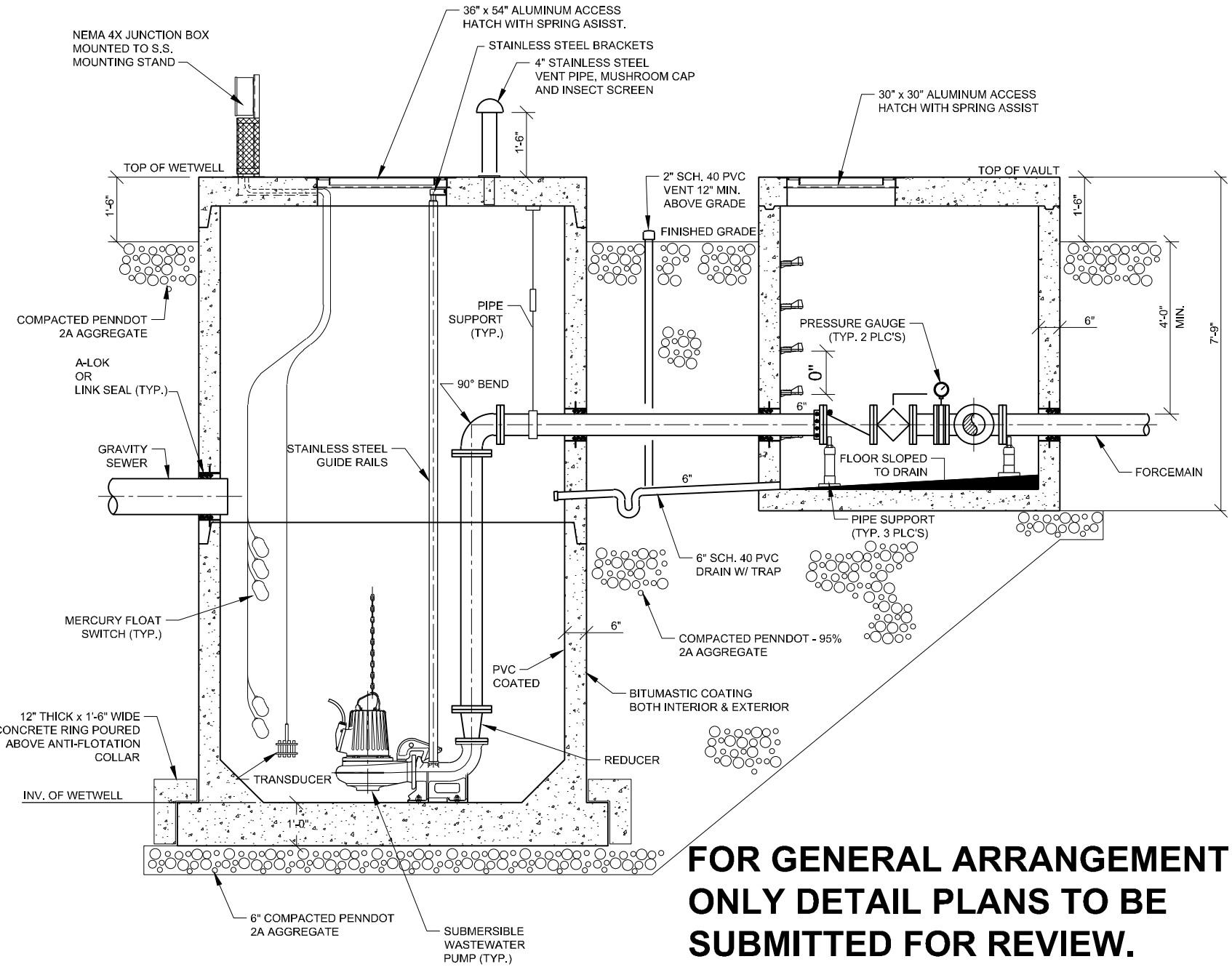
PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.
MAH	BAK	EJP	4111.89

DATE: 07/20/16

SCALE: NONE

PLAN VIEW - PUMP STATION

DRAWING NO. **S-30**



FOR GENERAL ARRANGEMENT ONLY DETAIL PLANS TO BE SUBMITTED FOR REVIEW.

SECTION VIEW - PUMP STATION

SCALE: NONE

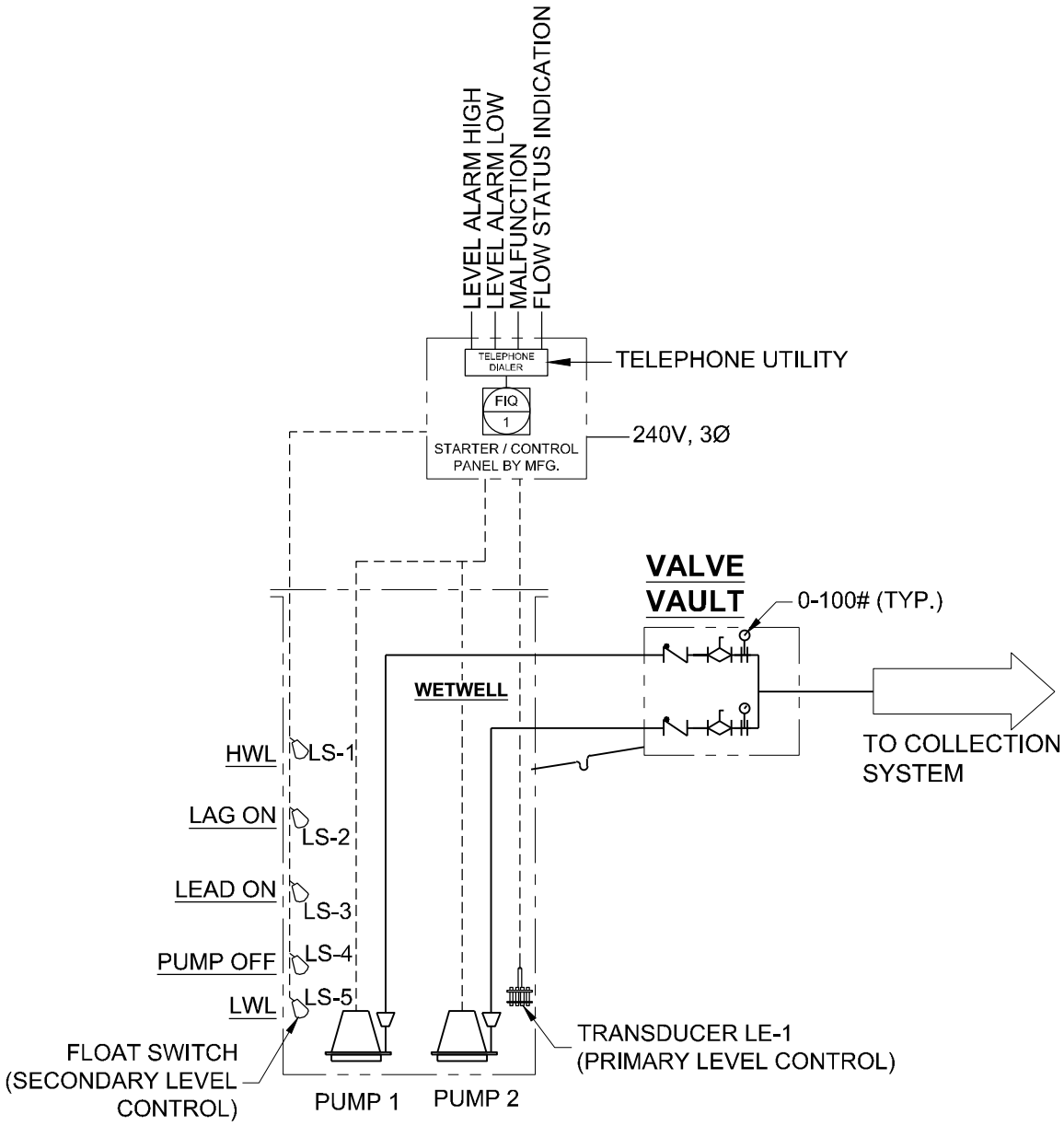
AQUA PENNSYLVANIA, INC.

762 WEST LANCASTER AVE, BRYN MAWR, PA. 19010

PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.	DATE:	SCALE:	DRAWING NO.
MAH	BAK	EJP	4111.89	07/20/16	NONE	S-31

SECTION - PUMP STATION

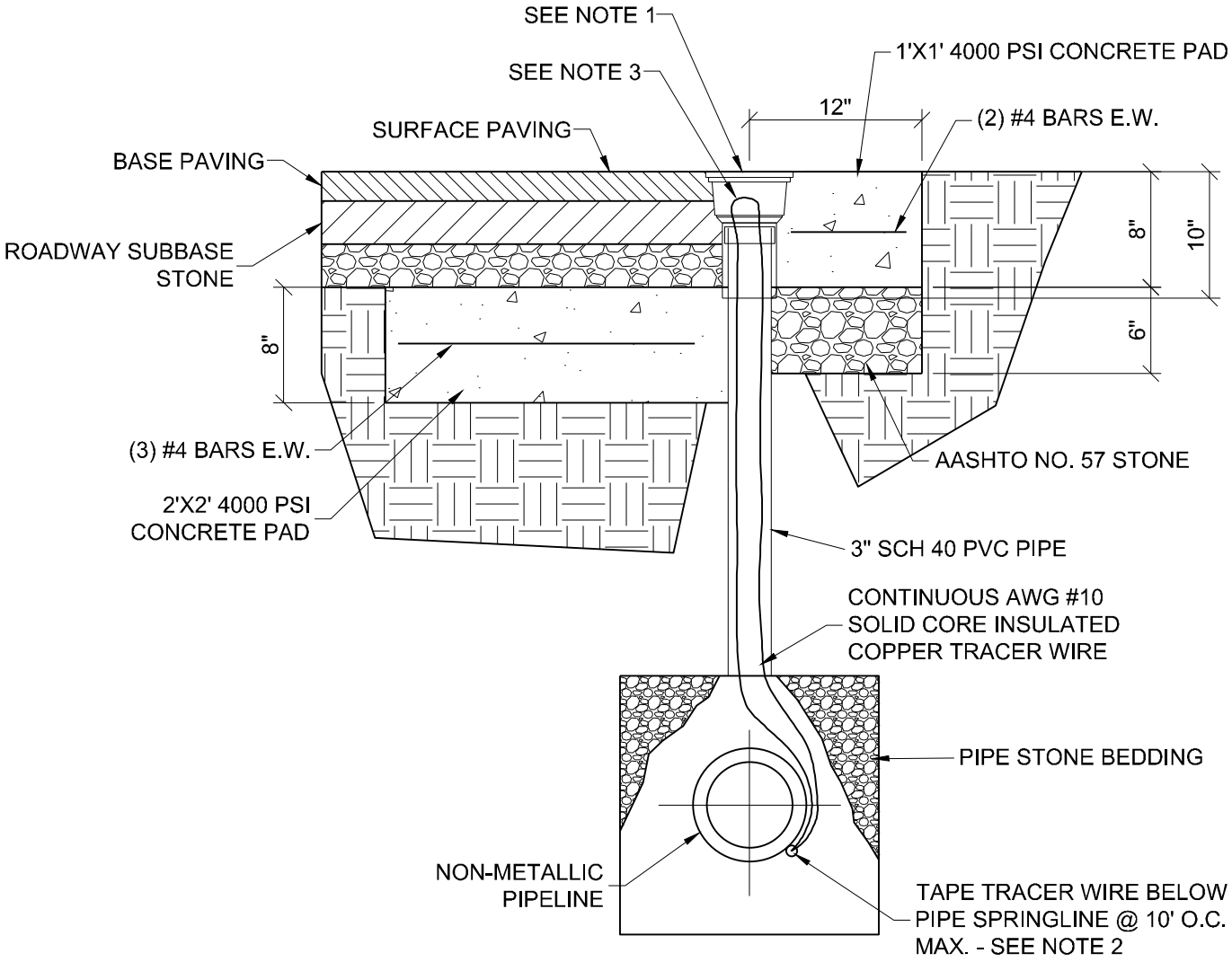
FOR GENERAL ARRANGEMENT ONLY DETAIL PLANS TO BE SUBMITTED FOR REVIEW.



PUMP STATION PROCESS & INSTRUMENTATION DIAGRAM

SCALE: NONE

AQUA PENNSYLVANIA, INC. AQUA 762 WEST LANCASTER AVE, BRYN MAWR, PA. 19010				PUMP STATION PROCESS & INSTRUMENTATION DIAGRAM	
				DATE: 07/20/16	DRAWING NO. S-32
PREPARED BY: MAH	CHECKED BY: BAK	APPROVED BY: EJP	PROJECT NO.: 4111.89	SCALE: NONE	



NOTES:

1. C.I. BOX SHALL BE TYLER 10" C.I. VALVE BOX TOP SECTION SLIP MODEL 10T-A WITH 5 1/4" DROP LID MODEL 14549 MARKED "SEWER"
2. DO NOT SPICE TRACER WIRE UNDERGROUND.
3. PROVIDE 3 FEET OF LOOPED WIRE WITHIN TEST STATION BOX.
4. SPACE TEST STATIONS 500 FEET MAX. AND AT ALL CHANGES IN FORCE MAIN DIRECTIONS
5. PROVIDE METALLIC CAUTION TAPE CENTERED ON FORCE MAIN 12" BELOW FINISHED GRADE.

FORCE MAIN TRACER WIRE TEST STATION

SCALE: NONE

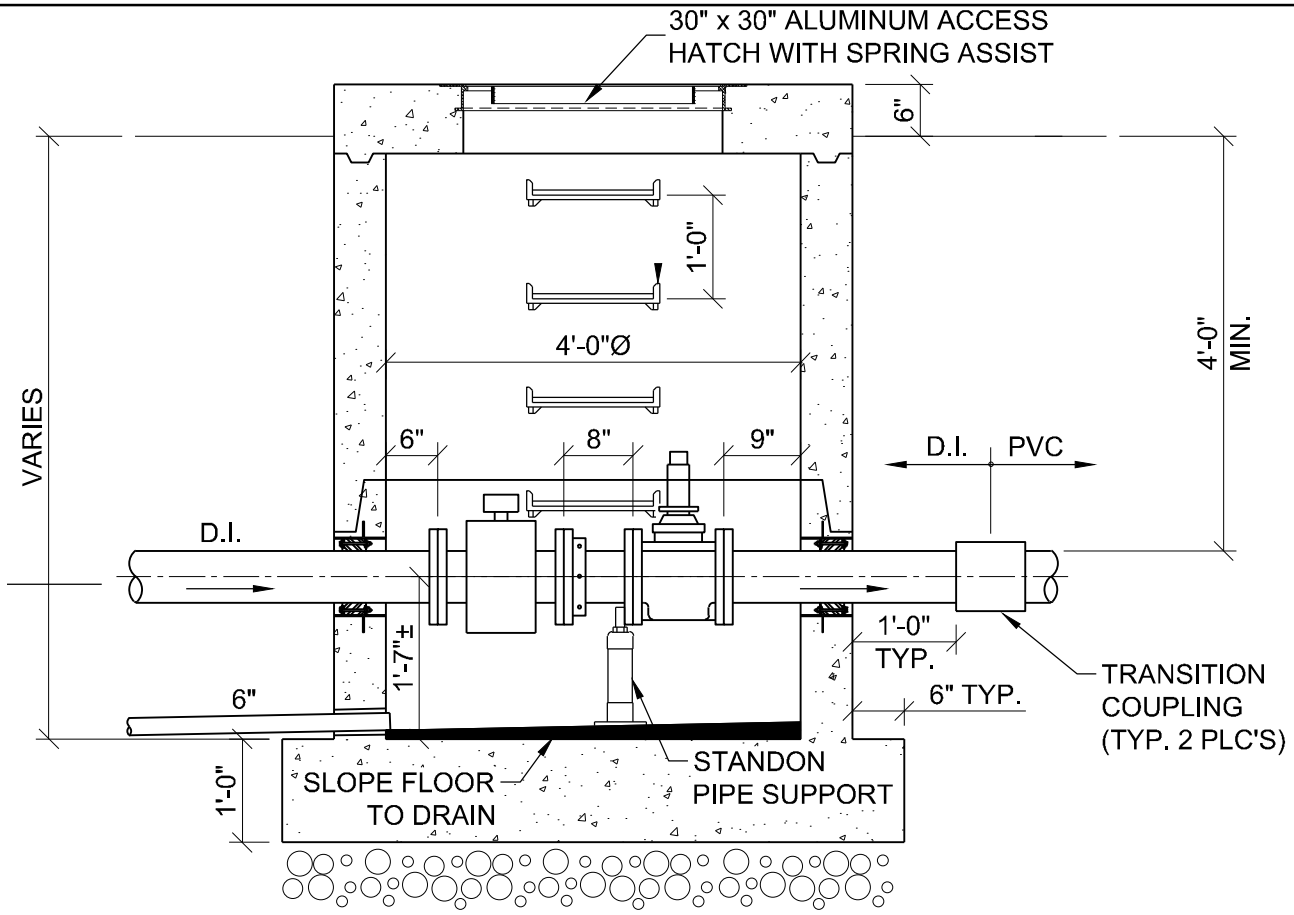
AQUA PENNSYLVANIA, INC.

AQUA

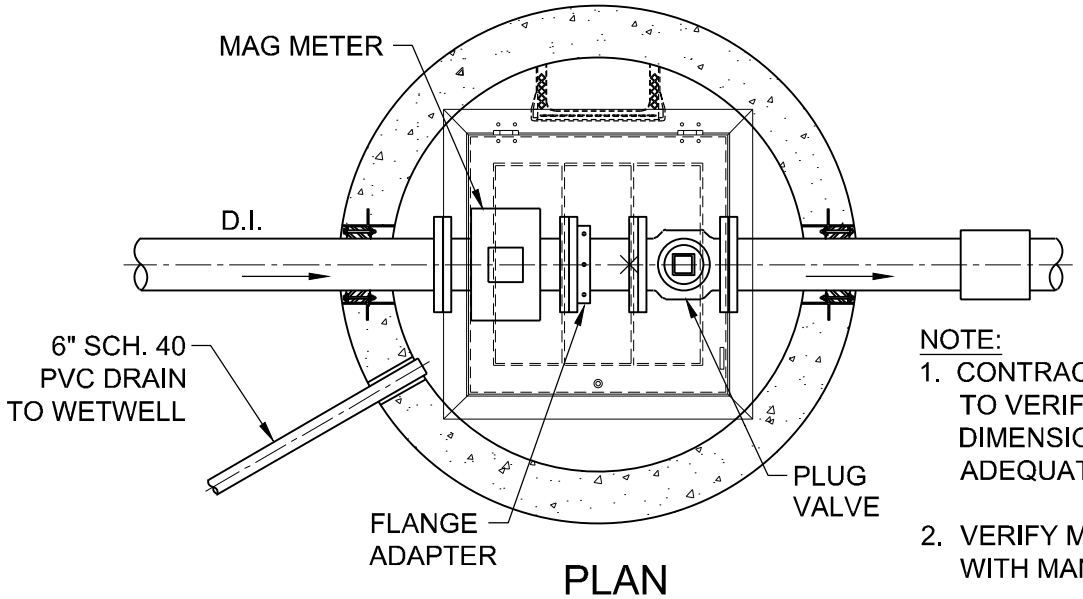
762 WEST LANCASTER AVE,
BRYN MAWR, PA. 19010

FORCE MAIN TRACER WIRE TEST STATION

PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.	DATE:	SCALE:	DRAWING NO.
MAH	BAK	EJP	4111.89	07/20/16	NONE	S-33



SECTION



PLAN

NOTE:

1. CONTRACTOR IS RESPONSIBLE TO VERIFY EXISTING DIMENSIONS AND PROVIDE FOR ADEQUATE WORKING SPACE.
2. VERIFY METER CONFIGURATION WITH MANUFACTURER.

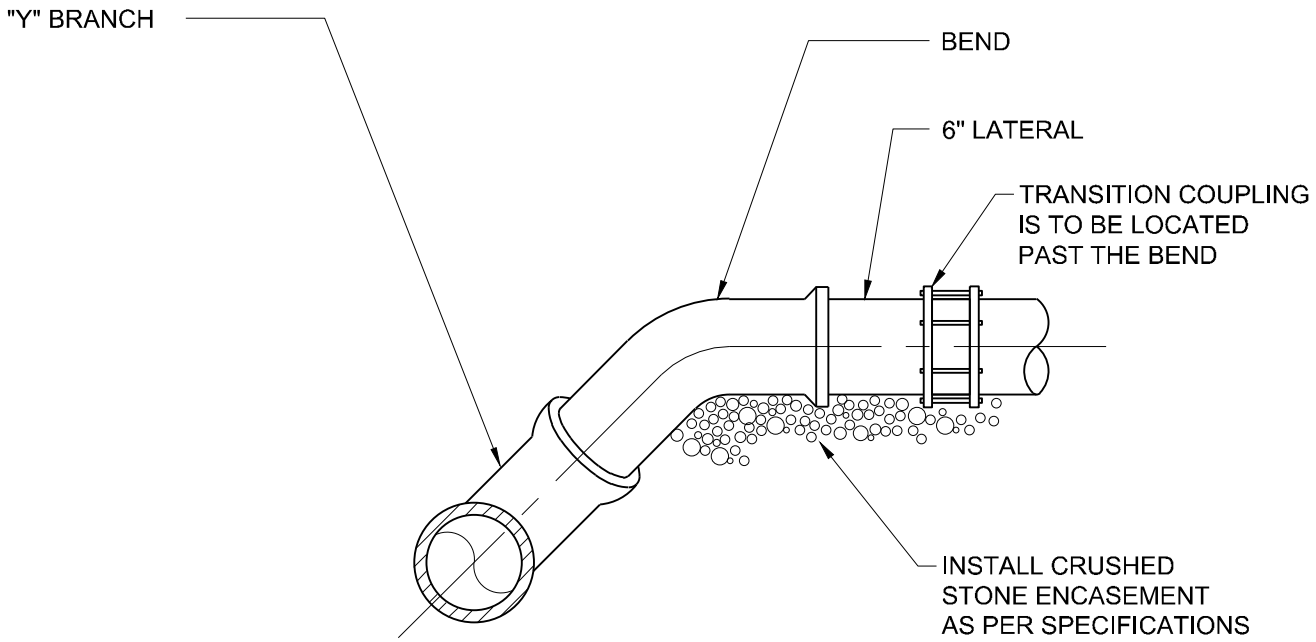
FORCE MAIN METERING MANHOLE DETAIL

SCALE: NONE

AQUA PENNSYLVANIA, INC.
AQUA
762 WEST LANCASTER AVE,
BRYN MAWR, PA. 19010

FORCEMAIN METERING MANHOLE DETAIL

PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.	DATE:	SCALE:	DRAWING NO.
MAH	BAK	EJP	4111.89	07/20/16	NONE	S-34



NOTES:

1. THE SIZE OF THE LATERAL BEND & "Y" BRANCH SHALL BE 6" IN ACCORDANCE WITH SPECIFICATIONS.

2. TRANSITION COUPLING TO BE DRESSER, ROMAC OR APPROVED EQUIVALENT.

"Y" BRANCH FOR LATERALS

SCALE: NONE

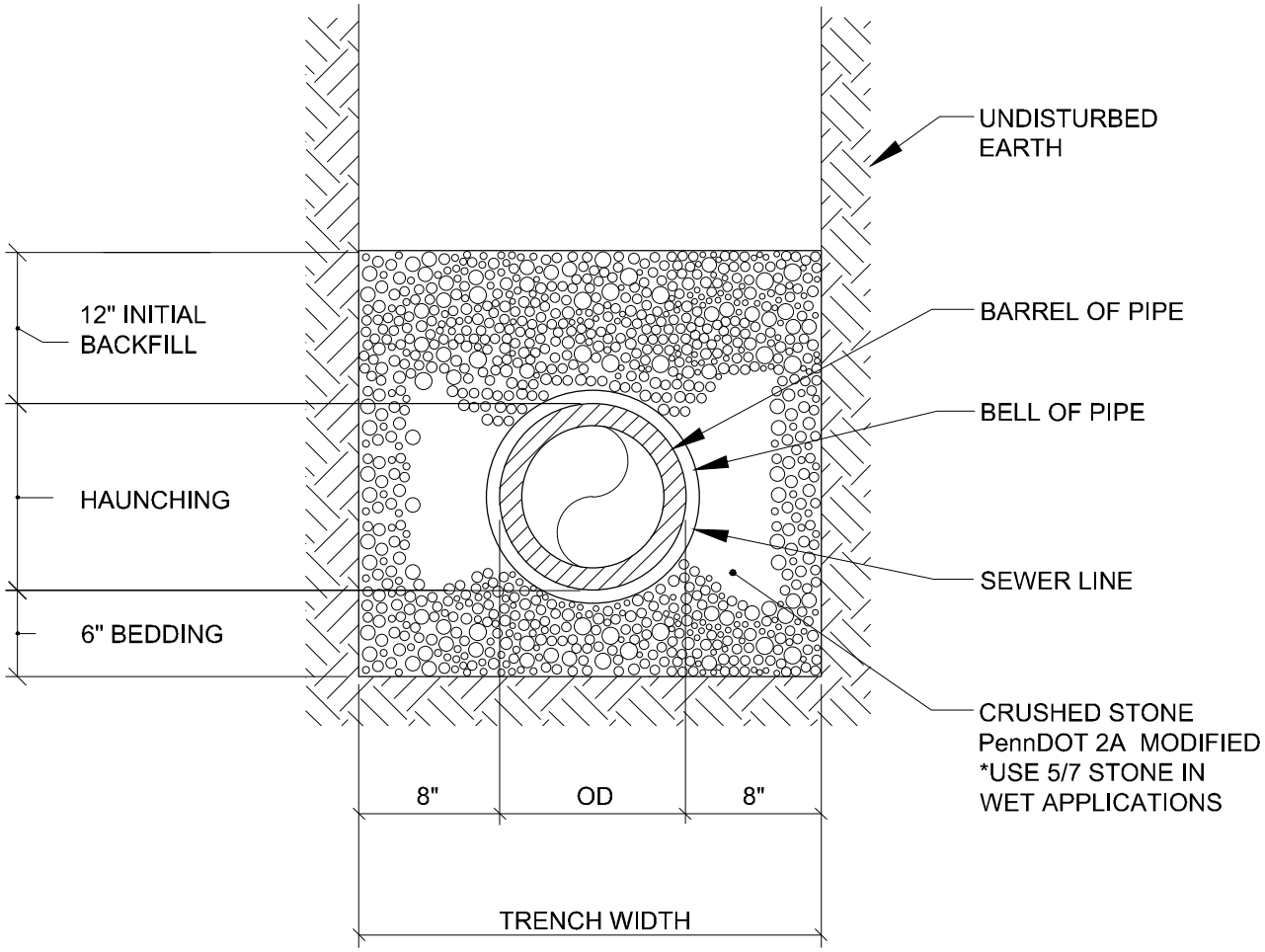
AQUA PENNSYLVANIA, INC.

AQUA

762 WEST LANCASTER AVE,
BRYN MAWR, PA. 19010

"Y" BRANCH FOR LATERALS

PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.	DATE:	SCALE:	DRAWING NO.
MAH	BAK	EJP	4111.89	08/22/16	NONE	S-35



CRUSHED STONE EMBEDMENT DETAIL

SCALE: NONE

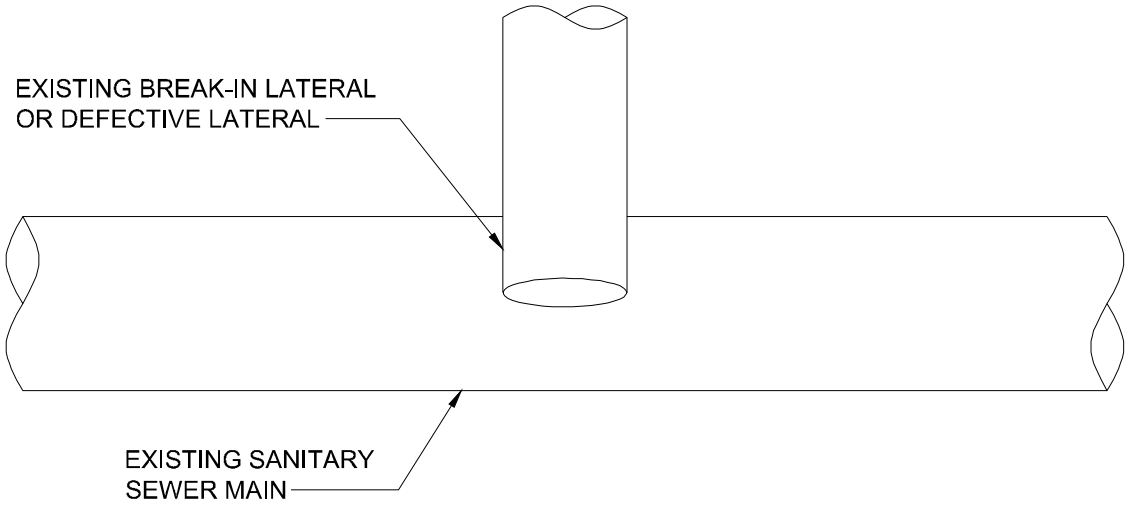
AQUA PENNSYLVANIA, INC.

AQUA

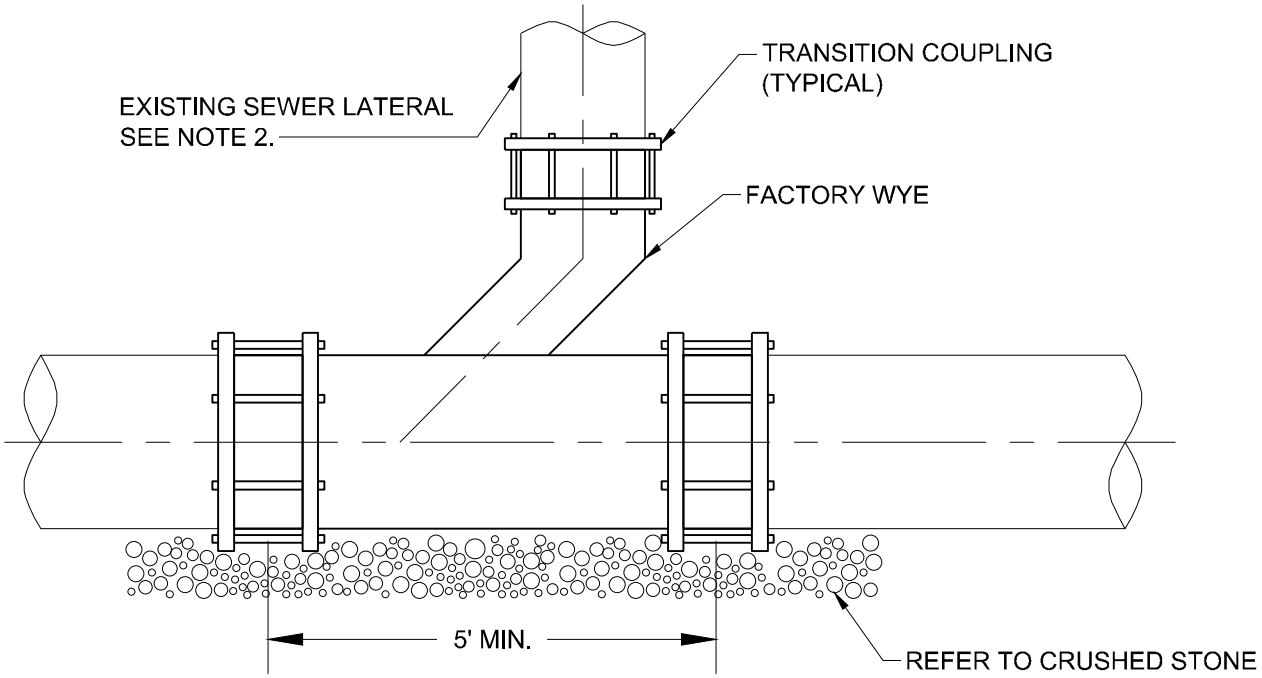
762 WEST LANCASTER AVE,
BRYN MAWR, PA. 19010

CRUSHED STONE EMBEDMENT DETAIL

PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.	DATE:	SCALE:	DRAWING NO.
MAH	BAK	EJP	4111.89	08/22/16	NONE	S-36



EXISTING CONDITION



RECOMMENDED REPAIR

NOTES:

1. THESE TYPE OF REPAIRS HAVE A TENDENCY TO SAG. MUST ENSURE PROPER COMPACTION. BEDDING SHALL BE INSTALLED PRIOR TO PIPE PLACEMENT.
2. LATERAL MUST BE A STRAIGHT ALIGNMENT FROM LATERAL TO SEWER MAIN WYE.
3. TRANSITION COUPLING IS TO BE DRESSER, ROMAC OR APPROVED EQUIVALENT.

REPAIR BREAK-IN CONNECTION

SCALE: NONE

AQUA PENNSYLVANIA, INC.
AQUA
762 WEST LANCASTER AVE,
BRYN MAWR, PA. 19010

REPAIR BREAK IN CONNECTION

PREPARED BY	CHECKED BY	APPROVED BY	PROJECT NO.	DATE:	SCALE:	DRAWING NO.
MAH	BAK	EJP	4111.89	08/22/16	NONE	S-37