



STANDARD SPECIFICATIONS AND DETAILS

FOR

WATER MAINS

SANITARY SEWERS

STORM DRAINS

STREETS, ROADS AND

ELECTRIC

JUNE 2017

Section A

**Standard Specifications
for
Water Mains
Sanitary Sewers
Storm Drains
Streets, Roads and
Electric**

SECTION A – STANDARD SPECIFICATIONS

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Adoption of Standard Specifications

STANDARD SPECIFICATIONS

The Town of Smyrna, Delaware adopts, as amended here, the Standard Specifications for Road and Bridge Construction, of the Delaware Department of Transportation August 2016 (or as later amended).

UNITS OF MEASUREMENT

Units of measurement and procedures for measuring finished work, other than lump sum work, shall be as indicated in Section 109 of the Delaware Department of Transportation's August 2016 (or later amended) Standard Specifications for Road and Bridge Construction in so far as the units are consistent with the special provisions.

MEASUREMENT AND PAYMENT

Measurement and payment of all items constructed in the Town of Smyrna, for which the Town of Smyrna may at some time own or control the items, shall be as specified in the special provisions section of the contract documents for the work being measured. If the special provisions of the contract in force for a particular job do not adequately indicate the method of measurement or basis of payment, the amendments contained here become the requirement for measurement and payment. If the amendments contained here do not cover the measurement or payment of an item, and it is also not included in the special provisions of a contract under which work is being performed, then measurement and payment will be as specified in the Delaware Department of Transportation's August 2016 (or later amended) Standard Specifications for Road and Bridge Construction.

INCOMPLETE OR INAPPROPRIATE SPECIFICATIONS

If, for any reason, the supplemental specifications contained here or the Delaware Department of Transportation's August 2016 (or later amended) Standard Specifications for Road and Bridge Construction, or latest revision thereof, are found by the Town to be incomplete, in conflict with the requirements of other government agencies, or inappropriate; the Town may, at its sole discretion, enforce the requirements of other government agencies, industry associations or professional organizations recognized as authorities or industry representatives within the State of Delaware.

SEVERABLE CLAUSE

It is hereby declared to be the intention of the Town of Smyrna that the sections, paragraphs, sentences, clauses, and phrases of this supplemental specification are severable, and if any such section, paragraph, sentence, clause, or phrase is declared unconstitutional or otherwise invalid by any court of competent jurisdiction in a valid judgment or decree, such unconstitutionality or invalidity shall not affect any of the remaining sections, paragraphs, sentences, clauses, or phrases of this document since the

same would have been enacted without the incorporation into this ordinance of such unconstitutional or invalid section, paragraph, sentence, clause, or phrase.

End of Section

DIVISION 100 GENERAL PROVISIONS

S100.01 DEFINITIONS

Whenever the words defined in this section, or pronouns used in their stead occur in the contract, they shall have the meanings here given.

1. OWNERS or OWNER shall mean the Town of Smyrna, Delaware.
2. ENGINEER shall mean the Town Manager of Smyrna, Delaware, acting for the Owners; or their duly authorized agents, said agent acting severally within the scope of the particular duties entrusted to him.
3. CONTRACTOR shall mean the party of the second part, or the agent appointed to act for the said party, entering into the contract for the performance of the work required by it.
4. ACCESS CONNECTION: Any roadway facility by means of which vehicles can enter or leave an arterial highway. Included are intersections at grade, private driveways, and ramps or separate lanes connecting with cross streets or frontage roads.
5. BIDDER – Any individual, firm or corporation submitting a proposal for the work contemplated, acting directly or through a duly authorized representative.
6. CHANGE ORDER – A written order to the contractor, signed by the Engineer, ordering a change in the work from that originally shown by the plans and specifications that has been found necessary. If the work is of a nature involving an adjustment of unit price, a Supplemental Agreement shall be executed by the Contractor Constitute authorized modifications of the contract.
7. CHANNEL: A natural or artificial watercourse.
8. CONTRACT – A written agreement executed between the Owners and the successful bidder, covering the performance of the work and the furnishing of labor and materials, by which the Contractor is bound to perform the work and furnish the labor and materials, and by which the Owners are obligated to compensate him therefore at the mutually established and accepted rate or price.

The contract shall include the invitation for bids, instructions to bidders, proposal, contract and contract bond, these specifications, supplemental specifications, all general or special provisions, general and detailed plans, and notice to proceed; also, any written change orders, mutual understandings and agreements that are required to complete the construction of the work in an acceptable manner, including authorized extensions thereof.

9. **CONTRACT BOND** – The approved form of security executed by the Contractor, including the performance of all work and the furnishing of all labor and the materials described in the respective articles or sections of the Specifications and Contract, or in the Special Provisions which are made a part thereof.
10. **CONTRACT ITEM** – The obligation of the Contractor, including the performance of all work and the furnishing of all labor and the materials described in the respective articles or sections of the Specifications and Contract, or in the Special Provisions which are made a part thereof.
11. **CONTRACT TIME** – The number of working days or calendar days shown in the proposal, indicating the time allowed for the completion of the work of the work contemplated in the contract.
12. **COUNTY:** Kent County Delaware, a body corporate and politic
13. **DEAD-END STREET:** A local street open at one end only without special provision for turning around.
14. **DEPARTMENT:** The Department of Public Works, Town of Smyrna.
15. **DRAWINGS:** All drawings or reproductions thereof pertaining to the construction of the work, which are approved by the Engineer.
16. **PITCH** – In general, any open drainage section other than gutters, constructed beyond the limits of cut or fill slopes for excavation or embankment as indicated by the typical section shown on the plans.
17. **EASEMENT** – The area secured beyond the right-of-way limits for the purpose of constructing or flattening slopes, side ditches, stream changes, etc. A grant of a right of use of the property of an owner for a certain purpose at the will of the grantee.
18. **FRONTAGE STREET OR SERVICE ROAD:** A local street or road auxiliary to and located on the side of an arterial highway for service to abutting property and adjacent areas and for control of access.
19. **GABIONS:** Open wire-mesh baskets filled with approved stone used for erosion protection of slopes and stream banks.
20. **GUTTER** – Any open drainage section, whether paved or not, constructed inside of the shoulder line in embankment or contiguous to the shoulder line and to the base of the cut slope in excavation sections. For the purpose of clarification of the above definition, a section shall be considered in embankment when the elevation of the extended shoulder slope is generally at or above the existing ground surface and shall be considered in excavation when the elevation of the shoulder line is below the existing

- ground surface.
21. INSPECTOR – An authorized representative of the Engineer, assigned to make any or all necessary inspections of the work performed and materials furnished by the Contractor.
 22. MATERIALS: Any substances specified for use in the construction of the project and its appurtenances.
 23. MAYOR AND COUNCIL: Governing body of the Town of Smyrna.
 24. MEDIAN LANE: A speed-change land within the median to accommodate left—turning vehicles.
 25. MINOR STRUCTURE: Any structure not classed as a bridge or a culvert. It shall include catch basins, inlets, manholes, retaining walls, steps, fences and other miscellaneous items.
 26. NOTICE TO PROCEED – A written notice to the Contractor of the date on or before which he is to begin the prosecution of the work contracted for.
 27. PLANS – All drawings, or reproductions thereof pertaining to the construction of the improvements and its appurtenances.
 28. PROJECT: The work included in the Proposal intended to be accomplished by the Contractor.
 29. PROPOSAL – The offer of the bidder submitted on the prescribed proposal form to perform the work and to furnish the labor and materials for the consideration of payment at the unit prices stated and submitted by the bidder on the prepared schedule.
 30. RIGHT-OF-WAY – The area which has been secured and reserved by the Owner for the use in constructing the proposed improvement and appurtenances thereto.
 31. ROADBED – That portion of the roadway extending from the shoulder line, and which is intended for traffic and/or for the direct and lateral support of base and surface courses.
 32. ROADWAY – That portion of the highway required for construction limited by the outside edges of the slopes and including ditches, channels and all structures pertaining to the proposed improvement.
 33. SHOULDER – The paved or unpaved area between the edge of the surfacing or pavement and the point of intersection of the extended shoulder with curb or slope line.

34. SLOPES – The graded area beyond the shoulder or curb and extending from the shoulders or curbs to the natural undisturbed surface of the ground.
35. SPECIAL PROVISIONS – Special clauses supplemental to these specifications, setting forth requirements peculiar to the specific work included in the contract.
36. SPECIFICATIONS – The directions, provisions, and requirements contained herein, together with all written agreements made or to be made, pertaining to the method and manner of performing the work, or to the quantities and qualities of materials to be furnished under the contract.
37. STATE: The State of Delaware acting through its authorized representative.
38. STREET: A general term denoting a public way for purposes of vehicular travel, including the entire area within the right-of-way.
39. SUB-CONTRACTOR – Any individual firm or corporation undertaking the construction of a part of the work under the terms of the contract, by virtue of an agreement with the contractor, who, prior to such undertaking, receives the consent of the Surety and the approval of the Owner.
40. SUBGRADE – The portion of the roadbed upon which the sub-base, the base courses, surface courses, or pavement will be or have been placed.
41. SUPERINTENDENT: The executive representative of the Contractor authorized to receive and execute instructions from the Engineer/Inspector and who shall supervise and direct the construction.
42. SURETY – The corporate body which is bound with and for the Contractor, who is primarily liable, and which engages to be responsible for his payment of all debts pertaining to and for his acceptable performance of the work for which he has contracted.
43. THROUGH STREET OR THROUGH HIGHWAY: Every highway or portion thereof at the entrance to which vehicular traffic from intersecting highways is required by law to stop before entering or crossing the same and when stop signs are erected.
44. TOWN: The Town of Smyrna, Delaware a body corporate and politic.
45. TRAFFIC LANE: The portion of a traveled way for the movement of a single line of vehicles.
46. UNDERCUTTING: The removal of unsuitable material below the grade of a proposed subgrade or embankment foundation.

47. UTILITIES: The word Utilities shall mean storm drains, sanitary sewers, water mains, gas mains, telephone and electrical lines, other special underground lines and their appurtenances.
48. WORK – Any or all things agreed to be furnished or done by the contractor, and which are required in the construction and completion of the project herein contemplated.
49. WORKING HOURS: Working hours shall be 7:30 a.m. to 4:00 p.m. Any derivation shall require approval of the Town.
50. Whenever the words DIRECTED, REQUIRED, ORDERED, or words of like import are used in the drawings or specifications, it shall be understood that the “direction, requirement or order” of the engineer is intended; and similarly, the words APPROVED, ACCEPTABLE, or words of like import, shall mean “approved by or acceptable to” the Engineer, unless otherwise stated.

The following are some common acronyms and abbreviations used throughout this specification:

AAN	American Association of Nurserymen
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACP	Asbestos Cement Pipe
ACCOMP	Asbestos Coated Corrugated Metal Pipe
AI	Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ASA	American Standards Association
ASCE	American Society of Civil Engineers
ASLA	American Society of Landscape Architects
ASTM	American Society of Testing and Materials
AWPA	American Wood Preservers Association
AWWA	American Water Works Association
BCMP	Bituminous Coated Corrugated Metal Pipe
C.A.P.	Corrugated Aluminum Pipe
CRSI	Concrete Reinforcing Steel Institute
CSPA	Clay Sewer Pipe Association
DIP	Ductile Iron Pipe
NFPA	National Fire Protection Association
VCPX	Vitrified Clay Pipe, Extra Strength
RCSP	Reinforced Concrete Sewer Pipe
RCCP	Reinforced Concrete Culvert Pipe
UCPX	Unglazed Clay Pipe, Extra Strength

UL Underwriters' Laboratories Incorporated
PCA Portland Cement Association
PCCP Prestressed Concrete Cylinder Pipe

END OF SECTION

S100.02 PROPOSAL REQUIREMENTS AND CONDITIONS

1. Preparation of Proposal

In filling out proposal forms bidders shall be governed by the following provisions:

- a. Proposals must be made on the blank forms provided by the Owner. The blank spaces in the proposal form, except as otherwise noted, must be filled in, and no change shall be made either in the phraseology of, or in the items mentioned in the proposal form.
- b. Proposal must be signed in ink by the bidder with the signature in full. When a firm is a bidder, the agent who signs the firm name to the proposal shall state, in addition, the names and addresses of the individuals composing the firm. When a corporation is the bidder, the person signing shall state under the laws of what state the corporation was chartered and the names and title of the officer having authority under the bylaws to sign contracts.

The proposal shall also bear the seal of the corporation, attested by its secretary. Anyone signing the proposal as agent must file with it legal evidence of his authority to do so. Post office address, county and state, must be given after the signature.

- c. Each proposal shall specify a unit price, written with ink in both words and figures, for each of the separate items as called for. In case of discrepancy between the written words and figures, the proposal shall be considered irregular.
- d. Bidders must present satisfactory evidence and references as to responsibility and that they have been engaged in the character of the work which they propose to do, or are reasonably familiar with the same, and that they are fully prepared with the necessary capital, material and machinery to conduct the work for which they proposed the contract, to the satisfaction of the Engineer, and to begin promptly within ten (10) days after notice to do so.
- e. Bidders must not change any item in the proposal for which a price has been stipulated by the Owner. Any change will cause rejection of the proposal.

2. Examination of Plans, Specifications and Site

Bidders shall make a personal examination of the location of the proposed work of the surroundings thereof, and shall thoroughly acquaint themselves with the details of the work to be done and all the conditions

and obstacles likely to be encountered in the performance and completion of the work. Bidders shall inform themselves as to the facilities for the transportation, handling and storage of equipment and materials and they shall carefully study the plans, specifications and other documents and thoroughly satisfy themselves as to the conditions under which the work is to be done and as to the character, qualities and quantities of work to be performed and materials to be furnished and be prepared to execute a finished job in every particular without any extra charge whatever, except as may be specifically provided for elsewhere in these contract documents. Borings, rock profiles, rock classification, pipe or other underground objects where shown on the drawings, are supposed to be approximately correct. Should they be found otherwise, or should the contractor encounter quicksand, springs or any materials other than shown, it should be understood that the Owner does not warrant such plotting of underground objects to be correct. Therefore, claims arising from increased or decreased quantities, or otherwise, shall be disposed of in accordance with the requirements of the specifications governing the particular question at issue

3. Interpretation of Approximate Estimate

Bidders are cautioned that the estimate of quantities attached to proposal will serve, as far as this Contract is concerned, only for the purpose of comparing bids. The basis of payment will be actual quantities of work performed and accepted, and if, upon the completion of the project the actual quantities will show either increase or decrease from the quantities shown in the approximate estimate, the unit prices mentioned in the proposal will still prevail.

4. Proposal Guaranty

No proposal will be considered unless accompanied by a "Proposal Guaranty" of the character and amount indicated in the proposal form, made payable to the Owner.

5. Public Openings of Bids

Proposals will be opened publicly and read at the hour and on the date set in the "Advertisement for Proposals" or "Notice to Contractors", in the office of the Owner. Bidders or their authorized agents are invited to be present.

6. Material Guaranty

a. Before any contract is awarded, the bidder may be required to furnish a complete statement of the origin, composition and manufacture of any or all materials to be used in the work, together with samples, which samples may be subjected to the tests

provided for these specifications to determine their qualities and fitness for the work.

- b. The Contractor shall notify the Engineer where and when the purchase pipe, joining material, etc., for this contract, and such notice shall be given the Engineer in sufficient time to allow for inspection of such materials at the point of manufacture.

7. Disqualification of Bidders

- a. The following causes will be considered sufficient to disqualify and bidder, and no proposals from disqualified bidders will be considered:
 - i. Interest by the same person in more than one proposal.
 - ii. Collusion among of between bidders.
 - iii. Unbalanced proposals: that is, proposals in which the prices bid for some items are out of all proportions to those bid for others.
 - iv. Lack of responsibility on part of the bidders.

8. Rejection of Irregular Proposals

Proposals that show any omission addition, or item not called for in the Engineer's estimate, or that show irregularities of any kind, shall be rejected. Any proposal which does not contain prices set opposite each of the several items for which there is a quantity in the Engineer's estimate, or any proposal which shall in any manner fail to conform to the conditions of he published notice inviting proposals, shall be rejected.

END OF SECTION

S100.03 AWARD AND EXECUTION OF CONTRACT

1. Award of Contract

The Contract will be awarded or rejected within forty-five (45) days from the opening bids.

2. Bid Bond

The Owners will hold as many of the checks submitted with the proposal as they may deem advisable until the execution and delivery of the contract documents, whereupon they shall be returned. All other checks will be returned as soon as award is made.

3. Contract Bond

The successful bidder will be required to be bonded to the Owners for a sum equal to 100% of the amount of his proposal according to the form of bond attached to the Proposal form.

4. Execution of Contract

The Contract shall be signed by the Contractor and satisfactory Contract Bond furnished within twenty (20) days after he has received notice of award. In Case of failure on the part of the Contractor to enter into contract and furnish Contract Bond as above required, the guaranty accompanying his proposal will become forfeited to the Owners. Award may then be made to the next lowest responsible bidder, or the work re-advertised, or the Owners may proceed in any lawful manner they deem advisable to secure the accomplishment of the work.

5. Service of Notice

The mailing in the United States post office box, of a written communication, notice or order, addressed filed with the Owner, or to his office at the site of the work, shall be considered as sufficient service upon the Contractor of such communication, notice or order, and the date of said service shall be the date of such mailing.

END OF SECTION

S100.04 SCOPE OF WORK

1. Intent of Plans and Specifications

The intent is to prescribe a complete work or improvement which the Contractor undertakes to do in full compliance with the Plans, Specifications, Proposal and Contract, together with any authorized alterations, special provisions and supplemental agreements. The Contractor shall perform all items of work covered and stipulated in the Specifications, Proposal and Contract, together with any authorized alterations, special provisions, extra work and supplemental agreements, all in accordance with lines, grades, cross sections and dimensions shown on the plans. The Contractor shall furnish, unless otherwise provided in these Plans and Specifications, all materials, implements, machinery, equipment, tools, supplies, transportation and labor necessary to the prosecution and completion of the work.

2. Work to be done and material to be furnished by the Contractor

- a. The Contractor shall do all the work and provide all labor, tools, tackle, apparatus, machinery, equipment, transportation, pumping, insurance (both compensation and public liability), and materials except as provided for, necessary to complete the work in all its parts, as shown or called for, or as may be reasonably implied, by the drawings and Specifications. He shall complete the entire work, together with such extra work as may be required, at the prices fixed therefor, to the satisfaction of the Owners and the Engineer and in accordance with the specifications and drawings.
- b. In the event that any materials to be furnished by the contractor is not available in the time it is required and will retard progress of the work, the Owners may or may not furnish such material on a loan basis to the Contractor. In any case the Contractor shall furnish evidence to the Owner that all effort has been made by him to procure the material in time.
- c. It shall be the Contractor's responsibility to procure this material from the Storage Yard designated by the Engineer. The Contractor shall examine and inspect all borrowed material before loading and he shall be responsible for the material after it is taken from the designated yard. All material borrowed by the Contractor shall be replaced by him in accordance with the terms of the loan.

3. Drawings

- a. The contract drawings show the location, dimensions and sizes of the materials, on the lines and slopes, at the depths, with the

connections and the manner in which they are to be placed as called for by the specifications, outlining the work and the materials to be provided for and placed under the contract, or in accordance with such changes as may be approved from time to time during the progress of the work, as hereinafter provided.

- b. The ground profiles shown on the drawings represent the elevations along the center-line of the street for all work in streets and the center-line of trenches for work not in streets. Should the actual elevations differ from those shown, the Contractor shall be entitled to no additional compensation over the unit price bid for the actual depth classifications encountered in the linear foot of pipe trenches, or the actual number of cubic yards excavated. Additional payment will be made on lump sum bids where the actual elevations differ from those shown on the profiles for pipe trenches.

4. Existing utilities shown on drawings

Water mains, storm drains, sanitary sewers, gas mains, and other utilities are shown on the drawings in accordance with the best information available, for the information of the Contractor. The Owners assume no responsibility for accuracy or completeness of information shown. Existing mains and services shall be carefully protected and any damage to them caused by the work, shall be immediately repaired to the satisfaction of the Engineer by the Contractor at his expense, using materials of the kinds damaged.

5. Removal and disposal of structures and obstructions

All structures, materials, or resources within the right-of-way or construction area, which are not to remain in place or have not been designated for use in the construction, shall remain the property of the Owners, and shall be salvaged and stored or otherwise disposed of by the Contractor as hereinafter specified, indicated on the plans, or directed by the Engineer.

6. Making connections to existing structures

The Contractor shall, at his own cost and expense and as part of his work under the contract, furnish all labor, materials, tools, and appliances, and do all work required for making connections to existing storm drain, water or sewer structures, and the cost of making such connections shall be included in the prices bid for excavation and refill and furnishings and laying pipe, unless otherwise specified in the proposal of special provisions.

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7. Construction in rights-of-way
 - a. All permanent construction will be within public right-of-way through private property acquired by the Owners as shown on the drawings, and the Contractor shall confine his operations strictly within the limits of the right-of-way and limits of construction as shown, unless he has the written permission of the Owner of the adjacent property to occupy additional ground. A copy of the written permission shall be placed on file with the Owners. Trees in the limits of construction shall not be cut down except with the written permission of the Owner of the property. Trees marked to be protected in right-of-way or limits of construction shall be barricaded by 2" by 4" boards in a box form 10' square. Trees permitted to be cut down shall be cut to cord length and stacked. Stumps, roots, branches, and other debris shall be removed from the site unless otherwise noted or directed.
 - b. All work through private property shall be done in such manner as to avoid all cutting of vegetation and other disturbances of the terrain not actually necessary in the installation of the storm drain, sewer or water main. Lunch papers shall be promptly disposed of and empty cans, milk bottles, and other empty containers shall not be strewn around or allowed to accumulate on the property. Upon completion of the work, the Contractor shall clean up within the rights-of-way and construction strips and shall restore the surface, shrubbery, fences, and other valuable improvements to at least equal to original condition. The above work is to be included in the contract price bid.
 - c. Any damage to property outside the limits of the rights-of-way or construction strips, as the case may be, shall be made good by the Contractor at his own expense.
 - d. The Owners have not arranged for any means of access to the rights-of-way or construction strips and the Contractor shall, therefore, make his own arrangements in writing for access to the work, and a copy of same shall be furnished to the Owners.
 8. Engineer may Increase or decrease quantities
 - a. The Engineer reserves the right to increase or decrease the quantity of material to be furnished or work to be done under a unit price contract by not more than ten (10) percent of the original bid, wherever he deems it advisable or necessary, and such Increase or decrease shall in no way violate the contract.
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- b. The Contractor will be paid for the actual quantity of authorized work done or material furnished under each Item of the Proposal, at the Unit price stipulated for such item. In case the quantity of any item is increased as above provided, the Contractor shall not be entitled to compensation over and above the unit price bid for such item; and in case the quantity of any item is decreased as above provided, the Contractor shall have no claim for damages on account of loss of anticipated profits because of such decrease.

9. Additional Work

The Contractor shall do such additional work, (other than that designated in the estimate of quantities) as may be deemed necessary to fully complete the work) and shall receive in full payment for such work the prices shown in the proposal or supplemental agreement for similar classes of work in the same manner as if the quantities had been Included In the original estimate of quantities.

10. Extra Work

- a. The Contractor shall do such extra work as may be ordered by the Engineer, in writing, and no claim for extra work shall be considered or allowed unless the said work has been so ordered. The extra work will be paid for, either on the basis of lump sum or unit prices mutually agreed upon by the Contractor and the Owners, or as follows:

Separate itemized statements and itemized bills, covering the extra work done in each month on each order for extra work, shall be delivered to the Engineer before the fifth (5th) day of the following month. To all such bills shall be attached vouchers showing the cost of materials supplied by the Contractor, and have been actually incorporated into such extra work. The Contractor shall permit such examination of his books, vouchers and accounts as the Engineer may require in checking bills for extra work. The amount to be paid the Contractor for extra work shall be made up of the following Items:

- i. Wages of necessary day laborers and foremen actually employed on extra work, for such time as they are so employed, plus twenty-five (25) percent. This 25% shall include and cover all overhead, insurance, workmen's compensation, etc.
- ii. Actual purchase price, as paid by the Contractor, for materials actually incorporated into extra work, plus ten (10) percent •

- iii. Such rental for vehicles, or heavy equipment or machinery while actually and actively used on extra work, as the Engineer shall determine to be reasonable and fair.
- b. Payment for extra work shall not include any allowance for the time of superintendents, timekeepers, water—boys, or of any workmen or foremen not employed upon the extra work in question for a definite and easily ascertainable period, nor for insurance of employees or the public, nor the use, maintenance or repair of tools, nor for the maintenance, operation or repair of machinery, nor office accounting, engineering or administrative expenses, nor any rent, interest, depreciation or bonding cost, nor any other overhead, collateral, or estimated expense, nor any profit; all of which costs shall be deemed to be, and shall be, included in said allowance of twenty-five (25) percent, and ten (10) percent, on labor and material items respectively.
- c. All extra work shall be done as economically and expeditiously as possible, and under sufficient but not disproportionate supervision. Labor shall be charged at the lowest market prices. The Owners may, at their option, furnish any materials required for extra work and the Contractor shall not be entitled to any allowance or percentage on materials so furnished; and likewise the Owners may supply any necessary machinery or equipment, and the Contractor shall not be entitled to any allowance thereupon.
- d. The decision of the Engineer shall be final and binding upon all questions relating to extra work. If he shall deem that any extra work bill is unreasonable or improperly made up in any particular, he shall be empowered to require its revision and adjustment in accordance with such terms as he shall judge to be fair and reasonable.
- e. The Engineer will certify to the Owners for payment, proper bills made out as above provided and submitted before the prescribed date, upon each written order for extra work. Payment, as approved, for the work done under each extra work order completed during any month will be made upon the current estimate for work during any month will be made upon the current estimate for work completed under the contract during that month, and shall be subject to all provisions of the contract relating to the payment of current estimates. Should the work under any extra work order remain uncompleted during any month, payment thereupon shall not be made until the current estimate is paid for the month during which the work under said extra work order is completed. The Contractor shall not be entitled to any claim for interest on any bill for extra work on account of delay in its

approval.

- f. All extra work shall be considered a part of the contract and shall be subject to all the provisions thereof.
- g. In case of neglect or refusal on the part of the Contractor to perform any required extra work, or to make satisfactory progress in its execution, the Contractor shall not interfere with the prosecution of such work by the Owners.
- h. During the progress of extra work the Contractor shall carry forward any or all parts of the work under the contract, or shall suspend any part of the work that may be necessary or required, and no claim by the Contractor for extra compensation shall thereby be allowed. The Contractor, however, shall be entitled to an extension of time, to the extent that the Engineer shall certify that the work under the contract has been delayed by the performance of said extra work, provided that a claim for such extension shall be submitted within the time prescribed for claims of this nature.

11. Omitted Items

Should any Items contained in the proposal be found unnecessary for the proper completion of the work contracted, the Engineer may, upon written order to the Contractor, eliminate such items from the contract and such action shall in no way invalidate the contract, and no allowance will be made for items so eliminated in making final payment to the Contractor except for such actual work as may have been done, materials actually purchased, and actual equipment costs prior to notification of the elimination of the Items.

12. Unauthorized Work

- a. Work done without lines and grades being given, work done beyond the lines and grades shown on the plans or as given, except as herein provided, or any extra work done without written authority, will be considered as unauthorized and at the expense of the Contractor and will not be measured or paid for by the Owners. Work so done may be ordered removed and replaced at the Contractor's expense.
- b. Borrow or any other, materials shall not be obtained from areas adjacent to the work for incorporation therein without written approval by the Engineer, and in no event shall the removal of materials be such as to detract from the uniformity and neatness of the improvements.

- c. All materials obtained contrary to the above restriction shall be considered unauthorized and shall not be measured or paid for, and, further, upon order of the Engineer, in writing all such materials shall be removed from within the limits of the work.

13. Rights in and use of materials found on the work

Except as provided in preceding section, the Contractor, with the approval of the Engineer, may use in the proposed construction, suitable stone, gravel, top soil or sand found in the excavation, but he shall replace at his own expense with other suitable material all of that portion of the material so removed and used as was contemplated for use in the embankment, back-fills, approaches, or otherwise. No charge for material so used will be made against the Contractor except the replacement herein provided for, which item when deductible shall be made from the respective not excavate or remove any material from within the limits of work which is not within the excavation, as indicated by the slope and grade lines, without written authorization from the Engineer.

14. Pipe lines to be kept clean

During the progress of the work and until the completion and final acceptance thereof, pipelines and their appurtenances shall be kept thoroughly clean throughout. Obstructions or deposits, at any time discovered, shall be removed at once by the Contractor without extra compensation. After the completion of the work, the pipeline and their appurtenances shall be left clean, free and in good order.

15. Cleaning up

- a. The Contractor shall, at his own expense, keep the site of his operations clean during construction and remove all rubbish as it accumulates.
- b. On or before the completion of the work, the Contractor shall, without charge therefor, tear down and remove all temporary structures built by him, shall remove rubbish of any kind from any grounds which he has occupied, and shall restore site of the work equal to or better than original condition. Curbs, drains, gutters, sidewalks, roadways, and other surfaces to be in a clean and neat condition.

16. Water Supply

The Contractor shall provide, at his cost and expense, such quantities of clean water as may be required for any and all purposes under the contract. Be shall take particular care to furnish his employees with pure and wholesome drinking water. All sources of water supply shall be subject to

the Engineer by the Contractor five (5) days before beginning work, so that examinations of said supplies can, be made.

17. Sanitary arrangements

Approved sanitary conveniences for the use of laborers and other employed on the work, properly secluded from public observation, shall be constructed and maintained by the Contractor, at his own cost and expense, in such manner and at such points as shall be approved or directed, and their use shall be strictly enforced. The collections in the same shall be disinfected and removed when and as directed.

18. Care and protection of work

From the commencement of the work until its completion and acceptance by the Owners, the Contractor shall be solely responsible for the care of the work, and all injury or damage to the same, by action of the elements or from any other cause, shall be repaired by him at his own expense, before the final estimate is made. He shall provide suitable means of protection for all materials intended to be used in the work in progress, as well as for completed work.

19. Rock shown on drawings

- a. Where rock is shown on the plans it has been so shown from the best information available and it is shown for the information of all parties concerned; however, the Owners assume no responsibility for the accuracy of such information and should any Bidder or Contractor rely on such information in preparing his bid or in the performance of the work, he does so at his own risk.
- b. Whether or not rock is shown on the plans the Contractor is not relieved of the responsibility of making his own investigations to determine for himself if rock is present, where the bid or proposal is at unit prices, the presence or absence of rock or the increase or decrease in quantities of rock shall not entitle the Contractor to additional compensation beyond the unit prices stipulated or bid for rock excavation.

20. Erosion and Sediment Control

- a. The contractor may not engage in any land-disturbing activity until an erosion and sediment control plan has been reviewed and approved. Land-disturbing activities will be inspected and the approved plan must be followed.
- b. There are many techniques to control erosion and sedimentation. The choice of these techniques is left to the person proposing a

land-disturbing activity as long as they meet the basic standards and specifications of the Delaware Erosion and Sediment Control Handbook and are acceptable to the Engineer.

END OF SECTION

S100.05 CONTROL OF WORK AND MATERIAL

1. Supervision and direction of Work
 - A. The work shall be done under the general supervision of the Engineer. While it is intended that the Contractor shall be allowed, in general, to carry on the work under the contract in accordance with such general plan as may appear to him most desirable, the Engineer at his discretion, may, from time to time, direct the order in which, and points at which the work shall be prosecuted, withhold lines, grades and elevations or may exercise such general control over the conduct of the work) at any time or place as in his judgment shall he required to comply with the intent of the specifications or covenants and stipulations therein, or to safeguard the Interest of the Owners and the public, and the Contractor shall have no claim for damages or extra compensation on account of the fact that it was necessary to exercise such control or that lines, grades and elevations had been withheld, or it had been necessary to carry on the work in different sequence from that which the Contractor may have contemplated. The Contractor shall immediately comply with any and all orders and instructions given by the Engineer, but nothing herein shall be considered such an assumption of control over the work by the Engineer as to relieve the Contractor of any of his obligations or liabilities under the contract.
 - B. For projects with a total contract amount in excess of \$500,000, the project superintendent and project manager assigned by the contractor cannot be the same person.
2. Orders to foreman

During the absence of the Contractor from any part of the work where and at such time as it may be necessary or desirable to give directions, said directions may be given by the Engineer to, and they shall be received and obeyed by, the superintendent or foreman who has charge of the particular part of the work concerning which said directions are given. The giving of orders in the manner aforesaid shall be equivalent to their receipt by the Contractor.
3. Lines, Grades, Elevations, etc.
 - a. The Contractor will furnish the field stakeout of all necessary lines, grades, and elevations to complete the work as shown on the plans and Specifications. Such stakeouts must be approved by the Engineer before the Contractor proceeds with construction. If in the judgment of the Engineer, the Contractor is not complying with the intent of the specifications, covenants, and stipulations therein under that Contract, the Contractor will be required to make the

necessary corrections in his stakeout prior to beginning construction. The Contractor shall have no claims for damages or extra compensation due to delays originating from unapproved stakeouts.

- b. The Contractor shall preserve and maintain in proper condition all stakes, grade-boards and lines until authorized to remove same; and in case any such are disturbed by the Contractor's employees, or by his neglect to give them proper protection, those so disturbed shall be reset at the Contractor's expense.
- c. The Contractor shall furnish, all necessary materials, labor and assistance for the setting of all stakes, grade-boards, lines, forms, etc., which may be required for the proper construction of the work.
- d. Finished surfaces, in all cases, shall conform with the lines and grades given as shown on the approved plans. Manhole frames shall be set to conform with the finished grade of the street, or as shown on the drawings.

4. Inspection

- a. (a) The Engineer will appoint such person as he may deem necessary to properly inspect the materials furnished or to be furnished, and the work done under the contract, and to see that the same strictly corresponds with the drawings and specifications; such materials and workmanship shall be always subject to the approval of the Engineer, but no Inspection, approval or acceptance of any part of the work contracted for, or of the materials used or any payment on account thereof, shall prevent the rejection of said work or materials at any time thereafter during the existence of the contract, should said work or materials be found to be defective, or not in accordance with the requirements of the contract.
- b. Work and material will be inspected promptly, but, if for any reason, delay should occur, the Contractor shall have thereby no claim for damages or extra compensation.
- c. The Contractor shall furnish the Engineer with every reasonable facility for ascertaining whether or not the work performed and materials used are in accordance with the requirements and intent of the Specifications and Contract. If the Engineer requests it, the Contractor shall, at any time before acceptance of the work, remove or uncover such portions of the finished work as may be directed. After examination, the Contractor shall restore said

portions of the work to the standard required by the Specifications. Should the work thus exposed or examined prove acceptable, the uncovering, or removing, and the replacing of the covering or making good of the parts removed shall be paid for as extra work, but should the work 50 exposed or examined prove unacceptable, the uncovering or removing, and the replacing of the covering or making good of the parts removed, shall be at the Contractor's expense. No work under this provision shall be done nor materials used without supervision or inspection by the Engineer or his representatives.

- d. The Contractor shall pay for all Inspection costs necessary to complete the work that are incurred by any other agency than the Owners or their duly authorized representatives, such as any railroad, or any public service utility company, or any governmental agency or any other agency whose jurisdiction affects the work in any manner unless otherwise specified herein.

5. Defective Work

Neither the inspection or the supervision of the work, nor the presence or absence of an employee to any part of the work shall relieve the Contractor of any of his obligations under the contract or of making his work conform to the lines, grades and elevations given by the Engineer, and defective or unsuitable materials or workmanship shall be rejected and shall be made good by the Contractor, notwithstanding that such material and workmanship may have been previously overlooked and accepted or estimated for payment. If the worker any part thereof shall be found to be defective or to have been damaged, before the final acceptance of the work, the Contractor shall forthwith make good such defect, or injury, In a manner satisfactory to the Engineer, without extra compensation therefor, even though said defect or injury may not have been due to any act, default or neglect on the Contractor's part.

6. Failure to remove and renew defective materials and work

- a. Should the Contractor fail or refuse to remove and renew any defective materials used, or work performed previously, or to make any necessary repairs in an acceptable manner and in accordance with the requirements of these specifications within the time indicated in writing, the Engineer shall have authority to cause the unacceptable or defective materials or work to be removed and renewed or such repairs to be made or defects corrected at the Contractor's expense.
- b. Continued failure or refusal on the part of the Contractor to make any or all necessary repairs promptly, fully and in an acceptable

manner, shall be sufficient cause for the Owners to declare the contract forfeited. In which case the Owners, at their option, may purchase materials, tools and equipment and employ labor or may contract with any other individual, firm or corporation to perform the work. Any and all cost or expense incurred by the Owners in making these removals, renewals or repairs, which the Contractor has failed or refused to make, shall be charged against the defaulting Contractor and the amount thereof deducted from any monies due or which may become due him under the contract. Any work performed, as described in this paragraph, shall not relieve the Contractor of his responsibility for the work performed by him.

7. Supervision of work

The Owners may suspend the whole or any part of the work under the contract, if in its judgment such action is necessary or advisable. Any claim for such damage shall be subject to the terms of the paragraph entitled "CLAIMS FOR DAMAGE" in Section S100.06.05, Claims for Damage. No allowances, however, will be made for minor interruptions to the work, from whatever cause.

8. Decisions and Explanations by Engineer

- a. The Engineer shall make all necessary explanations as to the meaning and intent of the specifications and drawings, and shall give all orders and directions, either contemplated therein or thereby, or in every case in which a difficult or unforeseen condition arises during the prosecution of the work. Should there be any discrepancies in or between, or should any misunderstanding arise as to the import of anything contained in the drawings and specifications, the decision of the Engineer shall be final and binding. Any errors or omissions on the drawings or in the specifications may be corrected by the Engineer when such corrections are necessary for the proper fulfillment of their intent as construed by him.
- b. The Engineer shall in all cases determine the amount, quality and acceptability of the work to be paid for under the contract, and shall decide all questions in relation to said work. His decision and estimate shall be final and conclusive, and in case any question shall arise between the parties touching the contract, such decision and estimate shall be a condition precedent to the right of the Contractor to receive payment under that part of the contract, which is in dispute.
- c. Decisions and interpretations will be rendered by the Engineer as promptly as possible but should delay occur for any reason, the

Contractor shall have thereby no claim for damages or extra compensation.

9. Alterations of plan or of character of work

The Engineer reserves the right to change the alignment, grade, form, length, dimensions or materials of the work under the contract, whenever any conditions or obstructions are met that render such changes desirable or necessary. All such alterations shall be paid for at a unit price bid for these items of work, except as follows:

In case such alterations make the work less expensive to the Contractor, a proper deduction shall be made from the contract prices and the Contractor shall have no claim on this account for damages or for anticipated profits on the work that may be dispensed with.

In case such alterations make the work more expensive, a proper addition shall be made to contract prices. Any such deduction or addition shall be determined by the Engineer.

10. Coordination of Plans, Specifications, and Special Provisions

These specifications, the accompanying Plans, Special Provisions and all supplementary documents are essential parts of the Contract. They are intended to be mutually supplementary and to describe and provide for a complete work. In case of discrepancy, figure dimensions shall govern over scale dimensions. Plans shall govern over Specifications. Special Provisions shall govern over both Specifications and plans.

11. Cooperation of Contractor Required

The Contractor will be supplied by the Engineer with two copies of the plans and of the specifications, and he shall have available on the work at all times, during the prosecution of the work, one copy each of said plans and specifications. He shall give the work his constant attention to facilitate the progress thereof and shall cooperate with the Engineer in every way possible. He shall at all time have a competent English-speaking representative on the work, authorized to receive orders and act for him.

12. Other Contractors

- a. The Contractor shall, cooperate with and so conduct his operations as not to interfere with or injure the work of other contractors or workmen employed by the Owners. He shall promptly make good, at his own expense, any injury or damage which may be done by him or his employees or agents on the work.

- b. The Contractor shall suspend such part of the work herein specified, or shall carry on the same in such manner, as may be ordered by the Engineer, when necessary to facilitate the work of such other contractors or workmen.

13. Source of Supply and Quality Requirements

- a. The material used on the work shall meet all the requirements of the contract. In order to expedite the inspection and testing of material, the contractor shall promptly notify the Engineer of his proposed sources of material and in no case shall material be incorporated into the project without prior approval. At the option of the Engineer materials may be approved at the source of supply before delivery is started. If it is found after trial that sources of supply for previously approved materials do not produce specified products the contractor shall furnish materials from other sources. No material which, after approval has in any way become unfit for use, shall be used in the work.
- b. The approval of material represented by any sample or samples shall not be considered as an approval of all materials from the same sources, and it shall be understood that all materials delivered on the work are subject to test at any time and will be rejected if they do not meet the requirements of these standard specifications.
- c. All materials shall be inspected, tested and approved before being incorporated in the work and any work in which materials are used without prior test and approval or written permission of the Engineer shall be performed at the contractor's risk and may be considered as defective and unauthorized and will not be paid for. Final acceptance of materials will be made at the latest practicable time the Engineer has the opportunity to check compliance be made by and at the expense of the Owner unless otherwise noted in the contract. Unless otherwise designated, when a reference is made in the specifications to a specification or test designation either of the AASHTO, ASTM, Federal Specifications, or any other recognized national organization, it shall mean the specification or test method (including Interim AASHTO and Tentative ASTM) which is current on the date of advertisement for bids. Samples shall be taken by or under the direction of the Engineer. All materials being used are subject to inspection, test or rejection at any time during the preparation and use.

When, in judgment of the Engineer, inconsequential quantities and uses of materials are required, they may be covered by a field inspection report of materials in lieu of the minimum requirements for sampling materials.

14. Storage of Materials

- a. Materials shall be stored so as to insure the preservation of their quality and fitness for the work.
- b. That portion of the right-of-way not required for public travel may be used for storage purposes and for the placing of the Contractor's plant and equipment, and any additional space required, unless otherwise stipulated, shall be provided by the Contractor at his expense.

15. Defective Materials

All materials not conforming to the requirements of these Specifications shall be considered as defective and all such materials, whether in place or not, shall be rejected and shall be removed immediately from the site of the work, unless otherwise permitted by the Engineer. So rejected material, the defects of which having been subsequently corrected, shall be used until approval has been given. Upon failure on the part of the Contractor to comply with any order of the Engineer made under the provisions of this article, the Engineer shall have authority to remove and replace defective materials and to deduct the cost of removal and replacement from any monies due or to become due the Contractor.

END OF SECTION

S100.06 LEGAL REGULATIONS AND RESPONSIBILITY TO THE PUBLIC

1. Laws to be observed

The Contractor shall at all times observe and comply with all Federal, State and/or local laws, ordinances, rules, and regulation in any manner affecting the conduct of the work, and all such orders or decrees as exist at present and those which may be enacted later, by bodies or tribunals that have any jurisdiction or authority over the work, and shall indemnify and save harmless the Owners, their agents or servants against any claims or liability arising from or based on violations of any such law, ordinance, regulation) order or decree, whether by himself or by his employees.

2. Insurance

a. The General Contractor shall carry all insurances required by law, such as, Unemployment Insurance, Workmen's Comp., etc. He shall carry such Insurance coverage as he desires on his own property, such as, his field office, storage sheds, or building materials on the project site that belong to him. The subcontractors involved with this project shall carry whatever insurance protection they consider necessary to cover the loss of any of their personal property, etc.

The General Contractor shall carry Builder's Risk Insurance to protect the Owner from losses to the partially completed, or completed building, until the Certificate of Substantial Completion, AIA form G704, is signed by the Owner, Contractor and Architect/Engineer.

Upon being awarded the contract, the General Contractor shall obtain a minimum of three copies of each certificate along with the executed contract and contract bonds and submit them to the Owner. The General Contractor shall not allow any of his subcontractors to commence any work on this project until the subcontractors have obtained all their necessary insurance.

The General Contractor shall carry Bodily Injury liability and Property Damage Liability Insurance in addition to the coverage required and shall include:

- i. Coverage for injury to, or destruction of any property arising out of the collapse of, or structural injury to any building or structure, due to excavation, moving, shoring, underpinning, razing, or demolition work.
- ii. Coverage for injury to, or destruction of any property arising out of blasting or explosion.

Evidence of these coverages shall be filed with and approved by the Owner.

- b. Insurance Program Requirements: The Contractor shall, at: his own expense, carry the following forms of insurance:

Public Liability and Automobile Liability Insurance

i. Minimum Coverage

a) Bodily Injury

\$1,000,000 - For injuries, including accidental death to any one person and subject, and subject to the same limit for each person.

\$2,000,000 - Any one accident

ii. Property Damage

a) \$1,000,000 - Any one accident

Policies shall include contingent and contractual liability coverage in the same minimum amount as paragraph A, above. (Contractual Liability coverage will protect the Owner. Contingent Liability will protect the Prime Contractor against claims arising from the activities of the Subcontractors.)

Certificates of Insurance must be filed with the Owner guaranteeing fifteen days' notice prior to cancellation.

Workmen's Compensation (including Employee's Liability

i. Minimum Coverage

a) Minimum limit on Employee's Liability to be \$100,000.

b) Minimum limit for all employees working at one site.

ii. Certificates of Insurance must be billed with the Owner, guaranteeing fifteen days' notice prior to cancellation.

NOTE: The Insurance program requirements as set forth above in Paragraph heading b., sub-paragraphs titled Public Liability and Automobile Liability Insurance and Workmen's Compensation (Including

Employee's Liability), are current State of Delaware, State Insurance Department "Insurance Coverage" requirements.

- c. **Social Security Liabilities:** With respect to all persons at any time employed by or on the payroll of the Contractor, or performing any work for or on his behalf, or in connection with or arising out of his business, the Contractor shall accept full and exclusive liability for the payment of any and all contributions, taxes, unemployment insurance, old age retirement benefits, pensions, or annuities now or hereafter imposed by the Government of the United States and the State or political subdivision thereof, whether the same be measured by wages, salaries, or other remuneration paid to such persons or otherwise.

The Contractor shall furnish the Owner such information on payrolls or employment records as may be necessary to enable it to fully comply with the law imposing the aforesaid contributions or taxes.

If the Owner is required by law and does pay any and/or all of the aforesaid contributions or taxes, the Contractor shall forewith reimburse the Owner for the entire amount, so paid by the Owner.

- d. **Laws, Rules and Regulations:** The contractor shall comply with all laws, rules, and regulations of the State and county and/or local authorities having jurisdiction, as may be applicable affecting the work under this contract, especially the following:

"Legislation Relating to Building in the State of Delaware"

Licenses: Each Contractor and Subcontractor shall be licensed to do business in the State of Delaware and shall pay all fees and taxes due under State Laws. In conformance with Section 2503, Chapter 25, Title 30 of the Delaware Code, the Contractor shall furnish the State Tax Department with a statement of the total values of each Contract and Subcontract, together with the names and addresses of the contracting parties within ten days after award of the Contract. The Contractor, before the payment of any award or amount payable to any Contractor or Subcontractor not a resident of Delaware, shall ascertain from said non-resident Contractor or Subcontractor, and/or the State Tax Department, whether he has obtained a license and satisfied his liability paid by the non-resident Contractor or Subcontractor. The Contractor shall deduct from the award, the amount of said license liability and shall pay same to the State Tax Department within ten days after final payment and settlement with the non-resident Contractor or Subcontractor.

Taxes: All Contractors and Subcontractors shall pay all sales, consumer, use, and other taxes as required of them by law.

Equal Opportunity Employment: The Contractor shall comply with all requirements set forth in Section 6920, Chapter 69, Title 29, of the Delaware Code.

During the performance of this contract the Contractor shall not discriminate against any employee or applicant for employment, because of race, creed, color, sex or national origin. The Contractor shall take affirmative action to ensure that applicants are employed and that employees are treated equally during employment without regard to their race, creed, color, sex, or national origin. Such action shall include, but not be limited to, the following: Employment, upgrading, promotion or transfer, recruitment or recruitment advertising, layoff or termination, rates of pay or other forms of compensation, and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places available to employees, the Applicants for Employment notices to be provided by the Contracting Agency, setting forth this nondiscrimination clause.

The Contractor will state that all qualified applicants will receive consideration for employment without regard to race, creed, color, sex, or national origin. In all solicitations or advertisements for employees placed by or on his behalf.

- e. Preference for Delaware Labor: The Contractor shall comply with all requirements set forth in Section 6913, Chapter 69, Title 39, of the Delaware Code.

In the construction of all public buildings and public works for the State of Delaware or any political subdivision thereof, preference in employment of laborers, workmen, or mechanics, shall be given to bona fide legal citizens of the State of Delaware who have established citizenship by residence of at least 90 days in the State. Each public works contract for the construction of public buildings and public works for the State or any political subdivision, thereof, shall contain a stipulation that any person, company, or corporation who violates this section, shall pay a penalty to the Secretary of Finance equal to the amount of compensation paid to any person in violation of this Section.

- f. Prevailing wages and payroll submission: The Contractor shall comply with all requirements set forth in Section 6912, Chapter 9, Title 29, of the Delaware Code.

All Contracts in excess of \$2,000 for the construction, alteration, and/or repair, including painting and decorating of public buildings and public works with the State of Delaware or any political subdivision thereof, shall contain stipulations for the payment of prevailing wages and submission of payroll reports.

- g. **Prevailing Wage Payment:** All laborers and mechanics of the Contractor and all subcontractors employed to perform work directly upon the site of the work, shall be paid unconditionally and not less often than once a week, without subsequent deduction or rebate on any account, the full amounts accrued at the time of payment computed at wage rates not less than those determined by the Division of Labor, State of Delaware, and the Federal Wage Rate Regulations as the prevailing rate in the project area. In the event of differing Federal and State Wage requirements for the same trade, the higher of the two will govern.

It is stipulated that there may be withheld from the Contractor such accrued payments as may be considered necessary the Contracting Officer to pay laborers and mechanics employed by the Contractor or any Subcontractor on the work, the difference between the published Prevailing Wage Rate incorporated in these Contract Documents and the rate of wages received by such laborers and mechanics and not refunded to the Contractor, Subcontractor, or their agents.

- h. **Payroll Submission:** In accordance with Executive Order So. 31 of the State of Delaware, dated December 10, 1963, each Contractor and Subcontractor must forward in duplicate to the State of Delaware, Department of Labor, Division of Industrial Affairs, all payroll data as hereinafter noted relative to each and every employee engaged on this project.

The following information shall be furnished weekly to the Contracting Agency by every Contractor or Subcontractor In the form of sworn copies of payrolls.

- i. Identification of the contract.
- ii. Payroll period covered.
- iii. Name of contractor or subcontractor.
- iv. For each worker listed on the payroll:
 - a) Name of worker.
 - b) Job classification or classifications at which he was employed during the payroll period
 - c) Hourly rate paid for work at such classification or classifications.
 - d) Number of hours worked at such classification or

classifications.

v. Notarization of payroll record.

3. Patent Fees, Royalties and Licenses

Whenever any materials, process, composition or thing used in the work done or materials furnished, under the contract, are covered by Letters Patent, the Contractor, before using or employing such material, process, composition or thing, must secure the assent in writing of the owner or licensee of such Letters Patent and file same with the Engineer. In the event that the Contractor shall fail to obtain such prior consent, he and his Surety Bond given for the faithful performance of his work under the Contract, shall be liable to the Owners for any and every claim, suit or demand brought against the Owners by reason of any default or neglect of the Contractor to obtain the assent in writing of such owners or licensees of such Letters Patent.

4. Permits and Licenses

- a. Such permits, licenses, insurance policies, etc., as may be necessary in order to comply with Federal, State or local laws in conducting the work, shall be provided by the Contractor at his own expense, except as herein provided.
- b. The Owners have or will obtain a permit for any work within State highways and the Contractor shall perform all work in accordance with the requirements of this permit and to the satisfaction of the Engineer.

5. Claims for Damages

- a. If the Contractor shall claim compensation for any damage sustained by reason of the acts of the Owners, or any official or agent thereof, he shall within five (5) days after sustaining of such damage make a written statement to the Engineer of the nature of the damage sustained, and shall, on or before the fifth (5th) day of the month succeeding that in which he shall allege that such damage has been sustained, file with the Engineer an itemized statement of the details and amount of such damage.
- b. Whenever it shall appear to the Contractor that, due to the exigencies of the work, he is about to incur damage, owing to the neglect or refusal of the Engineer to issue an extra-work order or to any other cause whatever, he shall at once notify the Engineer or his representative in writing, of such fact and state the nature of his possible claim, in order that the Engineer may obtain necessary and authentic information to guide future consideration and action

on such claim; and unless the Contractor shall comply with this requirement his claim for damage shall be forfeited and invalidated. Such notifications shall not take the place of, but shall be in addition to, written Statement hereinabove required to be submitted within five (5) days after the occurrence of and alleged cause for damage.

- c. In any case where the Contractor deems extra compensation is due him for work or materials not clearly covered in the contract, or not ordered by the Engineer as an extra, as defined herein, the Contractor shall notify the Engineer in writing of his intention to make claim for such extra compensation before he begins the work on which he bases the claim. If such notification is not given, or the Engineer is not afforded proper facilities by the Contractor for keeping strict account of actual cost, then the Contractor hereby agrees to waive claim for such extra compensation. Such notice by the Contractor, and the fact that the Engineer has kept account of the cost as aforesaid, shall not in any way be construed as proving the validity of the claim. The claim must be passed upon by the Engineer. In case the claim is found to be just, it shall be allowed and paid as an extra as provided for herein for extra work under Section 100.04.10.

6. Public convenience and safety

The Contractor at all times shall conduct the work in such a manner as to ensure the least obstruction to traffic practicable. The convenience and services of the general public and of the residents along and adjacent to the improvements shall be provided for in an adequate and satisfactory manner. Material stored along the improvement shall be placed so as to cause as little obstruction to the traveling public as is considered necessary. The contractor shall, unless otherwise specified, provide and maintain in passable condition such temporary highways and bridges as may be necessary to accommodate the traffic diverted from the roadbed affected by the construction, and shall provide and maintain in a safe condition temporary approaches to, and crossings of intersecting highways. On highways occupied by railway tracks, temporary platforms for the entrance and exit of passengers to and from the railway cars shall be provided and maintained in an approved manner by the Contractor. Fire hydrants on or adjacent to the improvement shall be kept accessible to fire apparatus at all times, and no material or obstruction shall be placed within five (5) feet of any such hydrant. All footways, gutters, sewer inlets and portions of highways adjoining the work under construction shall not be obstructed more than is absolutely necessary. Work closed down for the winter and at all other times shall be left entirely accessible at all points to fire apparatus. Detour routes over existing public roads will be marked and maintained by the Owner.

7. Use of Explosives

The use of explosives will not be permitted adjacent to or on existing structures unless authorized in writing by the Engineer. When the use of explosives is permitted, the Contractor shall use the utmost care so as not to endanger life of property, and whenever necessary, the number of charges and size of the charge shall be reduced. Expert powder men shall be required in the handling and use of explosives. All explosives shall be stored in a secure manner and all such storage places shall be marked clearly - "Dangerous Explosives", and shall be in care of competent watchmen at all times. Explosives shall be stored and handled in conformity with the provisions of the Statutes of the State of Delaware.

8. Traffic controls for construction and maintenance operations

- a. The purpose of traffic control devices is to help ensure highway safety by providing for the orderly and predictable movement of traffic and to provide such guidance and warnings as are needed for safe operation of vehicles.
- b. Because of a recognized need for reasonable nationwide uniformity and consistency in traffic control devices, a manual on uniform traffic control devices (MUTCD) has been developed by the Federal Highway Administration, and has been adopted by DELDOT. These standards are applicable to municipal roads and streets.
- c. The Delaware DOT has developed and adopted a separate publication entitled "Traffic Controls for Street and Highway Construction and Maintenance."
- d. The contractor shall be responsible to follow the Delaware DOT standards and provide sufficient amber lights on or near the work and keep them burning from twilight to sunrise, erect suitable railings, barricades, detour signs, danger signals or signs, as may be necessary for the public safety and for the prevention of accidents.
- e. The contractor shall obtain permission from the Fire Department and Police Department for any street or highway to be closed due to his work. Upon approval of this permission, the contractor shall send notice of time and place; barricades, etc. will be placed, so that all concerned can make the necessary arrangements and precautions to protect the public.

9. Preservation and restoration of property, trees, monuments, etc.

The Contractor shall not enter upon private property for any purpose without obtaining permission, and he shall be responsible for the preservation of all public and private property, trees, monuments, etc., along and adjacent to the work and shall use every precaution necessary to prevent damage or injury thereto. He shall use suitable precautions to prevent damage to tracks or pipes, conduits and other underground structures, and shall protect carefully from disturbance or damage all land monuments and property marks until an authorized agent has witnessed or otherwise referenced their location and shall not remove them until directed, and replacement of same shall be borne by the Contractor. The Contractor shall not willfully or maliciously injure or destroy trees or shrubs, and he shall not remove or cut them without proper authority. He shall be responsible for all damage or injury to property of any character, during the prosecution of the work, resulting from any act, omission or misconduct in his manner or method of executing said work or due to the non-execution thereof on the part of the Contractor; he shall restore, at his own expense, such property to a condition similar or equal to that existing before such damage or injury was done, by repairing, rebuilding or otherwise restoring, as may be directed, or he shall make good such damage or injury, in an acceptable manner. In case of the failure on the part of the Contractor to restore such property, or make good such damage or injury, the Engineer may, upon forty-eight (48) hour notice, proceed to repair, rebuild or otherwise restore such property as may be deemed necessary, and the cost thereof will be deducted from the monies due or which may become due the Contractor under his contract.

10. Indemnification of Owners

The Contractor shall indemnify and save harmless the Owners from all suits, actions, damages, or costs, of every nature and description, to which the Owners may be subjected or put by reason of injury to persons or property as a result of the work, whether caused by negligence or carelessness on the part of the Contractor, his servants or agents, or to other causes; and so much of the monies due or to become due the Contractor under the contract, as may be considered necessary by the Owners, shall be retained until such suits or claims for damages shall have been settled or otherwise disposed of and satisfactory evidence to that effect furnished to the Owners.

11. Right of Recovery

The Owners shall not, nor shall any employees thereof, be precluded or estopped by any return or certificate made or given by the Owners or any of their employees, under any provision of the Contract, from showing the true and correct amount and character of the work done and materials furnished by the Contractor or any other person under the contract, at any time before or after the final completion and acceptance of the work and

payment therefor, pursuant to any such return or certificate; or from showing at any time that any such return or certificate is untrue and incorrect or improperly made in any particular, or that the work, or any part thereof, does not in fact conform to the specifications and drawings, and the Owners shall not be precluded or estopped, notwithstanding any such return or certificate and payment in acceptance therewith, from demanding and recovering from the Contractor such damages as it may sustain by reason of his failure to comply with the terms of the contract.

12. Waiver of Contract

Neither the acceptance of the whole or any part of the work by the Engineer or the Owners, or any of their employees, nor any order, measurement or certificate by the Engineer, nor any order by the Owners, for the payment of money, nor any payment by the Owners for the whole or any part of the work, nor any extension of time, nor any possession taken by the Owners on their employees, shall operate as a waiver of any portion of the Contract or of any power therein reserved to the Owners, or any right to damage therein provided, nor shall any waiver of any breach of the contract be held to be a waiver of any other or subsequent breach.

END OF SECTION

S100.07 PROSECUTION AND PROGRESS

1. Time of Beginning and Completion
 - a. The Contractor shall begin work on the contract within the time stated therein and shall diligently prosecute the same, so that it shall be fully completed within the number of days stated in the proposal and contract.
 - b. In connection with the improvement, the right is reserved to award any work not included in the contract to another contractor for performance during the progress of the contract, or to perform such work by Owners forces, and the Contractor for this contract shall cooperate and so conduct his operations as to minimize the interference therewith.

2. Extension of Time
 - a. If the amount of work done under the contract is greater than indicated by the statement of quantities in the Proposal, or if the Contractor is materially obstructed or delayed in the prosecution of the work, by delays on the part of the Owners in furnishing such materials or facilities as are required to be furnished by them, or any other circumstance, causing delay beyond the Contractor's control, the Contractor shall be entitled to such extension of the contract time for the completion of the work as the Engineer shall certify, in writing, to be just and equitably proper, provided, and provided only, that a claim for such extension shall be made by the Contractor by a written request sent to the Engineer within ten (10) days after the date when such alleged cause for extension of time occurred. All such claims shall state specifically the amount of delay that the Contractor believes himself to have suffered. If said statement thus made out is not received within the prescribed time, the claim for extension of time shall be forfeited and invalidated. No allowance will be made in money due to the delay on the part of Owners other than an extension of time as herein provided for.
 - b. No extension, of time will be granted for ordinary delays, weather conditions or minor accidents.

3. Sub-Letting and Assignment

The Contractor shall give his personal attention to the contract and shall keep the same under his own control, and shall not sublet, sell, transfer, assign, or otherwise dispose of, the contract, or any portion thereof, or of the work provided for therein, or of his right, title or interest therein, to any person, firm or corporation without the written consent of the Owners. The Contractor shall not, either legally or equitably, assign any monies

payable under the contract, or his claim thereto, except with the consent of the Owners.

4. Workmanship

- a. Only first-class work shall be performed and all materials furnished in carrying out the contract shall be of character and quality required by the specifications. Where no standard is specified for such work or materials, they shall be the best of their respective kinds. Any unsatisfactory work done or materials furnished, at whatever time they may be discovered, shall be immediately removed and satisfactorily replaced by the Contractor, when notified to do so by the Engineer. If the Contractor shall neglect or refuse to remove such unsatisfactory work or material within forty-eight (48) hours after the receipt of the above-mentioned notice, or if he shall not make satisfactory progress in doing so, the Engineer may cause said work or material to be removed and satisfactorily replaced, by contract, or otherwise, and the expense thereof shall be charged to the Contractor. Such expense shall be deducted from any monies due or to become due the Contractor under the contract. Upon the completion of the contract, the entire work shall be delivered to the Owners perfect and complete in a satisfactory working condition.
- b. Work and materials which are necessary in the construction, but which are not specially referred to in the specifications or shown in the drawing but implied by the contract, shall be furnished by the Contractor at his own cost and expense, and shall be such as will correspond with the general character of the work as may be determined by the Engineer whose decision as to the necessity for and character of such work and materials shall be final and conclusive.

5. Only Competent Labor Shall Be Used

Only competent labor shall be used. Any employee of the Contractor who shall use profane or abusive language to the Inspector or other employees of the Owners, or is otherwise disorderly and interferes with him in the performance of his duties, or who shall disobey or evade his instructions, or who is careless and incompetent, shall be discharge from the job on the request of the Engineer and shall not again be employed on the job except with the Engineer's consent.

6. Abandonment of or delay in work

If the work under the contract shall be abandoned by the Contractor, or if at any time the Engineers shall be of the opinion, and shall so certify in writing to the Owners, that the performance of the contract is

unnecessarily or unreasonably delayed, or that the Contractor is violating any of the provisions of the contract or is executing the same in bad faith, or if the work be not fully completed within the time named for its completion, together with such extension of time as may have been granted, the Owners, by written notice, may order the Contractor to discontinue all work thereunder, or any part thereof; and thereupon the Contractor shall discontinue the work, or such part thereof, and the Owners shall have the power, by contract, or otherwise, to complete said work and deduct the entire cost thereof from any monies due or to become due the Contractor under the contract. For such completion of the work, the Owners may for themselves or their contractors, take possession of and use or cause to be used any or all materials, tools, machinery and appliances found on the line of said work. When any part of the contract is being carried on by the Owners as herein provided, the Contractor shall continue the remainder of the work in conformity with the terms of the contract, and in such manner as not to interfere with the workmen employed by the Owners.

7. Default or failure to complete work on time

Should the Contractor fail to complete fully the work as shown on the contract drawings in accordance with the specifications, under the contract and within the time specified, the Engineer shall determine the number of days that the Contractor is in default in completing the work under the contract and shall certify the same to the Owners in writing. For each day so certified, the Contractor shall pay the Owners the sum stipulated in the Proposal and the Contract for each and every day thereafter, until and including the day when the said work shall be completed to all intent and purposes, as set forth in the Proposal under the contract and the specifications, in an acceptable manner and to the satisfaction of the Engineer, which sum is agreed upon, not as a penalty, but as liquidated damages which the Owners shall, suffer by reason of such default; however, the Owners may, as hereinafter provided, extend the time for the completion of the work beyond the contract time. The Owners shall be fully authorized and empowered to deduct and retain the amount of any damages determined, as hereinbefore stipulated, for each day that the Contractor shall be in default in completing the work after the time fixed under the contract, or for any later date to which the time of completion may have been extended, from any monies due or to become due the Contractor under the contract, at any time after such damages are so incurred, provided, however, that the Owners may extend the time for the completion of the work beyond the contract time. The permitting of the Contractor to finish the work after the time fixed for its completion or after the date to which the time for completion may have been extended, shall not in any wise operate as a waiver on the part of the Owners of any of their rights under the contract.

END OF SECTION

S100.08 MEASUREMENT AND PAYMENT

1. General

Unless specifically indicated otherwise by the Owner all work shall be paid for on a lump sum basis.

- a. Paving Contracts - This lump sum payment shall Include clearing and grubbing, demolition and disposal of existing structures, relocation of City owned utilities, removal and replacement of existing sidewalks, shrubbery, driveways, poles, mail boxes, signs, or any other existing objects which are required to be restored to complete the work, and all new work such as grading, the preparation of subbase, paving, storm drainage, curb and gutter, sidewalks, shoulder treatment, fine grading, seeding, fertilizing, and mulching and any other operations required to complete the work.
- b. Utility Contracts - (Sewer, Water and Storm Drain) - This lump sum payment shall Include clearing and grubbing, relocation of existing City owned utilities, removal and replacement of existing sidewalks, shrubbery, driveways, poles, mail boxes, signs, or any other existing objects which are required to be restored to complete the work, and all new work such as trench excavation and backfill, furnishing and laying pipe, furnishing of materials and construction of manholes, vaults, headwalls, bends, wye branches, and any other structures incidental to the work, excavation of unsuitable material below subgrade, furnishing and placing of suitable material and all other operations required to complete the work.
- c. Unit Price Contracts where directed shall be paid for by measurements of all quantities of work and material by the Engineer according to the specifications and drawings and the working-lines that may be given. No allowance will be made for any excess above the quantities required by the specifications, drawings and lines on any part of the work, except where such excess material has been supplied or work done by written order of the Engineer and in the absence of default or negligence on the part of the contractor. Should the dimensions of any part of the work or of the materials be less than those required by the drawings or the directions of the Engineer, only the actual quantities placed will be allowed in the measurements.

Where unit price contracts are directed, following the completion of the work and before final payment is made therefor, the Engineer shall make final measurements to determine the quantities of various items of work

performed as the basis for final settlement. The Contractor, in case of unit price items, will be paid for the actual amount of work performed and for the actual amount of materials in place, in accordance with these specifications as shown by the final measurements. All work contemplated under the contract shall be measured by the Engineer according to the standards of weight and measures recognized by the National Bureau of Standards.

Measurements for items paid for on the basis of linear or surface area shall be along and parallel to the actual lines and surfaces on the roadway or structures, and no deduction shall be made for fixtures in roadway surfacing having an area of nine (9) square feet or less. In computing volumes, the method of average end areas will be used for excavation, embankments and removal of existing masonry and the prismoidal formula for new masonry. The pay weight for all items to be paid for by weight shall be determined by actual certified scale weight, certified shipping weight or by computed weight as hereinafter specified and no allowance for overrun, other than designated herein, shall be made.

Materials specified for measurement by tallying of vehicles having predetermined carrying capacity shall be hauled only in approved units, struck off at the top of the carrying unit or to permanent lines at the loading point and tallied at the point of delivery. Unless all vehicles have uniform carrying capacity, each hauling unit shall be marked identifying the approved capacity.

Bituminous material shall be measured on the basis of a gallon, which amount shall be determined from shipping invoices, tank cars and distributor measurements with the temperature at 60 degrees Fahrenheit of converted to this temperature from loading temperatures in accordance with the A.S.T.M. Specifications D-206, unless otherwise specified.

In the volumetric measurements of the "Tamped Fill" over pipe, "Masonry" and "Stone Backfill" around pipe, deduction shall be made for the volume occupied by the pipe.

In the measurement of pipe whenever special fittings are used, for which a separate item price is set up, the accumulative linear measurement occupied by these fitting shall be deducted from the total linear measurement of pipe placed.

2. Monthly Estimates

- a. The Engineer shall, except In the month following that during which the work under the contract is completed, as soon as possible after the fifth day of the month, make In writing an estimate, such as he shall believe to be just and fair, of the amount

of work done under each item of the contract during the next proceeding calendar month, such estimate shall not be required, to be made by strict measurements, but may be approximate only, and shall be subject to correction in later estimates. Monthly estimates shall not contain any allowance for materials delivered upon the site of the work but not incorporated therein, and the Contractor shall not be entitled to receive any payment therefor.

- b. Upon the Owner's approval of each monthly estimate, it will pay to the Contractor ninety (90) per cent of the total amount of the estimate; provided, however, that the Owners may retain out of such payment any or all sums which, by the terms of the contract, or of any law of the State of Delaware in force at the date of signing the contract, it is authorized to retain. Payment on monthly estimates may be at any time withheld if, in the judgment of the Engineer, the Contractor is not complying with the terms of the contract. In no case shall the withheld amount be less than five hundred dollars (\$500.00).

3. Final Estimate

- a. When the Engineer shall deem that the Contractor shall have fully completed the work under the contract, he shall make a written final estimate, based upon actual inspection and/or measurement, of the whole amount of authorized work done by the Contractor, and the value thereof under the terms of the contract, and shall certify to the Owners the completion of the work and the amount of the final estimate. All monthly estimates are subject to correction in the final estimate. The Engineer's measurements, upon which the final estimate is based, shall be deemed to be, and shall be) final and conclusive.
- b. Upon approval of the final estimate, the Owners will notify the Contractor, in writing, of the conditional acceptance of the work and transmit to him a copy of the estimate. Out of the amount representing the total of the final estimate, the Owners will deduct ten (10) per cent, which shall be in addition to any and all other amounts which under the contract It is entitled or required to retain, and shall hold said sum for a period of twelve (12) months from and after the date of payment of the final estimate, as herein below stipulated. Such part as may be necessary, or all, of said retained sum shall be applied to any expense to which the Owners may be subjected, during the said period of twelve (12) months, in repairing any defects found in the work under the contract which may be deemed to have been caused by failure of the Contractor to comply with the terms of the contract; or to any breach of the contract whatsoever on the part of the contractor. The Owners

shall be empowered to make any required repairs or renewals during said period, without notice to the Contractor, if they shall judge such action to be necessary, or if after notice, the Contractor shall refuse or neglect to do said required work or make satisfactory progress thereon within such period as the Engineer shall consider necessary or reasonable.

- c. Within fifteen (15) days after the approval of the final estimate, the Owners will pay to the Contractor the amount remaining after deducting from the total amount of the final estimate all such sums as have heretofore been paid to the Contractor under the provisions of the contract, and also such amounts as the Owners have or may be authorized under the contract to reserve or retain.

4. Final Acceptance and Payment

Upon the expiration of the aforesaid period of twelve (12) months succeeding the payment of the final estimate, as above stipulated, the Engineer will make a final inspection of all work under the contract, and upon final acceptance the Owners will pay the Contractor all sums reserved or retained, less such amounts as it may be empowered under the provision of the contract permanently to retain.

5. Evidence of Payment

The Contractor shall furnish the Owners with satisfactory evidence, before or within ten (10) days after the final completion and acceptance of the whole work under the contract, that all persons, partnerships and corporations who have done work or furnished materials under the contract, or in or about the work contracted for, and who have given written notice to the Owners of claims against the Contractor on account thereof, have been fully paid or secured. In the event such evidence is not furnished by the Contractor, such amount as may be deemed necessary by the Owners to pay such claims may be retained by the Owners out of any money due the Contractor under the contract until such claims shall have been fully discharged or such notice withdrawn. The Owners may also, with the written consent of the Contractor, use any money retained, due or to become due under the contract, for the purpose of paying for both labor and material for the work, for which claims have not been filed with the Owner.

6. Maintenance Bond

At any time after the approval of the final estimate the Contractor may furnish a Maintenance Bond in favor of the Owners in the amount which would otherwise be retained by the Owners. Such bond shall be in a form and with a surety approved by the Owners, binding the Contractor as

principal and the surety to promptly and properly replace any improper work or materials that may become apparent within a period of twelve (12) months following the conditional acceptance of the work. Upon acceptance by the Owners of such a bond, the sum retained by the Owners will be paid to the Contractor.

7. Termination of the Owner's Liability

The acceptance by the Contractor of the final payment, made as aforesaid, shall operate as and be a release to the Owners and every officer and agent thereof, for all claims by and liabilities to the Contractor for anything done or furnished for or relating to or affecting the work under contract.

END OF SECTION

DIVISION 200 EARTHWORK

The **Description, Materials, Construction Methods, Method of Measurement, and Basis of Payment** for the items as mentioned in the Table below shall be as set forth in the **following Sections** of the Standard Specifications for Road and Bridge Construction for the Delaware Department of Transportation dated August 2016 or as later amended, unless otherwise noted below or as directed by the engineer.

SECTION	ITEM
201	CLEARING AND GRUBBING
202	EXCAVATION AND EMBANKMENT
203	CHANNEL EXCAVATION
204	TEST HOLES
205	RESERVED
206	RESERVED
207	STRUCTURAL EXCAVATION AND BACKFILLING
208	FLOWABLE FILL
209	BORROW
210	RESERVED
211	REMOVAL OF STRUCUTRES AND OBSTRUCTIONS AND EXISTING PORTLAND CEMENT CONCRETE PAVEMENT, CURB AND SIDEWALK
S280	TRENCH SAFETY

S280 Trench Safety

All trenches or excavations over five (5) feet deep shall be supported by one of the following methods: sheathing, shoring, bracing, trench box, or the slope shall be cut back as required to comply with MOSAH and OSHA.

END OF SECTION

DIVISION 300 BASES

The **Description, Materials, Construction Methods, Method of Measurement, and Basis of Payment** for the items as mentioned in the Table below shall be as set forth in the **following Sections** of the Standard Specifications for Road and Bridge Construction for the Delaware Department of Transportation dated August 2016 or as later amended, unless otherwise noted below or as directed by the engineer.

SECTION	ITEM
301	GRADED AGGREGATE BASE COURSE
302	STONE

DIVISION 400 BITUMINOUS MATERIALS

The **Description, Materials, Construction Methods, Method of Measurement, and Basis of Payment** for the items as mentioned in the Table below shall be as set forth in the **following Sections** of the Standard Specifications for Road and Bridge Construction for the Delaware Department of Transportation dated August 2016 or as later amended, unless otherwise noted below or as directed by the engineer.

SECTION	ITEM
401	BITUMINOUS PAVEMENT
402	BITUMINOUS PAVEMENT MATERIALS, PATCHING
403	BITUMINOUS PAVEMENT FOR TEMPORARY ROADWAY MATERIAL (TRM)
S410	PAVEMENT SECTION DESIGN STANDARD
S411	ROAD INSPECTION PROCEDURES
S412	ROADWAY SAFETY
S413	ROAD RESTORATION PROJECTS - GENERAL CONTRACT PLAN NOTES
S414	ROADWAY PATCHING (SUPPLEMENT TO SECTION 406)

END OF SECTION

S410 PAVEMENT SECTION DESIGN STANDARD**S410.01 Description**

The paving of all streets and entrances to driveways and parking areas within the Town of Smyrna right-of-way shall be constructed as shown on the final approved plan and in accordance with the following standards.

S410.02 Street Design and Construction Requirements

All streets shall be constructed, both in materials and methods, in accordance with this specification. Unless specifically stated herewith, all construction shall be in accordance with the Standard Specifications for Road and Bridge Construction for the Delaware Department of Transportation dated August 2016 or as later amended. Wearing (Surface) Course shall be Warm Mix Asphalt Superpave – 9.5 mm and Binder Course shall be Warm Mix Asphalt Superpave – 12.5 or 19.00 mm, unless specified and approved on the plans.

S410.03 Minimum Slope Requirements

The minimum lateral cross slope for all streets shall be 2.0% as measured from the centerline of the street to the edge of pavement. The minimum longitudinal slope, as measured along the centerline of the street, shall be 0.50%.

S410.04 Soils Investigation Requirements

2. A soils investigation performed by a geotechnical engineer registered in the State of Delaware with experience in pavement engineering shall be required for the pavement design of all proposed streets within any subdivision that are designed utilizing the good soil conditions as shown in section S410.05. Boring locations, sampling procedures and method of testing shall be approved by the Town of Smyrna. Pavement designs based on poor soil conditions do not require a soil investigation. However, the Developer shall be responsible for stabilizing all weak and wet subgrade and installing underdrains prior to construction of the crushed aggregate base course.
3. At a minimum, at least one (1) boring for every 300 linear feet of street, with a minimum of three borings for each proposed street. The spacing of the borings shall be relatively uniform and alternate from one side of the street to the other side. Borings shall be within the area of the proposed street and be located in such a manner that all questionable areas (i.e. depressions, wet/weak areas, old streambeds, etc.) are investigated. Typical soil borings shall be made to a depth (at least four (4) feet below the subgrade of the proposed pavement system) adequate to sample soils. If extremely poor soils are discovered or anticipated to be below the minimum sampling depth (4' below the subgrade), the soil borings shall continue in order to determine the extent of the weak layer. The total

sampling depth required shall be determined by the geotechnical engineer and approved by the Town of Smyrna. The Town of Smyrna reserves the right to make a verification survey as part of the review of the Developer's investigation work.

4. Results of the soil investigation submitted to the Town of Smyrna shall include:
 - a. A plan view of the proposed subdivision streets showing all boring locations.
 - b. Boring logs containing the required data specified below.
 - c. Particle size (sieve) analysis and Atterberg Limits for all soil samples taken.
 - d. AASHTO soil classification for each foot of boring taken.
 - e. A profile view of each proposed street with borings plotted to scale showing AASHTO classification of soils encountered.

Testing: Soils testing shall be in accordance with the latest procedures found in the Delaware Department of Transportation Materials and Research Materials Manual.

Boring Logs: A log of each boring shall be kept, recording the following information:

- a. Name of Street
- b. Location of boring-station and offset
- c. Surface elevation referenced to the proposed roadway grade
- d. Date of boring
- e. Depth of each stratum
- f. Sample number
- g. Soil description
- h. Depth of water, if encountered

Water Level: When water is encountered, borings shall be left open until water level stabilizes and then the depth of water shall be recorded.

5. Whether the Developer utilizes good or poor soils for the pavement design, if weak or wet areas are suspected or encountered during construction, the Town of Smyrna reserves the right to require additional borings and testing. Underdrains shall be installed to drain wet areas. If the soils are found to be extremely weak with a soil resilient modulus less than 3400 psi, the Town of Smyrna reserves the right to require an in-depth soils strength analysis and a specific pavement design that will satisfactorily address the specific situation.
6. In the event that streets are to be constructed in areas that require the

removal of unsuitable material, the Town of Smyrna reserves the right to request an investigation to determine the extent of the unsuitable material to be removed.

S410.05 Pavement Construction Material and Thickness Requirements

1. Pavements shall be designed based on the soil conditions and the number of residential units or building floor space for commercial and industrial developments. All proposed streets shall be constructed, at a minimum, to the required type of materials and thickness of layers as specified in the tables below. If any street is expected to serve additional traffic in the future, such as an extension to a future development or tie-in to another development, the anticipated future increase in traffic shall be incorporated into the design.
2. All soils that clearly fall within the A-1, A-2 and A-3 AASHTO soils classifications shall be considered Good Soils. All soils that fall within the A-4, A-5, A-6 and A-7 AASHTO soils classifications shall be considered Poor Soils.
3. For developments larger than 500 residential units or 2,000,000 square feet of industrial/commercial building space, the Developer shall contact the Town of Smyrna for pavement design requirements necessary to meet the specific situation.
4. The finished pavement section shall include a minimum of four (4) inches of bituminous concrete (includes wearing course and binder course).

Minimum Material Type and Layer Thickness Requirements

Residential Street: Up to 50 Units

Pavement Layer	Good Subgrade Soil	Poor Subgrade Soil
Wearing (Surface) Course	2 in.	2 in.
Binder Course	3 in.	2 in.
Bituminous Concrete	---	2 ½ in.
Aggregate Subbase	8 in.	8 in.
Structural Number	3.12	3.52
Geotextile Separator	Yes	Yes

Residential Street: 51 to 100 Units

Pavement Layer	Good Subgrade Soil	Poor Subgrade Soil
Wearing (Surface) Course	2 in.	2 in.
Binder Course	2 ½ in.	2 ½ in.
Bituminous Concrete	2 in.	2 ½ in.
Aggregate Subbase	8 in.	8 in.
Structural Number	3.56	3.72
Geotextile Separator	Yes	Yes

Residential Street: 101 to 200 Units

Pavement Layer	Good Subgrade Soil	Poor Subgrade Soil
Wearing (Surface) Course	2 in.	2 in.
Binder Course	2 ½ in.	2 ½ in.
Bituminous Concrete	2 ½ in.	3 in.
Aggregate Subbase	8 in.	8 in.
Structural Number	3.72	3.88
Geotextile Separator	Yes	Yes

Residential Street: 201 to 300 Units

Pavement Layer	Good Subgrade Soil	Poor Subgrade Soil
Wearing (Surface) Course	2 in.	2 in.
Binder Course	2 ½ in.	2 ¼ in.
Bituminous Concrete	2 ¾ in.	4 in.
Aggregate Subbase	8 in.	8 in.
Structural Number	3.80	4.10
Geotextile Separator	Yes	Yes

Residential Street: 301 to 500 Units

Pavement Layer	Good Subgrade Soil	Poor Subgrade Soil
Wearing (Surface) Course	2 in.	2 in.
Binder Course	2 ½ in.	3 in.
Bituminous Concrete	3 ½ in.	4 in.
Aggregate Subbase	8 in.	9 in.
Structural Number	4.04	4.54
Geotextile Separator	Yes	Yes

Industrial/Commercial Street: Up to 100,000 Sq. Ft. Building Space

Pavement Layer	Good Subgrade Soil	Poor Subgrade Soil
Wearing (Surface) Course	2 in.	2 in.
Binder Course	2 ½ in.	2 ½ in.
Bituminous Concrete	2 in.	2 ½ in.
Aggregate Subbase	8 in.	8 in.
Structural Number	3.56	3.72
Geotextile Separator	Yes	Yes

Industrial/Commercial Street: 101,000 to 250,000 Sq. Ft. Building Space

Pavement Layer	Good Subgrade Soil	Poor Subgrade Soil
Wearing (Surface) Course	2 in.	2 in.
Binder Course	2 ½ in.	2 ¼ in.
Bituminous Concrete	2 ½ in.	4 in.
Aggregate Subbase	8 in.	8 in.
Structural Number	3.72	4.10
Geotextile Separator	Yes	Yes

Industrial/Commercial Street: 251,000 to 500,000 Sq. Ft. Building Space

Pavement Layer	Good Subgrade Soil	Poor Subgrade Soil
Wearing (Surface) Course	2 in.	2 in.
Binder Course	2 ½ in.	2 ½ in.
Bituminous Concrete	3 ½ in.	4 in.
Aggregate Subbase	8 in.	10 in.
Structural Number	4.04	4.48
Geotextile Separator	Yes	Yes

Industrial/Commercial Street: 501,000 to 1,000,000 Sq. Ft. Building Space

Pavement Layer	Good Subgrade Soil	Poor Subgrade Soil
Wearing (Surface) Course	2 in.	2 ½ in.
Binder Course	3 in.	3 in.
Bituminous Concrete	4 in.	4 in.
Aggregate Subbase	8 in.	10 in.
Structural Number	4.40	4.88
Geotextile Separator	Yes	Yes

Industrial/Commercial Street: 1,001,000 to 2,000,000 Sq. Ft. Building Space

Pavement Layer	Good Subgrade Soil	Poor Subgrade Soil
Wearing (Surface) Course	2 in.	2 ¼ in.
Binder Course	3 in.	3 in.
Bituminous Concrete	4 1/2 in.	5 in.
Aggregate Subbase	9 in.	12 in.
Structural Number	4.70	5.38
Geotextile Separator	Yes	Yes

Tabulation of Structural Numbers

<u>Use</u>	<u>Material</u>	<u>Structural Number per Inch Thickness</u>
Surface Course	9.5 mm Superpave	0.40
Binder Course	12.0 mm Superpave	0.40
	19.5 mm Superpave	0.40
Base Course	Graded Aggregate	0.14
	Bituminous Concrete	0.32

Note: Wearing (Surface) Course shall be Warm Mix Asphalt Superpave – 9.5 mm and Binder Course shall be Warm Mix Asphalt Superpave – 12.5 or 19.00 mm, unless specified and approved on the plans.

S410.06 Subgrade Verification Requirements

1. After the Developer has prepared the soil subgrade in accordance with these construction specifications, a stability verification of the prepared subgrade shall be required prior to placing the geotextile separator and asphalt base course. Density testing to verify compaction shall be performed in the field as required by the Town of Smyrna.
2. A proof roll of the prepared subgrade and crushed aggregate base course shall be performed prior to the placing of the geotextile separator and asphalt base course. This consists of an Inspector walking behind a slowly moving fully loaded aggregate truck (10-wheeler dump truck, gross weight 38-40 tons) observing the reaction of the subgrade to the imposed wheel loading.

The truck shall be required to run the entire street subgrade including curb lines, over all trenches and anywhere directed by the Town of Smyrna inspector. Areas displaying movement, pumping, pronounced elasticity or deformation under the loaded tri-axel dump truck will be considered unstable and will be noted and or marked. The areas marked and or noted

showing unstable subgrade shall be corrected and re-verified for the required stability prior to placing the geotextile separator and asphalt base course. Underdrains shall be installed when wet areas are encountered. (See Sections S905 and 715).

3. A Town of Smyrna inspector shall perform an inspection to verify the grade elevations of the subgrade and crushed aggregate base course prior to placement of the geotextile separator and asphalt base course. Contractor shall ensure that sufficient grade stakes are in place to allow for the appropriate measurements. Any areas that are not at the proposed design grade shall be corrected and re-inspected prior to placing the geotextile separator and asphalt base course.

S410.07 Requirements for Placement of Bituminous Concrete

1. The placement of all bituminous concrete shall occur between the dates of April 15th and October 31st. No bituminous concrete will be permitted to be laid between Nov. 1st and April 14th unless written approval has been given from the Town of Smyrna.
2. No bituminous concrete 2.0 inches thick or less shall be placed when the ambient (air) temperature at the location of paving is below 50 degrees F. The minimum ambient (air) temperature for any hot mix course greater than 2.0 inches thick shall be 40 degrees F.

END OF SECTION

S411 ROAD INSPECTION PROCEDURES**S411.01 Road Inspection**

There are four (4) inspection checkpoints:

1. Proof-Rolling of Subgrade
2. Proof-Rolling of Base Course
3. Inspection of HMA Binder Course Placement
4. Inspection of HMA Surface Course Placement

The road construction must be approved by the Town or its representative at each checkpoint before construction can continue.

Two working days' notice must be given to arrange for inspection. All vehicles, equipment, trash containers, construction materials, etc. must be cleared from the roadway to be inspected and/or proof-rolled prior to inspection.

The detailed inspection procedure is as follows:

S411.02 Proof-Rolling of Subgrade (prior to placing base course)

This consists of an Inspector walking behind a slowly moving fully loaded aggregate truck (10-wheeler dump truck, gross weight 38-40 tons) observing the reaction of the subgrade to the imposed wheel loading.

Any section of subgrade that exhibits pumping, rutting, cracking, etc. shall not be approved; it is the Contractor's responsibility to take whatever measures are required to bring the subgrade into compliance. A minimum of three (3) passes (left side, middle, and right side) by the aggregate truck is required. Underdrains shall be installed when wet areas are encountered. (See Sections S905 and 715).

The subgrade shall be proof rolled again after one (1) month lapses or after severe rainstorms that affect the integrity of the subgrade.

S411.03 Proof-Rolling of Base Course (prior to placing surface course)

This consists of an Inspector walking behind a slowly moving fully loaded aggregate truck (10-wheeler dump truck, gross weight 38-40 tons) observing the reaction of the base course to the imposed weight of the truck.

Any section of base course that exhibits pumping, rutting, cracking, etc. shall not be approved; it is the Contractor's responsibility to take whatever measures are required to bring the base course into compliance. A minimum of three (3) passes (left side, middle, and right side) by the aggregate truck is required.

The base course shall be proof rolled again after one (1) month or after severe rainstorms that affect the integrity of the base course.

The Contractor shall furnish the Town Inspector with weigh slips for each load of aggregate used in forming the base course; aggregate used for any stabilized construction entrance/exit and for refilling of undercut areas shall be accounted for separately.

The Town Inspector shall make a yield determination based upon the aggregate supplier's unit weight and the street alignment/pavement section as established by the approved final plans. Any deficiency in the base course thickness shall be compensated for by increasing the bituminous concrete thickness. (The additional thickness will be determined using the Flexible Pavement Structural Number Design Methodology.)

S411.04 Inspection of Placement of Bituminous Concrete Binder Course

This consists of continuous inspection of the placement of the base course and monitoring temperature and thickness.

The Town Inspector shall make a yield determination based upon the HMA supplier's unit weight and the street alignment/pavement section as established by the approved Final Plans. Any deficiency in the HMA thickness shall be compensated for by increasing the bituminous concrete wearing course thickness.

S411.05 Inspection of Placement of Surface Course

This consists of continuous inspection of the wearing (surface) course and monitoring temperature and thickness.

The surface of the base course shall be tack coated if exposed to the elements for more than 7 days or if contaminated with dirt or debris.

The Town Inspector shall make a yield determination based upon the HMA supplier's unit weight and the street alignment/pavement section as established by the approved Final Plans. The final wearing course of bituminous concrete shall not be placed on residential streets until 75% of the houses are completed. The Contractor shall furnish the Town Inspector with certified weigh slips for each load of HMA.

S411.06 General Hot Mix Placement Requirements

1. Mix composition and construction methods shall conform to Section 904 of the latest edition of Delaware Department of Transportation Standard Specifications for Road and Bridge Construction.
2. Hot Mix Asphalt shall not be less than 225°F at time of placement.
3. Minimum outside temperature shall be 32°F and rising for base course and 40°F and rising for surface course.

4. Maximum temperature before next lift placement shall be 140°F.
5. The placement surface shall be free of dirt or deleterious materials.
6. Placement thickness shall be 125% of compacted thickness; i.e., 1.25" thickness placed for each 1.00" thickness compacted.
7. All manholes, water valves or other utilities constructed within the paved roadway shall be set flush with the base course of bituminous concrete and adjusted when the final wearing course of bituminous concrete is placed.
8. The mixture shall be delivered at the spreader with a loss not greater than 20 degrees Fahrenheit from the temperature determined at the plant by the Engineer.

S411.07 Equipment

Equipment shall consist of trucks, pavers, and rollers normally associated with the placement of bituminous concrete.

Trucks used for hauling bituminous concrete shall have tight, clean, smooth, metal beds, which have been thinly coated with an emulsified oil, soap solution or other approved release agent to prevent adherence of the bituminous mixture to the beds. Each truck shall have a securely fastened cover of canvas or other suitable material of such size as to protect the mixture from the weather and prevent heat loss.

Bituminous pavers shall be self-contained units, provided with an activated screed or strike-off assembly, heated, and capable of spreading and finishing asphaltic concrete in lane widths applicable to the specified typical section and thickness shown on the plans. The paver shall be equipped with a receiving hopper having sufficient capacity for a uniform spreading operation. The front of the screed or strike-off assembly shall be equipped with an automatic control device as required herein and shall effectively produce a finished surface of the required evenness and texture without segregation, tearing, shoving, or gouging the mixture. The paver shall be capable of operation at forward speeds consistent with satisfactory laying of the mixture. Equipment used for shoulders and similar construction shall be capable of spreading and finishing the courses in widths shown on the plans.

The screed of the mechanical spreading and finishing machine shall be regulated by an automatically controlled grade leveling and slope control device approved by the Engineer. The device shall be of a standard commercial quality adapted to the type of paver used and shall provide control for producing a uniform surface to the established grade, and a cross slope conforming to the requirements of the typical section. The device shall also be equipped with the necessary controls to permit the operator to adjust or vary the slope throughout super-elevated curves. Grade control shall be accomplished by use of a sensor following a traveling reference plane not less than 30 feet in length and/or a joint matching shoe referencing to an adjacent mat.

Minimum eight (8) tons rollers shall be used and shall be of the steel wheel, static or vibratory, and/or pneumatic-tire type and shall be in satisfactory working condition. All rollers shall be capable of reversing without backlash, and steel wheel rollers shall be equipped with scrapers. Pneumatic tire rollers shall be self-propelled, of the oscillating type, and equipped with smooth tires of equal size, diameter, and ply rating, all maintained at the same inflation pressure. Rollers shall have a system for moistening each wheel or roller. The rollers shall be operated with the drive wheels nearest the paver and at speeds slow enough to avoid displacement of the mixture. The number and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. The use of equipment, which results in excessive crushing of the aggregate or marring of the pavement surface, will not be permitted.

All rollers shall be approved prior to use, shall be continuously maintained in a satisfactory working condition, and shall bear the manufacturer's nameplate on which shall be stamped the model number and the weight without ballast.

Rollers shall move at a slow but uniform speed with the drive roller or wheels nearest the paver. Rolling shall start longitudinally at the sides, parallel to and proceed toward the center of the work, overlapping on successive trips by at least one-half the width of the roller. Alternate trips of the roller shall be of slightly different lengths. When paving an abutting previously placed lane, the longitudinal joint shall be rolled first, followed by the regular rolling procedure. On super-elevated curves the rolling shall begin at the low side and progress to the high side by overlapping of longitudinal trips parallel to the centerline.

The motion of the roller at all times shall be slow enough to avoid displacement of the bituminous concrete, and any displacement occurring as a result of the reversing of any direction of the roller, or from any other cause, shall at once be corrected by the use of lutes and of fresh mixture when required. To prevent adhesion of the mixture to the wheels of the roller, they shall be kept properly moistened, but excess water will not be permitted.

END OF SECTION

S412 ROADWAY SAFETY

S412.01 Roadway Safety

Any person that installs, maintains, services, operates or otherwise works on utilities within the street right-of-way shall consider the safety of the general public. This includes providing appropriate traffic control within work areas.

1. All reasonable measures shall be taken for the protection and safe operation of traffic during and after installation of facilities. For all work within the street right-of-ways:
 - a. All traffic control shall conform to the requirements specified in the current Delaware Traffic Control Manual and any other applicable Local, State and Federal regulations.
 - b. Failure by the permittee to provide for traffic safety shall be cause for immediate suspension of operations. The work will not be allowed to continue until the Department is satisfied that the proper traffic control is established and the permittee is notified in writing.
 - c. The Delaware Manual on Uniform Traffic Control Devices (MUTCD) governs if there are discrepancies between the Traffic Control Manual and the MUTCD.
2. All gutters shall be left open so as not to obstruct the free passage of water, and the sidewalks and footways must be kept in a safe and passable condition.
3. All excavations or material from them shall have placed upon them sufficient lights and barricades to identify them from all directions during the day and after dark.
4. If, for safety purposes, the Department deems it necessary to install additional warning devices such as lights, barricades or signs, the permittee shall be notified of the decision and shall receive instructions on the installation.

If the permittee fails to install such devices in a timely fashion the Town shall install them and charge the permittee rental cost. The Town shall invoice the permittee for rental and installation costs incurred from the date of installation until the date of removal. Payment not made by the permittee within thirty days of the invoice date will be chargeable against the posted bond including all fees and costs involved in the collection of this payment.

S412.02 Additional Work

In no case shall a permittee open or remove a greater area of street surface than specified in the original application. The permittee shall not open any street area at any location not

specified in the original street-opening permit. If the permittee determines during construction that an additional area of the street will have to be opened, he shall notify and secure permission from the Department for the additional opening. Upon receipt of permission, the permittee shall file a supplementary application for the work no later than the next workday.

S412.03 Guarantee of Work

The permittee shall guarantee and maintain his work for twelve (12) months from the completion of the restoration and replacement work. Within this twelve-month period, upon notification from the Town of necessary correction work required, the permittee shall correct or cause to be corrected all restoration work required within five working days of receipt of the notification. The Department shall determine the extent of restoration required and the method of correction. Any and all work not completed within this five-day period shall be completed by the Town and the permittee shall be billed for all costs incurred by the Town in performance of this work. Payment not made within thirty days of the invoice date will be chargeable against the posted bond including all fees and costs involved in the collection of this payment.

S412.04 Cleanup

The permittee shall keep the work area and surrounding area free from accumulation of waste materials or rubbish caused by work under the permit. At the completion of the work, the permittee shall remove from the site all materials, rubbish, the permittee's tools, equipment, machinery and all other objects associated with said work. Upon failure of the permittee to keep the site of the work clean to the satisfaction of the Department, the Department may upon twenty-four (24) hours notification to the permittee, remove any rubbish, materials, tools or equipment is deemed necessary. The permittee shall be responsible for all associated costs.

END OF SECTION

S413 ROAD RESTORATION PROJECTS – GENERAL CONTRACT PLAN
NOTES

1. Construction of this contract shall conform to Delaware Department of Transportation Standard Specifications, the special provisions, and these plans.
2. The purpose of this contract is to make general improvements to roads and/or streets within the town herein specified. Depending on fund availability, the town reserves the right to add or delete locations for this contract. Such location additions or deletions shall not be cause for an increase or decrease in any contract unit bid prices.
3. Location listings indicate general limits of construction, major types of improvements and estimated quantities. Any questions pertaining to any location shall be referred to the town or their representative.
4. Unless specified, overlay widths shall match existing widths.
5. The cost of clipping the edges back, picking up and disposing of excess sod and sweeping and cleaning existing pavement prior to overlay shall be incidental to the pavement overlay item.
6. Butt joints shall be placed at all intersecting bituminous concrete roads and at any other locations as directed by the engineer. Butt joints at railroad crossings and at bridge or drainage structures not to be resurfaced shall be 15 feet long. Butt joints cut prior to the day of the pavement overlay shall be ramped with bituminous concrete trim at the contractor's expense. Pavement milling material will not be allowed for this purpose. Butt joints, in full mill areas shall be incidental to the milling item.
7. The contractor and all others shall perform all work in a manner that will ensure the least practical obstruction to the traveling public.
8. Excavation for curb, sidewalk or valley gutter shall be incidental to the price bid for curb, sidewalk or valley gutter. Excavated material, not needed on the project, shall be removed from the site at the contractor's expense. Topsoil shall be used as backfill material for curb and sidewalk when so directed by the engineer. When replacement of curb and gutter has been completed and the forms removed at each location of this contract, backfilling shall be done immediately. Complete restoration, topsoil, seeding and removal of all materials for curb and gutter or sidewalk; sealing of valley gutters and parging of catch basins, shall be completed within seven (7) calendar days. Failure to comply will result in a suspension of all other contract work with time charges continuing to be assessed. The above work shall be incidental to the curb, sidewalk and valley gutter items.

9. Graded Aggregate Base Course, shall be used as base material for new construction of curb, sidewalk, and valley gutter. And shall be incidental to the curb, sidewalk, and valley gutter items.
10. All raised edges of adjusted manholes, catch basins, water valve boxes, etc. Shall be ramped with bituminous concrete trim at the contractor's expense. Such adjustments shall not be made more than seven (7) calendar days prior to the placement of bituminous concrete pavement. Failure to comply will result in a suspension so all other contract work with time charges continuing to be assessed.
11. Pavement paving is to be completed within seven (7) calendar days of the pavement rotomilling for any particular location. Failure to comply will result in a suspension of all other contract work with time charges continuing to be assessed.
12. Pertaining to butt joints at full width rotomilling and tapermill locations, the removal and cleanup of the bituminous concrete residue wedge left from milling operations along curb lines, adjacent to valley gutters, along speed humps, across intersecting streets, and at the beginning and ending points of the milling operation, shall be incidental to the rotomilling and tapermill items. No separate payment for butt joints shall be made in these locations.
13. The contractor shall have a competent superintendent or foreman on the project at all times.
14. The basis of method of measurement and basis of payment for the pavement milling item, 1"-2" depth, is modified to be square yards. This item shall include all rotomilled depths from 1" to 2-1/4" (inclusive) for measurement and payment purposes. Payment for rotomilling depths greater than 2-1/4" shall be negotiated by the engineer. All milled material shall remain the property of the town, to be hauled to a location in town as directed by the Public Works Director.
15. Where pavement milling is specified, this item shall be performed prior to placement of bituminous concrete patches. After milling, contractor shall provide a loaded truck for proof rolling (incidental to milling item) and at that time the town's representative will determine area of bituminous concrete patch.
16. At each location, the contractor shall note all existing pavement markings and submit a drawing, which depicts the striping pattern to the town prior to the start of any work at the location. The contractor will be responsible to correct any erroneous markings immediately. Failure to comply will result in suspension of all other contract work with time charges continuing to be assessed. Final pavement markings shall conform to all

existing patterns and shall be placed within five (5) calendar days (maximum) after placement of the final course of asphalt. The town will charge the contractor for necessary labor involved to layout a new striping plan if the contractor fails to note existing markings.

Temporary striping required on final course shall be incidental to HMA item.

17. Prior to patching and/or overlay operations, the contractor shall provide a loaded tandem dump truck and driver to proof roll the entire street to be patched and/or overlaid. This shall be incidental to the contract.
18. Adjustment of water valve boxes and incidentals necessary to complete the item. Adjustment rings will be provided to the contractor by the Town of Smyrna at no expense to the contractor. Any damage to the water valve boxes caused by the contractor shall be replaced at the contractor's expense.
19. The contractor is advised that his operation may require staging and/or working in one street at a time to properly coordinate his activities with the residents vehicle parking. The contractor will cooperate and effectively coordinate all activities pertaining to the residential vehicle parking.
20. The contractor shall give residents 48 hours advance warning flyers when the street needs to be cleared of vehicles.
21. The contractor shall submit a construction schedule prior to the start of work.
22. The contractor shall submit a two weeks schedule each Friday to the inspector.

END OF SECTION

S414 ROADWAY PATCHING (SUPPLEMENT TO SECTION 402)**S414.01 Description**

This item consists of making temporary and or permanent bituminous concrete patches to roadways related to the installation, replacement, extension, repair, maintenance and/or inspection of utilities and infrastructure, which will disturb any part of the paved or unpaved portions of the Town's right-of-ways or the soil beneath any paved street in accordance with this specifications and details and as shown on the Plans.

This work may include, but not limited to, utility main and/or lateral replacement or repair; valve replacement and repair; installation of new underground mains or laterals, structures or accessories; splices, buries drops; pole changes for height, accident, etc.; cathodic protection; boxes and vault installations and jacking or boring under the right-of-way where disturbance within the right-of-way may occur.

S414.02 Construction Methods

Construction methods shall conform to all applicable subsections of these Specifications.

S414.03 Temporary Patching

Temporary patching shall consist of furnishing and placing 2" thick bituminous concrete asphalt surface (HMA surf SC) to patch pipe trenches, around new structures, utility test pits, or as directed by the engineer in order to maintain traffic until the milling and final course of pavement is placed. It shall be used to seal the road during the winter months or when the area will have to be reopened within a short period of time (90 days or less)

S414.04 Permanent Patching

Permanent patching shall be by means of bituminous concrete materials meeting the requirement of section 504. Bituminous concrete shall be laid as soon as the work being done is completed and in such a manner that it provides a smooth transitions between the patch and surrounding roadway.

The surface layer of a permanent patch shall be made wider than the area of patch itself to create a cap. The two areas shall be bridged by the placement of geotextile material made for that purpose and approved by the town for its use.

S414.05 Roadway Permit Required

Any person working in the vicinity of a town street who in any manner disturbs such street or who in any manner causes damage to a street shall be required to obtain a permit and correct this damage in accordance with the standards of these Specifications.

1. All contractors performing work under contract for the Town of Smyrna shall obtain the street opening permit for street opening work.

2. All work performed on a state road will require the contractor to get a permit from the state.
3. If street openings are necessitated by emergencies, street opening permits shall be obtained on the first regular business day on which the office of the Town of Smyrna is open for business and such permit shall be retroactive to the date when the work began. If the emergency occurs after regular business hours, weekends or holidays, the permittee shall notify the Public Works Department prior to opening the street. Such notification will be made by notifying the Smyrna Police Department, who in turn will contact the appropriate Public Works personnel.
4. Open cuts in roadways shall not be permitted. Exceptions will be made only in cases where there is no alternative as determined by the Director of Public Works on a case-by-case basis. When exceptions are made, the permittee may be required to perform more extensive restoration, as determined by the Director of Public Works and stated on the permit.
5. In cases where the permittee must use private property for the boring set-up, the permittee shall be fully responsible for notification of the affected property owners and to obtain permission, including easements, if necessary. The permittee shall be required to fully restore all disturbed areas to the original condition.

S414.06 Work Requirements

The following general requirements shall be required for all work done in conjunction with the granting of a utility permit within Smyrna.

1. This section shall not apply to new development construction.
2. The permittee shall be responsible for restoring the right-of-way, including the pavement surface, subsurface and drainage facilities to its original condition prior to the work.
3. Temporary roadway repairs shall be made immediately upon the installation or repair and shall remain in place a minimum of two (2) weeks prior to permanent roadway repairs. The temporary roadway repairs shall be maintained in good condition at all times. Permanent repairs shall be completed within sixty (60) days after the completion of the temporary repairs, except that, during the period from November 1 to April 1, inclusive, they shall be completed not later than May 15.
4. When trenching is allowed, the length of trench that may be opened at any one time shall not exceed 150 feet.
5. The permittee shall be responsible to maintain proper storm drainage flows during the course of all work and shall be responsible for all water

- damage and costs due to the work.
6. The permittee shall be responsible for pedestrian safety, keeping all sidewalks clean, clear and protected.
 7. Except in emergencies, or when prior approval has been granted by the Director of Public Works and stated on the permit, one lane of traffic shall remain open at all times, and traffic control shall be provided by the permittee as specified herein. If the work requires a full road closure, the permittee shall submit with the application a written explanation in letter form to the Director of Public Works and shall thoroughly explain the reasons for the closure plus the amount of time required for the road closure.
 8. Except when prior approval has been granted by the Director of Public Works and stated on the permit, streets shall be opened to traffic each night with all openings covered by a plate or an asphalt patch.
 9. All work areas outside the pavement shall be restored to original condition after completion of said work. All openings including pits and trenches shall be barricaded or fenced on all sides to insure pedestrian and motorist safety.
 10. In cases where open trenching has been approved, if the disturbance to the roadway is between the edge of paving and the centerline, then the wearing surface shall be replaced from the existing edge of paving to the centerline of the road. If the disturbance is on both sides of the centerline of the road, then the wearing surfaces shall be replaced from existing edge of paving to existing edge of paving (entire paving width of the road). The length of restoration shall be the entire length of trench including but joints. Refer the Contract Documents for paving section requirements for geotextile, stone and paving.
 11. In case the work has not been completed before the date of expiration as shown on the permit, which time shall be fixed when the permit and/or time extension is granted, the Department of Public Works may take steps to backfill the trench and replace the street surface over the opening for which the permit has been issued upon proper notification from the Department to the permittee. The Town shall invoice the permittee for all costs incurred by the Town in the performance of this work. Payment not made within thirty days will be chargeable against the posted bond including all fees and costs involved in the collection of this payment. If utility work is incomplete, Smyrna Public Works personnel or authorized contractor(s) shall be hired to complete the necessary work. The Town shall invoice the permittee for all costs incurred by the Town in the performance of this work. Payment not made within thirty days will be chargeable against the posted bond including all fees and costs involved in

the collection of this payment.

12. The permittee shall be responsible for the work performed and the Department will contact the permittee for required adjustments or corrections regardless of whether the permittee performed the work itself or subcontracted and assigned the work. The permit is issued to the permittee and it is solely responsible for the work performed. The permittee or its subcontractors shall have a copy of the permit on the job site at all times.
13. The permittee shall be responsible for location of all existing utilities and shall contact "Miss Utility" as necessary. Any damage to existing utilities, structures such as curbing, sidewalk, drainage facilities, utility boxes, etc. shall be replaced and/or repaired by the permittee at no expense to the Town or property owner. The Department shall determine the extent of restoration required and the method of correction. Any and all work not completed within a reasonable period of time, not to exceed thirty (30) days may be completed by the Town at the discretion of the Director of Public Works. The Town shall invoice the permittee for all costs incurred by the Town in performance of this work. Payment not made within thirty days of the invoice date will be chargeable against the posted bond including all fees and costs involved in the collection of this payment.
14. The permittee shall be responsible to make permanent repairs to any portion of road they opened in accordance with these specifications. All repairs shall be warranted for twelve (12) months or until such time as the Town shall resurface or reconstruct the pavement. Should the condition of the patch, trench or underground facility become such that additional pavement is in jeopardy of failure, then the utility may be held responsible for an area larger than the original repair.
15. The permittee shall be responsible for timely notification of intended work to the local media, all emergency response agencies including the police and fire departments, and all affected property owners.
16. Inspection of work by the Department does not relieve the permittee of the responsibility of ensuring the quality of all work and materials, safety, or liability for loss, damage, or injury to persons or property. Any omission or failure on the part of the Department to disapprove or reject any defective work or materials shall not be construed to be acceptance of any defective work or material.
17. Inspectors shall have the right to suspend work if it does not comply with this Section, or any other codes, specifications, regulations or policies.
18. The Department is authorized to make such other rules and regulations for work performed by the permittee which it may deem necessary to protect

the health, safety and welfare of the public and adjacent property. These rules and regulations shall be printed upon the permit granted or forwarded from the Department in writing from time to time.

S414.07 Test Holes

A roadway opening permit shall be obtained for any test hole work. No test holes shall be made in or upon a greater surface of the highway than as specified in such permit, and no excavation or test holes shall interfere with any of the water pipes, sewers or drains of the Town or any other underground utility service. Test holes shall be backfilled in accordance with the provisions of these specifications.

S414.08 Method of Measurement

The yardage of patching to be paid for under this section shall be the actual number of square yards of patching, of the thickness specified, constructed in accordance with these requirements, complete in place and accepted. The width for measurement will be the width from outside of the completed patches as constructed and the length shall be the actual length measured along the centerline of pavement.

S414.09 Basis of Payment

The number of square yards of patching, determined as provided above, will be paid for at the contract unit price per square yard bid for roadway patching, which price and payment shall be full compensation for removal and disposal of existing materials, furnishing, hauling, placing all materials including aggregate, bituminous concrete for preparing the subgrade, saw cutting edges, proper compaction; and for all labor, equipment, tools, and incidentals necessary to complete the work.

END OF SECTION

DIVISION 500 RIGID PAVEMENT

The **Description, Materials, Construction Methods, Method of Measurement, and Basis of Payment** for the items as mentioned in the Table below shall be as set forth in the **following Sections** of the Standard Specifications for Road and Bridge Construction for the Delaware Department of Transportation dated August 2016 or as later amended, unless otherwise noted below or as directed by the engineer.

SECTION	ITEM
501	PORTLAND CEMENT CONCRETE PAVEMENT
502	RESERVED
503	PATCHING PORTLAND CEMENT PAVEMENT
504	CRACKING AND JOINT SEALING
502	RESERVED
503	PATCHING PORTLAND CEMENT CONCRETE PAVEMENT
504	CRACK AND JOINT SEALING
505	PORTLAND CEMENT CONCRETE PATCHING, PARTIAL DEPTH

END OF SECTION

DIVISION 600 STRUCTURES

The **Description, Materials, Construction Methods, Method of Measurement, and Basis of Payment** for the items as mentioned in the Table below shall be as set forth in the **following Sections** of the Standard Specifications for Road and Bridge Construction for the Delaware Department of Transportation dated August 2016 or as later amended, unless otherwise noted below or as directed by the engineer.

SECTION	ITEM
601	PIPE STRUCTURES
602	DRAINAGE STRUCTURES
603	RESERVED
604	TEMPORARY WORKS
605	DRIVEN PILES
606	DRILLED SHAFTS
607	MECHANICALLY STABILIZED EARTH WALLS
608	PERMANENT SHEET PILES
609	RESERVED
610	CONCRETE STRUCTURES
611	CONCRETE REINFORCEMENT
612	PRECAST CONCRETE
613	CONCRETE COATINGS AND MEMBRANES
614	RESERVED
615	STEEL STRUCTURES
616	STEEL COATINGS
617	STEEL SIGN STRUCTURES
618	RESERVED
619	STONE AND BRICK MASONARY
620	RESERVED
621	WOOD STRUCTURES
622	RESERVED
623	BEARING DEVICES
624	JOINTS
625	CONCRETE OVERLAYS
626	METAL RAILINGS
627	RESERVED
628	CONCRETE REPAIR AND REHABILITATION

END OF SECTION

DIVISION 700 MISCELLANEOUS CONSTRUCTION

The **Description, Materials, Construction Methods, Method of Measurement, and Basis of Payment** for the items as mentioned in the Table below shall be as set forth in the **following Sections** of the Standard Specifications for Road and Bridge Construction for the Delaware Department of Transportation dated August 2016 or as later amended, unless otherwise noted below or as directed by the engineer.

SECTION	ITEM
701	P.C.C. CURB,INTREGAL P.C.C. CURB, P.C.C. MONOLITHIC MEDIAN AND CURB OPENINGS
702	TRIANGULAR CHANNELIZING ISLANDS
703	RESERVED
704	RESERVED
705	P.C.C. SIDEWALK, CURB RAMPS, AND SIDEWALK DETECTABLE WARNING SYSTEM
706	MONUMENT
707	RIPRAP
708	GEOTEXTILES
709	PERFORATED PIPE UNDERDRAINS
712	RESERVED
713	RESERVED
714	RESERVED
715	RESERVED
716	RESERVED
717	RESERVED
718	RESERVED
719	RESERVED
720	GUARDRAIL
721	GUARDRAIL END SECTIONS AND TRANSITION
722	GUARDRAIL END TREATMENT
723	CONCRETE BARRIER
724	IMPACT ATTENUATOR
725	RESERVED
726	RESERVED
727	FENCE
728-559	RESERVED
760	PAVEMENT MILLING AND RUMBLE STRIPS
761	RESERVED
762	SAW CUTTING AND BUTT JOINTS
763	INITIAL EXPENSE/ DE-MOBILIZATION
S773	REMOVAL OF PIPE
S774	TAPERING MILLING
S775	SCARIFY/RECOMPACT EXISTING ROAD MATERIAL
S776	DRIVEWAY PAVING

S777	JOINT/CRACK SEALING
S778	BRICK SIDEWALKS

END OF SECTION

S773 REMOVAL OF PIPE**S773.01 Description**

Removal of pipe shall consist of removal, wholly or in part, and satisfactory disposal of all pipe, and any other obstructions which are not designated or permitted to remain, except for the obstructions to be removed and disposed of under other sections in these specifications. It shall also include the salvaging of designated materials and backfilling the resulting trenches, holes and pits.

S773.02 Method of Measurement

The removal of pipe to be paid for under this section will be measured from end of pipe to end of pipe.

S773.03 Basis of Payment

The accepted quantities of Removal of pipe as provided above, shall be paid for at the contract price bid for this section, Removal of pipe, which price shall be full compensation for removing and disposing of the obstructions in accordance with the contract and excavation incidental to their removal. The price shall also include salvage of materials removed, their custody, preservation, storage on the right-of-way and disposal as may be directed.

END OF SECTION

S774 TAPER MILLING**S774.01 Description**

The item consists of furnishing a pavement milling machine and milling or planing the existing bituminous concrete and P.C.C. pavement at the locations and to the depths shown on the plans and/or as directed by the Engineer. The pavement milling machine shall be one with a proven record for use in milling and planing bituminous concrete and P.C.C. pavements. The Contractor shall reuse, salvage or dispose of the milled materials as called for by the plans.

S774.02 Method of Measurement

The quantity of taper milling to be paid for shall be the number of square yards at a depth of 2" tapered to 0". Any additional depth, not approved by the Engineer, will not be included for payment.

S774.03 Basis of Payment

Pavement-Milling measured as provided above shall be paid for at the contract unit price bid per square yard for Taper Milling, which price and payment shall constitute full compensation for furnishing an accepted pavement-milling machine and operator, for removal and disposal of the milled material, for transporting equipment, for all labor, tools, equipment and incidentals necessary to complete the item.

END OF SECTION

S775 SCARIFY/RECOMPACT EXISTING ROAD MATERIAL**S775.01 Description**

The item consists of milling the existing road surface to a depth of 6" maximum, placing the milled material (maximum diameter of 1/2") on the road surface and re-compacting the existing material.

S775.02 Method of Measurement

This item shall be measured by square yards of existing road scarified and re-compacted to a depth of 6".

S775.03 Basis of Payment

Scarify/Re-compact Existing Road Material measured as provided shall be paid at the contract unit price per bid per square yard.

END OF SECTION

S776 Driveway Paving**S776.01 Description**

This item will only be considered for driveways adjacent to the roadway paving that cannot be completed as part of the mainline roadway and auxiliary lane operation. The limits shall be from the outermost roadway element to the limits of the driveway as Directed by the Engineer.

When the bituminous concrete can be tapered to meet the existing roadway material within 3 feet, the Contractor shall not be paid a surcharge and shall be expected to do the tie in as part of the continuous operation.

When tying-in to an intersecting street, the Contractor shall not be paid a surcharge and shall be expected to do the tie in as part of the continuous operation.

S776.02 Method of Measurement

The area of Driveway Paving Surcharge to be paid for under this item shall be the actual number of square yards of paving placed in driveways as described in this item. There will only be one measurement at each location regardless of the number of lifts of paving required.

S776.03 Basis of Payment

The number of square yards of Driveway Paving, determined as provided above, will be paid for the contract unit price per square yard bid for Driveway Paving, which price and payment shall be full compensation for the additional labor and equipment costs involved with the reduced production caused by such work. This item shall include sawing existing driveway, removing a portion of the driveway to create a butt-joint effect, tack coat and applying new bituminous concrete. Butt-joints within the driveways shall be incidental to Driveway Paving.

END OF SECTION

S777 Joint/Crack Sealing**S777.01 Description.**

This work shall consist of sealing any joints or cracks in the existing asphalt roadway. An elastomeric-type one component, hot applied joint sealant, resistant to weathering, shall be used and shall conform to ASTM D 3406.

Joints and/or cracks are to be cleaned with a plow, router, concrete saw or other suitable tool(s) for the purpose of neatly cleaning the pavement, joints and cracks without spalling the edges. Loose material shall be blown free of the JOINT/CRACK. Joints and cracks shall be sealed with a double-boiler melter or applicator, taking care to avoid overfilling of joint/crack space. Joints/cracks shall be filled to within 0.125 to 0.25 in. below flush with the paved surface.

S777.02 Method of Measurement.

The measurement of the sealing of joints or cracks to be paid for under this section shall be the number of linear feet of joints and/or cracks filled and sealed in accordance with these specifications, completed and accepted.

S777.03 Basis of Payment.

The footage of sealed joints and cracks, measured as provided above, shall be paid for at the Contract unit price bid for Joint/Crack Sealing, which price and payment shall constitute full compensation for furnishing and placing all material, disposal of surplus material, labor, equipment and tools, and incidentals necessary to complete the section.

END OF SECTION

S778 BRICK SIDEWALKS**S778.01 Description**

This work shall consist of repairing and/or replacing brick sidewalks or constructing new brick sidewalks as specified in the Contract Documents or as directed by the engineer.

S778.02 Construction Method

Method of work shall include removal of existing brick sidewalk, excavation of existing bedding material, placement of graded aggregate or concrete base and sand, resetting of brick found to be in acceptable condition as determined by the engineer and setting of new brick as shown on the plans or as directed by the engineer. Contractor shall be responsible for replacement of brick that is found to be broken or deemed unacceptable by the engineer.

Materials and placement pattern shall match existing or as shown in the plans. The payment will be full compensation for all excavation, furnishing and placement of graded aggregate, or concrete base, sand, replacement brick, new brick, backfill, disposal of excess, or unsuitable material, forms, compaction, finishing and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

S778.03 Method of Measurement and Basis of Payment

Brick sidewalk will be measured and paid for at the contract unit price per square foot of finished surface.

END OF SECTION

DIVISION 800 TRAFFIC

S860 TRAFFIC DESIGN GUIDELINES

All traffic and traffic related facilities for all public and private developments shall be designed to conform Standard Specifications for Road and Bridge Construction for the Delaware Department of Transportation dated August 2016 or as later amended, unless otherwise noted below or as directed by the engineer.

The **Description, Materials, Construction Methods, Method of Measurement, and Basis of Payment** for the items as set forth in the **following Sections 801 through 851** of the Standard Specifications for Road and Bridge Construction for the Delaware Department of Transportation dated August 2016 or as later amended, unless otherwise noted below or as directed by the engineer.

SECTION	ITEM
801	TEMPORARY TRAFFIC CONTROL
802	ARROW BOARDS
803	PORTABLE CHANGEABLE MESSAGE SIGNS (PCMS)
804	PORTABLE LIGHT ASSEMBLY (FLOOD LIGHTS)
805	PLASTIC DRUMS
806	TRAFFIC OFFICERS
807	TEMPORARY SAFETY BARRIER
808	TRUCK MOUNTED ATTENUATOR
809	TEMPORARY IMPACT ATTENUATOR
810	TEMPORARY WARNING SIGNS
811	FLAGGERS
812	CERTIFIED TRAFFIC CONTROL SUPERVISOR
813	TEMPORARY BARRICADES
814	RESERVED
815	RESERVED
816	RESERVED
817	PAVEMENT MARKINGS
818	SIGN PANELS
819	SIGN POSTS
820	BREAKAWAY I-BEAMS SIGNS
821	BARRIER-MOUNTED SIGNS
822	OVERHEAD AND CANTILEVER SIGN PANELS
823	SPAN WIRE/ MAST ARM SIGN PANELS
824	DELINEATORS
825	FLEXIBLE TUBULAR MARKERS, PERMANENT
826	PERMANENT WOOD BARRICADE
827	RESERVED
828	RESERVED
829	RESERVED
830	CONDUIT JUNCTION WELLS
831	CONDUIT

832	ELECTRICAL CABLE AND SPLICING
833	GROUNDING
834	POLE BASES; EXTENSIONS; AND SHEETING
835	CABINET BASES
836	TRAFFIC SIGNAL POLES AND MAST ARMS
837	TRAFFIC SIGNAL INDICATIONS
838	SPAN WIRE AND MESSAGE WIRES
839	WOOD POLES
840	DOWN GUYS AND ANCHORS
841	WEATHERHEADS
842	SERVICE PEDESTAL AND SAFETY SWITCH
843	ELECTRICAL TESTING
844	EMERGENCY PREEMPTION DETECTOR
845	RESERVED
846	LOOP DETECTOR
847	LIGHTING CONTROL CABINETS
848	RESERVED
849	RESERVED
850	LUMINAIRE
851	ALUMINUM LIGHTING STANDARD
S861	STREET SIGNS
S862	ROADWAY LIGHTING
S863	SPEED HUMPS
S864	LOOP DETECTORS
S865	FLAGGER

END OF SECTION

S861 STREET SIGNS

S861.01 Description

Signs shall consist of furnishing, and placing approved regulatory, warning, directional and street signs at such locations as may be indicated on the plans, or as directed and in reasonable close conformity with the requirements of these specifications.

S861.02 Standards

All signs and devices shall comply with the most current edition of the Manual on Uniform Traffic Control Devices (MUTCD), the Delaware supplements, DelDOT Specifications and DelDOT Details.

S861.03 Sign Posts

Sign posts, their foundations and sign mountings shall be so constructed as to hold signs in a proper and permanent position, to resist swaying in the wind or displacement by vandalism.

Signpost for regulatory, warning, restrictive parking and speed limit signs shall be hot dipped galvanized square channel with 3/8" holes on 1" centers.

1. The post shall be constructed in two parts the bottom (base) section shall be slightly larger than the top section (Sign Post) and placed in the ground to hold the upper section. The base section shall measure 1 3/4" X 1 3/4" X 3'.
2. The upper section shall be placed inside the bottom section and held in place by bolts. The signpost section shall measure 1 1/2" X 1 1/2" X 8'.

Signposts for street name signs shall be hot dipped galvanized steel round pipe

1. The post shall be constructed in two parts. The bottom section (base) shall be placed in the ground encased in concrete to hold the upper section (Sign Post). The base section shall be 2 3/8" O.D. with 0.065" wall.
2. The upper section shall be connected to the bottom section with a round "Break-out" post coupler (360-degree break-away, flush mount coupler, manufactured by 3s, Sign Support Systems, 866-549-7706 or an equal breakaway mechanism as approved by the Town). The upper signpost section shall measure 2 3/8" O.D. with 0.065" wall.

S861.04 Street Name Signs (Blades)

Street name blades shall be installed by developer.

1. Street names shall be displayed on top of a hot dipped galvanized round pipe as described above. The height of the pole shall be a minimum of 7'

as measured from the ground to the bottom of the street nameplate and the pole is to be long enough to allow 3' of the pole to be buried in the ground encased in concrete. The lower street nameplate shall be mounted on top of the round pole with a round cap bracket with 5 ¼" slot designed to fit extruded aluminum blades with set screws. The upper street nameplate when applicable shall be mounted to the lower street nameplate with a 90 degree crosspiece with 5 ¼" slot.

2. Street Name Plates (Blades) shall be manufactured of extruded aluminum 0.091" thickness.
3. Color shall be white reflective lettering on green background.
4. Letters shall be 4" in height and the overall height of the plate shall be on 6". The length shall be long enough to display the full name of the street. Abbreviated forms for street, lane, circle etc. are permitted but the height shall be the same as for the street name.
5. Street Blades shall be installed on the left side corner of all intersection as entering the intersection.
6. Street Blades installed at intersections of two or more streets shall list the name of all streets on the assembly.

S861.05 STOP Sign

STOP signs are intended for use where traffic is required to stop. The STOP sign shall be an octagon with white message and border on a red background.

1. Stop signs shall be 30 x 30 inches in size for all municipal streets.
2. At a multi-way stop-intersection, a supplementary plate should be mounted just below each STOP sign. If the number of approach legs to the intersection is three or more, the numeral on the supplementary plate shall correspond to the actual number of legs, or the legend ALL-WAY may be used. The supplementary plate shall have white letters on a red background and shall have a standard size of 12 x 6 inches or 18 x 6 inches.

S861.06 Location of STOP Sign

A STOP sign should be erected at the point where the vehicle is to stop or as near thereto as possible, and will be supplemented with a Stop bar on the pavement. Location of the stop sign shall be per section S1202.02. Where there is a marked crosswalk at the intersection, the stop sign should be installed in advance of the crosswalk line nearest the approaching traffic (generally about 6' from the intersection). Stop bars and stop signs shall be further supplemented by placing the word "STOP" in 6' high letters on the ground prior to the stop bar.

S7861.07 Parking Sign

Parking signs on all municipal roads shall be 12 x 18 inches in size and installed in accordance with Delaware MUTCD.

1. Parking signs should display as much of the following information as is appropriate, from top to bottom of the sign, in the order listed:
 - a. Restriction or prohibition.
 - b. Time of day it is applicable, if not at all hours.
 - c. Days of week applicable, if not every day.
2. Where parking is prohibited at all times or at specific times, parking signs shall have red letters and border on a white background (Parking Prohibition signs).
3. Where only limited-time parking or parking in a particular manner are permitted, the signs shall have green letters and borders (Parking Restriction signs).
4. Where parking is prohibited during certain hours and permitted under a time limit at other periods of the day, two parking signs should ordinarily be used, the red above the green. As an alternative both messages, in different colors may be used on a single plate, with the sign lengthened vertically if necessary.

S861.08 Material

Parking signs shall be constructed of 18 gauge aluminum and be reflective.

S861.09 Method of Measurement and Basis of Payment

This item will not be measured but the cost will be incidental to other pertinent items specified in the Contract Document or as specified by the Engineer.

END OF SECTION

S862 ROADWAY LIGHTING**S862.01 Description**

This item shall consist of furnishing, and installing approved roadway cable, light poles, light fixtures, lamps, and all associated components at such locations as may be indicated on the plans, or as directed in accordance with these specifications and details.

1. Roadway lighting shall include the installation of light poles and fixtures both in public right of way and on private property where the public parks or walks.
2. All lighting installed shall be done in compliance with a electrical lighting plan designed by an electrical engineer.

S862.02 Codes

All work under this section shall comply with the latest edition of the National Electrical Code, the National Electrical Safety Code, and follow the standards as established for use by Delmarva Power for use in the installation of roadway and subdivision lighting.

S862.03 Material

All material used in the installation of lighting shall be UL approved and rated for its intended use.

1. LIGHT POLES. Light poles shall be either self-supporting fiberglass or metal.
2. LIGHT FIXTURES. Light fixtures shall be roadway (cobra head) or colonial type fixtures.
 - a. Cobra heads shall be used on roadways in excess of 35 feet in width.
 - b. Colonial fixtures shall be used in a residential subdivision and arterial roads that are less than 35 feet wide as measured for curb line to curb line.
 - c. Light fixtures installed in public right of way or land shall be supplied with and control by the use of a photoelectrical control (Photoelectric eyes). Photoelectric eyes shall be solid state, hermetically sealed units rated at 120 volts, 60 cycle AC and 1000 watts maximum load.
 - d. Lamps used in fixtures installed on residential streets after January 1, 2015 shall be 75 watt LED fixtures, except that a 50 watt fixture may be approved by the town engineer in cul-de-sacs where spillover from the 75 watt fixtures might be excessive. Lamps installed at street intersections and development entrances shall be at least 150 watt LED fixtures. Lamps installed on collector streets

- and interior arterial roadways, as determined by the town engineer, shall be at least 150 watt LED fixtures.
- e. Luminaires shall produce 0 light above 90°.
 - f. Fixtures placed within close proximity to residential uses shall be required to provide house shields to prevent light spill over into residential structures.
3. **LUMINANCE LEVELS.** Luminance levels shall be provided in accordance with IESNA RP8-2000 methodology based upon the appropriate pavement type, road classification and pedestrian conflict.
 4. **LIGHTING COLOR.** Light color for LED fixtures shall have a color temperature range from 3,000 Kelvin to 4,500 Kelvin.
 5. **LIGHTING WIRE (Cable).** Wire used for lighting systems may be either direct burial or for use in conduit. It shall be of the proper size and type as specified on the electrical print.

S862.04 Ground System

All light poles and electrical equipment installed for use shall be connected to a Ground Systems made up of the proper size and length ground rod and wire connected to the earth.

S862.05 Requirements

1. Light fixtures installed on subdivision streets shall be:
 - a. Self-supporting fixtures 17 to 20 feet in length.
 - b. Spaced at 200 foot intervals and be staggered on both sides of the roadway.
 - c. All intersections shall provide sufficient light to illuminate the entire intersection.
 - d. Lamps wattage shall be 100 for interior streets and 250 or 400 at intersections.
2. Light fixtures installed on non-subdivision roads shall be:
 - a. Spaced at 200 foot intervals and be staggered on both sides of the road way except if there is a median provided the fixtures may be placed in the median instead of on the road way.
 - b. If lights are installed in a median they must illuminate travel lanes on both sides of the median.
 - c. Light poles shall be installed at the proper height to provide sufficient lighting for both pedestrian and vehicular safety.
 - d. Light fixture refractors shall be constructed to provide 90 percent of their light output onto the travel lane(s)
 - e. Lamps used at locations other than intersections shall be rated at

- 100 watts.
- f. Lamps used to illuminate intersections shall be rated at 400 watts.
3. All fixtures shall be supplied with individual operated photocells.
 4. Cable and wire shall be buried a minimum of 24 inches deep and have a detector tape placed the full length at a depth of 6 inches below the finished grade.
 - a. The tape shall be imprinted with a continuous warning message that reads "CAUTION ELECTRICAL CABLE" The warning message shall be repeated every 36 inches.
 - b. The tape shall be inductively and conductively traceable using a standard pipe and cable locating device.
 5. All light fixtures shall be equipped with individual fuses for safety and protection.
 6. There shall be no cable or wire exposed after installation is complete.
 7. All light fixtures shall be individually grounded.
 8. There shall be an electrical meter installed for each different wattage of lighting installed at each location that will be used to read electrical consumption and billing.

S862.06 Electrical Inspection

All installed fixtures and associated equipment must be certified to be properly installed and in compliance with all codes prior to being energized by an independent electrical inspector properly licensed by the State of Delaware and a copy of the certification must be presented to the Director of Public Works.

S862.07 Installation

The contractor is fully responsible for designing all street lights as part of the development. Street lights are owned, operated, and maintained by the town and shall be installed by the town at the expense of the owner and/or developer.

1. No C.O. (Certificate of Occupancy) shall be issued if street lighting is not installed and working in the area of the new building.
2. The contractor shall be responsible for any electrical payments pertaining to street lighting until the road is accepted by the town.
3. All maintenance shall be performed by the town following dedication.

S862.08 Method of Measurement

The number of roadway lights to be paid for under this section shall be the actual number of roadway lights called for on the plans and installed according to these specifications complete in place and accepted.

S862.09 Basis of Payment

The number of roadway lights as determined above shall be paid for at the contract unit price bid for roadway lights, complete in place, which price and payment shall constitute full compensation for furnishing and placing roadway cable, light poles, light fixtures, lamps, and all associated components.

END OF SECTION

S863 SPEED HUMPS**S863.01 Description**

This work consists of furnishing all materials and construction of speed hump(s) in accordance with the detail and at the location(s) determined by the engineer. All warning signs and delineators must be erected immediately before or coincidental to the installation of the speed hump(s).

S863.02 Materials

1. Bituminous concrete. The bituminous concrete shall be HMA surface SC meeting the requirements of DelDOT Specifications.
2. Striping. The striping shall be 4 and 5 inch yellow thermoplastic meeting the requirements of DelDOT Specifications.
3. Delineators. The delineators shall be white 6" x 12" high-intensity reflectorized aluminum panels mounted on 7 foot galvanized u channel post. Two reflectorized panels per post and two posts per speed hump.

S863.03 Construction Methods

The construction of the speed hump(s) shall occur after bituminous concrete overlay has been completed. The location(s) of the speed hump(s) is to be determined by the engineer.

1. The construction of the speed hump(s) shall be in accordance with DelDOT Standards.
2. If construction of the speed hump(s) occurs seven or more days after the bituminous concrete overlay, asphalt tack coat shall be required.
3. Contractor is to verify underground utility locations before placement of delineators.
4. Speed hump(s) shall not be installed at intersections.
5. Speed hump(s) shall not be installed on grades greater than 8 percent.
6. Speed humps shall be designed and installed with tapered ends next to the curb to allow a gap for drainage.
7. Speed humps shall be either parabolic, circular or sinusoidal in shape.
8. Speed humps shall be installed with Delaware MUTCD approved advanced warning signs and pavement markings.
9. Speed humps shall be warranted according to policy established by the

Town of Smyrna.

S863.04 Method of Measurement

The quality of speed hump(s) will be measured as the actual number of speed humps constructed and accepted.

S863.05 Basis of Payment

The quantity of speed humps will be paid for at the contract unit price per each. Price and payment will constitute full compensation for all materials including bituminous concrete, thermoplastic striping, delineators, tack coat, saw cutting, pavement milling, placement and compaction, verification of underground utilities, driving of post, mounting of delineators, warning signs, disposing of existing pavement, excess material and for all labor, equipment, tools, and incidentals required to complete the work.

END OF SECTION

S864 LOOP DETECTORS**S864.01 Description**

This item consists of sawing a ¼” wide kerf in existing pavement, furnishing and installing loop detector wire in the kerf and sealing the kerf with an approved sealer, in accordance with the details on Plans and as directed by the Engineer. Prior to any work involving loop detectors, contact DeIDOT.

Loop lead-in wire cable shall consist of one continuous run with no splices, and shall be installed at the bottom of the kerf, with 3” from top of wire to finished pavement surface.

The flexible embedding sealer will be supplied by the Contractor and shall be a cold poured, resilient type epoxy joint sealer.

¼” Rolled approved oiled oakum shall be supplied by the Contractor.

S864.02 Method of Measurement

The length of kerf to be measured under this shall be the number of linear feet of kerf in which wire is installed complete in place and accepted.

The additional wire needed beyond kerf to reach the Junction Well, and connecting cables shall be incidental to this item and there will be no separate measurement or payment.

S864.03 Basis of Payment

The number of linear feet of kerf measured as provided above shall be paid for at the contract unit price per Linear Foot bid for “Loop Detector”, which price and payment shall constitute full compensation for furnishing and placing all materials including detector wire, oiled oakum and sealer, labor, equipment, tools, and incidentals necessary to complete this item.

END OF SECTION

S865 FLAGGER**S772.01 Description**

Flagger shall consist of furnishing men/women and necessary equipment for the controlling of traffic through work areas.

S865.02 Flag Training Certificate

No person shall be allowed to flag traffic unless they have attended the American Traffic Safety Services Association (ATSSA) flagger certification training, within the last three years. The flag person will be required to have in their possession a card signed by an ATSSA certified instructor.

1. Since flag person make the greatest number of public contacts of all construction personnel and are responsible for human safety, it is important that well qualified personnel be selected.
2. A flag person shall possess the following qualifications:
 - a. Average intelligence
 - b. Good physical condition, including sight, and hearing
 - c. Mental alertness
 - d. Courteous but firm manner
 - e. Neat appearance
 - f. Pleasing personality
 - g. Sense of responsibility for safety of public and crew
 - h. Adequate communication skills in English

S865.03 Flagperson Stations

Flagperson stations shall be located far enough from the work site so that vehicles will have sufficient distance to slow down before entering the project but not so far that vehicles will tend to speed up into the work site. Normally the flagperson will stand either on the shoulder adjacent to the lane of traffic he/she is controlling or in the barricaded lane. At a spot obstruction he/she may have to stand on the shoulder opposite the barricaded section. Under no circumstances shall he/she stand in the traffic lane. In rural areas he/she shall be clearly visible to the traffic he/she is controlling for a distance of 500'. For this reason he/she must stand alone, never permitting a group of workers to congregate around him/her. Flagperson stations must be adequately protected and preceded by proper advance warning signs.

S865.04 Flagging Procedures

The flag person shall wear approved colored clothing on the upper portions of the body, such as vest, shirt, or jacket; and shall be required to wear the appropriate colored headgear at all times. For nighttime conditions, the use of similar outside garments or belting, reflectorized, shall be used. In addition, flag person stations shall be adequately illuminated to attract attention.

1. The flagperson shall use only a STOP/SLOW paddle for controlling traffic through the work areas, unless otherwise use of flag is required in emergency situations.
2. When sign paddle is used with arm extended, it shall be held stationary in a vertical position supported by a rigid vertical handle 7' high. For further explanation and details, the Contractor shall refer and comply with the requirements of Delaware's Traffic Control Manual, latest revisions.
3. Lights, and/or reflectorized sign paddles shall be used to control traffic at night. To stop traffic the light shall be waved back and forth across the path of the approaching vehicle. The signal to proceed shall be given verbally or by a hand motion. Adequately reflectorized sign paddles or flags may be used at night provided that the reflectorization is of a type that will retain its brilliance when wet. Daytime flagging procedure shall be followed whenever such paddles or flags are used at night.
4. Whenever practicable the flagperson should advise the motorist of the reason for the delay and the approximate period that traffic will be halted. Flagperson and operators of construction machinery or trucks should be made to understand that every reasonable effort must be made to allow the driving public the right-of-way and prevent excessive delays.

S865.05 Unsatisfactory Performance

Any flagperson performing duties unsatisfactorily in the opinion of the Director of Public Works shall immediately be discharged from the project and replaced with an approved flagperson. Flaggers are required to have their approved flagger card and photo identification on them at all times while flagging.

S865.06 Method of Measurement and Basis of Payment

Flagger shall be paid for at a unit price per hour for each flagger required, which payment shall constitute full compensation for conforming to all the requirements outlined herein.

The cost of equipment and reflectorized clothing shall be included in the cost of this section.

END OF SECTION

**DIVISION 900 EROSION, SEDIMENT AND
STORMWATER MEASURES**

The **Description, Materials, Construction Methods, Method of Measurement, and Basis of Payment** for the items as mentioned in the Table below shall be as set forth in the **following Sections** of the Standard Specifications for Road and Bridge Construction for the Delaware Department of Transportation dated August 2016 or as later amended, unless otherwise noted below or as directed by the engineer. All storm drain and stormwater management facilities for public and private developments shall be designed to conform with the Delaware Department of Transportation criteria set forth in the current version of the Road Design Manual and the current amended version of the Delaware Sediment and Stormwater Regulations by DNREC and the Town of Smyrna Code and these specifications.

SECTION	ITEM
901	EROSION, SEDIMENT AND STORMWATER MANAGEMENT
902	PUMPING OPERATIONS
903	POLLUTION PREVENTION
904	RESERVED
905	SEDIMENT TRAP DEVICES
906	DEWATERING PRACTICES
907	WATER CONTROL PRACTICES
908	SOIL STABILIZATION PRACTICES
909	WATERWAY CONSTRUCTION PRACTICES
910	STORMWATER MANAGEMENT FACILITIES
911	PLANTINGS
S912	LONGITUDINAL DITCHING
S913	DRAINAGE PIPE
S914	ADJUST/REPAIR CATCH BASINS
S915	UNDERDRAINS (Supplement To Section 709)

END OF SECTION

S912 LONGITUDINAL DITCHING**S912.01 Description**

Longitudinal Ditching shall consist of excavating longitudinal ditches to the typical section shown on the plans. This section includes the necessary clearing beside the ditches.

S912.02 Construction Methods

All material that has been excavated from the ditches shall be spread on top of the land on each side of the ditch, graded to conform to the surface contours, and blended into the surrounding land. Where necessary the land shall be prepared and conditioned in all sections along both sides of each ditch to be excavated to the width necessary to receive the material.

S912.03 Method of Measurement and Basis of Payment

The number of linear feet of Longitudinal Ditching shall be paid for at the contract unit price per linear foot bid for Longitudinal Ditching, excavated to the width and depth of the typical section, which price and payment shall constitute full compensation for clearing, excavating, disposing of brush, topsoil, seed and mulch, etc; and for all labor, equipment, tools, and incidentals necessary to complete the work.

END OF SECTION

S913 DRAINAGE PIPE**S913.A Reinforced Concrete Pipe (R.C.P.)****S913.B Reinforced Concrete Elliptical Pipe (R.C.E.P)****S913.C Aluminized Steel Type 2 Corrugated Steel Pipe (as manufactured by AK Steel or approved equal)****S913.D Polyethylene (PE) Plastic Drain Tube or Pipe****S913.01 Description**

Drainage Pipe shall consist of furnishing, installing, excavating, removal and storage and rehandling excavated material, backfill, backfilling, compaction, dewatering, placement and removal of shoring, cribbing and sheeting, removal of unacceptable excavated material from the project site, construction of joints and connections to existing and new pipes, catch basins, manholes, etc., forming the bed or foundation, removing and disposing of temporary pavement patching for the installation of the Drainage Pipe to and in close conformity with the lines and grades and at such places shown on the plans or established or as directed by the Engineer.

Drainage Pipe shall meet the requirements of Section 601 of the Delaware Department of Transportation Standard Specifications for Road and Bridge Construction, latest edition.

S913.02 As-Built Drawings

As-builts shall be furnished to the Town in accordance with the General Conditions of the Town of Smyrna prior to the Town accepting any section, subsection, or phase of construction the contractor/developer wishes to convey to the Town. As-builts shall be provided in both paper and electronic AutoCAD, pdf, or jpg format on a CD. As-builts shall be in conformance with the As-Built Drawings Submission Checklist provided in the appendix.

S913.03 Method of Measurement

Drainage Pipe will be measured complete in place, accepted by the Engineer, from end to end of the pipe, including the structure wall thickness but excluding the structure interior.

S913.04 Basis of Payment

Price and payment will be full compensation for furnishing, installing, excavating - removal and storage and rehandling excavated material, backfill, backfilling, compacting, dewatering, placement and removal of shoring, cribbing and sheeting, removal of unacceptable material from the project site, construction of joints and connections to existing and new pipes, catch basins, manholes etc., forming the bed or foundation, removing and disposing of temporary pavement patches for the installation of the

Drainage Pipe and for all materials, labor, equipment, tools and incidentals necessary to complete the work.

Perform all work in accordance with Standard Specifications for Road and Bridge Construction

END OF SECTION

S914 ADJUST/REPAIR CATCH BASINS**S914.01 Description**

Catch basins shall be adjusted to grade and shall be repaired as necessary prior to the paving operations. Covers of catch basins shall be removed and all masonry found to be in poor condition shall be rebuilt using materials conforming to the original structure.

The materials necessary to be excavated under this section shall be removed from the site. All such excavations shall be backfilled with approved materials.

S914.02 Method of Measurement

The number of Catch Basins adjusted and/or repaired to be paid for under this section shall be the actual number of catch basins and manholes completed and accepted.

The unit price bid per each for Catch Basins adjusted or repaired shall constitute full compensation for repairs from the top of grate to 3' below. Repairs below 3' and not more than 4 1/2' shall be paid for at 1.5 times the unit price bid per each for catch basins adjusted or repaired. Repairs that are more than 4 1/2' below the top of grate shall be paid for at two (2) times the unit price bid per each for catch basins adjusted or repaired. In no case, regardless of the depth of repairs shall the payment exceed twice the unit price bid for catch basin adjusted or repaired.

S914.03 Basis of Payment

The number of Catch Basins adjusted and repaired, as provided above shall be paid for at the contract unit price bid for this section. Adjusting and Repairing Existing Catch Basins, which price and payment shall constitute full compensation for excavating, removing the covers and portions of structures, furnishing and placing all materials, backfilling, resetting the covers to proper grades, labor, equipment, tools and incidentals necessary to complete the work.

The unit price bid per each for this section shall constitute full compensation for repairs from the top of grate 3' below. Repairs below 3' and not more than 4 1/2' shall be paid for at 1.5 times the unit price bid for each for this section. Repairs that are more than 4 1/2' below the top of grate (or cover) shall be paid for at two times the unit price bid per each for this section. In no case, regardless of the depth of repairs shall the payment exceed twice the unit price bid for this section.

END OF SECTION

S915 UNDERDRAINS (SUPPLEMENT TO SECTION 709)**S915.01 Description**

The purpose of underdrains is to remove groundwater that may be detrimental to the stability of a road section and shoulders.

S915.02 Locations

The areas that require underdrains should be evident during pre-design field investigations, wetlands investigations, soils investigations and during utility and street construction. Wet soils, areas of lush vegetative growth, evidence of seasonal high water (i.e. grayish colors or mottles in the soil), seeping cut slopes, apparent spring interception and/or excessive groundwater are all indications that groundwater may be present.

Possible locations of underdrains are: along the toe of a cut slope; along a toe of fill; and across a roadbed at a cut sump area.

S915.03 Street Design Requirements

Underdrains are required to be installed on all new street construction when the surrounding existing grade is eight (8) percent or greater. When wet soil conditions are found during the pre-design investigations the design of the proposed roadway system should avoid these areas. If these areas cannot be avoided a subsurface drainage system shall be designed as part of the street construction plans.

S915.04 Groundwater Encountered during Construction

An underdrain system shall be installed when groundwater or evidence of seasonal high water is encountered during construction between the subgrade elevation and two feet below subgrade within a proposed right-of-way. Groundwater is typically encountered during rough grading, sewer, water and storm drain construction, and subgrade preparation. The underdrain system shall be proposed, designed, and approved by the Town of Smyrna prior to the placement of the roadway system's geotextile separator and base course. It is recommended that a system be proposed soon after groundwater is encountered so that potential construction delays are minimized.

S915.05 Design, Materials and Construction

The underdrain system shall be designed and constructed as per Section 709 Standard Specifications for Road and Bridge Construction for the Delaware Department of Transportation dated August 2016 or as later amended. Also, see Section B, Standard Construction Details, Category R, Roadways for details.

END OF SECTION

DIVISION 1000 MATERIALS

The **Description, Materials, Construction Methods, Method of Measurement, and Basis of Payment** for the items as set forth in the following **Sections 1001 through 1080** of the Standard Specifications for Road and Bridge Construction for the Delaware Department of Transportation dated August 2016 or as later amended, unless otherwise noted below or as directed by the engineer.

SECTION	ITEM
1001	BORROW
1002	CLAY BORROW
1003	FINE AGGREGATE
1004	COURSE AGGREGATE
1005	GRADED AGGREGATES
1006	STONE FOR RIPRAP
1007	RESERVED
1008	RESERVED
1009	RESERVED
1010	RESERVED
1011	TACK COAT
1012	ASPHALT CEMENT
1013	ANTI-STRIPPING ADDITIVES
1014	ASPHALT MATERIALS PRODUCTION
1015	COLD PATCH
1016	EMULSIFIED ASPHALT
1017	RESERVED
1018	RESERVED
1019	RESERVED
1020	CEMENT AND POZZOLANIC MATERIALS
1021	WATER FOR PORTLAND CEMENT CONCRETE
1022	PORTLAND CEMENT CONCRETE PRODUCTION
1023	PORTLAND CEMENT CONCRETE PATCHING MATERIAL, PARTIAL DEPTH
1024	RESERVED
1025-1029	RESERVED
1030	BAGGED RIPRAP
1031	PIPE CULVERTS
1032	PILE MATERIALS
1033	ACCESS TUBES FOR CROSSHOLE SONIC LOG TESTING
1034	CASINGS
1035	SLURRY
1036	ADDITIONAL CONCRETE REQUIREMENTS FOR DRILLING SHAFTS
1037	EMBEDDED REINFORCEMENT AND HARDWARE
1038	PRESTRESSING STRANDS
1039	STRUCTURAL STEEL
1040	MASONRY UNITS

S1081 PAVING FABRIC**S1081.01 Description**

This work shall consist of furnishing and placing an asphalt overlay textile (paving fabric) beneath a pavement overlay or between pavement layers to provide a water resistant membrane and crack retarding layer in accordance with this specification and details as shown on the plans.

S1081.02 Material

Paving Fabric shall be Amoco Petromat 4597 polypropylene non-woven needle-punched fabric or approved equal unless otherwise specified and approved on the construction plans or specifications.

S1081.03 Construction

Paving Fabric shall be installed in accordance with manufacturer's specifications.

S1081.04 Method of Measurement and Basis of Payment

The payment for the items specified in the Contract Documents will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Paving Fabric will be measured and paid for on the basis of the number of square yards of material installed according to these specifications or as specified by the engineer.

END OF SECTION

DIVISION 1100 SANITARY SEWER SYSTEMS

S1001 EXCAVATION AND BACKFILL FOR SANITARY SEWER PIPE TRENCHES**S1101.01 Description**

Excavation and Backfill for Sanitary Sewer Pipe Trenches shall consist of the removal and replacement or disposal of all materials necessary for the placement of pipes in accordance with this specifications and details and as shown on the Plans.

S1101.02 Construction Methods

Normal excavation will be considered from the outside pipe dimension plus 18" each side, unless otherwise designated on the plans.

1. Unsuitable foundation material shall be removed below the normal designed elevation as directed by the engineer.
2. When a pipe is to be placed either partially or completely in a fill, the embankment shall be compacted to an elevation of one foot above the top of the proposed pipe installation for a minimum of 36" on each side of the pipe. For parallel pipe installations, allow enough space between the pipes for proper compaction. Minimum spacing between pipes shall be 24 inches, unless otherwise noted on the plans.
3. Trench or ditch bottoms containing bedrock, soft areas such as muck or refuse, or other material unable to provide long-term support to the pipe are unacceptable. Remove rock and other unyielding material one-foot below the pipe bottom and six inches on either side of the pipe unless otherwise directed by the Engineer. Excavate soft areas to a depth of two feet below the pipe bottom and three times the width of the pipe unless otherwise directed by the Engineer to excavate deeper or wider. If a firm foundation is exposed, replace the excavated material with acceptable backfill material and compact to 95 % Modified Proctor density.
4. If the soft area remains after excavation, and if approved by the Engineer, synthetic fabric (geotextile) shall be used to separate the native soil from the backfill. After the fabric has been laid on the native soil, replace the excavated material with acceptable backfill material and compact to 95 % Modified Proctor density.
5. When rock, hardpan or other unyielding material is encountered, the trench shall be excavated as shown on the plans for bedding in rock and shall be backfilled with materials meeting the requirements of Section 916.

S1101.03 Backfill Procedure

Backfilling of the pipe shall be as follows:

1. Place the pipe on a minimum 6" bedding of #57 stone meeting the requirement of section 813 and carefully tamp. Install Mirafi 600X (or equal) geotextile fabric to surround stone bedding and overlap a minimum of twelve inches.
2. The next layer of backfill, the haunching, is the most important since it is this layer that provides the pipe with support against the soil and traffic loadings. Haunching should be placed in lifts of about 4 to 6 inches for optimum construction on both sides of the pipe. Tamp to achieve the specified compaction, or shovel into the area, eliminating voids, if the material doesn't require compaction. Construction of each lift should be repeated up to the crown of the pipe. Backfill material shall be of #57 stone meeting the requirement of section 813.
3. Initial backfill extends from the crown of the pipe to a minimum of six inches above the crown of the pipe. This area of the backfill anchors the pipe and ensures that loads are distributed as evenly as possible into the haunching. When using a material that requires compaction it is important not to use mechanical compaction equipment directly on the pipe itself. Backfill material shall be of #57 stone meeting the requirement of section 813.
4. Final backfill, which extends from the initial backfill layer to the ground surface, does not directly support the pipe. Backfill material shall meet Section 209.

Flowable fill can be used as an alternative to compacted granular material. Flowable fill will cause the pipe to float or misalign. Therefore, the pipe will need to be weighted with sandbags or held with some type of anchoring system. Alternatively, the flowable fill can be poured in layers that are allowed to cure before the next layer is poured.

5. Where the pipes are under the roadway pavement or shoulders, the backfill material shall be compacted in 8" lifts to 95% of the Modified Proctor density.
6. Where pipes are not under the roadway pavement or shoulders, compaction shall be in 8" lifts to 92% Modified Proctor density.

S1101.04 Method of Measurement and Basis of Payment

The payment for the items specified in the Contract Documents will be full compensation for all applicable excavation, sheeting, shoring, dewatering, hauling, invert paving, storing, re-handling of material, removal and disposal of excess and unsuitable material,

tamped fill, forming bed or foundation, backfilling, compaction, testing and for all material, labor, equipment, tools, and incidental necessary to complete the work.

Excavation and backfill for sanitary sewer pipe trenches will not be measured and paid separately but will be included in the pertinent cost of the Contract or as specified by the engineer.

END OF SECTION

S1102 SANITARY SEWER GRAVITY MAINS

S1102.01 Description

This item shall consist of gravity sanitary sewers mains of ductile iron pipe (DIP) or polyvinyl chloride (PVC) pipe of the diameter shown on the Plans, installed or constructed within the right-of-way or within easement, laid on a firm bed true to line and grade in accordance with these Specifications and Details.

S1102.02 General Guidelines

Sanitary sewer gravity main design shall be as set forth in the Kent County Code and or as later amended, unless otherwise noted in these specifications or as directed by the engineer.

S1102.03 Minimum Size

No sewer shall be less than eight (8) inches in diameter.

S1102.04 Minimum Slope

All sewers shall be designed and constructed to provide mean velocities, when full, of not less than two (2.0) feet per second. Based on Kutter's formula or Manning's formula, an "n" value of 0.013 is generally used. Use of other practical "n" values may be permitted if the available research or field data show justification. The following are the minimum slopes that should be provided; however, slopes greater than these figures are desirable:

Sewer Size (inches)	Minimum Slopes ft./ft.
8	0.0050
10	0.0028
12	0.0022
15	0.0015
18	0.0012
21	0.0010
24	0.0008
27	0.00067
30	0.00058
36	0.00046

S1102.05 Materials.

Material used for gravity sewer mains shall be polyvinyl chloride, (PVC), ductile iron pipe (DIP), or high-density polyethylene (HDPE). HDPE pipe will be approved for specific applications on a case-by-case basis.

1. PVC Pipe. PVC pipe, used for gravity sewer construction, shall equal or exceed the requirements of ASTM D-3034 and shall have a minimum Standard Dimension Ratio (SDR) of 26 and the minimum pipe stiffness, as tested in accordance with ASTM D-2412. Pipe shall be manufactured with integral wall bell and spigot joints in standard lengths.
 - a. PVC pipe shall be green in color.
 - b. Gravity sewer mains installed at a depth in excess of eighteen (18) feet shall be ductile iron.
2. Ductile Iron Pipe (DIP). Ductile iron pipe shall be manufactured in accordance with ANSI A21.51, latest edition, and shall be Class 52 unless otherwise approved by the engineer.
 - a. The Pipe shall have an internal coating system. The internal coating system shall be a ceramic epoxy and shall be an amine cured novolac epoxy containing at least 20% by volume of ceramic quartz pigment. The coating shall be US Pipe and Foundry Protecto 401 or an approved equal. The pipe shall receive an external standard bituminous foundry coating in accordance with ANSI A21.4.
 - b. Gravity sewer mains installed at depths exceeding 18' shall be required to be ductile iron pipe.
3. HDPE Pipe used for gravity sewer construction, shall be PE3608 high density polyethylene meeting ASTM D-3350. Pipe and fittings shall be from the same manufacturer. Pipe shall be manufactured in accordance with ASTM F714 and shall be so marked. The pipe shall have a minimum Standard Dimension Ratio (SDR) of 17.0 (100psi WPR) unless otherwise approved by the Town Engineer.
4. Pipe fittings shall be of the same materials as the pipe to which it is connected.
 - a. PVC pipe fittings shall utilize an elastomeric O-ring gasketed joint assembly in accordance with the manufacturer's recommendations.
 - b. PVC "Y" branches, "T-Y" branches, pipe stoppers and other fittings shall be manufactured in accordance with the same specifications and shall have the same thickness, depth of socket, and annular space as the main. "Y" and "T-Y" branches shall be complete pipe sections.
 - c. Service saddles will not be permitted for use in new construction.

- d. All fittings used to connect ductile iron sewer main pipe shall be made of ductile iron in accordance with ANSI A21.10 and be Class 52.
 - i. The contractor shall have the option of furnishing mechanical or push-on joints conforming to ANSI A21.11, latest edition.
 - ii. Ductile iron pipe shall use mechanical and push on joints such as “Tyton” joint ends.
 - iii. Mechanical joints shall be assembled using either Ford Uni-Flange series 1400 Wedge Action Retainer Glands, Mueller Aqua Grips, or EBBA Iron Mega lug series 1000 Mechanical Joint Retainer glands.
 - e. All fittings shall be coated on the interior and exterior in the same manner as ductile iron pipe, as described above.
5. Concrete. All concrete for manhole base slabs and cradles, flow channels, encasements, blocking, etc., shall have a minimum compressive strength of 3,000 psi at 28 days. Type II Portland Cement shall be used.
 6. Brick. All brick shall conform to the “Standard Specifications for Sewer Brick,” ASTM Designation C 32, Grade SS, except that the maximum absorption for the average of five bricks shall not exceed 10 percent; and the individual brick maximum shall not exceed 14 percent.
 7. Mortar. Cements shall be Class B Sulfur resistant in accordance with the “Standard Specifications for Portland Cement,” ASTM Designation C 150 for Type II.

Mortar shall be fresh mixed in small batches for the work in hand. Tight boxes or platforms made for the purposes shall be used. The sand and cement shall be thoroughly mixed dry, in the proper proportions, until a uniform color has been produced, whereupon a moderate dose of water shall be added, so as to produce a stiff paste of the proper consistency.
 8. Sand. Sand shall be composed of sharp, angular, siliceous grains, coarse, or graded from fine to coarse with the coarsest grains predominating, and sensibly free from clay, loam, dirt, mica, organic matter, or other impurities.
 - a. Sand containing more than 5 percent by weight of foreign material shall not be used. This limit may be changed for special classes of work if hereinafter specified.
 - b. Sand exhibiting more than an acceptable amount of fine matter or impurities may be required to be washed after delivery or shall be rejected altogether. The Contractor shall submit samples of the sand he proposes using. Sand for mortar shall be screened to reject

- all particles of a greater diameter than 1/4 inch and shall not contain more than 5 percent by weight passing through #200 sieve.
- c. Unless hereinafter specified otherwise, all mortar shall be composed of cement and sand of the character above specified. The proportion by volume shall be one part of cement to two of sand. One volume of cement shall be 94 pounds net. One volume of sand shall be 0.9 cubic feet, the sand not being packed more closely than by throwing it into a box in the usual way.
 - d. Sand obtained from the excavation shall not be used.

S1102.06 Storage

PVC pipe shall be delivered and stockpiled in unit pallets. No stacking of pallets above 5 feet in height will be allowed. If pipe is stockpiled for more than 30 days prior to installation, it must be suitably covered with reflective material to protect the pipe from ultra-violet rays emanating from sunlight. Do not use plastic sheets. Allow for air circulation under covering.

Bowed sections of pipe will be unacceptable and installation of pipe, which has bowed, whether or not the bow has been corrected, will not be allowed.

S1102.07 Construction Methods

1. Laying Pipe. Pipe shall be carefully handled and lowered into the trench. In laying pipe, special care shall be taken to ensure that each length shall abut 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.
 - a. No wedging or blocking will be permitted in laying any pipe unless by written order or permission from the Town.
 - b. Install geotextile fabric along the trench to allow the sewer main and bedding to be encased with a twelve inch overlap.
 - c. Before joints are made, each pipe shall be well bedded in a solid foundation. The stone bedding shall extend 6" above the bedded pipe. Bell holes shall be dug sufficiently large to insure that the pipe is firmly bedded on the full length of the barrel.
 - d. Proper and suitable tools and appliances for the safe and convenient handling and laying of pipes shall be used.
 - e. The pipes shall be thoroughly cleaned before they are laid and shall be kept clean until the acceptance of the completed work. The open ends of all pipelines shall be provided with a stopper carefully fitted, so as to keep dirt and other substances from entering. This stopper shall be kept in the end of the pipe line at all times when laying is not in actual progress.
 - f. Whenever a pipe requires cutting to fit into the line or to bring it to the required location, the work shall be done in a satisfactory manner so as to leave a smooth end, without extra compensation.

2. All concrete required to support and reinforce Y branches and bends shall be placed as shown in the Standard Details or as directed by the Town.
3. All sewer house connections shall be laid in accordance with International Plumbing Code unless otherwise directed by the Town.
4. All sewer house connections shall be constructed to terminate at an angle perpendicular to the property lines unless otherwise noted on the plans.
5. The excavation in which pipe is being laid shall be kept free from water and no joint shall be made under water. Water shall not be allowed to rise in the excavation until pipe bedding and backfill has been completed. The greatest care shall be used to secure water tightness and to prevent damage to, or disturbing of, the joints during the backfilling process, or at any time. After pipes have been laid and the joints have been made, there shall be 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.
6. The PVC pipe shall be placed in accordance with the installation recommendations of the pipe manufacturer and applicable portions of this Specification.
7. No pipe shall be laid upon a foundation into which frost has penetrated at any time such that there is danger of the formation of ice or the penetration of frost at the bottom of the excavation, unless the minimum length of open trench and promptness of refilling are observed.
8. Pipe Detection. All installed sewer pipes and laterals shall be capable of being found once buried by the installation of tracer wire and detector tape.
 - a. Pipeline detectable tape shall be installed continuously along all gravity sewers. The tape shall be installed directly above the gravity sewers and twelve inches from the ground surface.
 - i. The tape shall be Lineguard Type III Detectable Tape as manufactured by Lineguard, Inc., of Wheaton, Illinois, or approved equal.
 - ii. The tape shall be minimum of two inches wide, green in color, imprinted with the word "CAUTION -- SEWER LINE BELOW," and be capable of being detected with inductive methods.
 - b. Detector wire shall be insulated copper AWG #10. It shall be installed with and laid on top of the pipe as it is being installed. It shall run the full length of the installed pipe and shall be accessible to the surface at every structure. The wire shall be brought to the

surface for access by attaching to the inside rim of each manhole. The detector wire shall run one manhole to the next manhole in a continuous line.

S1102.08 Storm Drain Separation

Sanitary sewers shall be laid at least 3 feet horizontally from any storm drain pipe measured edge to edge. Sanitary sewer mains that cross a drainage pipe shall be encased in concrete, a minimum of five (5) feet on either side of the centerline of the crossing, if there is less than one (1) foot of clearance between the outside diameter of the sanitary sewer and the outside diameter of the drainage pipe. A full length of sanitary sewer pipe shall be installed centered on the storm drain to maximize the distance to a sanitary sewer pipe joint.

S1102.09 Horizontal and Vertical Separation.

1. In general, horizontal and vertical separation shall be per 10 States Standards. Sewers shall be laid at least ten (10) feet horizontally from any existing or proposed water mains. The distance shall be measured edge to edge.
2. Sewers crossing water mains shall be laid to provide a minimum vertical distance of eighteen (18) inches between the outside of the water main and the outside of the sewer.
 - a. Sewer lines shall be located below water mains unless otherwise authorized by the Town.
 - b. When a sewer main crosses an existing water main, the crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water main joints.
 - c. Where a water main crosses under a sewer, adequate structural support shall be provided for the sewer to maintain line and grade and prevent damage to the water main.
3. When mains cross other utilities, refer to Town of Smyrna Standard Detail No. S-13.

S1102.10 Connection to Existing Manholes

Connection to existing manholes shall be made at such points and of such form, dimensions and elevations as indicated on the Contract Drawings or as the Town's Engineer shall require.

1. The size of the opening through the wall of the existing manhole for the pipeline connections shall not exceed the outside diameter of the pipe plus six inches. All connections shall be fully grouted by using a non-shrinking grout.
2. Manhole adapters shall be used on all connections to existing manholes.

3. Care shall be taken by the Contractor to prevent broken brick and mortar from entering the existing or proposed pipes. A screen shall be provided below the area of work to catch any falling debris.
4. Core drilling is the only acceptable method of making a new opening in an existing reinforced concrete manhole.

S1102.10A Connection to Existing Sewer Mains and Laterals

All couplings shall be Flex-Seal Adjustable Repair Couplings or equal and meet the following requirements:

1. The steel band shall span the entire width of the coupling.
2. Molded rubber sleeve, extruded in larger sizes, conforming to ASTM C425 and ASTM C1173.
3. Stainless steel shear rings with a minimum thickness of 0.012” and conforming to ASTM A240.
4. Stainless Steel clamps with nut and bolt takeup.

Refer to 4.d. of S1002.05 “Materials” if connecting to Ductile Iron Pipe.

S1102.11 Alignment

Sanitary sewers shall be installed with straight horizontal and vertical alignments between manholes.

When a smaller sewer joints a larger one, the invert of the larger sewer should be lower to allow the crowns of both pipes to be at the same elevation. The invert of a pipe exiting a manhole shall be lowered the appropriate distance compared to the invert of the pipe(s) entering the manhole to account for the head loss within the manhole.

S1102.12 CCTV Inspections

1. All CCTV inspections shall be coded to PACP standards. All pipe deficiencies shall be coded (to PACP standards). In addition, all pipe joints shall be scanned around the entire pipe joint circumference while the camera is stationary and the maximum rate of travel for the CCTV camera is 20 feet per minute. A CCTV inspection that does not meet the requirements listed above will not be accepted.
2. Inspection Logs: Unless otherwise indicated, submit inspection logs that include the following as a minimum:
 - a. Project title
 - b. Time of day

- c. Zone atlas map number
 - d. Manhole to manhole pipe section
 - e. Pipe segment length
 - f. Pipe material
 - g. Line size
 - h. Specify upstream manhole and downstream manhole (Specify if CCTV is upstream or downstream)
 - i. Direction of camera's travel
 - j. Pipe depth
 - k. Operator name and license number (must be NASSCO PACP certified)
 - l. Tape counter reading continuously throughout the CCTV inspection
3. External Hard Drive: Contractor shall provide MPEG files delivered with data on an external hard drive. In addition, data shall be submitted electronically in a PACP 4.2 certified database format (Microsoft Access).
 4. Maintain a copy of all inspection documentation (external hard drive, databases, and logs) for duration of Work and warranty period.

S1102.13 Acceptance Testing

The Contractor shall furnish all labor, tools, material, including water, and equipment, including pumps, compressors, stopwatch, gauges, and meters, subject to the approval of the Town for testing in accordance with these Specifications.

S1102.14 Testing Procedure

The Contractor shall immediately replace all sections of pipe, which deflect more than 5 percent as measured by CCTV inspection.

1. Low Pressure Air Acceptance Test. The Contractor shall furnish all equipment and personnel necessary to conduct this test in accordance with the following procedure:
 - a. All branch fittings and ends of lateral stubs shall be securely plugged to withstand the internal test pressures. The section of line being tested shall also be securely plugged at each manhole. All stoppers shall be adequately braced for safety purposes.
 - b. A determination will be made as to the presence of groundwater on the pipeline exterior. If groundwater is present, the air pressure to be used for the test shall exceed the maximum pressure exerted by the groundwater in the section of pipeline being tested by 4.0 psi. The pressure exerted by the groundwater shall be determined by dividing the maximum distance the groundwater is determined or assumed to be above the pipe (in feet) by 2.31. The resulting number will be the external groundwater pressure in psi.

For example, if 5 feet of groundwater were present, the groundwater pressure would be 2.2 psi. The test pressure used in the pipeline would therefore be 2.2 psi + 4.0 psi = 6.2 psi in this example.

In cases where no groundwater is present, the air shall be slowly supplied to the plugged pipeline until the internal air pressure reaches 4.0 pounds per square inch. At least 2 minutes shall be allowed for temperature stabilization before proceeding further.

- c. The air hose used to introduce the air into the pipe shall be removed and the rate of air loss shall then be determined by measuring the time interval required for the internal pressure to decrease from 3.5 to 3.0 pounds per square inch in pipelines not having groundwater conditions. For pipelines having external groundwater pressure conditions, the time required for the internal pressure to drop from 0.5 psi to 1.0 psi less than the established test pressure shall be determined.
- d. The line shall be considered acceptable if the time required to reduce the air pressure per the above is not less than in the following table:

Pipe Diameter in inches	Minutes
6	2:50
8	3:47
10	4:43
12	5:40
15	7:05
18	8:30
21	9:55
24	11:20

- e. The Contractor shall not make any connections to the existing sanitary sewers until after the acceptance tests have been performed and accepted by the Town.

S1102.15 Alternate Acceptance Test – Sewers in Wet Locations

The Town reserves the right to utilize as an alternate method for pipe with a diameter of 39 inches or less the following Test for Leakage. The Contractor shall furnish all equipment and personnel necessary to conduct this test in accordance with the following procedure:

1. Sewer mains constructed in wet locations (i.e., water table 2' above crown of pipe) subject to infiltration / exfiltration shall be tested by infiltration /exfiltration method. All other sewer mains shall use the air test method.
2. Infiltration shall not exceed a rate of 100 gallons of water per inch diameter of pipe per mile of sewer pipe per day in any section of pipe between manholes. The amount of leakage shall be measured by a suitable weir or other device acceptable to the Town. When measurement of infiltration is not possible because of dry conditions, an exfiltration test shall be made on each section if so directed by the Town. The duration of each test shall be six (6) hours, unless a shorter test is permitted by the Town. If leakage exceeds a specified rate in a section, corrections satisfactory to the Town shall be made and the test repeated.

$$4' \text{ M.H.} = 93.9 \text{ gal/ft deep or } 7.825 \text{ gal/inch}$$

$$1 \text{ cu. ft.} = 7.48 \text{ gallons}$$

3. Sewers shall be tested in sections of not more than 1,000-foot lengths unless otherwise approved by the Town. Each section shall meet the infiltration or exfiltration requirements specified herein.
4. All sheeting shall be removed, except as may be indicated otherwise, backfill placed to finished grade, and dewatering operations ceased at least 3 days prior to infiltration tests.
5. The Contractor shall replace or repair all defects on section of sewers failing to meet the requirements of these tests.

S1102.16 Defects to be Made Good

If, at any time before the expiration of the guarantee period under the Contract, any broken pipe, or any other defects are found in any of the lines or in any of the appurtenances, the Contractor shall cause the same to be removed and replaced by proper material and workmanship. All materials shall be carefully examined by the Contractor for defects prior to installation, and any found defective shall be rejected for use.

S1102.17 Non-Public Property

Sewer mains and all accessories, excluding laterals, installed on non-public property (private property) shall be owned and maintained by the Town and shall be located within a twenty (20) foot minimum easement.

All materials employed in the construction of any non-public system that is attached, connected, or otherwise adjoined to any part of the Town's sewer system shall be subject to and follow the construction procedures set forth in this Specification and shall also comply with the Town Standard Details.

S1102.18 As-Built Drawings

As-builts shall be furnished to the Town in accordance with the General Conditions of the Town of Smyrna prior to the Town accepting any section, subsection, or phase of construction the contractor/developer wishes to convey to the Town. As-builts shall be provided in both paper and electronic AutoCAD, pdf, or jpg format on a CD. As-builts shall be in conformance with the As-Built Drawings Submission Checklist provided in the appendix.

S1102.19 Method of Measurement and Basis of Payment

Payment for the items specified in the Contract Documents will be full compensation for all applicable excavation, sheeting, shoring, dewatering, hauling, invert paving, storing, re-handling of material, removal and disposal of excess and unsuitable material, tamped fill, forming bed or foundation, backfilling, compaction, testing and for all material, labor, equipment, tools, and all work and materials incidental to but necessary to complete the work.

Sewer will be measured complete in place and paid for at the Contract unit price per linear foot.

END OF SECTION

S1103 SANITARY SEWER FORCE MAINS**S1103.01 Description.**

This item shall consist of sanitary sewers force mains of ductile iron pipe (DIP), polyvinyl chloride (PVC) pipe or of high density polyethylene (HDPE) of the diameter shown on the Plans, installed or constructed within the right-of-way or easement, laid on a firm bed true to line and grade in accordance with the plans and these Specifications and details.

Force mains shall be installed at the elevations indicated on the construction drawings. Earth cover in the trench shall not be less than four (4) feet over the top of the pipe unless indicated otherwise on the Drawings and approved by the Town.

S1103.02 Pipe and Fittings

1. PVC Pressure Pipe. All buried PVC pressure pipe shall be polyvinyl chloride pipe (PVC) Class 150 SDR-18 meeting the requirements of ASTM D-2241. Fittings shall be in accordance with ASTM D-2466 of the same color and pressure rating. Joints at the fittings shall be of the solvent weld type, utilizing solvent meeting the intent of ASTM D-2564. At the remaining joints push-on type joints with concrete buttresses may be used in accordance with ASTM 3139. The elastomer seals used for joining the pipe shall meet ASTM F477 Specifications. Lubricant shall be as recommended and supplied by the pipe manufacturer.

Provide a joint restrainer for the connection to ductile iron pipe if thrust forces present dictate this requirement. Provide a joint restrainer at all locations where a transition to HDPE pipe is required. The restrainer shall provide a full 360-degree contact with a serrated inside surface to secure the clamp to the pipe. The restrainer shall be UNI-FLANGE Series 1300 or an approved equal for PVC to ductile iron transitions. The restrainer between PVC and HDPE pipe shall be per the recommendations of the HDPE pipe manufacturer.

2. Ductile Iron Pipe. All buried ductile iron piping shall be Pressure Class 52 ductile iron meeting the requirements of AWWA C151. The Pipe shall be double cement lined per AWWA C104 and have an internal coating system. The internal coating shall be a ceramic epoxy and shall be an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment. The coating shall be US Pipe and Foundry Protecto 401 or an approved equal. Pipe intended for buried installation shall receive an external standard bituminous foundry coating in accordance with ANSI A21.4. All buried ductile iron pipe shall have mechanical joints in accordance with AWWA C111.
 - a. All fittings shall be ductile iron compatible fittings with mechanical joints meeting the requirements of AWWA C153. All

fittings shall be double cement lined per AWWA C104 and coated on the exterior with an asphaltic coating. The interior coating shall be the same as for the pipe, as noted above.

- b. Provide restrained joints for all buried ductile iron pipe. Joints shall be suitable for use with AWWA C111 mechanical joints. The follower gland shall include a restraining mechanism which, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Flexibility of the joint shall be maintained after burial. Glands shall be manufactured of ductile iron conforming to ASTM A536-80. Restraining devices shall be of ductile iron heat treated to a minimum hardness of 370 BHN. Dimensions of tie gland shall be such that it can be used with standard mechanical joint with tee bolts. Twist-off nuts, sized same as tee-head bolts, shall be used to insure proper torque and actuating of restraining devices. The mechanical joint restraining device shall have a working pressure of at least 250 psi with a minimum safety factor of 2, and shall be EBAA Iron, Inc. MEGALUG, Mueller Aqua Grip, or approved equal.
3. HDPE Pipe. HDPE pipe used for force main construction, shall be PE3608 high density polyethylene per the requirements of ASTM D-3350. Pipe and fittings shall be from the same manufacturer. Pipe shall be manufactured in accordance with ASTM F714 and shall be so marked. The pipe shall have a Standard Dimension Ratio (SDR) suitable for the design operating condition means of installation and depth of burial, as approved by the Town Engineer. HDPE force mains installed via the directional bore method shall be SDR 11.0, minimum.

S1103.03 Velocity and Diameter

Forcemain sizes on non-clog pumps shall not be less than 4 inches and forcemain on grinder pumps shall not be less than 1.5 inches. A minimum velocity of 2.5 feet per second of flow is required to be maintained. The following formula is to be used to determine the inside diameter of the forcemain.

$$D = .175 \times \sqrt{Qp \times .1334 \times \frac{C}{2.5}}$$

If the diameter of the forcemain is known, the following equation can be used to determine if the required velocity is available.

$$V = \frac{Qp \times .32}{Acs}$$

Where; D = Diameter of forcemain in inches
 V = Velocity in feet per second
 Qp = Peak Design Flow
 Acs = Cross-sectional inside diameter area of the pipe.

C = Coefficient Factor

Friction losses through force mains shall be based on the Hazen-Williams formula or other method acceptable to the Town. The following values of “C” shall be used for design:

PVC	130
Ductile Iron	120
HDPE	130

S1103.04 Air and Vacuum Relief Valves

Air relief valves (ARV) shall be provided at force main high points. Force mains shall be designed to minimize the number of air relief valves. The manufacturer’s flushing attachments shall be provided with each air relief valve and shall be neatly attached to the wall of the air release valve vault with stainless steel hardware.

Vacuum relief valves may be necessary to relieve negative pressure on force mains. The force main configuration and head conditions shall be evaluated as to the need for and placement of vacuum relief valves. Vacuum relief valves shall be provided at all locations indicated on the project plans. Force mains shall be designed to minimize the number of vacuum relief valves. The manufacturer’s flushing attachments shall be provided with each vacuum relief valve and shall be neatly attached to the wall of the valve vault with stainless steel hardware.

Combination relief valves shall be provided at all locations where a combination valve is required as indicated on the project plans. Force mains shall be designed to minimize the number of combination relief valves. The manufacturer’s flushing attachments shall be provided with each combination relief valve and shall be neatly attached to the wall of the valve vault with stainless steel hardware.

Combination Air Valves shall allow large volumes of air to escape out the large orifice when filling a pipeline and closes when liquid enters the valve. When the valve is closed and pressurized, the small air release orifice will open to allow small pockets of air to escape automatically and independently of the large orifice.

Air relief, Vacuum relief, and Combination valves shall be DeZurik, Val-Matic, Cla-Val, Crispin, or approved equal.

S1103.05 Termination

Force mains should enter the gravity sewer system at a point equal to the flow line of the receiving manhole.

S1103.06 Design Pressure

The force main, reaction blocking, and associated pump station piping shall be designed to withstand water hammer pressure and associated reversal of stresses that are expected with cycling of wastewater pumping stations. Surge protection valves shall be provided.

S1103.07 Special Construction

Force mains constructed near streams shall meet the applicable provisions of the "Recommended Standards for Wastewater Facilities" Section 37. Refer to Section S1102.09 for all horizontal and vertical separation requirements for force mains constructed near water works structures and at water main crossings.

S1103.08 Pipe Color

PVC force mains shall be either white or green in color. Blue colored pipe shall not be used for either gravity or force main sewer construction.

S1103.09 Pipe Detection

All installed force mains shall be capable of being found once buried by the installation of detector tape and detector wire.

1. Caution tape shall be installed directly above the pipe, 12" below the finished grade as it is laid in the ground during installation of both ductile and PVC pipe. The tape should be a minimum three inches in width, blue in color, and have the wording "Caution-Water Line Below" on it every 3 ft. Detector tape shall be manufactured by "Alarmatape" or approved equal to manufacturer's recommendations or as directed.
2. Detector wire shall be insulated copper AWG #10. It shall be installed with and laid on top of the pipe as it is being installed. It shall run the full length of the installed pipe and shall be accessible to the surface every 400 feet by way of an in-line valve box to bring the wire to the surface.

S1103.10 Thrust Blocks.

Thrust blocks shall be provided on all force main plugs, caps, tees, and bends deflecting 22-1/2 degrees or more either vertically or horizontally.

1. Thrust blocks shall be concrete with a minimum compressive strength of 3000 psi in 28 days.
2. Thrust blocking shall be located between solid ground and the fitting to be anchored.
 - a. Unless otherwise shown or directed by the Town, place the base and thrust bearing sides of thrust blocking directly against

- undisturbed earth.
 - b. Place thrust blocking so the fitting joints will be accessible for repair.
 - c. Protect steel rods and clamps by galvanizing or by coating with bituminous paint.
3. Thrust blocks and buttresses may be eliminated for tees, horizontal bends, and caps provided that mechanical joint restraint is provided through the use of MegaLugs or an approved equal. All vertical bends will still require thrust block/anchorage.

S1103.11 Valves

Plug valves for force main isolation service shall be the non-lubricated type designed for a minimum working pressure of 175 psi and suitable for buried service. The valve shall be suitable for tight closure with pressure on either side of the plug. Buried valves shall have mechanical joint ends. Valves installed in vaults shall have flanged ends unless otherwise noted. The body shall be semi-steel. The plug shall be semi-steel, resilient type neoprene faced for use in raw sewage service. The plug seat shall have an overlay of mechanical nickel, fusion-bonded Nylon II, or other suitable material on all surfaces in contact with the plug face. The port area of the valve shall not be less than 100% of the pipe area. The upper trunnion shall be sealed with either permanent "O"-ring type seals, or packing held in place by an adjustable packing gland. Packing shall be replaceable without disassembly of operator or valve. The upper and lower journals shall be fitted with replaceable permanently lubricated stainless steel sleeve type bearings. Valves shall be either hand wheel or 2-inch square nut operated as indicated on the Plans. Plug valves shall be manufactured by the DeZurik Unit of General Signal Corp. or an approved equal.

1. All plug valves shall be furnished with buried service type gear operators. Buried valves shall be furnished with a roadway valve box and an extension stem securely fastened to the operator to position a 2-inch square operating nut welded to the top of the stem within 12 inches of the ground surface. An open and closed indicator shall be provided on all valves at the operating nut. Valves shall open left (counterclockwise). Spacer discs or rods shall be installed in the valve box as required to center the extension stem. Extension stem shall be of the size recommended by the valve manufacturer.
2. The exterior of the valve, operator, and extension stem shall be bituminous coated unless otherwise noted.

S1103.12 Valve Boxes

Valve Boxes shall be cast iron, 3 piece screw type installed over the valve bonnet and operating nut. Valve boxes shall be capable of being adjusted to reach the surface of the existing or proposed grade but not to extend above the finished grade at any time.

1. Valve boxes shall be capable of receiving a Valve Box Trench Adapter in

accordance with section S1101.

2. Covers shall be cast with an “S” for sewage. Section shall not be less than 5-1/4 inches in diameter. Lengths shall be suitable for use in the location indicated.
3. Valve boxes shall be manufactured by Mueller or approved equal.

S1103.13 Couplings and Wall Seals

Couplings shall be provided where required to facilitate the installation or removal of valves and equipment, in addition to the couplings shown on the drawings. All couplings shall be designed for the same pressure rating as of the pipes on which installed. In addition:

1. The pipe couplings shall be of gasketed, sleeve-type, with diameter to properly fit the pipe. Each coupling shall consist of one (1) steel middle ring 0.154 inches thick and 5 inches in length, two (2) steel followers, two (2) rubber-compounded wedge section gaskets and sufficient track-head steel bolts to properly compress the gaskets. Field joints shall be made with this type of coupling.
2. The middle ring and followers of the coupling shall be true circular sections free from irregularities, flat spots, or surface defects. They shall be formed from mill sections with the follower-ring section of such design as to provide confinement of the gasket. After welding, they shall be tested by cold expanding a minimum of 1% beyond the yield point.
3. The coupling bolts shall be of the elliptic-neck track head design with rolled threads. The manufacturer shall supply information as to the recommended torque to which the bolts shall be tightened. All bolt holes in the followers shall be oval.
4. The gaskets of the coupling shall be composed of a crude or synthetic rubber base compounded with other products to produce material, which will not deteriorate from age, from heat, or exposure to air under normal storage conditions. It shall also possess the quality of resilience and ability to resist cold flow so that the joint will remain sealed and tight when subjected to shock, vibration, pulsation and temperature or other adjustments of the pipeline.
5. The couplings shall be assembled on the job in a manner to insure tight joints under all reasonable conditions of expansion, contraction, shifting and settlement, unavoidable variations in trench gradient, etc. The coupling shall be Dresser, Style 38, as manufactured by Dresser Manufacturing Division, Bradford, Penna., or approved equal.

Wall seals shall be provided at all penetrations in concrete structures. In addition:

1. The Contractor shall determine the required inside diameter of each individual wall opening or sleeve before ordering, fabricating or installing. The inside diameter of each wall opening shall be sized as recommended by the manufacturer to fit the pipe and seal to assure a water-tight joint.
2. Seals shall be Link-Seal, as manufactured by Thunder line Corporation, or approved equal.

S1103.14 Testing and Inspecting

All new pressure pipes shall be leakage tested as specified herein. The contractor shall be responsible for furnishing all labor, tools, equipment, materials, including water, pumps, compressors, pressure gauges, meters, and stopwatch subject to the approval of the engineer.

1. Any defective work, which shows up while conducting tests or before conditional acceptance, shall be replaced or repaired by the CONTRACTOR at his own cost and expense. Any leaks occurring after conditional acceptance but before final acceptance due to either blown joints or cracked pipe or fittings, shall be repaired by the Contractor at his own expense
2. Pressure Testing. Force mains shall undergo the same testing as required for water mains under section S1103 pressure testing of water mains.
3. Test Restrictions:
 - a. All tests shall be conducted in the presence of a Town inspector.
 - b. Testing of all pressure pipes shall be conducted in accordance with AWWA C600 testing requirements.
 - c. Test pressure shall be 1.25 times the working pressure at the highest point along the test section or 150 psi, whichever is greater.
 - d. The hydrostatic pressure test shall be of at least a 2-hour duration.
 - e. Test pressure shall not vary by more than 5 psi for the duration of the test.
 - f. Valves shall not be operated in either direction at a differential pressure exceeding the rated valve working pressure. The test pressure shall not exceed the rated pressure of the valves when the pressure boundary of the test section includes closed, resilient-seated gate valves or butterfly valves.
4. Pressurization
 - a. After the pipe has been laid, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 1.25 times the working pressure at the high point along the test section or 150 psi, whichever is greater. Each valved section of pipe shall be slowly filled with water, and the specified test

pressure (based on the elevation of the highest point of the line or section under test and corrected to the elevation of the test gauge) shall be applied by means of a pump connected to the pipe. Valves shall not be operated in either the opening or closing direction at differential pressures above the rated pressure. It is good practice to allow the system to stabilize at the test pressure before conducting the leakage test.

- b. Before applying the specified test pressure, air shall be expelled completely from the section of piping under test. If permanent air vents are not located at all high points, corporation cocks shall be installed 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 removed and plugged or left in place as directed by the Engineer.
- c. All exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damage or defective pipe, fittings, valves, hydrants, or joints that are discovered following the pressure test shall be repaired or replaced with sound material, and the test shall be repeated until satisfactory results are obtained.
- d. 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 (34.5 kpa) of the specified 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.
- e. No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

In inch-pounds units,

$$L = \frac{SD\sqrt{P}}{133,200}$$

Where:

L = allowable leakage, in gallons per hour

S = length of pipe tested, in feet

D = nominal diameter of the pipe, in inches

P = average test pressure during the leakage test, in pounds per square inch (gauge)

5. Acceptance of installation

- a. Acceptance shall be determined on the basis of allowable leakage. If any test of laid pipe discloses leakage greater than that specified above, repairs or replacements shall be accomplished as directed by the engineer.

- b. All visible leaks are to be repaired regardless of the amount of leakage.

S1103.15 Method of Measurement and Basis of Payment

The payment for the items specified in the Contract Documents will be full compensation for all applicable excavation, sheeting, shoring, dewatering, hauling, invert paving, storing, re-handling of material, removal and disposal of excess and unsuitable material, tamped fill, forming bed or foundation, backfilling, compaction, testing and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Sewer force main will be measured complete in place and paid for at the Contract unit price per linear foot or as specified in the contract document.

END OF SECTION

S1104 SANITARY SEWER MANHOLES AND MISCELLANEOUS STRUCTURES

S1104.01 Description

The work proposed under this heading involves sanitary sewer manholes and miscellaneous structures of concrete or brick masonry built to the shapes and dimensions in accordance with these Specifications and details as shown in the Standard Details, at the location indicated on the Plans or as directed by the Town Engineer.

S1104.02 Material

1. Precast Manholes. Precast reinforced concrete risers, eccentric cones and bases shall be as detailed on the drawings and in conformance with ASTM Designation C 478.
2. Joints between riser sections shall be fitted with an “O” ring rubber gasket, meeting the requirements of ASTM Designation C 443.
3. All pipe-to manhole connections shall be made by means of an integrally cast flexible connector which shall be Lock joint flexible manhole sleeve as manufactured by Interpace Corp., Parsippany, New Jersey, or A-Lok flexible manhole gasket as manufactured by A—Lok Corp., Trenton, New Jersey, or approved equal.
4. Manhole steps. Manhole steps shall be made of 3/8-inch diameter (No. 3) steel reinforcing bars, ASTM Designation A 615, Grade 60, encased in polypropylene plastic. Manhole steps shall have notched tread ridge with retainer lug on each side. Steps shall be spaced vertically and aligned as shown on the Standard Detail Drawing and set to provide a minimum of 6-inch tread.
5. Manhole Frames and Covers. Manhole frames and covers shall be furnished and set by the Contractor as the work progresses as shown in the Standard Detail Drawing. Frames shall be well bedded in mortar. Material for frames and covers shall be in accordance with the Standard Specifications for gray iron castings ASTM Designation A 48 for Class No. 35. The manhole frame and cover shall be East Jordan Iron Works Model 1545A, or approved equal.
 - a. The cover shall have written on it “Sanitary Sewer.”
 - b. The manhole frame and cover shall be as shown in the Standard Detail Section.
6. The flow pipe channel through manholes shall be made to conform in shape and slope to that of the sewers. The top of the brick channel shall be at the same elevation as the crown of the main sewer line in the manhole. The channel shall drop a minimum of 1 inch from influent pipe to the

effluent pipe.

7. Manhole Inserts. Watertight manhole inserts shall be made of non-corrosive materials only and shall be constructed so that the manhole cover can be removed without damage to the integral air and vacuum relief valves. The units shall be as Sewer Guards as manufactured by FOSROC, or approved equal.
8. Concrete, Brick, Mortar and Sand used for construction under this section shall comply with all the requirements and specifications of concrete, brick, mortar, and sand in section S1102.
9. All new laterals tying into existing concrete manholes shall require the manhole to be core drilled for the connection. The lateral shall be installed and a watertight seal accomplished with the use of Link Seal wall seals as noted in section S1103.
10. Waterproof Coating on new manholes shall consist of a heat shrinkable wrap designed to seal joints and prevent groundwater from entering the Town's sewer system. Materials shall meet ASTM E28, D638, D1000, D1044, and D2240 standards. Approved manufacturers of coatings include GPT Industries Riser-Wrap, CCI pipeline Systems Wrapidseal, or approved equal.

S1104.03 Construction Methods

Manholes installed within the sewer collection system shall be either pre-cast or site built of concrete or brick.

1. Precast and Poured in Place Reinforced Concrete Structures and Manholes:
 - a. Interior and exterior joint spaces of all manhole risers shall be filled prior to application of the exterior waterproofing. The interior joint shall be mortared. The exterior joint may be mortared or filled with a joint filler compound. Said compound shall be Pioneer 301 as manufactured by Daubert Chemical Co., Oakbrook, Illinois, or approved equal.
 - b. Lifting holes in the walls of precast reinforced concrete risers will be allowed but shall be plugged with rubber stoppers and grouted flush with the face of the manhole wall after installation of manhole riser sections. Not more than two holes shall be cast in the walls of each riser section for the purpose of handling.
 - c. The exterior surface of all manholes shall receive heat shrinkable wraps on all joints designed to seal joints against groundwater. Surfaces shall be prepared and coatings shall be applied in the field in accordance with the manufacturer's instructions. The coating material shall meet all requirements according to section S1104.02,

subsection 10.

2. Brick Structures and Manholes. - In constructing manholes, accurate templates, set at a height to which the manhole is to reach, may be required. From such templates not less than four lines shall be drawn, to serve as guides for the brickwork. All brick shall be laid by competent mechanics, and any workmen not deemed to be such by the Town shall be removed from the work at once.
 - a. All brick shall be laid in a full bed of mortar with all vertical and horizontal joints filled solid with mortar.
 - b. Joints shall not be less than 3/8-inch or more than 1/2-inch wide except as otherwise specified. Joints on the inside of manholes shall be neatly struck and pointed.
 - c. No brickwork shall be laid when the ambient air temperature is below 40 degrees Fahrenheit or when the indications are for lower temperatures within 24 hours. The Contractor shall take such measures as may be approved to prevent brick work from being exposed to freezing temperatures for a period of not less than five days after laying.
 - d. The outside of all brickwork shall be parged with cement mortar 1/2-inch thick. No backfill shall be accomplished around any brick structures within 48 hours after the completion of all brickwork. Two coats of the coal tar type protective coating (minimum 24 mils total thickness) shall be applied after mortar coating has cured.
3. Channels for receiving and passing water shall be formed in the bottom of manholes as shown in the Standard Details or as directed by the Town. All such channels shall be formed with concrete or lined with brick. Channels shall slope smoothly and evenly from the main pipe entering the manhole to the outlet pipe. Brick channels for future extensions shall be built into manholes where shown on the Plans or where directed by the Town Engineer. Rubber gaskets approved by the Town shall be used to seal the pipe at all connections to the manholes.
4. Wider or deeper foundations than shown on the Standard Details for manholes shall be constructed wherever directed by the Town.
5. Manholes shall be built as pipe laying progresses. The Town may stop the Contractor's work entirely on laying pipe until the manhole just passed has been completed.

S1104.04 Location

Manholes shall be installed at the end of each line; at all changes in grade, size, or alignment; at all intersections; and at distances not greater than 300 feet for sewers 15

inches or less, and 400 feet for sewers 18 inches to 30 inches. Manholes should not be located in the flow line of streets, within swales, nor within areas which may be subject to ponding conditions including low points which may periodically pond due to clogged stormwater inlets or other structures.

S1104.05 Lampholes/Cleanouts

Lamp holes (cleanouts) may be used only for special conditions and shall not be substituted for manholes nor installed at the end of main sewer lines greater than 150 feet in length.

S1104.06 Drops

A drop pipe should be provided for a sewer entering a manhole at an elevation of 24 inches or more above the manhole invert. Where the difference in elevation between the incoming sewer and the manhole invert is less than 24 inches, the invert should be filleted to prevent solids deposition.

1. Pipe drop sections shall be one pipe size (diameter) greater than the inflow pipe.
2. Drops shall be designed so they discharge sewer no higher than 6" above the flow channel of the manhole.

S1104.07 Minimum Diameter

The minimum diameter of manholes shall be 48 inches. A minimum access diameter of 24 inches shall be provided. An inside drop manhole shall be five feet in diameter minimum for up to 8 inch inflow pipes. The minimum manhole diameter for inflow pipes over 8 inches in diameter will be reviewed on a case by case basis.

S1104.08 Manhole Testing Procedures

Manholes shall be tested using one of the following testing procedures:

1. **Prior to Backfilling:** Manholes shall be vacuum tested in accordance with ASTM C-1244 prior to the placement of backfill. After acceptance of the manhole test, backfilling operations shall be done as to not shift or move the manhole. The Town shall reserve the right to require vacuum testing after backfilling should any shift or movement of the manhole occur.
2. **After Backfilling:** All pipes entering the manhole shall be temporarily plugged, taking care to securely brace the pipes and plugs to prevent them from being drawn into the manhole. The test head shall be placed at the top of the manhole in accordance with the manufacturer's recommendations. A vacuum of 4 in. of Hg. shall be drawn on the manhole and the vacuum shall not drop below 3.5 in. of Hg. for a duration

of five (5) minutes. If the manhole fails the test, the manhole shall be repaired by an approved method until a satisfactory test is obtained.

S1104.09 Measurement and Payment

Sanitary manholes will be paid for on the basis of the lump sum bid for each type and size of manhole.

Payment as noted above shall be full compensation for all labor, equipment, material and incidentals required to satisfactorily complete the work as specified in the Contract Documents. Payment for building drop connections complete, will be made at the unit price bid for each of the several types and various sizes constructed as shown, specified and directed.

END OF SECTION

S1105 ADJUST/REPAIR MANHOLES**S1105.01 Description**

Manholes shall be adjusted to grade and shall be repaired as necessary prior to the paving operations. Covers of manholes shall be removed and all masonry found to be in poor condition shall be rebuilt using materials conforming to the original structure. The materials necessary to be excavated under this section shall be removed from the site. All such excavations shall be backfilled with approved materials. Covers and frames may be required to be replaced with new frames and covers at the discretion of the Town. The type of frame and grate to be used will be East Jordan Iron Works 1545A or an approved similar type. The words SANITARY SEWER will be stamped on each lid. The old frame and lids shall remain the property of the Town. Contractor will deliver them to the Public Works yard at no additional cost.

S1105.02 Method of Measurement

The number of manholes adjusted and/or repaired to be paid for under this section shall be the actual number of manholes completed and accepted.

S1105.03 Basis of Payment

The number of manholes adjusted and repaired, as provided above shall be paid for at the contract unit price bid. Adjusting and Repairing Existing Manholes, which price and payment shall constitute full compensation for excavating, removing the covers and portions of structures, furnishing and placing all materials (except frame & grate, which will be supplied by the Town), backfilling, resetting the new covers and frames to proper grades, labor, equipment, tools and incidentals necessary to complete the work. The unit price bid per each shall constitute full compensation for repairs from the top of cover 3' below. Repairs below 3' and not more than 4 ½' shall be paid for at 1.5 times the unit price bid for each. Repairs that are more the 4 ½' below the top of cover shall be paid for at two times the unit price bid per each. In no case, regardless of the depth of repairs shall the payment exceed twice the unit price bid.

END OF SECTION

S1106 SANITARY SEWER LATERALS AND SANITARY HOUSE CONNECTIONS**S1106.01 Description**

This item shall consist of sewer laterals and house connections between the main line and residential, commercial, business or industrial user as shown on the plan and in accordance with these Specifications and the Town Standard Details.

S1106.02 Minimum Size

The minimum size sewer lateral connection shall be six (6) inches. Laterals for condominiums and apartments with multiple units shall be sized based on a computation of flow to be generated from the connected units; the minimum lateral size noted above shall apply.

S1106.03 Material

Material shall be in accordance with S1102.05 of these specifications.

S1106.04 Slope

All sewer laterals shall be laid to grade in accordance with applicable plumbing codes. Excessive slopes (more than 12%) should be avoided to prevent the separation of solids and liquids in the pipe.

S1106.05 Backflow Preventers

All sewer laterals between individual buildings and the main will have a back flow preventer installed prior to any branch line or internal cleanout unless the Town approves an exception.

1. They shall be located inside the foundation wall for buildings with basements and just prior to the base wall in buildings with crawl spaces or no basements.
2. The back flow preventer shall remain accessible to and installed ahead of any and all service lines or cleanouts.

S1106.06 Cleanouts

All sewer laterals shall have cleanouts installed on the exterior located at the Right-of-way line behind the face of curb. Laterals for townhouses shall have the cleanout installed between the parking bay and the townhouse. All cleanouts shall be 6" diameter, SDR 26 PVC.

1. Cleanouts shall be installed flush with the finished grade of the surrounding area.

2. No clean out will be allowed to extend more than 1/2 inch above finished grade.
3. Clean outs shall, by means of a sweeping 45 degree elbow, be connected in the direction of flow to an installed Y on the lateral
4. Cleanouts installed in driveways, sidewalks, or other paved surfaces must be placed in a Lincoln Box (East Jordan Iron Works Model #1566 or approved equal) per Town of Smyrna Standard Detail. The box cover shall be labeled with "S".
5. Install magnetic tape above lateral from house to the back of curb; 6" below finished grade.

S1106.07 Spacing

Separation between water and sewer laterals shall be a minimum of ten (10) feet as measured outside of pipe to outside of pipe.

S1106.08 Construction

All house connections shall meet the requirements of this specification as well as the following:

1. All sewer laterals shall be encased in clean stone in roadway areas.
2. All sewer house connections shall be constructed to terminate at an angle perpendicular to the property lines unless otherwise noted on the plans.
3. The excavation in which pipe is being laid shall be kept free from water and no joint shall be made under water.
4. Water shall not be allowed to rise in the excavation until the joint material has received its set.
5. The greatest care shall be used to secure water tightness and to prevent damage to, or disturbing of, the joints during the backfilling process, or at any time.
6. After pipes have been laid and the joints have been made, there shall be 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.
7. PVC pipe shall be placed in accordance with the installation recommendation of the pipe manufacturer and applicable portions of this Specification.
8. Branches shall be located in the position designated by the Engineer. Short

pieces of lateral sewer shall be field-cut to meet this condition.

9. The Contractor shall have on the job, 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.
10. No pipe shall be laid upon a foundation into which frost has penetrated, nor at any time there is a danger of the formation of ice or the penetration of frost at the bottom of the excavation, unless the minimum length of open trench and promptness of backfilling are observed.
11. If concrete curbing is replaced over the sewer lateral, the concrete curbing shall be embossed with a 2" high capital letter "S" (on the face of the curbing directly over the sewer lateral). The Town can supply the embosser upon request; however, it is the contractor's responsibility to obtain the embosser prior to the work being done.
12. Break in taps are not permitted; all connections to the sewer main shall be made using wye's.

S1106.09 Method of Measurement and Basis of Payment

Measurements for payment for sewer house connections shall be made along the centerline of the pipe and through fittings from the home to the "Y" branch on the main sewer to the end of the house connection.

The payment for the items specified in the Contract Documents will be full compensation for all applicable excavation, sheeting, shoring, dewatering, hauling, invert paving, storing, re-handling of material, removal and disposal of excess and unsuitable material, tamped fill, forming bed or foundation, backfilling, compaction, testing and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Sewer house connection will be measured complete in place and paid for at the Contract unit price per linear foot or as specified by the engineer.

END OF SECTION

S1107 LIFT STATIONS/PUMP STATIONS

S1107.01 Description

The work proposed under this Section involves the construction and or installation of sanitary sewer lift/pump stations and miscellaneous structures built to the shapes and dimensions in accordance with these Specifications and details as shown in the Standard Details, at the location indicated on the Plans or as directed by the Engineer.

S1107.02 Design Requirements

Sanitary Sewer Lift Stations/Pump Stations shall be designed in accordance with DNREC guidelines and these Specifications and may be package or site built. Lift stations shall be reinforced concrete unless otherwise approved by the Town.

1. Design Capacity

In determining the required size and capacity of the pumping station and forcemain the following factors should be considered:

- a. Maximum Hourly Domestic Sewage Flow
- b. Topography of area.
- c. Pump capacity.
- d. Pumping requirement.
- e. At no place on the pump curve should the horsepower rating of the pump motor be exceeded.
- f. The volume of the wet well shall be between the start elevation and the stop elevation of a single pump.
- g. The force main pipeline inside diameter shall be sized so as to minimize friction losses.
- h. The worst case of "C" factor is to be anticipated over the life of the pump station so that the pump power rating is adequate. (C=130 PVC, C=120 DIP)
- i. The calculations for design of the pump station shall be included on the Project's Drawings, when submitted to the Town for review.

2. Design Calculations

- a. Per Capita Flow (Q_a)
 $Q_a \text{ (GPD)} = \text{EDU} \times 300$

The pumping station shall be designed on the basis of an average daily flow of sewage of not less than 300 gallons per day, per EDU. Flows from non-residential usage will be reviewed on a case by case basis.

- b. Peak Design Flow (Q_p)

$$Q_p \text{ (GPM)} = \frac{Q_a \times 3.5}{1440}$$

c. Wet Well Volume (V_{min})

$$V_{min} \text{ (GAL)} = \frac{T_{min} \times Q_p}{4}$$

V_{min} = The minimum effective sump volume in gallons. The effective sump volume is the volume between the pump start and stop levels in the station. The stop level is 24 inches above the top of the pump volute. The start level for a duplex pump station is 18 inches below the lowest influent invert elevation. The start for a triplex pump station is 24 inches below the lowest influent invert elevation.

T_{min} = Minimum cycle time in minutes. The minimum cycle time is 6 minutes and is the sum of the time it takes to fill the sump volume and the time to draw it down to the stop level.

Q_p = Peak Design Flow in GPM. (Q_p)

d. Structural Requirements.

The pump station wet well and valve box shall be designed for the following conditions as a minimum:

- i. Structure filled to top with water with no external soil pressure.
 - ii. Structure empty with soil backfill to finished grade. Assume soil dry density of 100 lbs./c.f. Assume soil is saturated to finished grade. Assume reinforced concrete at 150 lbs./c.f. If the Town approves the use of a steel wet well, the weight of steel shall be assumed at 140 lbs. per s.f. per one-inch thickness.
 - iii. Structure shall not float with saturated soil to finished grade. Assume soil load on concrete lip at 38 lbs./c.f.
 - iv. The wet well shall be designed to provide a factor of safety of 1.5 against buoyancy. The base section of concrete fabricated wet wells shall be monolithic poured structures.
- e. Hydraulic Analysis. Refer to section S1103 for force main friction head loss information.

S1107.03 General Site Considerations

1. Flooding - Sewage pump station structures, electrical and mechanical equipment shall be protected from physical damage by the one hundred (100) year flood. Sewage pump stations should remain fully operational and accessible during the twenty-five (25) year flood.
2. Accessibility - The pump station shall be readily accessible by maintenance vehicles during all weather conditions. The facility should

be located off the traffic way of streets and alleys.

3. Site Size - The pumping facility site shall be of sufficient size to allow free and unobstructed movement of service and hauling vehicles and personnel movement to each piece of equipment or component on site.
4. Fencing - The pump station facility shall be hidden from view by a security/privacy fence with gates large enough for vehicle access. The fence shall be installed in accordance with section 727.
5. Paving - The pump station site shall be blacktopped inside the fenced area.
6. Parking - Provide on-site parking and a turning area for maintenance vehicles.
7. Lighting - The site shall be illuminated with pole-mounted lights for nighttime operation. Lighting shall be operated from a switch as well as by a dusk to dawn sensor. A switch shall be provided so that the operator may select which function is desired.
8. Potable Water - Potable water shall be provided on the site.

S1107.04 General Station Arrangement

1. Sewage pumping stations shall be of the suction lift configuration. Submersible pump / wet well configuration may be used with approval of the Town. Consideration will be given for the use of package, fiberglass wet well, systems when the design calculations indicate the sizing and location is appropriate. This will be on a case by case basis only when the per capita flow (Q_a) is equal to or less than 15,000 gallons per day and the systems total dynamic head is equal to or less than 75 feet of head.
 - a. Stations equipped with motors sized up to 25 hp shall be suction lift, or wet well configured.
 - b. Stations equipped with motors sized greater than 25 hp shall be combination wet-well/dry-well configured.
 - c. All stations shall be equipped with permanently mounted confined space recovery equipment in accordance with OSHA, and regulatory agency requirements.
2. Where it is necessary to pump wastewater prior to grit removal, the design of the wet well and pump station piping shall receive special consideration to avoid operational problems from the accumulation of grit.
3. Provisions shall be made to facilitate removing pumps, motors, and other mechanical and electrical equipment. A stainless steel portable hoist shall be provided for each pump station.

S1107.05 Pump Stations – Special Considerations

1. Separation - Valve vaults and valve boxes shall be completely separated from the wet well.
2. Equipment Removal - Pump station site and equipment design shall be made to facilitate the removal of pumps, motors, and other mechanical and electrical equipment without relocating structures.
3. Access - Suitable and safe means of access shall be provided to valve vaults and to wet wells containing mechanical equipment requiring inspection or maintenance.
4. Construction Materials - Due consideration shall be given to the selection of materials because of the presence of hydrogen sulfide and other corrosive gases, greases, oils and other constituents present in sewage.
5. Construction. Submersible pumps and motors shall be designed specifically for raw wastewater use, including totally submerged operation during a portion of each pumping cycle and shall meet the requirements of the National Electrical Code for such units. The pumps shall be rated for continuous duty. An effective method to detect shaft seal failure or potential seal failure shall be provided.
6. Pump Removal. Submersible pumps shall be readily removable and replaceable without dewatering the wet well or disconnecting any piping in the wet well.
7. Electrical Equipment.
 - a. Power Supply and Control Circuitry. Electrical supply, control, and alarm circuits shall be designed to provide strain relief and to allow disconnection from outside the wet well. Terminals and connectors shall be protected from corrosion by location outside the wet well and use of watertight seals.
 - b. Controls. The motor control center shall be located outside the wet well and be protected by a conduit seal or other appropriate measures meeting the requirements of the National Electrical Code, to prevent the atmosphere of the wet well from gaining access to the control center. The seal shall be so located that the motor may be removed and electrically disconnected without disturbing the seal.
 - c. Power Cord. Pump motor power cords shall be designed for flexibility and serviceability under conditions of severe use and exposure and shall meet the requirements of the National Electrical Code standards for flexible cords in wastewater pump stations. Ground fault interruption protection shall be used to de-energize the circuit in the event of any failure in the electrical integrity of

the cable. Power cord terminal fittings shall be corrosion-resistant and constructed in a manner to prevent the entry of moisture into the cable, shall be provided with strain relief appurtenances, and shall be designed to facilitate field connecting.

8. Valves. Valves required under Section S1107.09 shall be located in a separate valve vault.
9. Pressure Gauge. Install a discharge pressure gauge rated for corrosive service that meets the following specifications: 4.5" Dial, Grade 1A, ASME B40.100, $\pm 1\%$ full scale accuracy, liquid filled, type 316 stainless steel bourdon tube, glass safety lens, full blowout protection, weatherproof, hermetic seal and with a standard 1/4 inch NPT. Pressure gauge shall be provided with a glycerin filled diaphragm seal and isolation ball valve. The pressure gauge rating shall be 3 times the operating pressure of the pump.

S1107.06 Wet Wells

Where continuity of pumping station operation is critical, consideration should be given to dividing the wet well into two sections, properly interconnected, to facilitate repairs and cleaning.

1. Size. The wet well size and control setting shall be appropriate to avoid heat buildup in the pump motor due to frequent starting and to avoid septic conditions due to excessive detention time. The design fill time and minimum pump cycle time shall be considered in sizing the wet well. The effective volume of the wet well shall be based on design average flow and a filling time not to exceed 30 minutes unless the facility is designed to provide flow equalization. The pump manufacturer's duty cycle recommendations shall be utilized in selecting the minimum cycle time. When the anticipated initial flow tributary to the pumping station is less than the design average flow, provisions should be made so that the fill time indicated is not exceeded for initial flows. When the wet well is designed for flow equalization as part of a treatment plant, provisions should be made to improve septic conditions.
2. Access. Access provisions to wet wells shall be on a case-by-case basis. In general, access steps into wet wells of submersible type pump stations shall not be provided.
3. Floor Slope. The wet well floor shall have a minimum slope of 1:1 to the hopper bottom. The horizontal area of the hopper bottom shall be no greater than necessary for proper installation and function of the inlet.
4. Air Displacement. Covered wet wells shall have provisions for air displacement to the atmosphere, such as an inverted "J" tube or other

means.

S1107.07 Dry Wells

A sump pump equipped with dual check valves shall be provided in the dry well to remove leakage or drainage with discharge to a point above the maximum high water level of the wet well. Water ejectors connected to a potable water supply will not be approved. All floor and walkway surfaces shall drain to the sump point. Pump seal leakage shall be piped or channeled directly to the sump. The sump pump shall be sized to remove the maximum pump seal water, which would occur in the event of a pump seal failure.

S1107.08 Pumps

Multiple pumps shall be provided. Where only two units are provided, they shall be of the same size. Units shall have capacity such that, with any unit out of service, the remaining units will have capacity to handle the design peak flow. Pumps and motors shall be designed specifically for raw sewage use. Submersible pumps shall be designed to operate under totally submerged operation during a portion of each pumping cycle. An effective method to detect shaft seal failure or potential seal failure shall be provided, and the motor shall be squirrel-cage type design without brushes or other arc-producing mechanisms.

1. All pumps shall be shop tested by the manufacturer. These tests should include a hydrostatic test and an operating test. The results of the test shall be provided to the Town.
2. Protection Against Clogging. Pumps handling sanitary wastewater from 30 inch or larger diameter sewers shall be protected by bar racks meeting the above requirements. Appropriate protection from clogging shall also be considered for small pumping stations.
3. Pump types are to be determined by the required forcemain size. Forcemains of 4" and larger will have non-clog pumps. Forcemains less than 4" will have grinder pumps.
4. Pump Openings. Non-clog pumps shall be capable of passing spheres of at least 3 inches in diameter. Pump suction and discharge piping for non-clog pumps shall be at least 4 inches in diameter. Pump suction and discharge piping for grinder pumps shall be at least 1.5 inches.
5. Priming. Dry well pumps shall be placed such that under normal operating conditions they will operate under a positive suction head.
6. Intake. Each pump shall have an individual intake. Wet well and intake design should avoid turbulence near the intake and to prevent vortex formation. The manufacturer's guidelines shall be followed.

7. Pumping Rates. The pumps and controls of main pumping stations, and especially pumping stations operated as part of treatment facilities, shall be selected to operate at varying delivery rates. Insofar as is practicable, such stations shall be designed to deliver as uniform a flow as practicable in order to minimize hydraulic surges. The station design capacity shall be based on peak hourly flow and shall be adequate to maintain a minimum velocity of 2 feet per second in the force main. Variable frequency drives shall be considered and provided given examination of wastewater flows over the design period.
8. Pump Removal - Submersible pumps shall be readily removable and replaceable without de-watering the wet well or disconnecting any piping in the wet well.
9. Hour meters. Pump run time hour meters shall be provided on the control panel face.
10. Cycle counters. Pump run cycle counters shall be provided on the control panel face.
11. Electrical Equipment

Electrical systems and components (e.g., motors, lights, cables, conduits, switch boxes, control circuits, etc.) in raw sewage wet wells, or in enclosed or partially enclosed spaces where hazardous concentrations of flammable gases or vapors may be present, shall comply with National Electrical Code requirements for Class I Group D, Division 1 locations. In addition, equipment located in the wet well shall be suitable for use under corrosive conditions. Each flexible cable shall be provided with watertight seal and separate strain relief. Junction Boxes and Cable Splices are prohibited from the Wet Well Area. A fused disconnect switch located above ground shall be provided for all pumping stations. When such equipment is exposed to weather, it shall meet the requirements of weatherproof equipment (NEMA 4).

12. Horsepower Requirements
 - a. Pump stations with pumps having a horsepower of 0 thru 2 horsepower shall be 240 volts, single-phase power.
 - b. Pump stations with pumps having a horsepower of 3 horsepower or greater shall be 240 volts, three-phase power.
 - c. Pump stations with pumps having a horsepower of 15 horsepower or greater shall be 480 volts, three-phase power.

S1107.09 Valves

Valves shall be installed on all suction and discharge lines. For force mains 1.5 inches through 4 inches in diameter ball valves may be used. Larger diameter force mains shall utilize solid wedge gate valves. Valves larger than 2 inches shall be mounted outside the wet well.

1. Suction Line. Suitable shutoff valves shall be placed on the suction line of dry pit pumps.
2. Discharge Line. Suitable shutoff and check valves shall be placed on the discharge line of each pump. The check valve shall be located between the shutoff valve and the pump. Check valves shall be suitable for the material being handled and shall be placed on the horizontal portion of the discharge piping except for ball checks, which may be placed in the vertical run. Valves shall be capable of withstanding normal pressure and water hammer.
3. All shutoff and check valves shall be operable from the floor level and accessible for maintenance. Outside levers shall be provided on swing check valves.
4. Valve vault. Valves for submersible pump stations shall be located in a separate valve vault. The designer has the option to call for a valve vault to house the valves. The Town will decide on a case-by-case basis to allow either a valve vault or than valve boxes.

S1107.10 Valve Vault

1. Provision requirement. Valve vaults shall be provided for all submersible type pump stations.
2. Vault drainage. Provisions shall be made to remove or drain accumulated water from the valve vault. The valve vault may be dewatered to the wet well through a drain line with a gas and watertight valve.
3. Lighting. Provide moisture proof light with protection cage in valve vault with switch located in control panel.
4. Access. Provide steps or stairs for access to all vaults.

S1107.11 Corrosion Protection

1. Construction materials. Construction materials shall be selected which are appropriate under conditions of exposure to hydrogen sulfide and other corrosive gases, greases, oils, and other constituents frequently present in wastewater. This is particularly important in the selection of metals and paints. Contact between dissimilar metals shall be avoided to minimize

galvanic action. Dielectric separators shall be used where it is necessary to join dissimilar metals.

2. Cathodic protection. Cathodic protection shall be installed on all metal entrance tubes, wet wells/dry wells, and holding tanks installed below the surface. The use of materials other than concrete for wet wells, dry wells, holding tanks and overflow tanks shall be approved by the Town. 40 lb anode bags minimum shall be provided for cathodic protection systems with facilities provided so that the status of the cathodic protection system may be checked from the surface. Protected test wires shall be housed in a standard valve box or other suitable structure approved by the Town so that the status of the cathodic protection system can be monitored.
3. Guide Rails. Guide rails for quick disconnect, retrievable type submersible pumps shall be stainless steel or of the fiberglass I-beam protruded rail type system only.
4. Structural supports, brackets, beams and angles. Structural elements within wet wells shall be stainless steel. Fiberglass structural shapes may be considered by the Town on a case-by-case basis. Structural supports within dry wells (except associated with sump pumps) may be galvanized steel or steel painted as follows. Surface shall be prepared to SSPC SP-6. Apply one 3-mil DFT primer coat – MAB Rust-O-Lastic 24-A-120 organic zinc primer, or approved equal. Apply two 4-mil finish coats – MAB Ponamid H-B 54 Series Epoxy, or approved equal.
5. Hardware. All fastening hardware within wet wells, dry wells, and valve and meter vaults shall be stainless steel. Hardware used to fasten panels and ancillary equipment shall be stainless steel.

S1107.12 Emergency Operation

1. Emergency pumping connections. Regardless of what type of wet well is provided, a riser connection from within the wet well with rapid connection capabilities and appropriate valving shall be provided for all pumping stations to hook up a portable pump. In a similar fashion, piping and valving shall be provided within the valve vault of submersible type pump stations such that a waste hauling truck could connect to the discharge manifold and receive pumped flow from the station.
2. Reserve Capacity. Regardless of what type well is installed, it shall be designed to have sufficient reserve storage capacity to allow alarm activation and response time in case of pump station failure and to allow hookup of the portable equipment and transportation prior to overflowing.

S1107.13 Emergency High Level Overflow

For use during possible periods of extensive power outages, mandatory power reductions, or uncontrollable emergency conditions, consideration shall be given to providing a controlled, high-level wet well overflow to supplement alarm systems and emergency power generation in order to prevent backup of wastewater into basements, or other discharges which may cause severe adverse impacts on public interests, including public health and property damage. Where a high level overflow is utilized, consideration shall also be given to the installation of storage/detention tanks, or basins, which shall be made to drain to the station wet well. Where such overflows affect public water supplies or other critical water uses, the regulatory agency shall be contacted for the necessary treatment or storage requirements.

S1107.14 Safety Ventilation

Adequate ventilation shall be provided for all pump stations. Where the dry well is below the ground surface, mechanical ventilation is required. If screens or mechanical equipment requiring maintenance or inspection are located in the wet well, permanently installed ventilation is required. There shall be no interconnection between the wet well and dry well ventilation systems.

1. Air Inlets and Outlets. In dry wells over 15 feet deep, multiple inlets and outlets are desirable. Dampers should not be used on exhaust or fresh air ducts. Fine screens or other obstructions in air ducts should be avoided to prevent clogging.
2. Electrical Controls. Switches for operation of ventilation equipment shall be marked and located at the entrance. All intermittently operated ventilation equipment shall be interconnected with the respective pit lighting system. Automatic controls shall be provided where intermittent operation is used. The manual lighting/ventilation switch shall override the automatic controls. Two speed ventilation systems with automatic switch over where gas detection equipment is installed shall increase the ventilation rate automatically in response to the detection of hazardous concentrations of gases or vapors.
3. Fans, Heating and Dehumidification. The fan wheel shall be fabricated from non-sparking material. Automatic heating and dehumidification equipment shall be provided in dry wells.
4. Ventilation may be either continuous or intermittent. Ventilation, if continuous, shall provide at least 12 complete air changes per hour; if intermittent, at least 30 complete air changes per hour. Ventilation, accomplished by introduction of fresh air into the wet well under positive pressure is required.
5. Dry well ventilation shall be sized to provide 10 complete air changes per

hour. In addition to manual control, time clock operation of fans shall be provided to allow a minimum of 4 complete air changes per hour.

S1107.15 Odor Control System

Odor control facilities shall be provided on stations where long detention times in the wet well or force main may precipitate the formation of noxious odors. Pump stations with a PEAK DESIGN FLOW (Q_p) of One Thousand and five hundred gallons per minute (1500) or greater shall incorporate a permanent odor control system. The self contained, skid-mounted modular absorber unit shall be a High FlowVentSorb Model HF-1500, as supplied by Calgon Carbon Corporation, or equal. The Town reserves the right to require that pump stations be pumped and hauled during the period of time when flow to the station is very low to address the issue of odors.

S1107.16 Alarm Systems

An auto-dialer phone line alarm systems shall be provided for all pumping stations. A minimum of eight alarm channels shall be provided. The alarm system shall be capable of being programmed with voice recorded alarm conditions. The alarm shall be activated in cases of power failure, generator start-up failure, pump failure, sump pump failure, wet well high and low levels, low level stop failure, unauthorized entry, or any cause of pump station malfunction. Pump station alarms shall be programmed to be transmitted to responsible person(s) in charge of the pump station prior to acceptance by the Town. Audible-visual alarm systems with a self-contained back-up power supply shall be also be provided. Alarm systems shall be approved by the Town DIRECTOR OF PUBLIC WORKS prior to installation to ensure conformity with the rest of the system.

The following wet well alarm conditions shall be provided as a minimum for pump stations:

1. Lead pump stop failure
2. Low level
3. Lag pump on
4. High level
5. Pump seal failure

S1107.17 Flow Measurement

Suitable devices for measuring wastewater flow shall be provided at all pumping stations. The flow measuring devices shall measure instantaneous and totalized flow. The flow-measuring device shall be capable of outputting flow in GPM, GPD, or MGD as be selected by the operator through a simple menu based meter interface.

The read for the flow meter shall be mounted in a control panel with the rest of the panels and shall not be located in a vault. A read rated for outdoor exposure could be provided if available from the manufacturer and mounted in the same location with the other panels. A circular chart graphical recorder shall also be provided equipped with seven-day charts.

S1107.18 Water Supply

Potable water shall be provided at each pump station. There shall be no physical connection between any potable water supply and a wastewater pumping station, which under any condition might cause contamination of the potable water supply. A reduced pressure principle backflow prevention device shall be provided before the first branch or connection on the water service line brought to all pump station sites. The reduced pressure principle backflow preventer shall be Watts Model 909QT, or approved equal. Provide at a minimum of one (1) freezeless yard hydrant.

S1107.19 Spare Parts

The following spare parts shall be provided for each lift station prior to acceptance by the Town.

1. One complete set of all bearings, racers, and all gaskets for each installed pump.
2. One complete set of mechanical seals for each installed pump.
3. One change of lubricant for submersible type pumps.
4. One set of gaskets for each type of valve provided.
5. One spool piece of pipe for removal of the flow meter provided.
6. Two electrical fuses of each size and type present on site.
7. One year's supply of seven-day flow meter charts and six replacement ink pens for the graphical recorder.

S1107.20 Electrical Service to Station

1. Electrical power to the Pump Station Facilities and equipment shall be in accordance with the requirements of S1107.08.
2. Main electrical service must be furnished through a double throw switch of sufficient size and rating for operation service of the lift station in the event emergency power is needed.

S1107.21 Electrical - General

Electrical systems and components (e.g., motors, lights, cables, conduits, switch boxes, control circuits, etc.) in raw wastewater wet wells, or in enclosed or partially enclosed

spaces where hazardous concentrations of flammable gases or vapors may be present, shall comply with the National Electrical Code requirements for Class I Group D, Division 1 locations. In addition, equipment located in the wet wells shall be suitable for use under corrosive conditions. Each flexible cable shall be provided with a watertight seal and separate strain relief. A fused disconnect switch located above ground shall be provided for the main power feed for all pumping stations. Outdoor panels shall be NEMA 4X. Lightning and surge protection systems shall be provided. A 110-volt power receptacle to facilitate maintenance shall be provided. Ground fault circuit interruption protection shall be provided for all outlets.

S1107.22 Electrical Equipment Location

All electrical panels, controls and associated components shall be installed in a building or under roof to protect the controls and maintenance personnel working on them from the elements, particularly under emergency conditions.

S1107.23 Electrical Controls

The materials and equipment covered by these specifications are intended to be standard materials and equipment of proven ability as manufactured by reputable concerns. Equipment shall be designed and constructed according to the best practice of the industry and assembled by a UL listed shop. The specifications call attention to certain features, but do not purport to cover all details entering into the construction of the equipment.

1. Controls. The motor control center shall be located outside the wet well, be readily accessible, and be protected by a conduit seal or other appropriate measures meeting the requirements of the National Electrical Code, to prevent the atmosphere of the wet well from gaining access to the control center. The seal shall be located so that the motor may be removed and electrically disconnected without disturbing the seal.
2. Control panels. Control panels located outdoors shall be NEMA 4X. All control panels shall be located under a roof as a minimum for operator safety. Provide a switched light to directly illuminate the panel area. The panel shall be a freestanding type complete with all shop-mounted and wired equipment, fixtures, devices controls, etc., requiring only field connections of incoming and outgoing wiring.
3. Pump control. Pump controls shall be float activated.
4. Control floats. Control floats shall be of the mercuric switch type and intrinsically safe. Control floats shall be located so as not to be affected by turbulent flows entering the wet-well or by the turbulent suction of the pumps. They shall be capable of being easily removed without entering the wet well or dry well. Alarm floats shall be “normally closed” such that the accidental severing of the float cable will produce an alarm.

5. Pump control selector switch. Provide Hand-Off-Automatic selector switch for each pump. Provide pump selector switch to allow normal pump operation with lead and lag floats with any pump out of service.
6. Pump alternation. Provision shall be made to automatically alternate the pumps in use with each run cycle.
7. Pump monitoring. Provide pump run lights for each pump on control panel face. Provide non-resettable elapsed time meter and cycle counter for each pump.
8. Control wiring. Control and power wiring shall be installed in separate conduits.

S1107.24 SCADA

A SCADA system from High Tide Technologies, LLC shall be installed at each pump station. The exact model number of system shall be indicated on the design documents for the project. The project engineer shall determine the appropriate model number based on the pump station design.

S1107.25 Emergency Backup Generators

All lift stations shall have a back-up generator installed permanently on site to provide emergency power in case of a power failure. The following general requirements shall apply to all internal combustion engines used to drive auxiliary pumps, service pumps through special drives, or electrical generating equipment. All electrical generators shall have at a Hospital Grade muffler system.

1. The installed generator shall be sized to provide 1.25 percent of the full load capacity at build out of the connected load.
2. Generating unit size shall be adequate to provide power for pump motor starting current and for lighting, ventilation, and other auxiliary equipment necessary for safety and proper operation of the pump station. Special sequencing controls shall be provided to delay the start-up of pump motors with auxiliary power operating the pump station.
3. Generating unit size shall be adequate to provide power for pump motor starting current and for lighting, ventilation, and other auxiliary equipment necessary for safety and proper operation of the lift station.
4. Special sequencing controls shall be provided to start pump motors unless the generating equipment has capacity to start all pumps simultaneously with auxiliary equipment operating.
5. Provisions shall be made for automatic and manual start-up and load transfer. The generator shall be protected from operating conditions that

- would result in damage to equipment. Provisions shall be provided to allow the engine to start and stabilize at operating speed before assuming the load.
6. Engine Drive Generating Equipment (Backup Generators) permanently installed on site shall be manufactured by Kohler, Onan or approved equal.
 - a. The generator shall have a diesel driven internal combustion engine as part of it installed components.
 - b. Engine Protection. The engine must be protected from operating conditions that would result in damage to equipment. Protective equipment shall be capable of shutting down the engine and activating an alarm on site. Protective equipment shall monitor for conditions of low oil pressure and overheating except that oil pressure monitoring will not be required for engines with splash lubrication.
 - c. Size. The engine shall have adequate rated power to start and continuously operate under all connected loads.
 7. Fuel Type. Fuel type shall be No. 2 diesel fuel only.
 8. Above Ground Fuel Storage. Above ground fuel storage and piping facilities shall be constructed in accordance with applicable state, county, and federal regulations. Storage tank shall be sized to hold enough fuel to operate the generator set for 72 hours of operation under normal load.
 9. Routine Start-up. All emergency equipment shall be provided with instructions indicating the need for regular starting and running of such units at full station loads. These units shall start under no load but shall "start up and run" at full load.
 10. All emergency equipment shall be provided with automatic controls for regular starting and running of such units at full loads for exercising purposes.
 11. Protection of Equipment. Emergency equipment shall be protected from damage at the restoration of regular electrical power.
 12. The engine shall be located above grade with adequate ventilation of fuel vapors and exhaust gases.
 13. Emergency equipment shall be protected from damage at the restoration of regular electrical power. Generator shall be grounded at the electric service entrance only.

S1107.26 Automatic Transfer Switch

Automatic transfer switches shall be installed at all lift stations to provide instant generator start in case of power failure. Provisions shall be made for automatic and manual start-up and load transfer via a non-circuit breaker type automatic transfer switch. The generator must be protected from operating conditions that would result in damage to equipment. Provisions should be considered to allow the engine to start and stabilize at operating speed before assuming the load.

1. The switch shall be a type NEMA I enclosed, 480-volt, three pole, 100-ampere, switch for normal and generator service. The switch shall be suitable for continuous operation. The transfer switch shall be arranged to close a pilot contact for remote starting of the generator set, after a time delay of 30 seconds adjustable from 0.5 to 60 seconds after power failure or drop in any phase voltage to 70 percent of line voltage. During the delay period, the load circuits shall not be disconnected from the normal service lines.
2. When the generator is delivering not less than 95 percent of rated voltage and frequency, the load circuits shall be transferred. Retransfer to normal service shall be automatic when full line voltage and phase are restored after a time delay of 0 to 30 minutes (set at 10 minutes). After transfer to normal source, the diesel generator shall continue to run for 10 minutes (adjustable 0 to 60 minutes) unloaded, shall shut down and shall be ready to start upon the next failure of the normal source or for manual start-up. If the diesel generator set should fail while carrying the load, retransfer to the normal source shall be made instantaneously upon restoration of the normal power. All voltage and frequency pick-up and drop-out settings shall be field adjustable. The transfer switch shall be mechanically held and electrically operated and have a single operator, which is momentarily energized. Capacitors, fuses, or thermal protection in the main operator control circuit is prohibited. Main operators of the circuit breaker type are unacceptable.
3. The transfer switch shall be approved in accordance with UL1008 for all classes of load.
4. The automatic transfer switch shall be as manufactured by the Automatic Switch Company (ASCO) Bulletin 940 (Accessory Group 7), or approved equal, rated as indicated on the drawings and complete with the following accessories.
 - a. Time delay on transfer to generator service adjustable 0 to 5 minutes, set at 0.
 - b. Close differential relay protection on all phases.
 - c. Pilot light to indicate switch is in the normal service position.
 - d. Pilot light to indicate switch is in the generator service position.

- e. Timer to automatically exercise the generator set, under load, for 30 minutes every 168 hours. The exercise timer shall be 7-day, 24-hour dial type with 6 day skip feature and spring reserve power supply.
- f. In phase monitor for protection of out of phase transfer of motor loads capable of functioning in both directions.
- g. Included with the transfer switch shall be a voltage monitor to sense failure of the utility service. Monitors shall be of solid state design; NEMA I enclosed, and shall be equipped with an N.O. contact (closes on utility power failure after a time delay of 0.1 to 6.0 seconds) for connection to the station's telephone dialer. Monitor shall be suitable for three phase, 480 volt operation and shall be ASCO Catalog No. 214A293, or approved equal.

S1107.27 Instructions and Equipment

Sewage pump stations and their operators shall be supplied with a complete set of operational instructions, including emergency procedures, maintenance schedules, special tools, and such spare parts as may be necessary.

S1107.28 Method of Measurement and Basis of Payment

The payment for the items specified in the Contract Documents will be full compensation for all material, labor, equipment, tools and incidentals necessary to complete the work.

The items specified in the Contract Document will be measured and paid for as specified by the Engineer.

END OF SECTION

S1108 SPRAY LINING CONCRETE STRUCTURES**S1108.01 Description**

This work applies only to rehabilitation of existing manholes and does not apply to new construction. The work consists of spray applying a urethane/epoxy-based material to the walls, inverts, and benches of the sanitary sewer manhole, meter vault, and wet well, resulting in a monolithic liner of a minimum 1/8 inch thickness or more, as determined by the manufacturer for the specific depth and water table. The applicator, approved and trained, shall furnish all labor, equipment and materials for installing the lining over brick, tile, pre-cast concrete, or concrete block manholes, new or used, using approved equipment. The installation shall be in accordance with the following Contract Specifications along with manufacturer's recommendations.

S1108.02 Materials

1. Mixture: A urethane/epoxy-based material specifically designed for manhole and wet well applications shall be SprayWall as manufactured by Sprayroq, Inc. (1-800-634-0504), or engineer approved equal. The product shall be corrosion resistant to the ingredients of the sanitary sewer environment and shall be designed to bond to wet (not running) surfaces.
2. Water: Shall be clean, potable, and supplied by the contractor.
3. Other Materials: No material shall be used with or added to mixture without prior approval by the Owner.
4. Properties
 - a. Physical:
 - i. Tensile stress, ASTM D-638 6,500 psi.
 - ii. Flexural stress, ASTM D-790 10,000 psi.
 - iii. Flexural modules, ASTM D-790 550,000 psi.
 - b. Liner Mix shall be made with manufacturer's recommendations for wet well and manhole applications.

S1108.03 Preparation

1. Place covers over invert before prepping.
2. All foreign materials shall be removed from the manhole, meter vault, or wet well walls and bench or floor using high-pressure water spray (minimum 1,200 psi). Loose and protruding brick, mortar and concrete shall be removed using a masons hammer and chisel. All non-leaking voids shall be filled with a nonshrink cement-based material containing hydraulic cement, as approved and directed by the Owner at least 1 hour

prior to spray application of the first coat of liner.

3. Active leaks shall be stopped using products specifically for that purpose and according to manufacturer's recommendations. Grouting with chemically resistant cement-based material shall be used to cease inflow into structures.
4. Excessively leaking structures shall be drilled through the wall and injected with grout sealant only after the event that normal leak stoppage methods are not effective and it is approved by the Owner.
5. All loose material shall be removed following the completion of preparation work.
6. Bypass pumping shall be performed as required for the rehabilitation.
7. Structure inverts and steps shall be protected during rehabilitation application.

S1108.04 Spraying

1. The surface prior to spraying shall be damp without noticeable free water droplets or running water. Material shall be spray applied to a minimum uniform thickness to insure that all voids and crevices are filled and a smooth.
2. The application of the liner shall provide a monolithic liner of a minimum of 1/8". The liner shall be applied to the invert, bench and wall and shall all be equal in thickness as determined by the water table and the product manufacturer. The invert and bench shall be smooth and sloped in the direction of the flow. The bench shall have a gradual slope to the invert. The invert transition to the pipe shall be smooth and shall not impair the flow.
3. No application shall be made when ambient temperatures are less than 40°F and when freezing is expected within 24 hours unless specific recommendations are made by the manufacturer.
4. A minimum of 30 minutes cure time or more as required by the product manufacturer shall be allowed before returning to active flow.

S1108.05 Testing

1. Two standard samples shall be taken from each day's work with the date, location and job recorded for each sample. The samples shall be sent to an established, local, and reputable commercial testing laboratory that has been approved by the Owner to determine if lining materials meet minimum requirements specified herein. All manholes shall pass a

Holiday Test per manufacture's recommendations.

END OF SECTION

S1109 DUPLEX GRINDER PUMP STATIONS**S1109.01 Description**

Provide all labor, materials, equipment and services necessary for and incidental to, the complete and satisfactory installation of the complete factory-built and tested duplex grinder pump units, each consisting of a grinder pump core suitably mounted on an integral stand of stainless steel, special polyethylene tank, electrical quick disconnect (NEMA 6P), pump removal harness, discharge assembly/shut-off valve, anti-siphon valve/check valve assembly, electrical alarm assembly and all necessary internal wiring and controls, as specified herein and as shown on the Contract Drawings.

S1109.02 Manufacturer

1. Duplex grinder pump stations, complete with all appurtenances, form an integral system, and as such, shall be supplied by one grinder pump station manufacturer. The Contractor shall be responsible for the satisfactory operation of the entire system. The equipment specified shall be a product of a company experienced in the design and manufacture of grinder pumps for specific use in low pressure sewage systems. The Manufacturer shall submit detailed installation and user instructions for its product, submit evidence of an established service program including complete parts and service manuals, and be responsible for maintaining a continuing inventory of grinder pump replacement parts. The Manufacturer shall provide, upon request, a reference and contact list from ten of its largest contiguous grinder pump installations of the type of grinder pumps described within this specification.
2. The Manufacturer of the duplex grinder pump station shall be Environmental One Corporation, Barnes, Vortech, or Proposed Alternate.

S1109.03 Quality Control

Warranty: The grinder pump Manufacturer shall provide a part(s) and labor warranty on the complete station and accessories, including, but not limited to, the panel for a period of 24 months after project substantial completion. Any manufacturing defects found during the warranty period will be reported to the Manufacturer by the Owner and will be corrected by the Manufacturer at no cost to the Owner.

S1109.04 Materials

1. Pump
 - a. The pump shall be a custom designed, integral, vertical rotor, motor driven, solids handling pump of the progressing cavity type with a single mechanical seal. Double radial O-ring seals are required at all casting joints to minimize corrosion and create a protective barrier. All pump castings shall be cast iron, fully epoxy coated to 8-10 mil Nominal dry thickness, wet applied. The rotor shall be through-hardened, highly polished, precipitation hardened stainless steel. The stator shall be of a specifically compounded ethylene propylene synthetic elastomer. This material shall be suitable for domestic wastewater service. Its physical properties shall include high tear and abrasion resistance, grease resistance, water and detergent resistance, temperature stability, excellent aging properties, and outstanding wear

resistance. Buna-N is not acceptable as a stator material because it does not exhibit the properties as outlined above and required for wastewater service.

2. Grinder

- a. The grinder shall be placed immediately below the pumping elements and shall be direct-driven by a single, one-piece motor shaft. The grinder impeller (cutter wheel) assembly shall be securely fastened to the pump motor shaft by means of a threaded connection attaching the grinder impeller to the motor shaft. Attachment by means of pins or keys will not be acceptable. The grinder impeller shall be a one-piece, 4140 cutter wheel of the rotating type with inductively hardened cutter teeth. The cutter teeth shall be inductively hardened to Rockwell 50 – 60c for abrasion resistance. The shredder ring shall be of the stationary type and the material shall be white cast iron. The teeth shall be ground into the material to achieve effective grinding. The shredder ring shall have a staggered tooth pattern with only one edge engaged at a time, maximizing the cutting torque. These materials have been chosen for their capacity to perform in the intended environment as they are materials with wear and corrosive resistant properties.
- b. This assembly shall be dynamically balanced and operate without objectionable noise or vibration over the entire range of recommended operating pressures. The grinder shall be constructed so as to minimize clogging and jamming under all normal operating conditions including starting. Sufficient vortex action shall be created to scour the tank free of deposits or sludge banks which would impair the operation of the pump. These requirements shall be accomplished by the following, in conjunction with the pump:
 - i. The grinder shall be positioned in such a way that solids are fed in an upward flow direction.
 - ii. The maximum flow rate through the cutting mechanism must not exceed 4 feet per second. This is a critical design element to minimize jamming and as such must be adhered to.
 - iii. The inlet shroud shall have a diameter of no less than 5 inches. Inlet shrouds that are less than 5 inches in diameter will not be accepted due to their inability to maintain the specified 4 feet per second maximum inlet velocity which by design prevents unnecessary jamming of the cutter mechanism and minimizes blinding of the pump by large objects that block the inlet shroud.
- i. The impeller mechanism must rotate at a nominal speed of no greater than 1800 rpm.
- c. The grinder shall be capable of reducing all components in normal domestic sewage, including a reasonable amount of “foreign objects,” such as paper, wood, plastic, glass, wipes, rubber and the like, to finely-divided particles which will pass freely through the passages of

the pump and the 1-1/4" diameter stainless steel discharge piping.

3. Electric Motor

1. The motor shall be a capacitor start, ball bearing, air-cooled induction type with Class F installation. The motor shall be press-fit into the casting for better heat transfer and longer winding life. Inherent protection against running overloads or locked rotor conditions for the pump motor shall be provided by the use of an automatic-reset, integral thermal overload protector incorporated into the motor. This motor protector combination shall have been specifically investigated and listed by Underwriters Laboratories, Inc., for the application. Non-capacitor start motors or permanent split capacitor motors will not be accepted because of their reduced starting torque and consequent diminished grinding capability. The wet portion of the motor armature must be 300 Series stainless. To reduce the potential of environmental concerns, the expense of handling and disposing of oil, and the associated maintenance costs, oil-filled motors will not be accepted.

4. Mechanical Seal

1. The pump/core shall be provided with a mechanical shaft seal to prevent leakage between the motor and pump. The seal shall have a stationary ceramic seat and carbon rotating surface with faces precision lapped and held in position by a stainless steel spring.

5. Tank: Polyethylene Construction

1. The tank shall be made of rotational molded polyethylene with high environmental stress cracking resistance. All seams created during tank construction are to be thermally welded and factory tested for leak tightness. The tank wall and bottom must withstand the pressure exerted by saturated soil loading at maximum burial depth. All station components must function normally when exposed to 150 percent of the maximum external soil and hydrostatic pressure.
2. The overall basin capacity shall be sized per the Manufacturer's Recommendations.
3. The tank and factory penetrations shall be factory tested and guaranteed to be watertight.

6. Discharge Hose and Disconnect/Valve

1. All discharge fittings and piping shall be constructed of polypropylene, EPDM or PVC. The discharge hose assembly shall include a shut-off valve rated for 200 psi WOG and a quick disconnect feature to simplify installation and pump removal. The bulkhead penetration shall be factory installed and warranted by the manufacturer to be watertight.

7. Electrical Quick Disconnect

1. The grinder pump core shall include a factory-installed NEMA 6P

electrical quick disconnect (EQD) for all power and control functions. The EQD will be supplied with 32' total, 25' of useable, electrical supply cable (ESC) to connect to the alarm panel. The EQD shall require no tools for assembly, seal against water before the electrical connection is made, and include radial seals to assure a watertight seal regardless of tightening torque. Plug-type connections of the power cable onto the pump housing will not be acceptable due to the potential for leaks and electrical shorts. Junction boxes are not acceptable due to the large number of potential leak points. The EQD shall be so designed to be conducive to field wiring as required.

8. Check Valve

1. The pump discharge shall be equipped with a factory installed, gravity operated, flapper-type integral check valve built into the discharge piping. The check valve will provide a full-ported passageway when open, and shall introduce a friction loss of less than 6 inches of water at maximum rated flow. Moving parts will be made of a 300 Series stainless steel and fabric reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly providing a maximum degree of freedom to assure seating even at a very low back-pressure. The valve body shall be an injection molded part made of an engineered thermoplastic resin. The valve shall be rated for continuous operating pressure of 235 psi. Ball-type check valves are unacceptable due to their limited sealing capacity in slurry applications.

9. Anti-Siphon Valve

1. The pump discharge shall be equipped with a factory-installed, gravity-operated, flapper-type integral anti-siphon valve built into the discharge piping. Moving parts will be made of 300 Series stainless steel and fabric-reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly, providing a maximum degree of freedom to ensure proper operation even at a very low pressure. The valve body shall be injection-molded from an engineered thermoplastic resin. Holes or ports in the discharge piping are not acceptable anti-siphon devices due to their tendency to clog from the solids in the slurry being pumped. The anti-siphon port diameter shall be no less than 60% of the inside diameter of the pump discharge piping.

10. Core Unit

1. The grinder pump station shall have an easily removable core assembly containing pump, motor, grinder, all motor controls, check valve, anti-siphon valve, electrical quick disconnect and wiring. The watertight integrity of the core unit shall be established by a 100% factory test at a minimum of 5 PSIG.

11. Controls

1. All necessary motor starting controls shall be located in the cast iron enclosure of the core unit secured by stainless steel fasteners. Locating motor starting controls in a plastic enclosure is not acceptable. Wastewater level sensing controls shall be housed in a separate enclosure from motor starting controls. Level sensor housing must be sealed via a radial type seal; solvents or glues are not acceptable. Level sensing control housing must be integrally attached to pump assembly so that it may be removed from the station with the pump and in such a way as to minimize the potential for the accumulation of grease and debris accumulation, etc. Level sensing housing must be a high-impact thermoplastic copolymer over-molded with a thermo plastic elastomer. The use of PVC for the level sensing housing is not acceptable.
 2. Non-fouling wastewater level controls for controlling pump operation shall be accomplished by monitoring the pressure changes in an integral air column connected to a pressure switch. The air column shall be integrally molded from a thermoplastic elastomer suitable for use in wastewater and with excellent impact resistance. The air column shall have only a single connection between the water level being monitored and the pressure switch. Any connections are to be sealed radially with redundant O-rings. The level detection device shall have no moving parts in direct contact with the wastewater and shall be integral to the pump core assembly in a single, readily-exchanged unit. Depressing the push to run button must operate the pump even with the level sensor housing removed from the pump.
 3. All fasteners throughout the assembly shall be 300 Series stainless steel. High-level sensing will be accomplished in the manner detailed above by a separate air column sensor and pressure switch of the same type. Closure of the high-level sensing device will energize an alarm circuit as well as a redundant pump-on circuit. For increased reliability, pump ON/OFF and high-level alarm functions shall not be controlled by the same switch. Float switches of any kind, including float trees, will not be accepted due to the periodic need to maintain (rinsing, cleaning) such devices and their tendency to malfunction because of incorrect wiring, tangling, grease buildup, and mechanical cord fatigue. To assure reliable operation of the pressure switches, each core shall be equipped with a factory installed equalizer diaphragm that compensates for any atmospheric pressure or temperature changes. Tube or piping runs outside of the station tank or into tank-mounted junction boxes providing pressure switch equalization will not be permitted due to their susceptibility to condensation, kinking, pinching, and insect infestation. The grinder pump will be furnished with a 6 conductor 14 gauge, type SJOW cable, pre-wired and watertight to meet UL requirements with a **FACTORY INSTALLED** NEMA 6P EQD half attached to it.
12. Alarm Panel(s): MOD T260 Duplex
1. Each grinder pump station shall include a NEMA 4X, UL-listed alarm panel suitable for wall or pole mounting. The NEMA 4X enclosure shall be manufactured of thermoplastic to ensure corrosion resistance. The enclosure shall include a hinged, lockable

cover with padlock, preventing access to electrical components, and creating a secured safety front to allow access only to authorized personnel. The standard enclosure shall not exceed 12.5" W x 16" H x 7.5" D.

2. The panel shall contain one 15-amp single pole circuit breaker for the alarm circuit and one 15-amp double pole circuit breaker per core for the power circuit. The panel shall contain a push-to-run feature, an internal run indicator, and a complete alarm circuit. All circuit boards in the alarm panel are to be protected with a conformal coating on both sides and the AC power circuit shall include an auto resetting fuse.
3. The visual alarm lamp shall be inside a red, oblong lens at least 3.75" L x 2.38" W x 1.5" H. Visual alarm shall be mounted to the top of the enclosure in such a manner as to maintain NEMA 4X rating. The audible alarm shall be externally mounted on the bottom of the enclosure, capable of 93 dB @ 2 feet. The audible alarm shall be capable of being deactivated by depressing a push-type switch that is encapsulated in a weatherproof silicone boot and mounted on the bottom of the enclosure (push-to-silence button).
4. The high-level alarm system shall operate as follows:
 - a. The panel will go into alarm mode if either pump's alarm switch closes. During the initial alarm mode both pumps will run and the alarm light and buzzer will be delayed for a period of time based on user settings (default is 3-1/2 minutes). If the station is still in high-level alarm after the delay, the light and buzzer will be activated.
 - b. The audible alarm may be silenced by means of the externally mounted push-to-silence button.
 - c. The visual alarm remains illuminated until the sewage level in the wet well drops below the "off" setting of the alarm switch for both pumps.
5. The entire alarm panel, as manufactured and including any of the following options shall be listed by Underwriters Laboratories, Inc.

S1109.05 Serviceability

The grinder pump core, including level sensor assembly, shall have two lifting hooks complete with lift-out harness connected to its top housing to facilitate easy core removal when necessary. The level sensor assembly must be easily removed from the pump assembly for service or replacement. All mechanical and electrical connections must provide easy

disconnect capability for core unit removal and installation. Each EQD half must include a water-tight cover to protect the internal electrical pins while the EQD is unplugged. A pump push-to-run feature will be provided for field trouble shooting. The push-to-run feature must operate the pump even if the level sensor assembly has been removed from the pump assembly. All motor control components shall be mounted on a readily replaceable bracket for ease of field service.

S1109.06 OSHA Confined Space

All maintenance tasks for the grinder pump station must be possible without entry into the grinder pump station (as per OSHA 1910.146 Permit-required confined spaces). *“Entry means the action by which a person passes through an opening into a permit-required confined space. Entry includes ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant’s body breaks the plane of an opening into the space.”*

S1109.07 Safety

1. The grinder pump shall be free from electrical and fire hazards as required in a residential environment. As evidence of compliance with this requirement, the completely assembled and wired grinder pump station shall be listed by Underwriters Laboratories, Inc., to be safe and appropriate for the intended use. UL listing of components of the station, or third-party testing to UL standard are not acceptable.
2. The grinder pump shall meet accepted standards for plumbing equipment for use in or near residences, shall be free from noise, odor, or health hazards, and shall have been tested by an independent laboratory to certify its capability to perform as specified in either individual or low pressure sewer system applications. As evidence of compliance with this requirement, the grinder pump shall bear the seal of NSF International. Third-party testing to NSF standard is not acceptable.

S1109.08 Factory Test

1. Each grinder pump shall be submerged and operated for 1.5 minutes (minimum). Included in this procedure will be the testing of all ancillary components such as, the anti-siphon valve, check valve, discharge assembly and each unit’s dedicated level controls and motor controls. All factory tests shall incorporate each of the above listed items. Actual appurtenances and controls which will be installed in the field shall be particular to the tested pump only. A common set of appurtenances and controls for all pumps is not acceptable. Certified test results shall be available upon request showing the operation of each grinder pump at two different points on its curve. Additional validation tests include: integral level control performance, continuity to ground and acoustic tests of the rotating components.
2. The Engineer reserves the right to inspect such testing procedures with representatives of the Owner, at the Grinder Pump Manufacturer’s facility.

3. All HDPE basins shall be factory leak tested to assure the integrity of all joints, seams and penetrations. All necessary penetrations such as inlets, discharge fittings and cable connectors shall be included in this test along with their respective sealing means (grommets, gaskets etc.).

S1109.09 Certified Service Program

1. The grinder pump Manufacturer shall provide a program implemented by the Manufacturer's personnel as described in this specification to certify the service company as an authorized serviced center. As evidence of this, the Manufacturer shall provide, when requested, sufficient evidence that they have maintained their own service department for a minimum of 10 years.
2. As part of this program, the Manufacturer shall evaluate the service technicians as well as the service organization annually. The service company will be authorized by the Manufacturer to make independent warranty judgments. The areas covered by the program shall include, as a minimum:
 - a. Pump Population Information — The service company will maintain a detailed database for the grinder pumps in the territory that tracks serial numbers by address.
 - b. Inventory Management — The service company must maintain an appropriate level of inventory (pumps, tanks, panels, service parts, etc.) including regular inventory review and proper inventory labeling. Service technicians will also maintain appropriate parts inventory and spare core(s) on service vehicles.
 - c. Service Personnel Certification — Service technicians will maintain their level-specific certification annually. The certifications are given in field troubleshooting, repair, and training.
 - d. Service Documentation and Records — Start up sheets, service call records, and customer feedback will be recorded by the service company.
 - e. Shop Organization — The service company will keep its service shop organized and pumps will be tagged with site information at all times. The shop will have all required equipment, a test tank, and cleaning tools necessary to service pumps properly.

S1109.10 Delivery

All grinder pump core units, including level controls, will be delivered to the job site 100 percent completely assembled, including testing, ready for installation. Grinder pump cores will be shipped separately from the tanks. Installing the cores and discharge piping/hose into the tanks is the only assembly step required and allowed due to the workmanship issues associated with other on-site assembly. Grinder pump cores must be boxed for ease of

handling.

S1109.11 Installation

1. Earth excavation and backfill are specified under Earthwork Section, but are also to be done as a part of the work under this section, including any necessary sheeting and bracing.
2. The Contractor shall refer to the front end specifications for the dewatering requirements.
3. The grinder pump stations shall not be set into the excavation until the installation procedures and excavation have been approved by the Owner's Representative.
4. Remove packing material. User instructions **MUST** be given to the Owner. Hardware supplied with the unit, if required, will be used at installation. The basin shall be supplied with inlet grommet (s) for connecting the incoming sewer line as shown on the Contract Drawings. The basin may not be dropped, rolled or laid on its side for any reason.
5. Installation shall be accomplished so that 1" to 4" of access way, below the bottom of the lid, extends above the finished grade line. The finished grade shall slope away from the unit. The diameter of the excavated hole must be large enough to allow for the concrete anchor.
6. A 6" inch (minimum) layer of naturally rounded aggregate, clean and free flowing, with particle size of not less than 1/8" or more than 3/4" shall be used as bedding material under each unit.
7. A concrete anti-flotation collar, as designed by manufacturer, shall be required and shall be pre-cast to the grinder pump or poured in place. Design shall be certified by a licensed engineer in State of Delaware. Each grinder pump station with its pre-cast anti-flotation collar shall have a minimum of three lifting eyes for loading and unloading purposes.
8. If the concrete is poured in place, the unit shall be leveled, and filled with water, to the bottom of the inlet, to help prevent the unit from shifting while the concrete is being poured. The concrete must be manually vibrated to ensure there are no voids. If it is necessary to pour the concrete to a level higher than the inlet piping, an 8" sleeve is required over the inlet prior to the concrete being poured.
9. The electrical enclosure shall be furnished, installed and wired to the grinder pump station by the Contractor. An alarm device is required on every installation, there shall be **NO EXCEPTIONS**. It will be the responsibility of the Contractor to coordinate with the Owner/Engineer to determine the optimum location for the alarm panel.
10. The Contractor shall mount the alarm device in a conspicuous location, as per national and local codes. The alarm panel will be

connected to the grinder pump station by a length of 6-conductor type TC cable. The power and alarm circuits must be on separate power circuits. The grinder pump stations will be provided with 32' total, 25' of useable, electrical supply cable to connect the station to the alarm panel. This cable shall be supplied with a **FACTORY INSTALLED** EQD half to connect to the mating EQD half on the core.

S1109.12 Backfill Requirements

Backfilling shall be in accordance with Section 312000 Earthwork.

S1109.13 Start-up and Field Testing

1. The Manufacturer shall provide the services of qualified factory trained technician(s) who shall inspect the placement and wiring of each station, perform field tests as specified herein, and instruct the Owner's personnel in the operation and maintenance of the equipment before the stations are accepted by the Owner.
2. All equipment and materials necessary to perform testing shall be the responsibility of the Installing Contractor. This includes, as a minimum, a portable generator and power cable (if temporary power is required), water in each basin (filled to a depth sufficient to verify the high level alarm is operating), and opening of all valves in the system. These steps shall be completed prior to the qualified factory trained technician(s) arrival on site.
3. Upon completion of the installation, the authorized factory technician(s) will perform the following test on each station:
 - a. Make certain the discharge shut-off valve in the station is fully open.
 - b. Turn ON the alarm power circuit and verify the alarm is functioning properly.
 - c. Turn ON the pump power circuit. Initiate the pump operation to verify automatic "on/off" controls are operative. The pump should immediately turn ON.
 - d. Consult the Manufacturer's Service Manual for detailed start-up procedures.
4. Upon completion of the start-up and testing, the Manufacturer shall submit the start-up authorization form describing the results of the tests performed for each grinder pump station. Final acceptance of the system will not occur until authorization forms have been received for each pump station installed and any installation deficiencies corrected.

S1109.14 Operation and Maintenance

MANUALS: The Manufacturer shall supply four copies of Operation and Maintenance

Manuals to the Owner.

S1109.15 Method of Measurement and Basis of Payment

The payment for the items specified in the Contract Documents will be full compensation for all material, labor, equipment, tools and incidentals necessary to complete the work.

The items specified in the Contract Document will be measured and paid for as specified by the Engineer.

END OF SECTION

DIVISION 1200 WATER SYSTEM

S1201 WATER MAINS**S1201.01 Description**

This item shall consist of installing new water mains, including tapping sleeves and valves, hydrants, fittings, concrete buttresses, and all other miscellaneous accessories as shown on the Plans and in accordance with these Specifications and Standard Details.

S1201.02 General Requirements

1. Railroad Crossings. When a water main crosses beneath a railroad, the line shall be placed inside a culvert or steel casing large enough to provide protection against external vibration and loading.
2. Mains shall have no less than forty-eight (48) inches of cover over the top of the pipe. When the main must dip below an existing utility, the dip in depth shall be the shortest length possible by using 45 degree fittings.
3. Common Trench. No water main shall be placed in the same trench with a sewer, non-potable water line, or gas.
4. Separation of Utilities. See section S1002 and S1201 of this specification.
5. Dead Ends. The distribution system should be designed to promote loops and avoid dead ends due to water quality issues. When dead ends cannot be avoided, a fire hydrant or flushing hydrant shall be installed on the dead end so the line can be flushed.
6. Unbalanced Pressure. All tees, bends, caps, plugs, hydrants or other fittings that change the direction of flow shall be buttressed or anchored to prevent pipe movement caused by surges, water hammer or unbalanced pressure which could result in a water main break.
7. Concrete. Concrete for water main buttresses shall be 3,000 psi concrete using Type II Portland Cement.
8. Pressure. The distribution system and piping shall be designed so that the pressure at the customer's service connection shall be between 40 and 65 psi.
 - a. For fire protection, the minimum system pressure at ground level anywhere on the system under all conditions of flow shall never be less than 20 psi.
 - b. All customers' services shall have a pressure-reducing valve installed after the water meter to protect against pressures in excess of 80 psi.
 - c. Where building lot grade conditions are such that minimum pressure conditions within a residence required by the National

Plumbing Code cannot be met, a booster pump system shall be required within the dwelling to provide the required flow and pressure conditions.

9. **Minimum Size.** The minimum size water main installed in a non-commercial area shall be 6" except where good engineering practices, such as the provision of a short dead end run, permits the use of a smaller pipe. The minimum size main installed to service commercial and industrial areas shall be 8".

S1201.03 Water Main Pipe

All pipe used for water mains shall be ductile iron pipe (DIP) or polyvinyl chloride (PVC).

1. Ductile iron pipe (DIP) used for water mains shall be manufactured in accordance with ANSI/AWWA C151/A21.51, latest edition, and shall be a minimum of Class 52.
 - a. The Pipe shall be double cement mortar lined with seal coat. Pipe intended for buried installation shall receive an external standard bituminous foundry coating in accordance with ANSI/AWWA C104/ A21.4.
 - b. Pipe installed above ground shall be installed by means of flanged fittings in accordance with ANSI A21.10.
 - c. Buried ductile iron pipe shall be installed using push on joints such as "Tyton" joints or mechanical joint pipe as manufactured by US Pipe and Foundry or approved equal. Rubber gaskets shall conform to C-111 and ANSI A21.11 for mechanical and push-on joints.
2. PVC pressure pipe for water shall meet the requirements of AWWA C-900 and shall be furnished in cast iron pipe equivalent outside diameters with rubber gasketed joints as listed C-900 standard.

S1201.04 Fittings

All fittings used to connect water main pipe shall be of the same material as the water main. Ductile iron fittings shall be manufactured in accordance with ANSI A21.10 and have a pressure rating of 250 psi. PVC fittings shall be manufactured according to AWWA C907.

1. Mechanical joints shall be used for all buried pipe.
2. Mechanical joint fittings shall have retainer glands if so indicated on the plans or in the Standard Details. The retainer glands shall be Ford Uni-Flange series 1400 Wedge Action Retainer Glands, Mueller Aqua Grips, EBBA Iron MegaLug series 1000 Mechanical Joint Retainer glands, or approved equal.

3. Flanged fittings shall be used on all pipe installed above ground.

S1201.05 Gate Valves

Gate Valves shall be resilient wedge type valves conforming to AWWA standard C509.

1. The body shall be ductile iron.
2. The gate valve shall be epoxy coated inside and out
3. The valve stem shall be constructed of manganese bronze.
4. Dual “O” rings shall be used to seal the stem to allow replacement of the “O” rings while the valve is open under pressure.
5. The valve shall be installed in accordance with standard installation practices as defined by AWWA for the application.
6. Valves shall open left and close right.
7. Valves shall be Resilient Wedge Valve by Mueller, Waterous, or an approved equal.

S1201.06 Valve Boxes

Valve Boxes shall be cast iron, 3-piece screw type installed over the valve bonnet and operating nut. Valve boxes shall be capable of being adjusted to reach the surface of the existing or proposed ground surface but shall not extend above the finished grade at any time.

S1201.07 Extension Stem Assembly

All new line valves (5 feet or more below finished grade) shall be installed with an extension stem assembly. This shall apply to both replacement valve and new installations. The extension stem assembly shall be a complete unit composed of:

1. An extension rod.
2. 2” square nut attached to the top of the rod.
3. A wrench nut and coupling pinned to the bottom side of the extension rod by use of a steel drive pin.
4. The upper wrench nut (model 367-4953) and lower nut coupling (model 367-4963) shall be ductile iron, grade 65-45-12.
5. The extension stem rod shall be solid carbon steel (7/8” in diameter)
6. The extension shall be sized to reach from the installed valve to 6” below

finished street grade.

7. The extension stem assembly shall be Style “A” manufactured by Trumbull Industries or approved equal.

S1201.08 Flushing Hydrants

Flushing Hydrants or Standard Fire Hydrants shall be installed on all permanent dead end lines. For temporary dead end lines, a cap and blowoff would be acceptable. All hydrants shall be painted red.

1. Flushing Hydrants shall be compression type closing with the water pressure and furnished with a 2” FIP inlet.
2. Flushing Hydrants installed shall be flush (hidden) type.
3. Flushing hydrants shall be arranged for depths of bury no less than 3’-6” and no more than 4’-0”.
4. Working parts, thread protector and operating rod shall be brass and removable from the flushing hydrant without the need for excavation.
5. Brass thread protector shall have a 2” square nut.
6. Flushing Hydrants shall have the ability to be self-draining.
7. Hidden flushing hydrants shall be installed underground in a standard Ford valve box with cover.
8. Flushing hydrants shall be Model TF-500 as manufactured by John C Kupferle Foundry Co., St. Louis MO or approved equal.

S1201.09 Water Main Location

1. Water mains installed in residential areas shall be located as shown on Standard Details: Roadway Detail – Normal Location of Public Utilities (Townhouse and other).
2. In commercial and other non-residential areas, the mains shall be laid in areas, which cause the least impact to traffic in case of repairs.
3. At intersections, valves shall be located within the confines of the intersection.

S1201.10 Pipe Placement

Pipe and fittings shall be carefully handled and lowered into the trench onto the pipe bedding material. No large rocks or other sharp objects shall be allowed in the trench.

1. Special care shall be taken to insure that the pipes are well bedded on a solid foundation, and any defects due to settlement shall be made good by the contractor.
2. At the close of each workday the end of the pipeline shall be tightly closed with an expansion type stopper or plug so that no dirt or other foreign substance may enter the line, and this stopper or plug shall be kept in place until pipe installation is resumed.
3. No pipe shall be installed upon a foundation into which frost has penetrated, nor at any time when the Town deems that there is danger of the formation of ice or the penetration of frost at the bottom of the excavation, unless all required precautions as to the minimum length of open trench and promptness of backfilling are observed.
4. The ends of pipe shall abut against each other in such a manner that there shall be no shoulder or unevenness on the inside of the main.
5. Water pipe shall be encased with 3,000-psi minimum concrete where indicated on the drawings. Type II Portland Cement shall be used.

S1201.11 Pipe Bells

It is important that pipe bells do not have any undue weight placed on them. Bell holes shall be dug for each pipe bell to cradle the joints and evenly support the pipe. Use the gasket lubricant specified by the pipe manufacturer and approved for water service for proper pipe joint installation.

S1201.12 Separation of Utilities

Water and Sewer Mains cannot be placed closer than ten feet horizontally as measured edge to edge. Water mains crossing sewer mains shall be laid to provide a minimum vertical distance of eighteen (18) inches between the outside of the water main and the outside of the sewer (storm and sanitary).

When a water main is in close proximity or crosses a sewer main, the water mains shall be placed at least 18" above (preferred) or 18" under the sanitary sewer main. The distance between the pipes are measured from the outside of pipe to outside of pipe. See Section S1002.09 for additional separation requirements. Concrete encasement is not permitted to be used as a substitute for not meeting the minimum separation requirements.

S1201.13 Pipe Detection

All installed water main shall be capable of being found once buried by the installation of detector tape and detector wire.

1. Caution tape shall be installed directly above the pipe, 12" below the finished grade as it is laid in the ground during installation of both ductile

and PVC pipe. The tape should be a minimum three inches in width, blue in color, and have the wording "Caution-Water Line Below" on it every 3 ft. Detector tape shall be manufactured by "Alarmatape" or approved equal to manufacturer's recommendations or as directed.

2. Detector wire shall be insulated copper AWG #10. It shall be installed with and laid on top of the pipe as it is being installed. It shall run the full length of the installed pipe and shall be accessible to the surface at every structure. The wire shall be brought to the surface for access by attaching to the hydrants and valve boxes throughout the project.

S1201.14 Construction Methods

All pipe and fittings shall be installed according to the applicable requirements of AWWA, the manufacturer's guidelines, as specified herein, and as indicated in the Standard Details.

Normal excavation will be considered from the outside pipe dimension plus 18" each side, unless otherwise designated on the plans.

1. Unsuitable foundation material shall be removed below the normal designed elevation as directed by the engineer.
2. When a pipe is to be placed either partially or completely in a fill, the embankment shall be compacted to an elevation of one foot above the top of the proposed pipe installation for a minimum of 36" on each side of the pipe.
3. Trench or ditch bottoms containing bedrock, soft areas such as muck or refuse, or other material unable to provide long-term support to the pipe are unacceptable. Remove rock and other unyielding material one-foot below the pipe bottom and six inches on either side of the pipe unless otherwise directed by the Engineer. Excavate soft areas to a depth of two feet below the pipe bottom and three times the width of the pipe unless otherwise directed by the Engineer to excavate deeper or wider. If a firm foundation is exposed, replace the excavated material with acceptable backfill material and compact to 95 % Modified Proctor density.
4. If the soft area remains after excavation, and if approved by the engineer, synthetic fabric (geotextile) shall be used to separate the native soil from the backfill. After the fabric has been laid on the native soil, replace the excavated material with acceptable backfill material and compact to 95 % Modified Proctor density.
5. When rock, hardpan or other unyielding material is encountered, the trench shall be excavated as shown on the plans for bedding in rock and shall be backfilled with materials meeting the requirements of Subsection 916.01.03.

S1201.15 Backfill Procedure

Backfilling of the pipe shall be as follows:

1. Install Mirafi 600X geotextile fabric (or equal) along the trench to allow the water main and bedding to be encased with a twelve inch overlap. Place the pipe on a minimum 6" bedding of #57 stone meeting the requirement of section 813 and carefully tamp.
2. The next layer of backfill, the haunching, is the most important since it is this layer that provides the pipe with support against the soil and traffic loadings. Haunching should be placed in lifts of about 4 to 6 inches for optimum construction on both sides of the pipe. Tamp to achieve the specified compaction, or shovel into the area, eliminating voids, if the material doesn't require compaction. Construction of each lift should be repeated up to the crown of the pipe. Backfill material shall be of #57 stone meeting the requirement of section 813.
3. Initial backfill extends from the crown of the pipe to a minimum of six inches above the crown of the pipe. This area of the backfill anchors the pipe and ensures that loads are distributed as evenly as possible into the haunching. When using a material that requires compaction it is important not to use mechanical compaction equipment directly on the pipe itself. Backfill material shall be of #57 stone meeting the requirement of section 813.
4. Final backfill, which extends from the initial backfill layer to the ground surface, does not directly support the pipe. Backfill material shall meet Section 209.

Flowable fill can be used as an alternative to compacted granular material. Flowable fill will cause the pipe to float or misalign. Therefore, the pipe will need to be weighted with sandbags or held with some type of anchoring system. Alternatively, the flowable fill can be poured in layers that are allowed to cure before the next layer is poured.

5. Where the pipes are under the roadway pavement or shoulders, the backfill material shall be compacted in 8" lifts to 95% of the Modified Proctor density.
6. Where pipes are not under the roadway pavement or shoulders, compaction shall be in 8" lifts to 92% Modified Proctor density.

S1201.16 Thrust Restraint – Concrete Buttress

Thrust Restraints shall be used in all cases where there is a dead end, hydrant, valve, tee, or bend, which is not restrained by the use of fittings in accordance with section S1201, above.

1. The size and shape of concrete thrust blocks shall be as specified in the Standard Details.
2. The length of restrained joint piping and details of joint restraint glands, rodding, clamps, friction slabs, or other anchors shall be as specified by the engineer.
3. Thrust blocks and buttresses may be eliminated for tees, horizontal bends, and caps provided that mechanical joint restraint is provided through the use of MegaLugs or an approved equal. All vertical bends will still require thrust block/anchorage.

S1201.17 Tools

Proper and suitable tools and appliances for the safe and convenient handling and installation of pipes and fittings shall be used. Great care shall be taken to prevent the damage to the pipe, and bell and spigot ends. Any damaged pipe shall be replaced to the satisfaction of the Town.

S1201.18 Cleaning

Pipe and fittings shall be thoroughly cleaned before they are laid and shall be kept clean until the acceptance of the completed work.

S1201.19 Cutting

Whenever a pipe or fitting requires cutting, to fit into the line or to bring it to the required location, the work shall be done in a satisfactory manner to leave a smooth end, and without extra compensation.

S1201.20 Joining Pipe and Fittings

In joining pipe and fittings, the Contractor shall exercise particular care to insure that the outside of the spigot and inside of the bell is entirely free of oil, tar and greasy substances to insure a tight fit. All concrete required to construct buttresses behind plugs, tees, hydrants, bends and other fittings and anchorages beneath vertical bends shall be placed in accordance with the Standard Details or as shown on the plans.

S1201.21 Installation of Valves and Fittings

Install fittings and valves where indicated on the drawings, or as directed by the Engineer/Inspector or Town Official. Where valves occur on the end of the pipeline, place a cast iron plug and secure in the exposed bell before backfilling the trench. Buttress the valve.

1. A valve box shall be carefully placed over the bonnet of each gate valve with the top at the finished surface of the street sidewalk or at such other elevation, as the Engineer/Inspector or Town Official shall direct. It shall

be set plumb. In tamping the backfill around the box, special care shall be taken to keep the box plumb and to have it firmly supported to avoid settlement. Any box which is found out of plumb, or which is not firmly supported, shall be excavated and reset in a satisfactory manner.

2. There shall be as many valves installed as there are pipes entering and leaving any pipe intersection, typically three valves at each tee, four valves at each cross.
3. Street valve location shall be per section 1201.
4. Valve boxes shall be set in such a manner that the operating nut of the installed valve is set center in the valve box.
5. Concrete Collar: Any valve box installed in an area other than blacktop or concrete shall have a 12" x 12" x 12" concrete collar poured at time of installation.
6. Maximum valve spacing should not exceed eight hundred (800) feet.

S1201.22 Installation of Tapping Sleeve and Valves

Location of tapping sleeves and valves shall be as indicated on the drawings or as directed by the Town Engineer. Installation shall be as per the manufacturer's recommendations.

1. The Contractor shall notify the Town Department of Public Works at least 72 hours prior to tapping the water main. The Contractor shall install the tapping sleeve and valve in such a manner so as not to disrupt the existing water service.
2. Tapping sleeves shall be style FAST manufactured by Ford. It shall be constructed of grade 18-8 type 304 Stainless Steel. It shall have a test plug incorporated into its body. The flanges shall conform to AWWA C207 Class D ANSI 150. Gaskets shall conform to ASTM D2000-80M4AA607.
3. Tapping sleeves shall be rated for 150-PSI working pressure minimum.

S1201.23 Non Public Property

Fire hydrants, water mains 6" and larger and all accessories installed on non-public property (private property) shall be owned and maintained by the Town and shall be located within a minimum twenty (20) foot wide easement. Water mains smaller than 6" and all accessories installed on non-public property (private property) shall be owned and maintained by the Developer or Owner.

All materials employed in the construction of any non public system that is attached, connected, or other wise adjoined to any part of the Town's water distribution system

shall be subject to and follow the construction procedures set forth in this Specification and shall also comply with the Town Standard Details.

1. Each individual service shall be required to have a street (gate) valve sized in accordance to the size of the water main servicing the property located at the property line.
2. The street valve shall meet the requirements of sections S1201.
3. The main shall be required to have a meter sized in accordance to the size of the water line servicing the property
4. The meter shall be capable of recording both low and high flows.
5. The meter and its installation shall meet all the requirements of section S1206 of this document.
6. The main shall be required to have a backflow preventer installed between the Town's system and the customer's meter. The backflow preventer shall be the same size as the size of service line.

S1201.24 Method of Measurement and Basis of Payment

The payment for the items specified in the Contract Documents will be full compensation for all applicable excavation, sheeting, shoring, dewatering, hauling, invert paving, storing, re-handling of material, removal and disposal of excess and unsuitable material, tamped fill, forming bed or foundation, backfilling, compaction, testing and for all material, labor, equipment, tools, and incidentals necessary to complete the work

Water mains will be measured complete in place and paid for at the Contract unit price per linear foot or as specified by the engineer.

END OF SECTION

S1202 STERILIZATION OF WATER MAINS

S1202.01 Description

This item shall consist of disinfecting all newly laid water mains, including valves, fittings, fire hydrants, and all other miscellaneous accessories which carry potable water for use for domestic consumption or fire suppression in accordance with these Specifications. The procedure to be used for disinfecting shall be in accordance with the latest edition of AWWA Standards C601.

S1202.02 Flushing and Disinfection

All new sections of water main must be thoroughly flushed, disinfected and tested for bacteriological quality before the water main undergoing can be put in service.

1. Flushing is primarily required to remove any mud and debris left in the pipe from the installation. All flushing activity must be coordinated with the Town Department of Public Works a minimum of 72 hours in advance of the need.
 - a. One or more fire hydrants should be used for flushing so that a velocity of at least 2.5 ft/s and preferably 3.5 ft/s is obtained in the pipe. The flushing velocity should be maintained until the water runs visibly clean.
 - b. The number of hydrants required to adequately flush mains is as follows.

Pipe Diameter	Min. Flow Rate	No. of Hydrants
4"	100 gpm	1
6"	200 gpm	1
8"	400 gpm	1
10"	600 gpm	1
12"	900 gpm	2

If a fire hydrant is not to be installed at the end of a new main, a flushing hydrant shall be provided.

2. Disinfection. New water mains and equipment shall be disinfected with either tablets or chlorine solution.
 - a. Tablet Method. With the tablet method, calcium hypochlorite tablets are placed in each section of pipe and fire hydrant as the work progresses in sufficient quantities to produce a chlorine residual of 25 ppm after they have dissolved.

- i. The number of tablets required per pipe section is listed in Section S1202.04 below.
 - ii. After the main has been filled with water, the chlorine solution should be maintained in the pipe for at least 24 hours. Because the tablets are placed only at the end of each pipe section, it is advisable to periodically bleed off a small amount of water at the end of the line to move the chlorine solution to new locations in the piping.
 - iii. When tablets are used for disinfection, the velocity of the water filling the pipe must be kept below 1 ft/s (0.3 m/s), or the tablets will be dislodged and washed to the end of the pipeline. When the tablet method is used, workers must take particular care to keep the pipe clean during installation because the main cannot be flushed before it is disinfected.
 - iv. Do not use the tablet method if it is anticipated that working conditions will make it difficult to keep the pipe clean, so that the line can be flushed before being disinfected. At the end of the contact period, the chlorinated water shall be flushed from the pipeline, dechlorinated (to a maximum of 1 ppm of chlorine), and disposed of in an environmentally responsible manner.
- b. Hypochlorite Disinfection. Calcium hypochlorite and sodium hypochlorite (bleach) are used for disinfecting smaller mains. Concentrated chlorine solution is usually injected through a corporation stop that has been installed close to the valve that connects to the existing water system.
- i. The chlorine is administered by either the continuous feed or the slug method.
 - ii. In the continuous feed method, water is slowly admitted to the new pipeline while solution is forced in through the connection using a chemical feed pump or booster pump.
 - iii. The water flow rate can be gauged by measuring the flow of water at the end of the line. The chemical feed rate should be such that it will produce a concentration of about 50 ppm when mixed with the incoming water.
 - iv. The feed should continue until a residual of at least 25 ppm can be measured in the flow at the end of the line.
 - v. The flow should then be stopped and the chlorine solution allowed to remain in the pipe for at least 24 hours. During this time, all valves and hydrants on the line should be operated to make sure they are also properly disinfected.
 - vi. At the end of the contact period, the chlorinated water shall be flushed from the pipeline, dechlorinated and disposed of

in an environmentally responsible manner.

S1202.03 Hypochlorite Tablets

Hypochlorite tablets used for disinfection shall measure 5 grains each by weight.

S1202.04 Construction Methods

1. During construction the contractor shall place in each length of pipe, hydrants, hydrant branches and other appurtenances, the number of tablets as shown in the following table to insure adequate disinfection of the main after its completion.

Pipe Size Inches	Length of Pipe Section (ft)				
	13	18	20	30	40
4	1	1	1	1	1
6	1	1	1	2	2
8	1	2	2	3	4
10	2	3	3	4	5
12	3	4	4	5	7
16	4	6	7	10	13

2. Tablets shall be fastened to the inside top of every length of pipe as laid, using a food grade adhesive or glue that is non harmful to human consumption.
 - a. All adhesives or glues used to secure tablets must be approved by the Town prior to use.
 - b. When more than one tablet is required, they should be place with an equal number attached at each end.
 - c. If tablets are attached before the pipe is placed in the trench, their position shall be marked on the outside so it can be installed with the tablets on top.
 - d. There shall be no adhesive on the tablets except that on the side that attaches to the surface of the pipe.

S1202.05 Water Source

Water for disinfection shall be furnished by the contractor from an approved source. The Contractor shall not make use of water from Town hydrants unless properly permitted to do so.

1. The contractor shall furnish and install all material, labor and equipment required to sterilize the pipe section.

2. Water for filling the mains shall be introduced at a velocity of less than 1 foot per second in order to permit the tablets to completely dissolve and have a reasonably uniform distribution throughout the mains.
3. The chlorine solution should be maintained in the pipe a minimum of 24 hours before a bacteriologic sample is taken.

S1202.06 Chlorine Residual

After the chlorine has been in contact with the mains for twenty-four (24) hours or longer, samples collected from the extremities of the mains shall indicate residual chlorine content of 25 ppm or more.

1. The Contractor will be held entirely responsible for securing a minimum residual chlorine content of 25 ppm at the extremities of the mains after twenty-four (24) hours or more contact with the full water pressure on the main.
2. If less than 25 ppm residual chlorine is indicated, the system shall be drained, dechlorinated, and the disinfection treatment repeated.
3. If samples collected at the extremities indicate a residual chlorine of 25 ppm or more, the system shall be flushed until there is only a normal chlorine residual (1.0 ppm. or less) present, as determined by the DPD Method Test.
4. All chlorinated water flushed from the pipe system in compliance with 2 and 3 above shall be dechlorinated as it is being discharged.

S1202.07 Dechlorination

All water used for disinfection and bacteriological testing must be dechlorinated before it is released to a waterway. Chlorine residual of disposed water shall be neutralized by treating with one of the chemicals listed in the following Table.

Table of the amounts of chemicals required to neutralize various residual chlorine concentrations in 100,000 gallons of water. The contractor is cautioned that chemicals used for dechlorination are also oxygen scavengers. As such, the Contractor shall conduct testing to determine the actual dose required and be extremely cautious in applying only the required dose to achieve dechlorination. The Contractor shall be solely responsible for any and all environmental damage caused by the Contractor's dechlorination activity.

Approximate Chemical Required				
Residual Chlorine Conc.	Sulfur Dioxide	Sodium Bisulfite	Sodium Sulfite	Sodium Thiosulfite
ppm	lb	lb	lb	lb
1	0.8	1.2	1.4	1.2
2	1.7	2.5	2.9	2.4
10	8.3	12.5	14.6	12.0
50	41.7	62.6	73.0	60.0

S1202.08 Bacteriological Testing

After a new pipe has been disinfected and flushed, it shall be refilled with water from the distribution system and tested for bacteriological quality.

1. No pipe or pipe section shall be placed into service until after it has been tested.
2. No samples shall be taken until after the pipe has been filled for 24 hours with system water.
3. All bacteriological test samples shall be taken by a third party currently licensed Water Operator or Approved Sampler Tester (AST). The contractor is responsible for all coordination of water sampling and water testing.
4. The contractor is responsible for furnishing all labor, equipment, and material necessary to take the required samples.
 - a. Samples of water shall be collected from various points along the lines. The contractor is responsible for having the samples tested by either the State Health Department or an approved Laboratory.
 - b. No sample or other testing will be done without a Town inspector present on site to witness the sampling.
 - c. If satisfactory bacteriological results are obtained, the lines may then be allowed to be placed in service.
 - d. If the test results are not satisfactory, the system shall be sampled again. If the results from the second sample are still positive for the presence of bacteria, the Contractor will be required to repeat the disinfection and bacteriological testing of the pipeline until the bacteriological testing is satisfactory.

S1202.09 Test Results

Before any pipe or part thereof is placed in service a copy of all test results shall be submitted to the Department of Public Works. No water main will be placed into service until permission is obtained from the Department of Public Works.

S1202.10 Method of Measurement and Basis of Payment

This item will not be measured but the cost will be incidental to other pertinent items specified in the Contract Document or as specified by the Engineer.

END OF SECTION

S1203 PRESSURE TESTING WATER MAINS**S1203.01 Description**

This item shall consist of pressure testing all newly installed water mains, including valves, fittings, fire hydrants and all other miscellaneous accessories which carry potable water for use for domestic consumption or fire suppression in accordance with these Specifications.

S1203.02 General Requirements.

The Contractor shall furnish all labor, tools, material, including water, and equipment, pumps, compressors, stopwatch, gauges, and meters, subject to the approval of the Town for testing in accordance with these Specifications. If poured concrete buttressing was used, allow it to cure 7 days before testing.

S1203.03 Cross-Connection Control

When existing water mains are used to supply test water, they should be protected from backflow contamination by temporarily installing a double check-valve assembly between the test and supply main or by other means approved by the Town. Prior to pressure and leakage testing, the temporary backflow protection shall be removed and the main isolated from the supply main.

S1203.04 Testing Procedure

Pressure Test. Pressure testing of water mains shall be in accordance with Section 1003 and the following:

1. All tests shall be conducted in the presence of a Town inspector.
2. Fire Hydrants shall not be tested with the main. They shall be tested individually.
3. Fire Hydrant valves shall be closed when the main is being tested.

S1203.05 Defects to be Made Good

If at any time before the final acceptance of the Contract, any broken pipes or any defects are found in the water mains or in any of their appurtenances, the Contractor shall cause the same to be removed and replaced by proper material and workmanship. All materials shall be carefully examined by the Contractor for defects, just before placing, and any found defective shall not be installed in the line.

S1203.06 Method of Measurement and Basis of Payment

This item will not be measured but the cost will be incidental to other pertinent items specified in the Contract Document or as specified by the Engineer.

END OF SECTION

S1204 FIRE HYDRANTS**S1204.01 Description**

This item shall consist of installing new fire hydrants and valves, fittings, concrete buttresses, and all other miscellaneous accessories as shown on the plans and in accordance with these Specifications and Standard Details.

S1204.02 Fire Hydrant

All installed fire hydrants shall be 4' bury Mueller Super Centurion 250 3-Way Fire Hydrant (A-423) with Mueller AquaGrip restraining connections attached. All fire hydrants shall be painted red.

1. Hydrants shall conform to AWWA C 502, latest edition. The hydrant shall be required to have: a means of lubricating the operating threads without disassembly; the hydrant seat shall be provided with bronze connections, a 5-1/4" main valve opening left, one 1-1/2" operating nut, one 4—1/2" steamer nozzle, two 2-1/2" hose nozzles and a 6" mechanical joint inlet.
2. Drain mechanisms shall be bronze to preclude galvanic corrosion of dissimilar metals and shall operate automatically with the opening and closing of the main valve.
3. Hydrants shall be 4'6" in length and a bury depth of 4'.
4. The operating nut shall be six (6) sided, sized per local fire department requirements.
5. Threads of all nozzles shall be National Standard threads.
6. The smallest size main a hydrant can be connected to shall be 6".
7. Non-kinking hose nozzle chains shall be provided.
8. Hydrants to be installed in the Town of Smyrna shall be red in color. They should receive prime and shop coats of paint at the factory. The Contractor shall be responsible for field touch up or repainting of hydrants as required.
9. The entire hydrant assembly, including the valve seat and all moving parts, shall be removable from the top without the need to excavate and/or remove the hydrant.
10. Installed hydrants shall open left and close right.

S1204.03 Location and Spacing

Fire hydrants shall be spaced no more than six hundred (600) feet apart as measured along curb lines.

1. In commercial or business areas no part of a building or part thereof shall be more than 300 feet from a fire hydrant as measured in a straight line.
2. Fire hydrants shall be located at intersections when practical but not more than the spacing as required above.
3. Fire hydrants located at mid blocks shall be installed at property lines and located so they do not interfere with driveways.
4. Successive hydrants in a street should be alternated to opposite side of the street.

S1204.04 Hydrant Installation

NO FIRE HYDRANT SHALL BE INSTALLED AT A DEPTH GREATER THAN 4' (48") REGARDLESS OF LOCATION OR DEPTH OF MAIN.

1. Hydrants shall be installed on a bed of crushed stone extending the full width of the trench, covering the area beneath the shoe, and extending upward to a point 6 inches above the drain rings.
2. Hydrants shall be strapped to the main and restrained with mechanical joint restraints (i.e. MegaLug, or approved equal).
3. Fire hydrant connections shall be installed level and in a manner as specified for installing pipe in section S1201.
4. Hydrants will be secured to the supply pipe by use of underground clamps and pipe retainers for the type of pipe installed.
5. The Hydrant shall be installed with the steamer outlet facing the street line unless otherwise directed by the engineer/inspector.
6. Fire hydrants shall be set plumb and level at locations shown on the construction plans or as directed by the engineer/inspector. Also see S1204.03 for spacing criteria.
7. Hydrants shall be installed so there is 20 inches of clearance as measured between the finished grade and the center of the operating nut on the steamer nozzle.
8. Fire hydrants shall not be placed closer than 2'6" or more than 9' from the face of the curb or road shoulder on streets without curb.
9. If the main is considerably deeper at the hydrant location it shall be angled up to allow the installation of a 4' buried hydrant in all cases.
10. Hydrants shall be installed so that the break away flange is between 1-1/2 and 2-1/2 inches above finished grade.

S1204.05 Testing New Hydrants

New hydrants installed in conjunction with the installation of a new water main shall be tested separately from the main water lines. Hydrants shall be tested in accordance with sections S1202 and S1203.

1. All hydrant valves shall be closed during main testing.
2. Once the system pressure reaches test pressure (150 psi), check for leaks at flanges, outlet nozzles, and the operating stem. If leaks are found, tighten any loose bolts and retest.
3. After the hydrants are tested, flush them to remove any foreign material.
4. Check to make sure the hydrants are draining by shutting the main valve, immediately removing one cap, and placing the palm of a hand over the nozzle. If the barrel is draining properly, a noticeable vacuum can be felt. If there is still a question of the proper drainage, a string with a small weight can be introduced into the hydrant and then inspected to see if it is wet upon removal.
5. The contractor must repair or replace any hydrant or hydrant section found defective during the hydrant leakage and hydrostatic testing and then retest the hydrant.
6. All newly installed fire hydrants shall be flow tested and color-coded in accordance with the provisions set forth in the National Fire Protection Act, "NFPA 291" latest edition. Test results shall be provided to the Town Director of Public Works prior to the Town accepting maintenance responsibility for the section, subsection, or phase the owner wishes to convey to the Town. At a minimum the test results shall indicate the date and time, location, name of testing technician and company, static pressure, residual pressure, static flow and flow at 20 psi. A representative of the Town of Smyrna shall witness all tests for the tests to be valid. All hydrants shall be color coded once they are flow tested in accordance with the color code as found in NFPA 291. The only part of the hydrant to be color-coded shall be the hydrant bonnet.

S1204.06 Method of Measurement and Basis of Payment

The payment for the items specified in the Contract Documents will be full compensation for all material, labor, equipment, tools and incidentals necessary to complete the work.

The items specified in the Contract Document will be measured and paid as specified by the engineer.

END OF SECTION

S1205 WATER SERVICES**S1205.01 Description**

This item shall consist of installing new water services between the main line and the customer's property within the right-of-way using copper pipe, and associated fittings as shown on the plans and in accordance with these Specifications and the Standard Details.

1. All fire suppression equipment using potable water shall have a dedicated connection to the water main and a dedicated water meter. Potable water service shall have a separate dedicated service connection from the water main. Each water service shall have a dedicated water meter.
2. Water service installation during initial construction shall utilize open trench construction whenever possible.
3. Water service replacement of existing service shall be accomplished by boring, tunneling or jacking into place in lieu of open cutting unless the service is outside of a paved area.

S1205.02 Materials

1. Service Pipe/House Laterals. Water service pipes between the distribution main and the curb stop of the property shall be soft copper tubing, Type K in accordance with ASTM B-88. At the Towns discretion and direction, service pipes over 100 feet may be HDPE PE4710 DR17 in accordance with ASTM F714.
2. Fittings. All fittings used to connect service lines shall be compression type fittings manufactured by Mueller or approved equal unless specifically listed otherwise in this section.
3. Corporation Stops. Corporation stops shall not be less than 3/4 inch with AWWA standard inlet threads, suitable for connection to K-copper service piping as specified herein. Stops shall be ground key design with copper flare (Model H-15000) or compression connection for CTS O.D. tubing (Model H-15008) outlet as manufactured by Mueller, or approved equal.
4. Saddles. Saddles shall have a bronze body, double stainless steel straps with AWWA taper threads Mueller part number BR-2-S or approved equal.
5. Curb Stop. Curb stops are to be of brass construction, closed-bottom body. The top shall be configured to allow the attachment of a stationary rod to allow the valve to be turn off or on without the use of curb box key.
 - a. For copper service pipe, the curb stop shall be a Mueller Mark II Oriseal, with copper flare nuts on both ends, or approved equal.

For HDPE service pipe, the curb stop shall be a Mueller Mark II Oriseal, with Mueller Insta-Tite connection for CTS PE tubing, both sides. PE tubing shall be provided with pipe stiffeners at all fittings. All fittings shall be lead free.

- b. For valves buried more than 5' below existing grade, a stationary rod shall be of sufficient height so that it is not less than 6" from the top of the installed curb box to allow the curb stop to be shut off or turned on without the use of a valve key.
 - c. The stationary rod shall be compatible with the curb stop and manufactured by Mueller or approved equal
6. Curb Box. The curb box shall be cast iron, arch pattern compatible with the curb stop and be manufactured by Mueller or approved equal as shown on the Standard Details. Curb boxes shall be located behind parking bays for townhouse units.
 7. Curb Box Lid. The curb box lid shall be cast iron with standard pentagon bolt as manufactured by Mueller or approved equal. Curb box lid shall be centered over valve assembly.
 8. Curb stops installed in driveways or other paved surfaces must be placed in a Lincoln Box (East Jordan Iron Works Model #1566 or approved equal) per Town of Smyrna Standard Detail. The box cover shall be labeled with "W".

S1205.03 Construction Methods

Before installation, pipe shall be carefully inspected for cuts, punctures, and excessive abrasion. Damaged areas shall be cut out and the pipe re-coupled to form a continuous length.

1. Care shall be taken during hot weather installation to insure that pipe has contracted to normal length before trench backfilling commences.
2. Pipe, curb boxes and fittings shall be carefully handled in and out of the trench. Special care shall be taken to insure that pipe is well bedded on a solid foundation and any defects due to settlement shall be corrected by the Contractor.
3. Proper and suitable tools and appliances for the installation of pipe fittings shall be used. Pipe damaged in any way shall be replaced by the Contractor.
4. Pipe and fittings shall be thoroughly cleaned before they are installed and shall be kept clean until acceptance of the completed work.
5. Whenever pipe or fittings require cutting to fit in the line or to bring it to

- required location, the work shall be done in a satisfactory manner to leave a smooth end.
6. Corporation stops shall be spaced a minimum of 24 inches apart along the barrel of the main.
 - a. Corporation stops should be located at least two feet from the pipe ends. If two insertions are made, one on each side of the main, they should be separated (measured along the pipe length) by at least two foot. Multiple insertions made on the same side of the main should be staggered 30 degrees around the circumference as well and separated by at least two feet.
 - b. Corporation stops installed in PVC pipe shall be with a saddle.
 - c. Corporation stops installed in new or existing ductile iron pipe shall be with an approved tapping machine.
 7. Spacing. See section S1006.07 of these specifications for spacing guidelines.
 8. Valves, fittings and curb boxes shall be placed and installed in accordance with the manufacturer's recommendations.
 9. Curb Stop: The curb stop shall be located eight (8) feet behind the face of curb. In those instances where there is an existing sidewalk, the curb stop will be located a minimum of 12 inches behind the sidewalk so that it is easy to access without removing the sidewalk.
 10. Concrete Collar: Any valve installed in an area other than blacktop or concrete shall have a 12" x 12" x 12" concrete collar poured at time of installation.
 11. Couplings: No couplings are allowed between the corporation stop and the curb stop. Couplings to connect terminal ends of copper tube shall be Mueller H-15405 two-part union, or approved equal.
 12. Sweat Joints: Sweat joints are not allowed.
 13. Laterals. Individual service lines (laterals) shall be made at a 45-degree angle down from the top of the main. The service line shall be laid in a "S" curve down from the tap so there is plenty of slack to allow for earth settlement and pipe expansion and contraction.
 14. Cover. The service line shall have a minimum of 48" inches of cover.
 15. If concrete curbing is replaced over a water service, the concrete curbing shall be embossed with a minimum 2" high capital letter "W" (on the face of curbing directly over the water service). The Town can supply the embosser upon request; however, it is the contractor's responsibility to

obtain the embosser prior to the work being done.

S1205.04 Pressure Testing of the Water Service

After installation of the water service pipe and appurtenances has been completed, but prior to backfilling of the trench and connecting to the house, each water service line shall be flushed out for a minimum of three (3) minutes. The Owner shall be responsible for disposal of the flushed water.

1. The pipe shall then be plugged at the house and the corporation stop reopened to fill and pressurize the service line. The line shall be kept at the Town residual water pressure for a period of two hours.
2. Should the test show any leakage of the service pipe, corporation stop, curb stop or fittings, the Contractor shall immediately remedy the defects causing leakage and the test re-instituted until the service pipe and appurtenances withstand the Town pressure for a full two hour period.

S1205.05 Defects to be Made Good

If, at any time before the Final Acceptance of the Contract, any broken pipes, or any defects, are found in the water services or in any of their appurtenances, the Contractor shall cause the same to be removed and replaced by proper material and workmanship. All materials shall be carefully examined by the Contractor for defects, just before placing, and any found defective shall not be placed in the line.

S1205.06 Method of Measurement and Basis of Payment

This item will not be measured but the cost will be incidental to other pertinent items specified in the Contract Document or as specified by the engineer.

END OF SECTION

S1206 METERS**S1206.01 Description**

This item shall consist of installing water meters, fittings, and all other miscellaneous accessories as shown on the plans and in accordance with these Specifications and Standard Details.

S1206.02 Meter Supply

Every home, apartment, store, business or place where people work, live or have water connected to its' premises shall be metered for water use. A meter is required on all water service and fire suppression lines.

1. All meters installed within the Town's water service territory will be furnished or purchased through the Department of Public Works.
2. Meters for business, commercial or industrial users larger than 5/8" or 3/4" shall be obtained through the Town at the owner's expense unless the Town waives its right of purchase.
3. All meters installed in the Town water system shall be manufactured by Badger and be of the size and type for the intended use in accordance with section S1206.03.
4. Meter yokes shall include an angle valve and a dual check valve

S1206.03 Meter Type

1. Meters size 5/8" through 3/4" shall be Badger Model 25 Recordall Bronze Disc meter with remote reading capabilities.
2. Meters sized 3" and larger shall be either Badger Turbo Series, Compound Series, or Fire Hydrant Meters. All meters shall be equipped with remote reading capabilities.
3. Meters 3 inches or larger shall have a meter by-pass installed for continuity of service in case of emergency or if the meter has to be removed for service.
 - a. The by-pass shall be designed by an engineer and its configuration shall be shown on the construction drawings as part of the water plan submission.
 - b. The by-pass shall include a meter sized according to the size of the by-pass and meet the requirements of section S1206.09 and S1206.14.

4. METERS FOR APARTMENTS, TOWNHOUSES OR INDIVIDUAL STORES WITHIN A SHOPPING COMPLEX SHALL BE TREATED AS AN EQUIVALENT DWELLING UNIT (EDU). As such, each unit will be subject to the requirements as set forth for a single meter installation and will be subject to the same fees and cost of single meter installation.
5. All meters shall read in gallons.

S1206.06 Meter Installation

The meter shall be installed in a horizontal position with upstream and downstream shut-off valves allowing for adequate maintenance and removal.

1. All water meters shall be installed in a heated space within the building wherever possible. In multi configured buildings, apartment, strip shopping center, etc. the water meters may be grouped within meter rooms, which are accessible 24 hours and 7 days a week to Town employees.
2. When it is impractical to install the meter(s) within the confines of a building, the meter(s) shall be located in a meter pit or vault approved by the Town with suitable means of access in accordance with sections S1206.08, S1206.09 and S1206.10.
3. All fire suppression equipment shall have a dedicated connection to the water main and have a dedicated water meter.

S1206.07 Shutoff Valves

All meters, regardless of location, shall have two valves installed, one upstream and the other downstream on each meter installed at that location. The upstream and downstream valves must be ¼ turn full flow ball type valves.

S1206.08 Pit Meters

Meters installed in pits other than large commercial applications, shall be Sensus Touch Read meters or approved equal as specified in S1206.03 above and installed in meter pits as specified in S1206.09 below.

S1206.09 Meter Pits

No water meter shall be installed in crawl spaces, under manufactured (Mobile) homes, or other inaccessible area of a home or building. Meter pits shall be used to house meters up to 2" in size when there are no provisions made to install them in heated indoor space in accordance with section S1206.06-1. Meter pits shall be constructed and installed in accordance with the requirements of section S1206.15.1.

S1206.10 Meter Vaults

Meter vaults shall be used to house meters 3” or larger used in commercial or industrial application when no provisions have been made to install the meter and meter by pass in a meter room within the building it services. Meter vaults shall be constructed and installed in accordance with the requirements of section S1206.15.2.

S1206.11 Meter Service for Apartments

Each unit (apartment) within an apartment building or complex will be serviced by an individual water meter that provides water service to only that unit.

S1206.12 Commercial/Industrial Meters

Meters servicing commercial or industrial sites consisting of only single use of water to the site will be serviced by one point metering which shall be located in a meter vault at a point on the property line.

1. Meters may be downsized only one size from the size of the main in commercial or industrial applications.
2. When a business owner wishes to have both fire and domestic service supplied by one line, the domestic service shall be metered by a Sensus type SRH compound meter or Type SR positive displacement meter or a Hersey type MFM II or MHR in accordance with the requirements of section S1206.03 and an Ames fire check valve with by pass for the fire service in accordance with S1206.13. When the owner has separate services for domestic and fire flow, the meters shall be Hersey type MHR or approved equal for domestic service.

S1206.13 Fire Check Meters

All mains or service lines used exclusively for fire protection systems in all buildings excluding single detached residential homes shall install an Ames fire detector check meter with bypass meter of equal sizes according to the supply line.

S1206.14 Meter Capacity

The capacity of the meter shall be consistent with the customer's water needs as determined by the Town.

S1206.15 Construction Methods

1. Meter Pits. Meter pits used for small commercial meters shall be of PVC construction.
 - a. Meter Pits for small commercial meters sized 1, 1 1/2" or 2” shall be a minimum of 30” inch in diameter, have a copper rising yoke

assembly that is set to allow 2 inches of clearance between the riser assembly and the bottom of the pit.

- i. No by-pass assembly shall be allowed with meters up to 2 inches.
 - ii. The yoke assembly shall be a Ford 70 series copper setter or approved equal.
 - iii. The inlet shall have a lockable ball valve and a vertical dual check valve on the outlet side.
 - iv. The height of the copper setter shall be 15"
 - v. The frame and cover shall be type Wabash Double lid cover.
 - vi. The frame and cover shall be cast iron extra heavy construction.
 - vii. The frame shall have an ID of 26 $\frac{1}{4}$ ".
 - viii. The cover shall be 20" in diameter and include lifter worm lock and standard Pentagon bolt.
 - ix. The cover shall be equipped with a 1-3/4" diameter hole for a touch read device. The hole shall be a minimum of 2-1/2" from the nearest edge and 1" minimum from the nearest rib on the cover underside.
 - x. Meter Pits shall be installed at the customer's property line.
 - xi. Meter pits shall provide for positive drainage.
 - xii. Meter pits used for small commercial meters manufactured by Ford, Mueller or approved equal.
2. Meter Vaults. Meter vaults shall be installed at the property line and shall be commercially constructed out of concrete, have a ladder, sump pump, a bilco type door for access, and a type TRC meter vault box as part of the vault top. The vault box shall be separate from the bilco type access door.
- a. The door shall be positioned to allow easy removal of the meter.
 - b. The ladder shall be made of aluminum and permanently mounted within the vault.
 - c. The ladder shall be installed in such a manner that a person using it has direct unobstructed access. It shall have an opening positioned right above it large enough to allow a person to directly step onto the ladder without any other movement other than straight down.
 - d. All gauges used within a vault shall be liquid filled.
 - e. Sump pumps installed in vaults shall have a check valve installed on the discharge line.
3. Valves. Valves to control the main and fire service entering the vault shall be installed on the exterior of the vault.
4. By-Pass Metering. By-Pass metering shall be in accordance with section S1206.03.

5. Fire Service lines shall include an inline check valve in accordance with section S1206.03 and a detector check valve. The detector check meter shall conform to section S1206.03.

S1206.16 Method of Measurement and Basis of Payment

The payment for the items specified in the Contract Documents will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Water meters will be measured and paid for on the basis of the count or number of each type of meter installed according to these specifications or as specified by the engineer.

END OF SECTION

S1207 BACKFLOW PREVENTERS**S1207.01 Description**

This item shall consist of installing backflow preventers in the water distribution system between the Town water mains and water service to private property to prevent contamination of the Town's water system in accordance with these Specifications and the Standard Details and as shown on the plans.

S1207.02 Contaminate Protection

The installed backflow preventer shall be capable of protecting the Town's water supply from backflow of the customer's water supply caused by:

1. back-pressure
2. back-siphonage.
3. cross-connections.

S1207.03 Type

The installed preventer shall be a reduced-pressure-zone device, type RPZ, RPBP, or RPZBP manufactured by Cla-Val or approved equal.

S1207.04 Installation

The preventer shall be located in a suitable vault in accordance with S1206.15. It shall be installed prior to any piece of pipe and/or meter servicing a customer's property.

S1207.05 Size

The preventer shall be the same size as the water pipe serving the property.

S1207.06 Method of Measurement and Basis of Payment

This item will not be measured but the cost will be incidental to other pertinent items specified in the Contract Document or as specified by the Engineer.

END OF SECTION

**S1208 ADJUST WATER VALVE BOXES/CONCRETE MONUMENT
BOXES/MANHOLES**

For Bidding Purposes:

S1208.01 Adjust Water Valve Boxes**S1208.02 Adjust Concrete Monument Boxes****S1208.03 Adjust Manholes****S1208.04 Description**

Adjust Water Valve Boxes/Concrete Monument Boxes/Manholes consists of furnishing all necessary materials and adjusting boxes/manholes.

All metal boxes/manholes, etc., shall be adjusted to grade with repairs being performed as necessary, and as directed.

The materials necessary to be excavated under these items shall be removed from the site. All such excavations shall be backfilled with approved materials.

S1208.05 Method of Measurement

The number of each Adjusted Boxes/Manholes to be paid for under this item shall be the actual number of boxes/manholes adjusted, complete and accepted.

S1208.06 Basis of Payment

The number each of Adjusted Boxes/Manholes as provided above shall be paid for at the contract unit price bid for Boxes/Manholes, which price and payment shall constitute full compensation for excavating, removing any covers or portions of structures, furnishing and placing all materials, backfilling, resetting the valve boxes to proper grades; removal of any debris dropped by contractor into flow line; and for all labor, equipment, tools, and incidentals necessary to complete the item. Any damage to the water valves, boxes, monuments or manholes caused by the contractor shall be replaced at the contractor's expense.

END OF SECTION

DIVISION 1300 ELECTRIC

All electric design pertinent to facilities owned by the Town of Smyrna Electric must comply with the latest edition of the National Electrical Safety Code (NESC)

Section B

Standard Construction Details For Storm Drains Streets and Road Sanitary Sewers Water Mains

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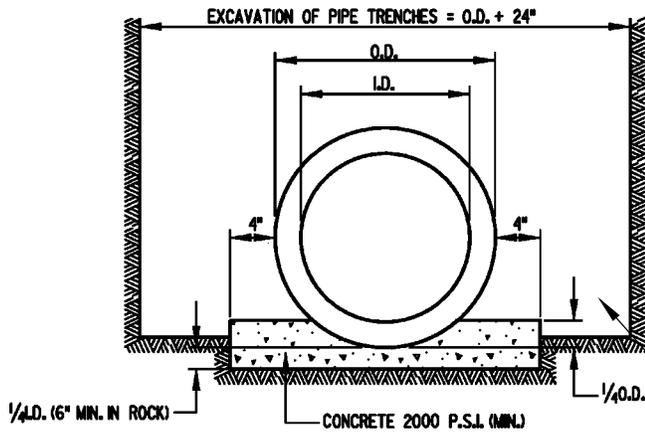
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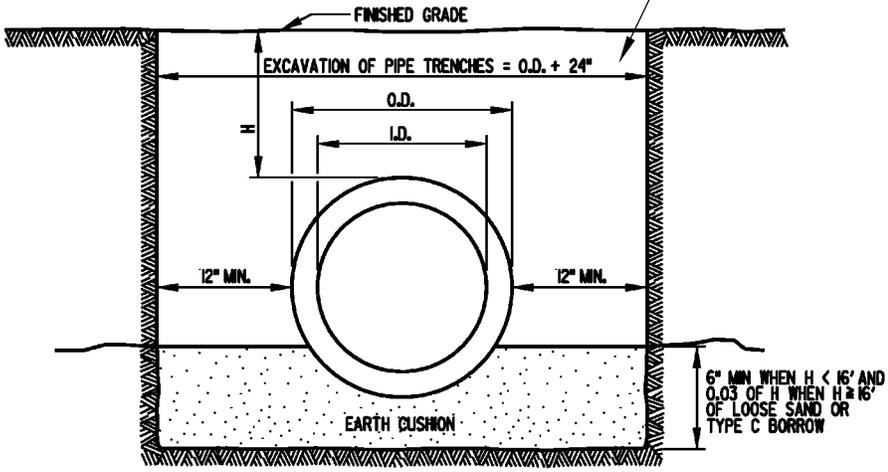
Category D

Storm Drainage Systems



CLASS A BEDDING

SELECT BACKFILL MATERIAL COMPACTED IN 8" LIFTS TO 92% MOD. PROCTOR DENSITY UNDER ROADWAY AREAS TO A POINT 2 FT. BELOW GRADE. THE TOP 2 FT. SHALL BE COMPACTED TO 95% MOD. PROCTOR DENSITY. AREAS OUTSIDE OF ROADWAYS SHALL BE COMPACTED TO 92% MOD. PROCTOR DENSITY UNLESS OTHERWISE NOTED ON THE PLANS.



CLASS C BEDDING

NOTE: USE CLASS C BEDDING UNLESS OTHERWISE INDICATED

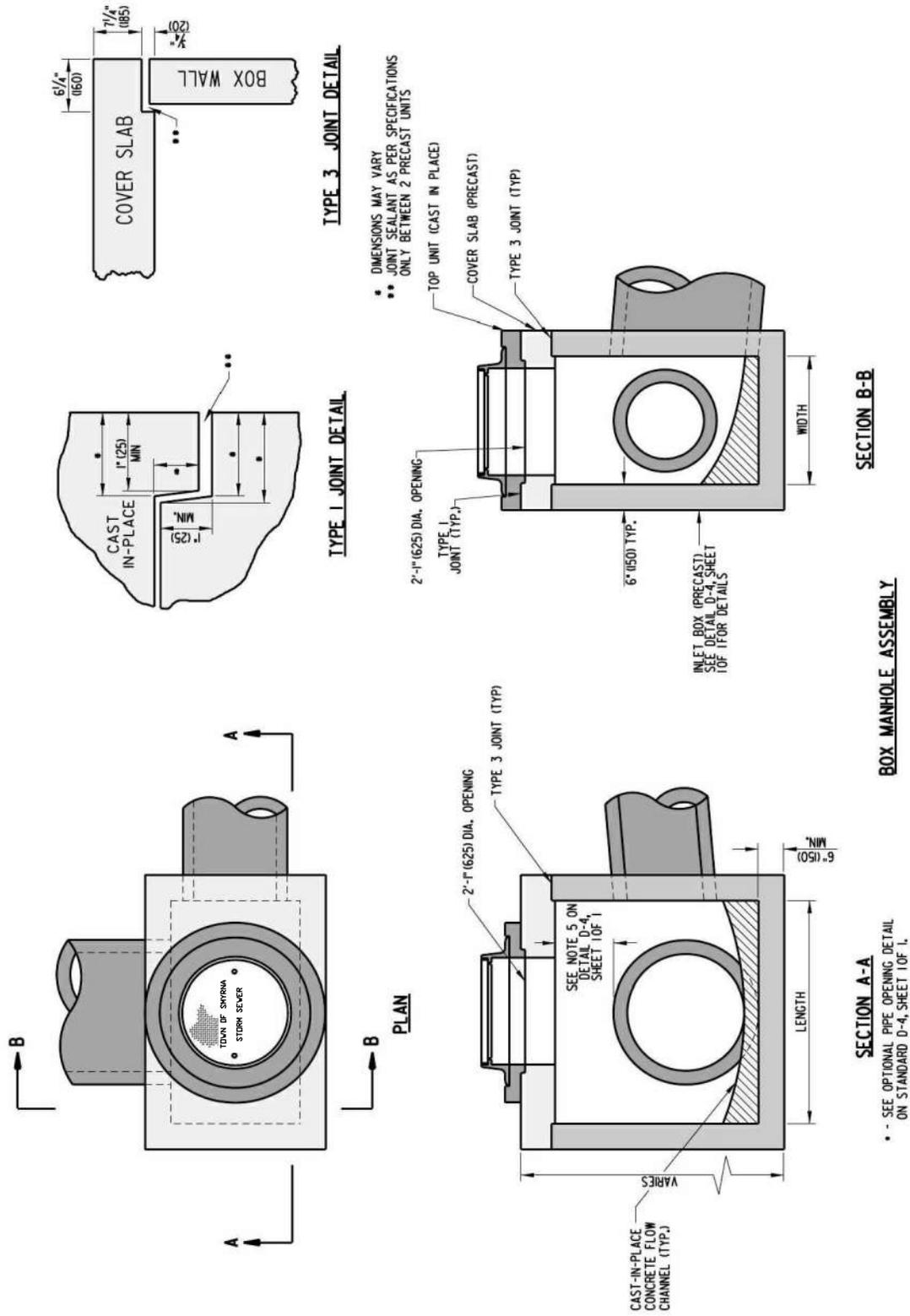
NOTES:

1. TRENCH SHALL BE BRACED OR SHEETED IN ACCORDANCE WITH OSHA REGULATIONS.
2. PROVIDE BEARING FULL LENGTH OF BARREL.
3. DIG BELL HOLES.
4. IF GRADED AGGREGATE IS USED FOR BACKFILL, THE TRENCH SHALL BE WRAPPED WITH GEOTEXTILE FABRIC (MIRAFI 600X OR APPROVED EQUAL).

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Revised	10/12
Source	DeIDOT



Trench Width and Detail	
Storm Drain Details	
Standard No.	D-1

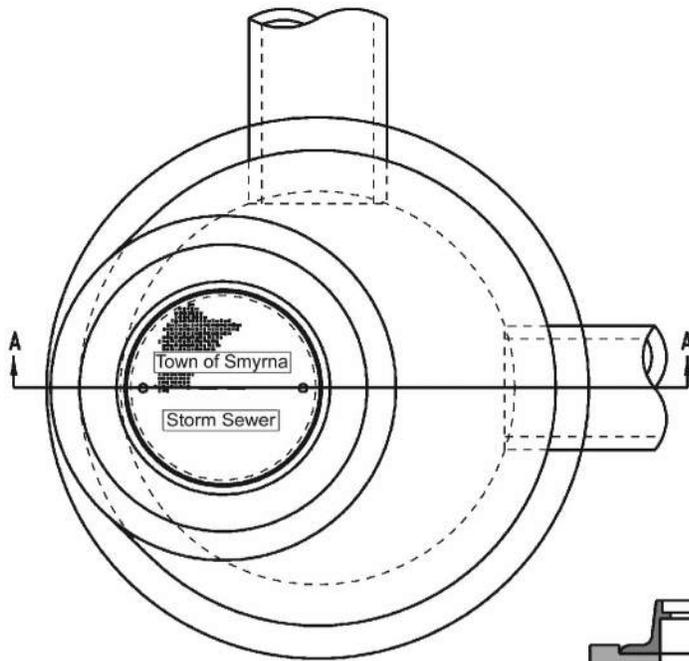


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Source	DelDOT

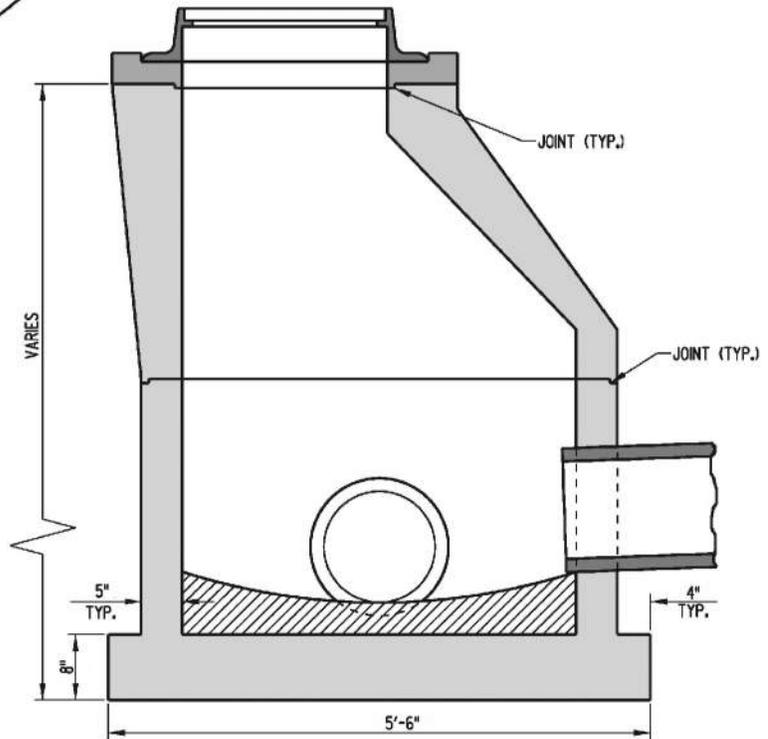


**Department of
Public Works**

Box Manhole	
Storm Drain Details	
Standard No.	D-2



PLAN

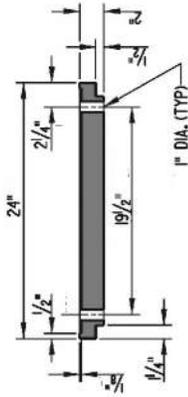


SECTION A-A

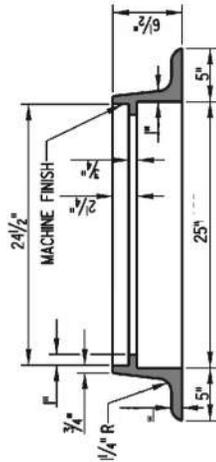
ROUND MANHOLE ASSEMBLY

NOTE: ROUND MANHOLES SHALL BE CONSTRUCTED IN ACCORDANCE WITH AASHTO M 199.

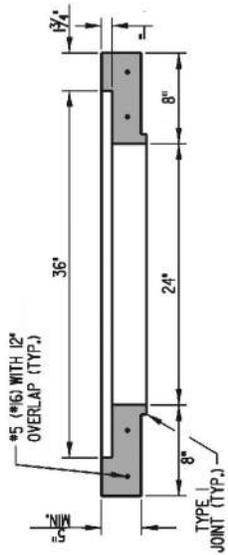
Issued	08/04	 <p>Department of Public Works</p>	<h2>Round Manhole</h2>	
Revised				<p>Storm Drain Details</p>
Source	DeIDOT			<p>Standard No. D-3</p>



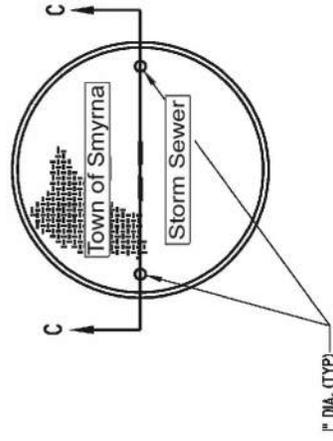
SECTION C-C



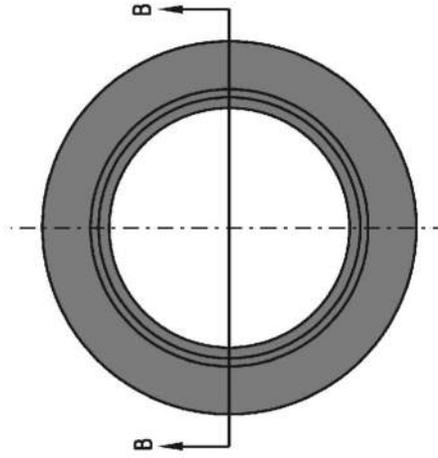
SECTION B-B



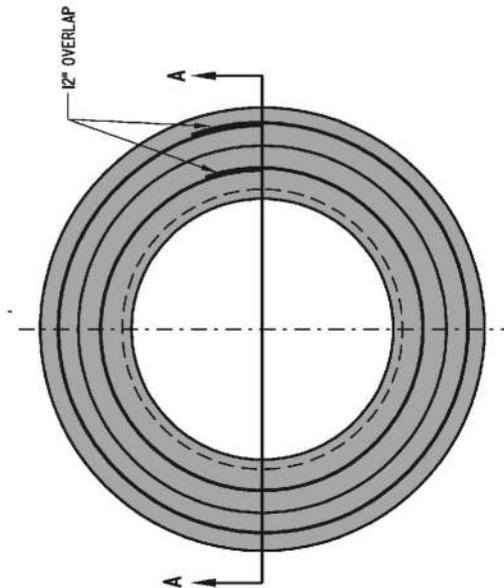
SECTION A-A



COVER



FRAME



TOP UNIT

Issued	08/04
Revised	
Source	DeIDOT

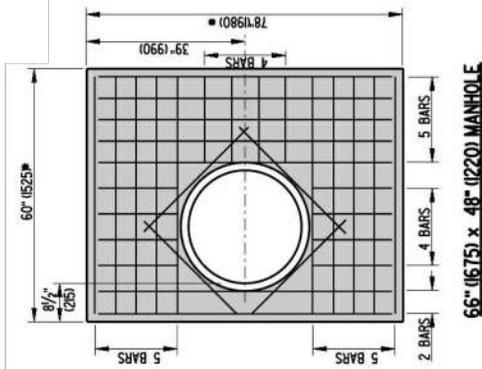


Department of Public Works

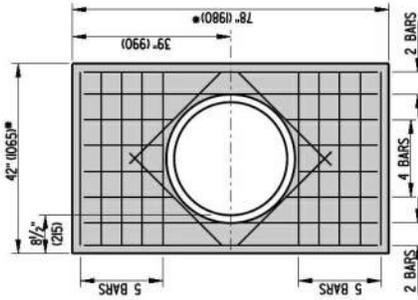
Manhole Frame and Cover

Storm Drain Details

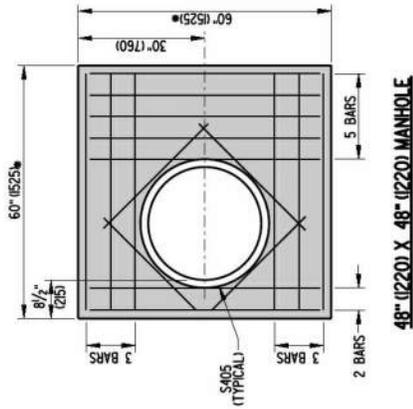
Standard No. **D-4**



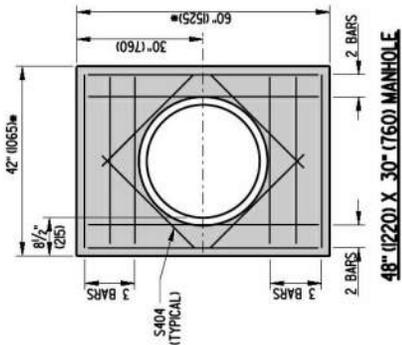
66" (1675) x 48" (1220) MANHOLE



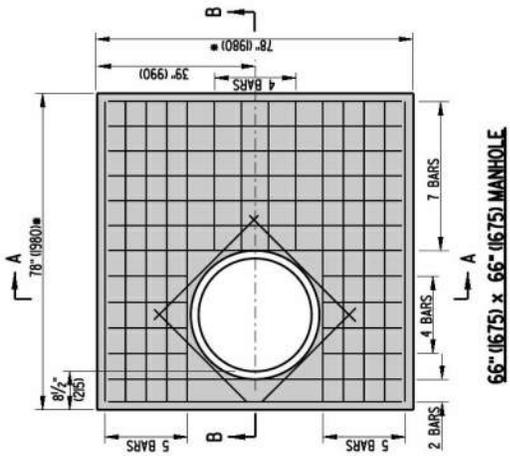
66" (1675) x 30" (760) MANHOLE



48" (1220) x 48" (1220) MANHOLE

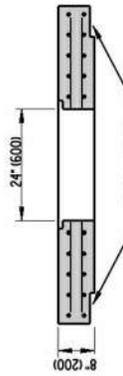


48" (1220) x 30" (760) MANHOLE

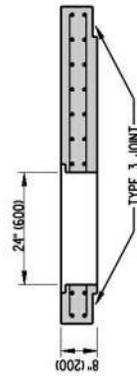


66" (1675) x 66" (1675) MANHOLE

- NOTES:
1. COVER SLABS SHALL BE PRE-CAST.
 2. ALL BARS SHALL BE #5 (16) SPACED AT 6" (150) ± UNLESS NOTED OTHERWISE.
 3. MINIMUM BAR COVER = 1/2" (38).
- * - DIMENSIONS TO MATCH OUTSIDE TO OUTSIDE DIMENSIONS OF BOX.



SECTION A-A



SECTION B-B

BOX MANHOLE COVER SLAB DETAILS

Issued	08/04
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Source	DeIDOT



Department of Public Works

Manhole Cover Slabs

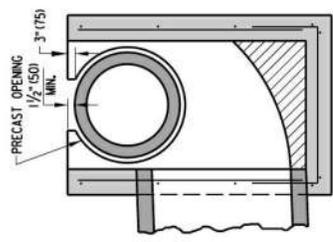
Storm Drain Details

Standard No. D-5

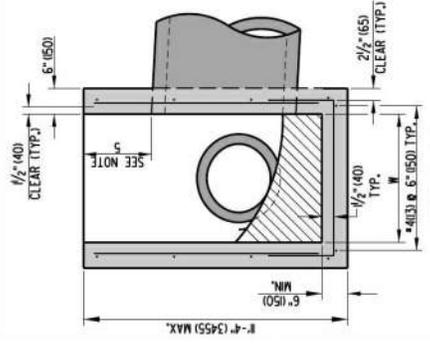
INTERIOR WALL DIMENSION	AREA OF HORIZONTAL REINFORCEMENT PER FOOT (mm ²)	AREA OF VERTICAL REINFORCEMENT PER FOOT (mm ²)
LESS THAN 4' (1220)	0.32 (85)	0.32 (85)
4' (1220) TO 4.5' (1370)	0.63 (165)	0.32 (85)
4.5' (1370) TO 5' (1525)	0.98 (251)	0.32 (85)
5' (1525) TO 5.5' (1675)	1.29 (328)	0.32 (85)
5.5' (1675) TO 6' (1830)	1.64 (419)	0.32 (85)

L	W	FABRICATION TOLERANCE
17 1/8" (450)	17 1/8" (450)	+1" (25)
24" (600)	24" (600)	+1" (25)
34" (865)	18" (455)	-1" (25)
34" (865)	24" (600)	-1" (25)
48" (1220)	30" (760)	+6" (150)
48" (1220)	48" (1220)	+6" (150)
66" (1675)	30" (760)	+6" (150)
66" (1675)	48" (1220)	+6" (150)
72" (1830)	24" (600)	+1" (25)
72" (1830)	48" (1220)	+1" (25)
72" (1830)	72" (1830)	-1" (25)

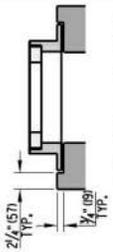
* THESE BOXES ARE TO BE USED FOR LAWN INLETS AND ARE NOT INTENDED TO BE USED IN THE TRAVELWAY. THE MAX DEPTH FOR THESE BOXES IS 4' (1220). SEE NOTE 8 FOR REINFORCEMENT.



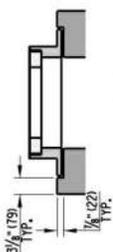
OPTIONAL PIPE OPENING DETAIL
SEE NOTE 5



SECTION A-A



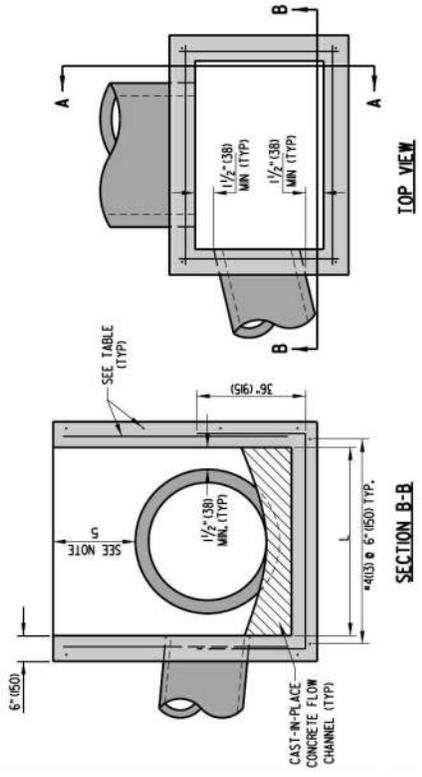
17 1/8" (450) X 17 1/8" (295)
LAWN INLET BOX DETAIL



24" (600) X 24" (600) LAWN
INLET BOX DETAIL

NOTES:

- INLET BOXES SHALL BE PRECAST OR CAST-IN-PLACE.
- PIPES SHALL NOT BE INSTALLED THROUGH ANY CORNER OF THE INLET BOX.
- RISE SECTIONS MAY BE USED FOR DEEP INLET BOXES.
- PIPES MAY BE INSTALLED NEAR OR THROUGH JOINTS FOR RISER SECTIONS.
- WHEN THE COVER ABOVE THE PIPE IS LESS THAN 4" (100) TO THE COVER SLAB OR TOP LIMIT OPENING, THE PORTION OF BOX WALL ABOVE THE PIPE MAY BE REMOVED AS SHOWN IN THE OPTIONAL PIPE OPENING DETAIL. THE AREA ABOVE THE PIPE SHALL THEN BE FORMED AND FILLED WITH HIGH-STRENGTH, NON-SHRINK GROUT MIXED WITH COARSE AGGREGATE IN A 1:1 RATIO BY WEIGHT.
- CONCRETE FLOW CHANNEL SHALL BE WARRPED FOR POSITIVE DRAINAGE.
- WHEN INLET BOX IS PRECAST, PIPE OPENING SHALL BE BETWEEN 3" (75) AND 4" (100) LARGER THAN OUTSIDE DIAMETER OF PIPE AND SHALL NOT ENDOUR ON ADJACENT WALL.
- REINFORCEMENT FOR LAWN INLET BOXES SHALL BE 4" (102), #4 X 4" (102), #4 X #4 (W26 X W26) WELDED WIRE.



TOP VIEW

SECTION B-B

Issued	08/04
Revised	10/12
Source	DeIDOT

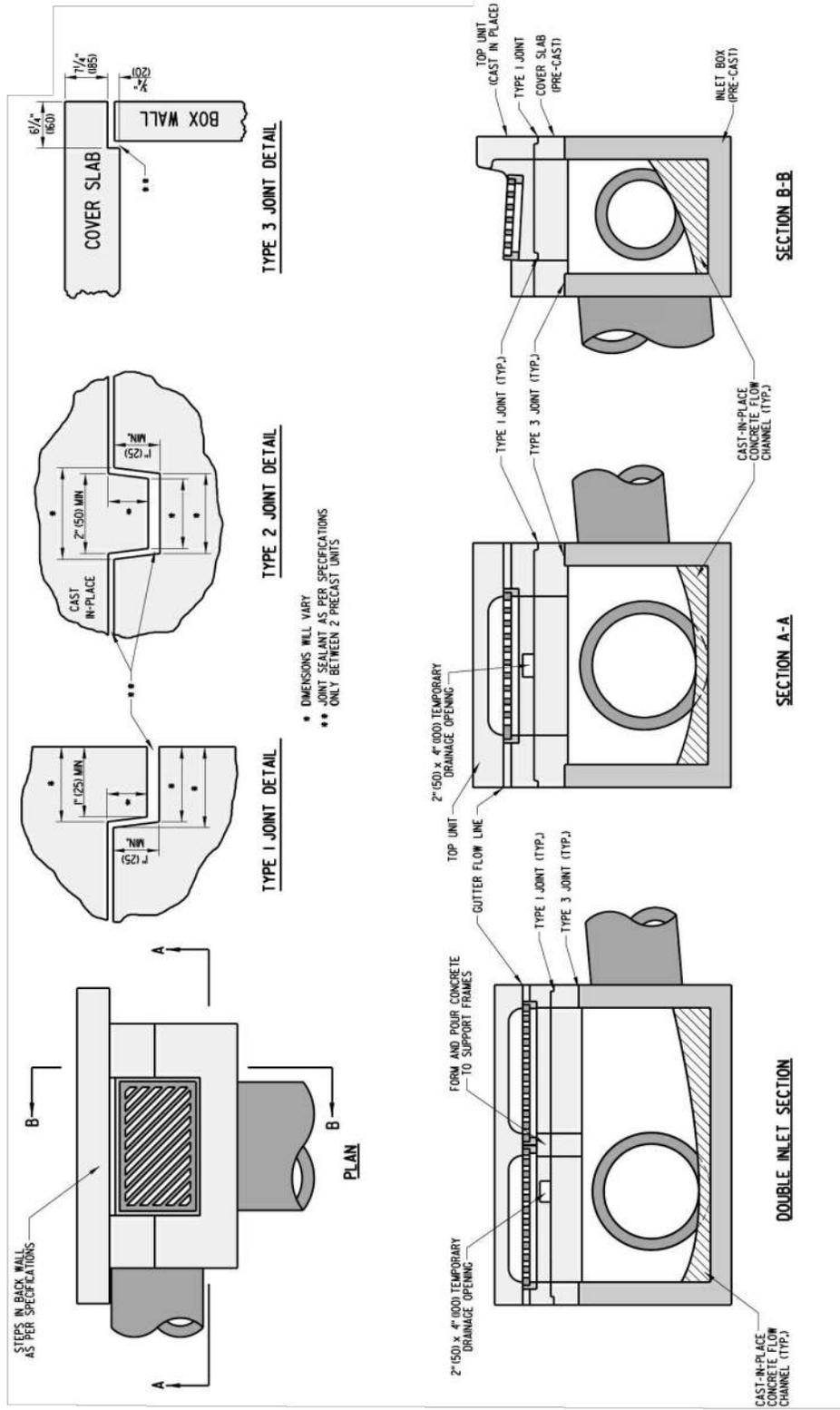


Department of Public Works

Inlet Box

Storm Drain Details

Standard No. D-6



Issued	08/04
Revised	10/12
Source	DelDOT

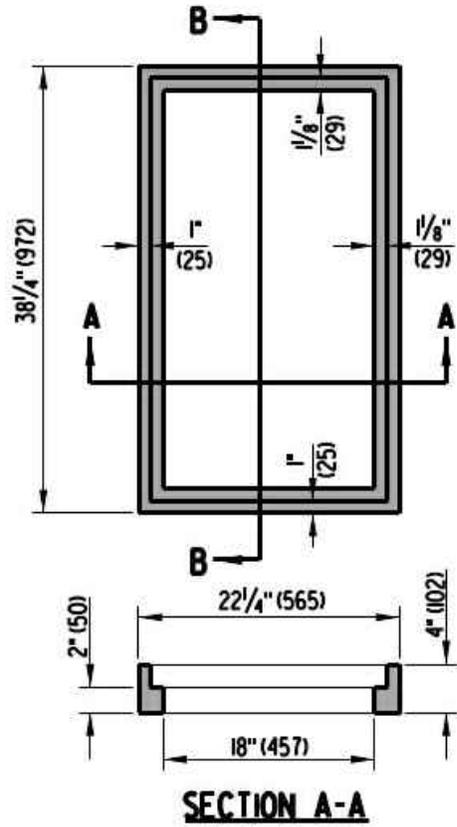
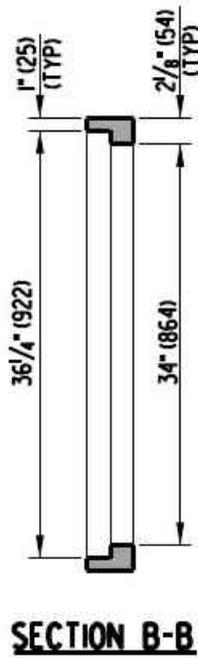
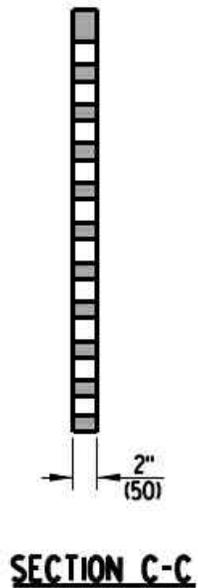
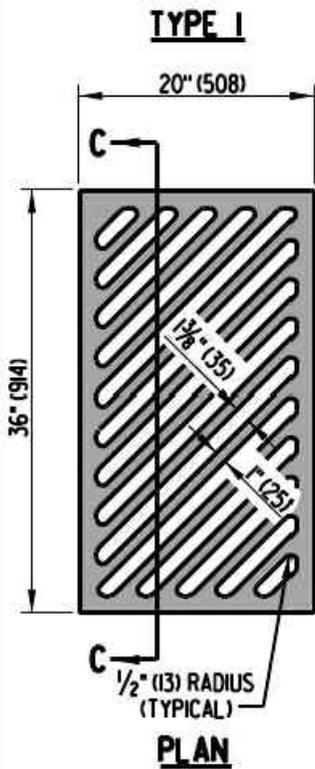


Department of Public Works

Drainage Inlet Assembly

Storm Drain Details

Standard No. D-7



DRAINAGE INLET FRAME
THIS FRAME IS TO BE USED WITH TYPES 1 THROUGH 4 GRATES ONLY.

Issued	08/04
Revised	10/12
Source	DeIDOT

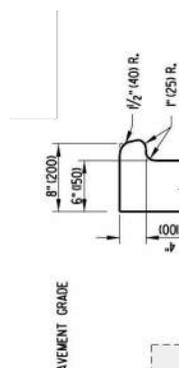


Department of
Public Works

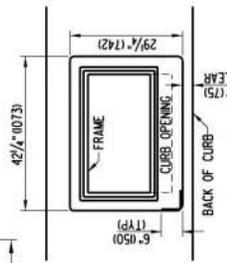
Drainage Inlet Frame and Grates

Storm Drain Details

Standard No. D-8

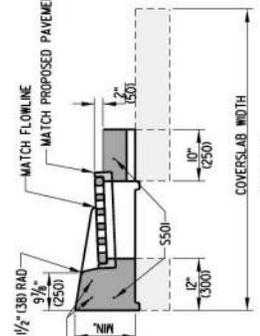


CURB OPENING DETAIL

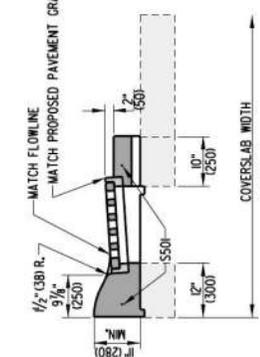


S501 BENDING DIAGRAM

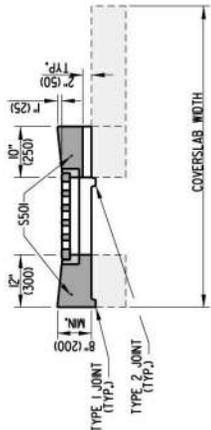
S501 IS NOT REQUIRED TO BE ONE CONTINUOUS BAR, IF MORE THAN ONE BAR IS USED, THERE MUST BE A 12" (3000) OVERLAP BETWEEN BARS.



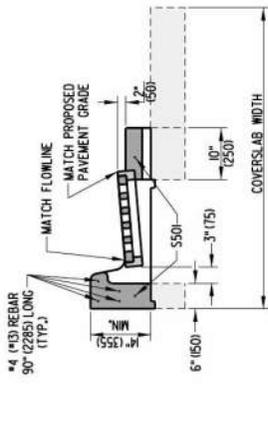
TYPE E



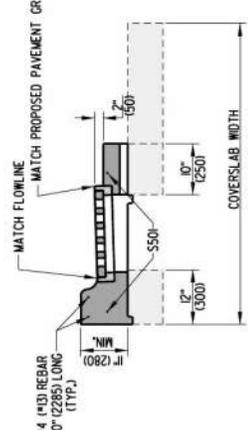
TYPE D



TYPE A



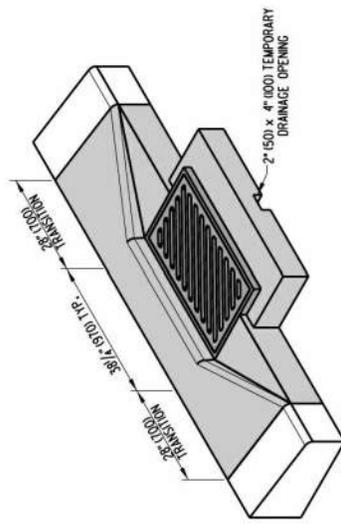
TYPE B



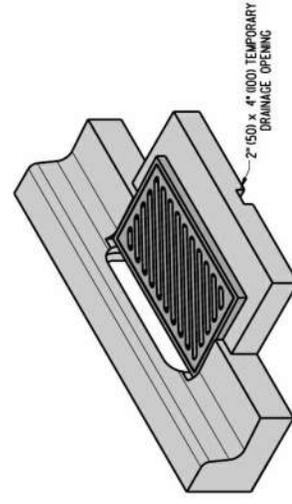
TYPE C

TOP UNIT	CURB
TYPE A	USE IN DRAINAGE SWALE
TYPE B	INTEGRAL PCC CURB & GUTTER, TYPE 1 & 3, PCC CURB TYPE 1
TYPE C	INTEGRAL PCC CURB & GUTTER, TYPE 4, PCC CURB TYPE 3
TYPE D	INTEGRAL PCC CURB & GUTTER, TYPE 2
TYPE E	PCC CURB TYPE 2

INLET TOP UNIT APPLICATIONS



**ISOMETRIC VIEW
TYPE E UNIT SHOWN
WITH INTEGRAL CURB & GUTTER TYPE 3**



**ISOMETRIC VIEW
TYPE B TOP UNIT SHOWN WITH
INTEGRAL CURB & GUTTER TYPE 3**

Issued	08/04
Revised	10/12
Source	DeIDOT

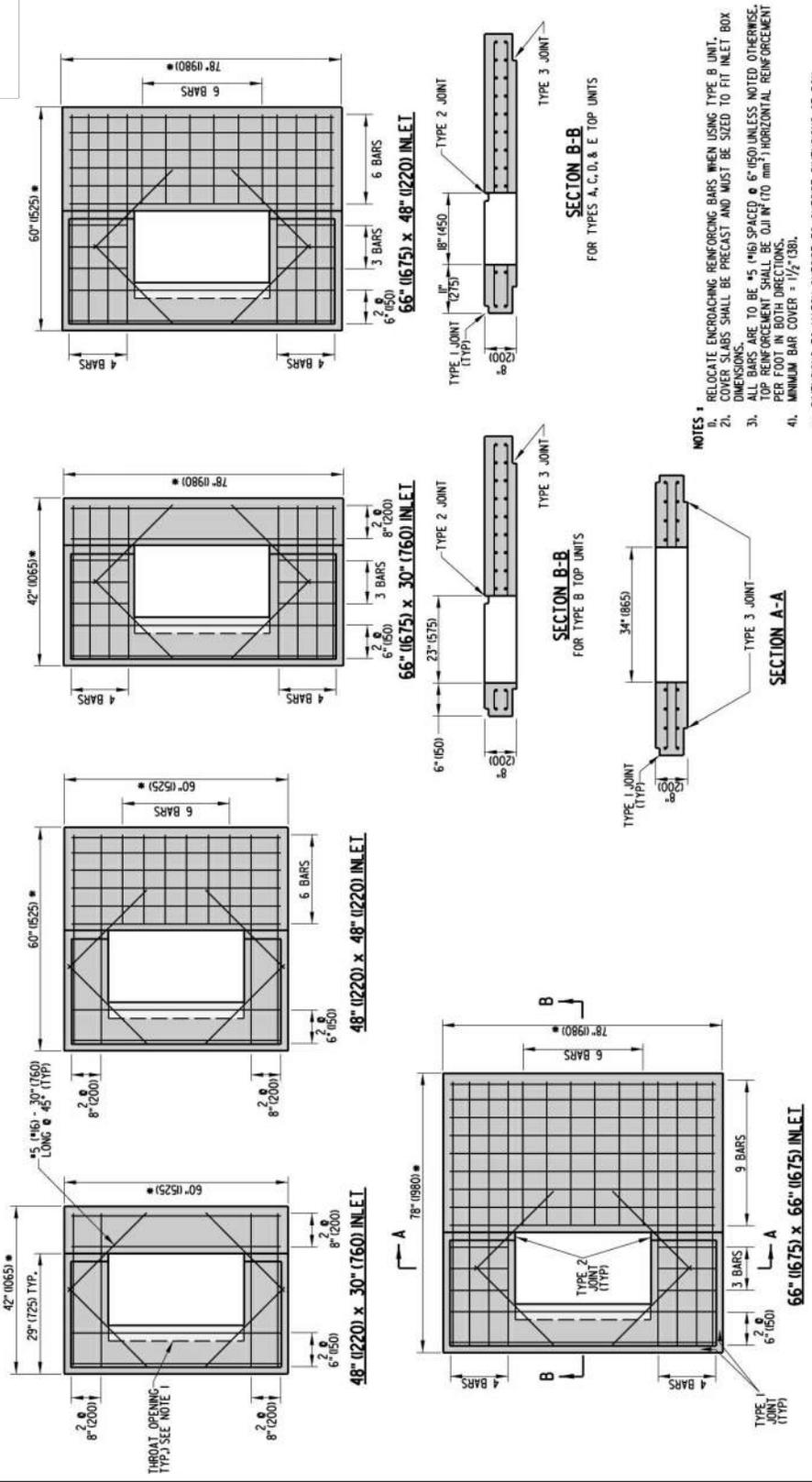


Department of Public Works

Drainage Inlet Top Units

Storm Drain Details

Standard No. **D-9**



- NOTES:**
1. RELOCATE ENCRACING REINFORCING BARS WHEN USING TYPE B UNIT.
 2. COVER SLABS SHALL BE PRECAST AND MUST BE SIZED TO FIT INLET BOX DIMENSIONS.
 3. ALL BARS ARE TO BE #5 (#6) SPACED @ 6" (#5) UNLESS NOTED OTHERWISE. TOP REINFORCEMENT SHALL BE OUT IN (70 mm) HORIZONTAL REINFORCEMENT PER FOOT IN BOTH DIRECTIONS.
 4. MINIMUM BAR COVER = 1 1/2" (38).
- * - DIMENSIONS TO MATCH OUTSIDE TO OUTSIDE DIMENSIONS OF BOX.

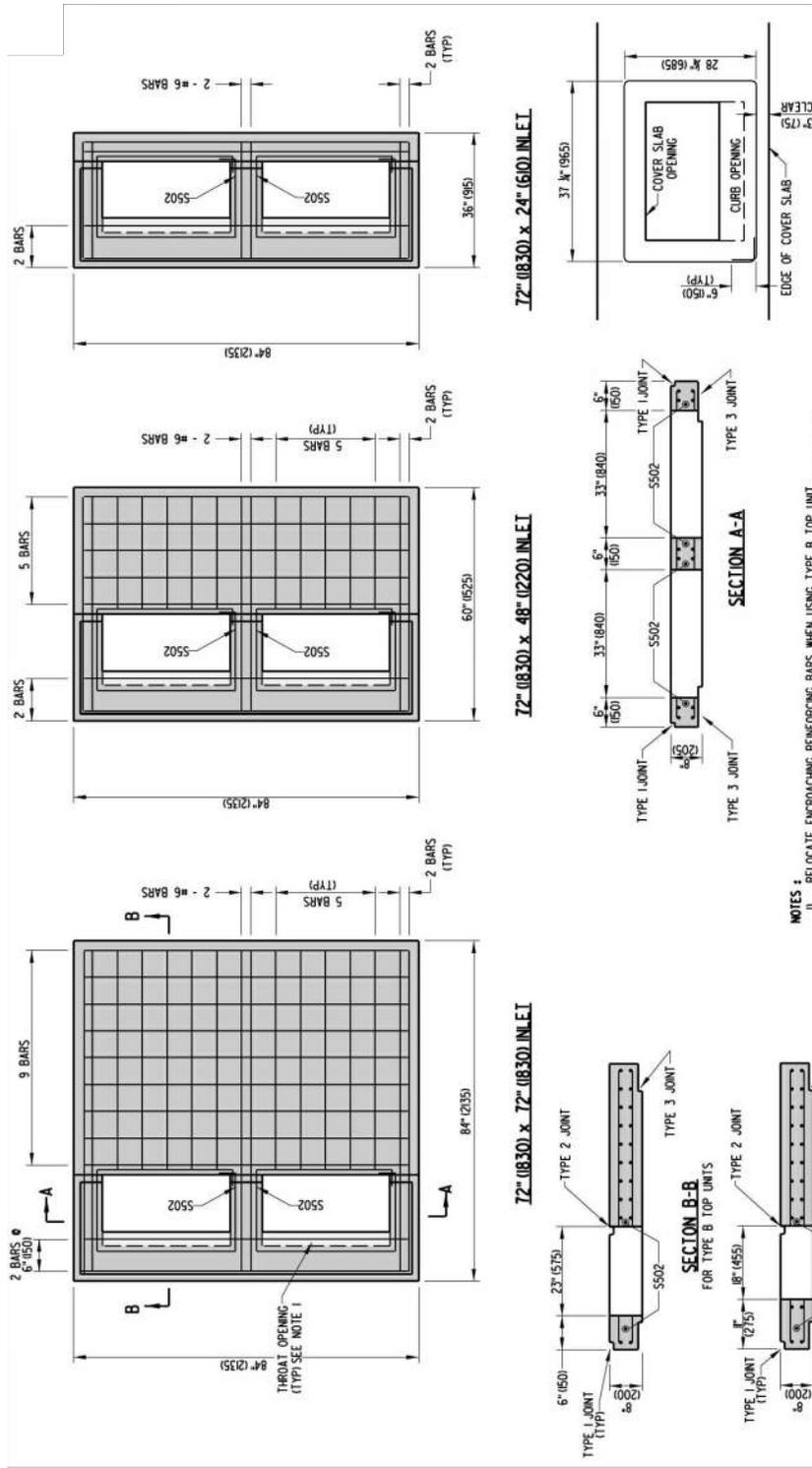
Issued	08/04
Revised	10/12
Source	DelDOT



Drainage Inlet Cover Slab

Storm Drain Details

Standard No. **D-10**



SECTION A-A

SECTION B-B

SECTION B-B

72" (1830) x 24" (610) INLET

72" (1830) x 48" (1220) INLET

72" (1830) x 72" (1830) INLET

- NOTES:**
1. RELOCATE ENCRANCHING REINFORCING BARS WHEN USING TYPE B TOP UNIT.
 2. COVER SLABS ARE TO BE PRECAST AND MUST BE SIZED TO FIT INLET BOX DIMENSIONS.
 3. REINFORCING BARS ARE TO BE SPACED @ 6" UNLESS NOTED OTHERWISE. TOP REINFORCEMENT SHALL BE AT LEAST (10 mm) MIN. HORIZONTAL REINFORCEMENT PER FOOT IN BOTH DIRECTIONS.
 4. MINIMUM BAR COVER = 1 1/2" (38).

FOR TYPES A, C, D, & E TOP UNITS

FOR TYPE B TOP UNITS

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Revised	10/12
Source	DelDOT

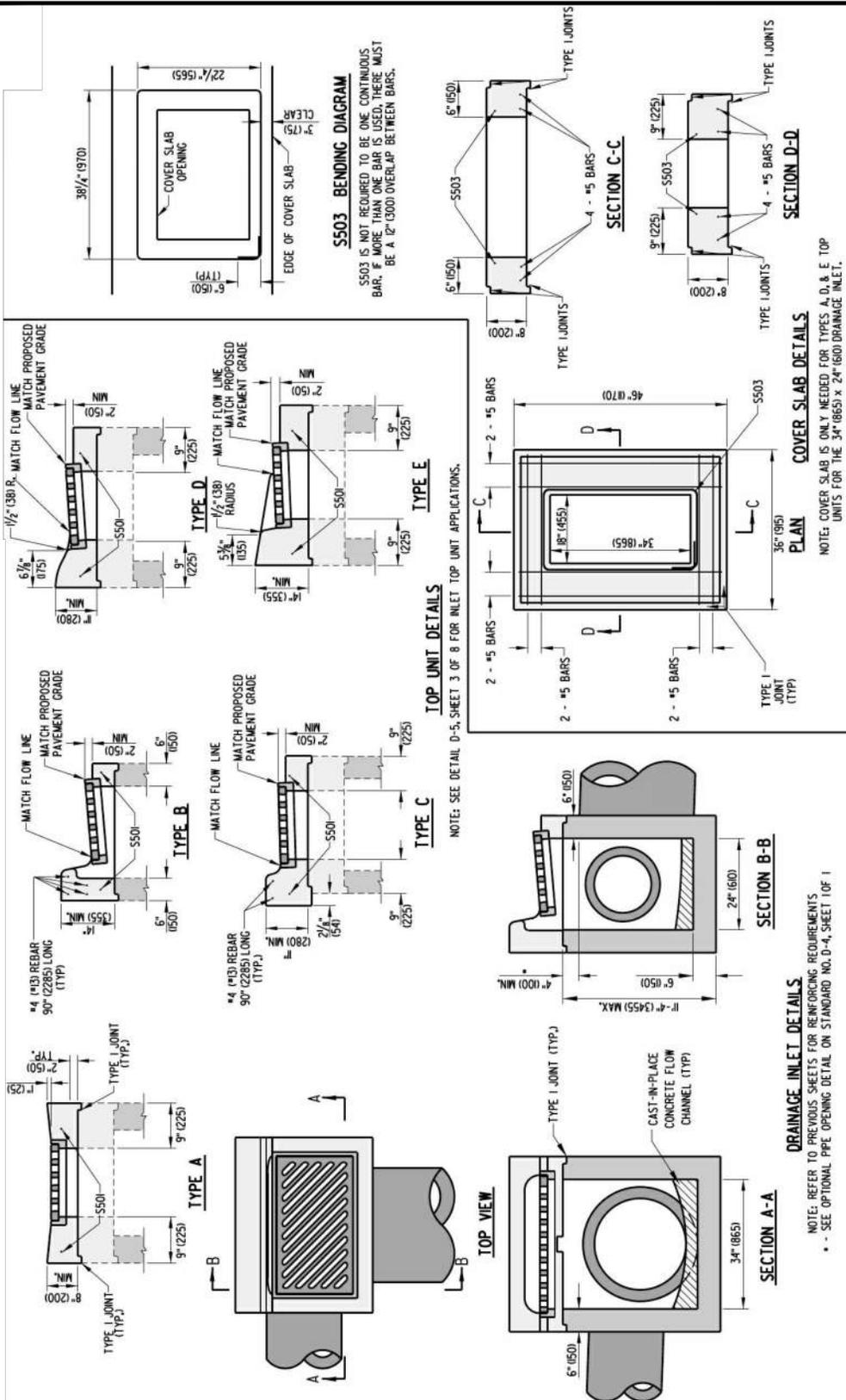


Department of Public Works

Double Inlet Cover Slab

Storm Drain Details

Standard No. **D-11**



Issued	08/04
Revised	10/12
Source	DeIDOT

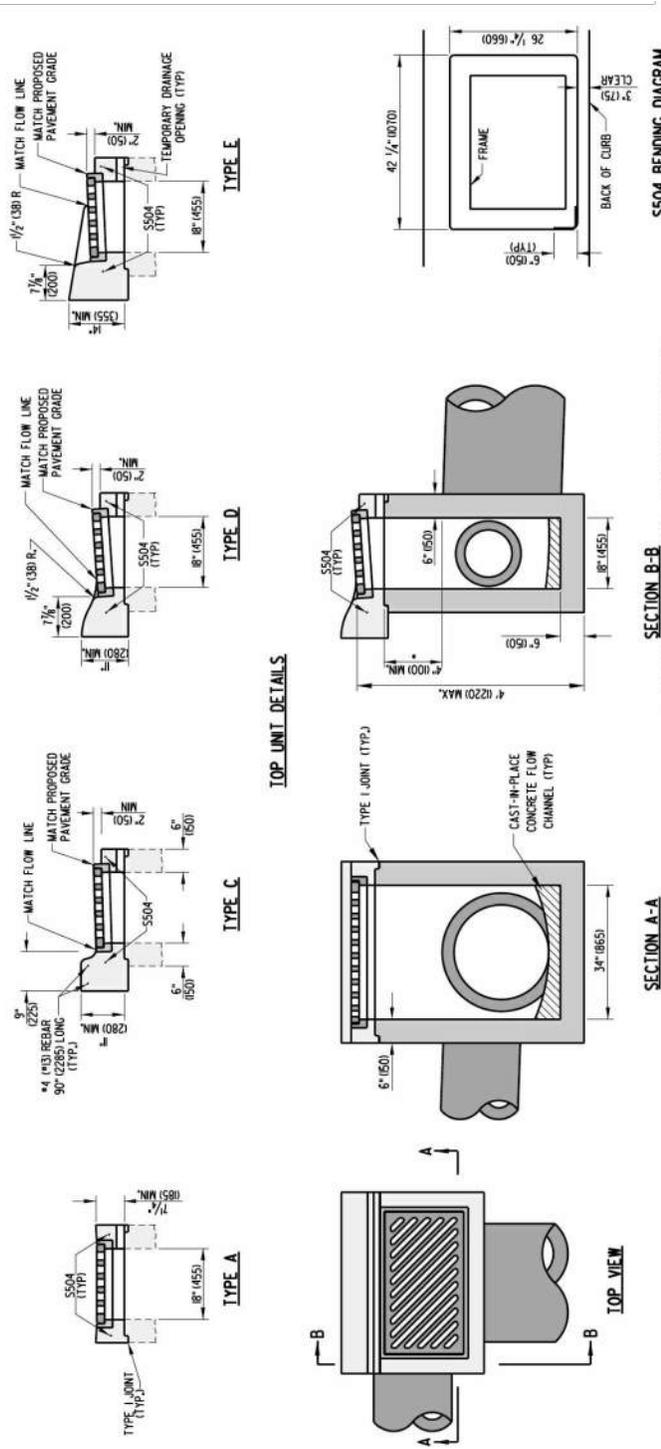


Department of Public Works

34" x 24" Inlet

Storm Drain Details

Standard No. **D-12**



SECTION A-A

SECTION B-B

SECTION C-C

SECTION D-D

SECTION E-E

- NOTES:
1. REFER TO PREVIOUS SHEETS FOR REINFORCEMENT REQUIREMENTS.
 2. THE HEIGHT OF THIS INLET IS LIMITED TO 4" (102.0) MAXIMUM, THEREFORE, THE HEIGHTS WILL NOT BE REQUIRED AND SHOULD NOT BE INSTALLED ON THIS INLET.
 3. REFER TO DETAIL D-5, SHEET 3 OF 8 FOR INLET TOP UNIT APPLICATION.

S504 BENDING DIAGRAM
 S504 IS NOT REQUIRED TO BE ONE CONTINUOUS BAR. MINIMUM OVERLAP MUST BE A 12" (300) OVERLAP BETWEEN BARS.

• - SEE OPTIONAL PIPE OPENING DETAIL ON STANDARD D-4, SHEET 1 OF 1.

TOP UNIT DETAILS

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Revised	10/12
Source	DelDOT

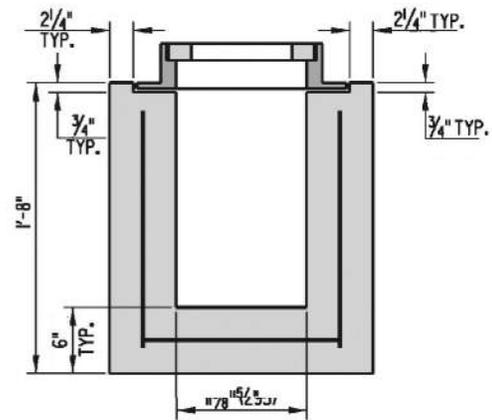
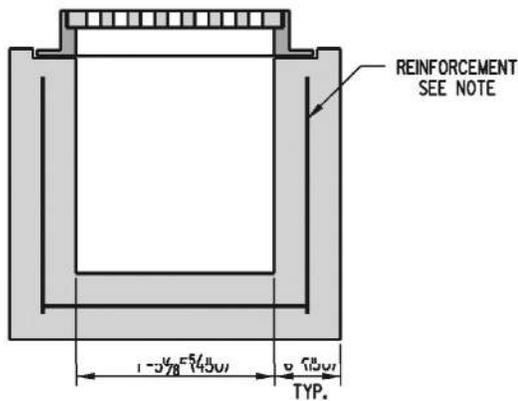
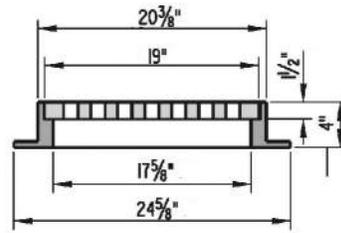
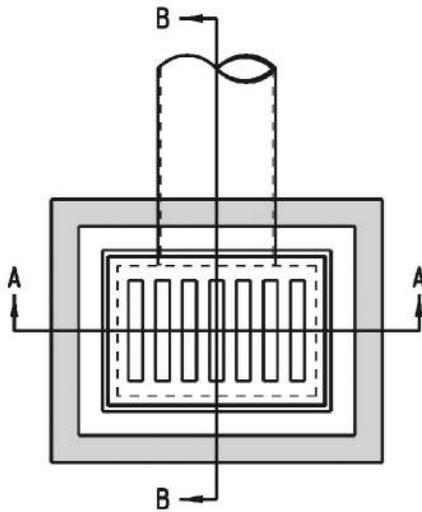


Department of Public Works

34" x 18" Inlet

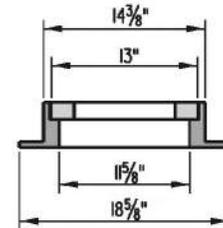
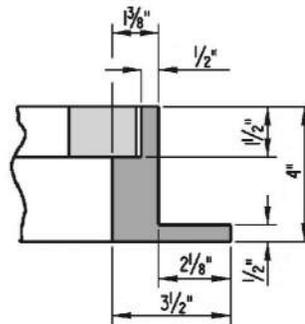
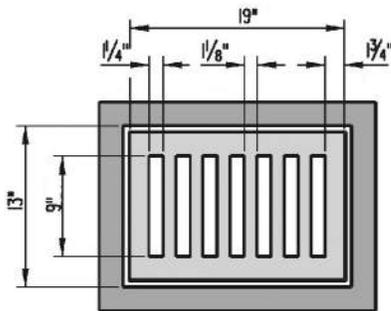
Storm Drain Details

Standard No. **D-13**



SECTION A-A

SECTION B-B



NOTE: 1. REINFORCEMENT SHALL BE 4" X 4" W4 X W4
 2. INLET BOXES ARE TO BE PRE-CAST OR CAST-IN-PLACE.

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Revised	
Source	DeIDOT

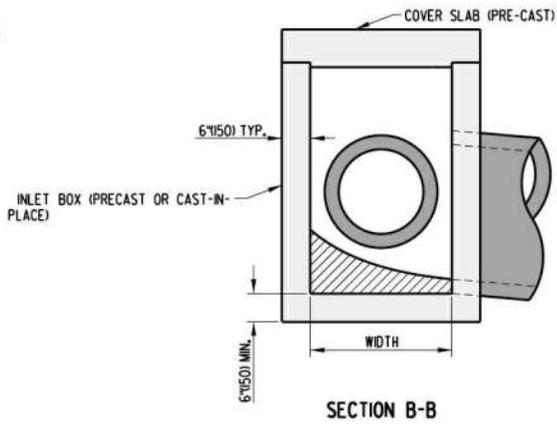
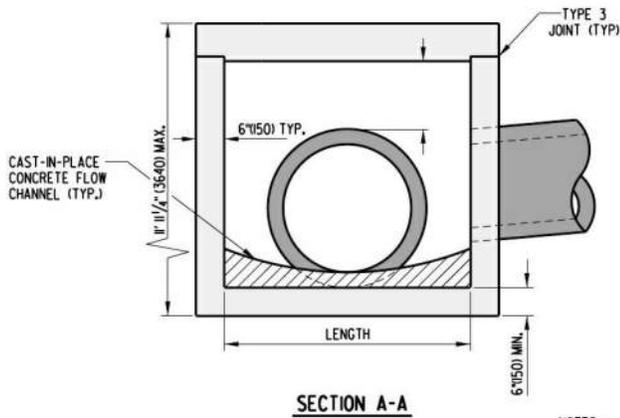
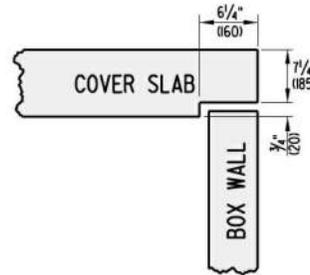
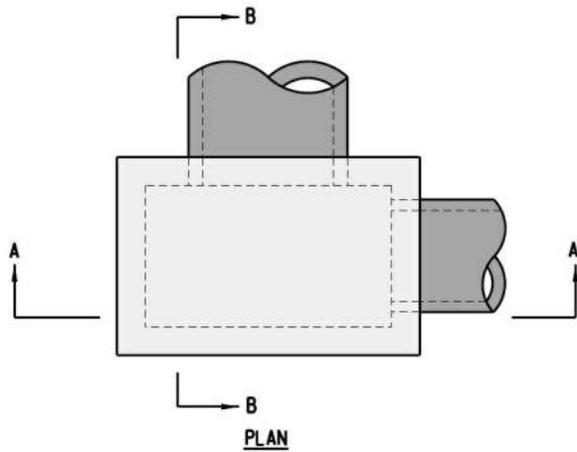


Department of
Public Works

Lawn Inlet

Storm Drain Details

Standard No. D-14



NOTES:

- 1). INLET BOXES SHALL BE PRECAST OR CAST-IN-PLACE.
- 2). PIPES SHALL NOT BE INSTALLED THROUGH ANY CORNER OF THE INLET BOX.
- 3). RISER SECTIONS MAY BE USED FOR DEEP INLET BOXES.
- 4). PIPES MAY BE INSTALLED NEAR OR THROUGH JOINTS FOR RISER SECTIONS.
- 5). WHEN THE COVER ABOVE THE PIPE IS LESS THAN 4" (100) TO THE COVER SLAB OR TOP UNIT OPENING, THE PORTION OF BOX WALL ABOVE THE PIPE MAY BE REMOVED AS SHOWN IN THE OPTIONAL PIPE OPENING DETAIL. THE AREA ABOVE THE PIPE SHALL THEN BE FORMED AND FILLED WITH HIGH-STRENGTH, NON-SHRINK GROUT MIXED WITH COARSE AGGREGATE IN A 1:1 RATIO BY WEIGHT.
- 6). CONCRETE FLOW CHANNEL SHALL BE WARPED FOR POSITIVE DRAINAGE.
- 7). WHEN INLET BOX IS PRECAST, PIPE OPENING SHALL BE BETWEEN 3" (75) AND 4" (100) LARGER THAN OUTSIDE DIAMETER OF PIPE AND SHALL NOT ENCR OACH ON ADJACENT WALL.
- 8). REINFORCEMENT FOR LAWN INLET BOXES SHALL BE 4" (102) X 4" (102), W4 X W4 (W26 X W26) WELDED WIRE.

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Revised	10/12
Source	DeIDOT

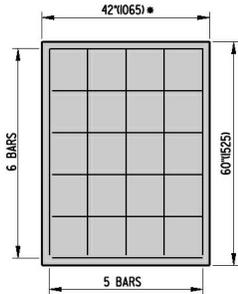


Department of Public Works

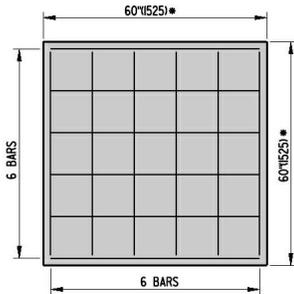
Junction Box Assembly

Storm Drain Details

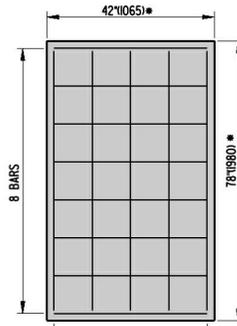
Standard No. **D-15**



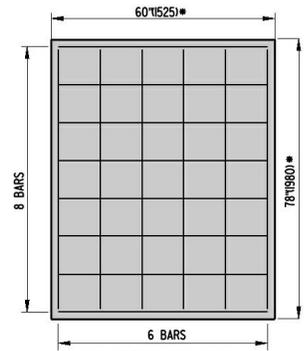
48" (1220) x 30" (760)
JUNCTION BOX



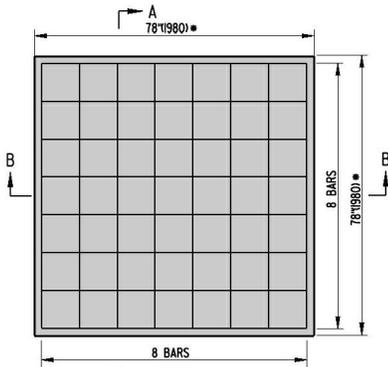
48" (1220) x 48" (1220)
JUNCTION BOX



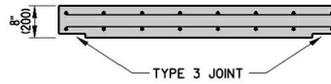
66" (1675) x 30" (760)
JUNCTION BOX



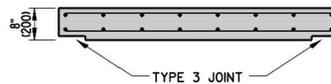
66" (1675) x 48" (1220)
JUNCTION BOX



66" (1675) x 66" (1675)
JUNCTION BOX



SECTION A-A



SECTION B-B

JUNCTION BOX COVER SLAB DETAILS

NOTES:

1. COVER SLABS ARE TO BE PRE-CAST.
 2. ALL BARS ARE TO BE #5 (16) SPACED @ (200) * UNLESS NOTED OTHERWISE.
 3. MINIMUM BAR COVER = 1/2" (38).
- * - DIMENSIONS TO MATCH OUTSIDE TO OUTSIDE DIMENSIONS OF BOX.

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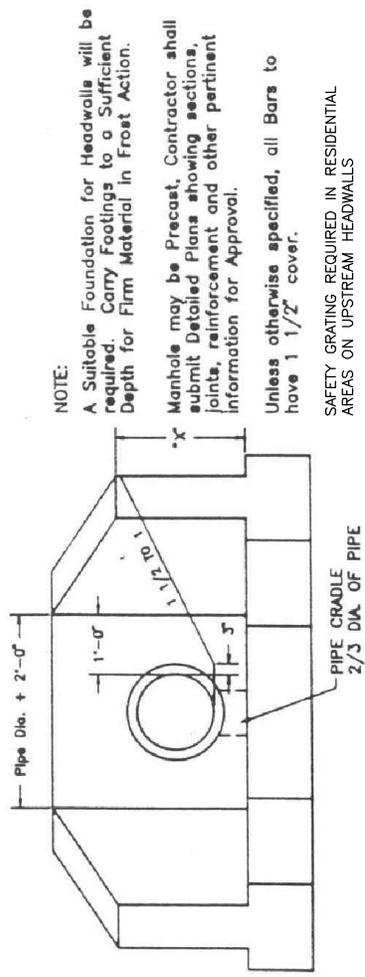


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Junction Box Cover Slab

Storm Drain Details

Standard No. D-16

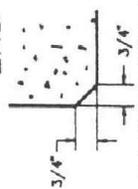


NOTE:
 A Suitable Foundation for Headwalls will be required. Carry Footings to a Sufficient Depth for Firm Material in Frost Action.
 Manhole may be Precast, Contractor shall submit Detailed Plans showing sections, joints, reinforcement and other pertinent information for Approval.
 Unless otherwise specified, all Bars to have 1 1/2" cover.

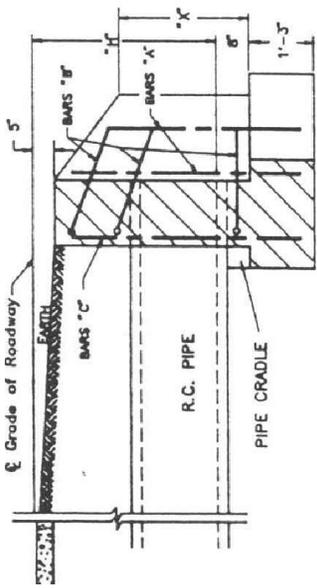
SAFETY GRATING REQUIRED IN RESIDENTIAL AREAS ON UPSTREAM HEADWALLS

NOTE:
 Minimum "H" @ Grade Roadway to Discharge
 18" PIPE = 3.25'
 24" PIPE = 3.75'
 30" PIPE = 4.25'
 36" PIPE = 4.75'

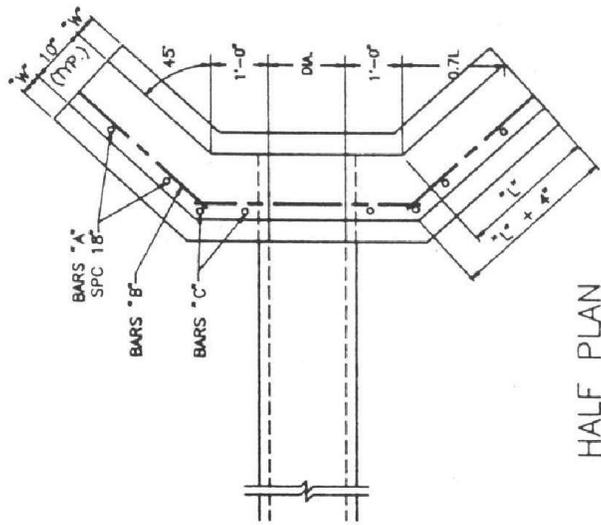
END ELEVATION



UNLESS OTHERWISE NOTED, FINISH CORNERS AS SHOWN



HALF SECTION



HALF PLAN

QUANTITIES FOR TWO HEADWALLS

H	L	X	W	BARS "A"				BARS "B"				BARS "C"						
				NO.	LENGTH	TOTAL LENGTH	NO.	LENGTH	TOTAL LENGTH	NO.	LENGTH	TOTAL LENGTH	NO.	LENGTH	TOTAL LENGTH			
3.25	2'-6"	2'-6"	6"	8	3'-8"	32'	6	9'-6"	57'	6	9'-6"	57'	8	4'-6"	36'	8	4'-6"	36'
3.50	2'-6"	2'-6"	7"	8	4'-8"	34'	6	10'-0"	60'	6	10'-0"	60'	8	4'-6"	36'	8	4'-6"	36'
3.75	3'-0"	3'-0"	8"	12	4'-8"	54'	6	10'-6"	63'	6	11'-0"	66'	8	5'-0"	40'	8	5'-0"	40'
4.00	3'-3"	3'-3"	8"	12	4'-8"	54'	6	11'-0"	66'	6	11'-6"	69'	8	5'-3"	42'	8	5'-3"	42'
4.25	3'-6"	3'-6"	8"	12	4'-8"	54'	6	11'-6"	69'	6	12'-0"	72'	8	5'-6"	44'	8	5'-6"	44'
4.50	3'-9"	3'-9"	10"	12	4'-8"	60'	6	12'-0"	72'	6	12'-6"	75'	8	5'-9"	46'	8	5'-9"	46'
4.75	4'-0"	3'-9"	10"	12	4'-8"	66'	6	12'-6"	75'	6	13'-0"	78'	8	5'-9"	46'	8	5'-9"	46'
5.00	4'-3"	3'-9"	11"	16	4'-8"	88'	6	13'-0"	84'	6	13'-6"	81'	8	6'-0"	48'	8	6'-0"	48'
5.25	4'-6"	3'-9"	11"	16	4'-8"	92'	6	13'-6"	87'	6	14'-0"	84'	8	6'-3"	50'	8	6'-3"	50'
5.50	5'-0"	3'-9"	12"	16	4'-8"	92'	6	14'-0"	84'	6	14'-6"	87'	8	6'-6"	52'	8	6'-6"	52'
5.75	5'-3"	4'-3"	12"	16	4'-8"	100'	6	15'-0"	90'	6	15'-6"	93'	8	6'-9"	54'	8	6'-9"	54'
6.00	5'-6"	4'-3"	13"	16	4'-8"	100'	6	15'-6"	93'	6	16'-0"	96'	8	6'-9"	54'	8	6'-9"	54'
6.00	5'-6"	4'-3"	13"	16	4'-8"	100'	6	15'-6"	93'	6	16'-0"	96'	8	6'-9"	54'	8	6'-9"	54'

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Source	

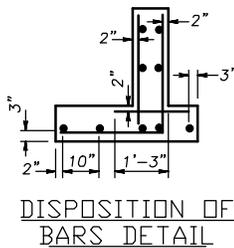
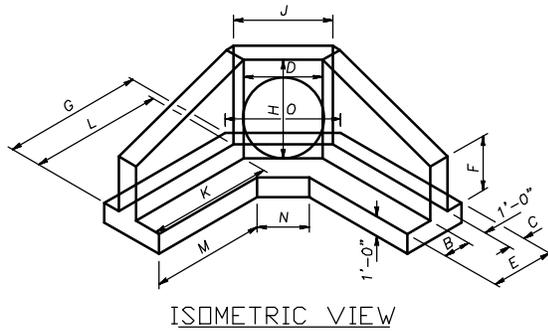
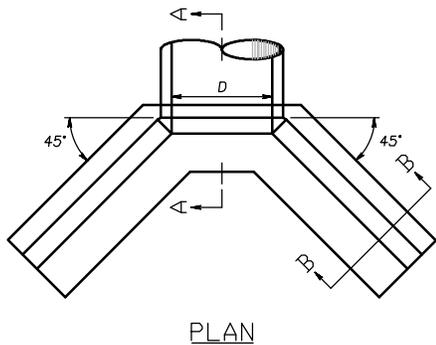
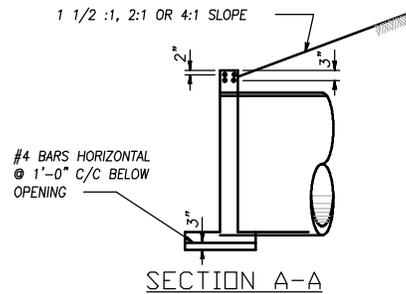
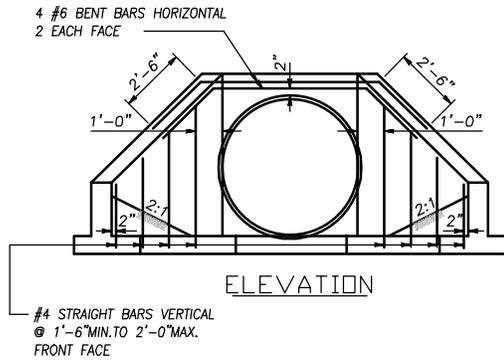


Department of Public Works

45° Standard Headwall (18" To 36" Pipe)

Storm Drain Details

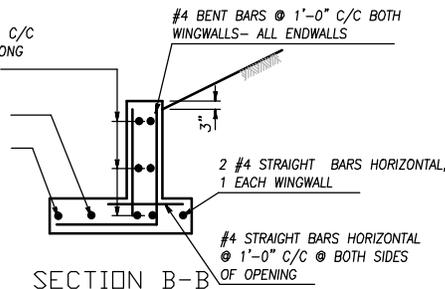
Standard No. D-17



#4 BARS HORIZONTAL @ 1'-7" MAX. C/C BOTH FACES BOTTOM BARS BENT ALONG ENDWALL OTHERS STRAIGHT.

1 #4 BENT BAR HORIZONTAL

1 #4 BENT BAR HORIZONTAL



NOTES

SPECIFICATIONS: LATEST TOWN OF SMYRNA
CONCRETE SHALL BE CLASS B
REINFORCING: DEFORMED STEEL BARS #4 & #6
CHAMFER: ALL EXPOSED EDGES 1"x1" OR AS DIRECTED
SAFETY GRATING REQUIRED IN RESIDENTIAL AREAS ON UPSTREAM HEADWALLS

OPENING		DIMENSIONS												VOL. CONC. C.Y.	STEEL LBS.
D INCHES	AREA SQ.FT.	B	C	E	F	G	H	J	K	L	M	N	O		
48	12.57	1'-4"	10"	3'-2"	2'-9"	7'-0 3/4 "	5'-0"	4'-10"	6'-3 1/2"	6'-8 1/2"	5'-9"	2'-10 3/4"	5'-6"	4.3	262
54	15.9	1'-8"	1'-0"	3'-8"	3'-0"	7'-8 1/2 "	5'-6"	5'-4"	6'-10 1/2"	7'-3 1/2"	6'-2 1/4"	3'-1 1/2"	6'-2"	5.3	301
60	19.64	1'-8"	1'-0"	3'-8"	3'-3"	8'-5"	6'-0"	5'-10"	7'-7 1/4"	8'-0 1/4"	6'-11"	3'-7 1/2 "	6'-8"	6.0	361

QUANTITIES IN TABLE TO BE USED FOR ESTIMATING ONLY

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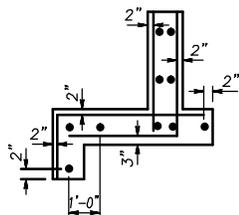
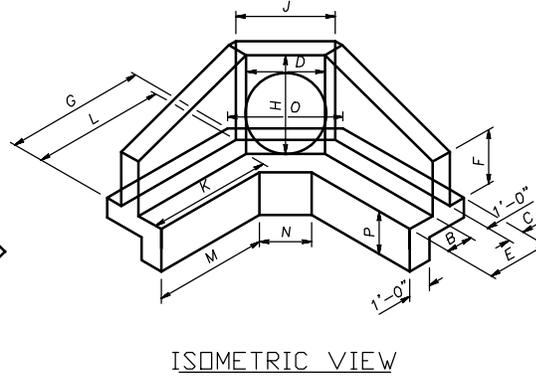
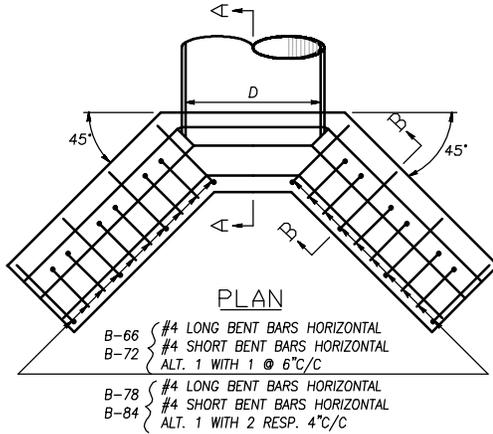
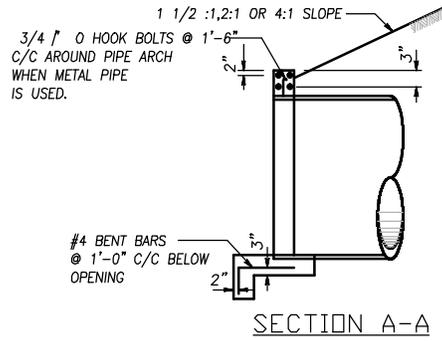
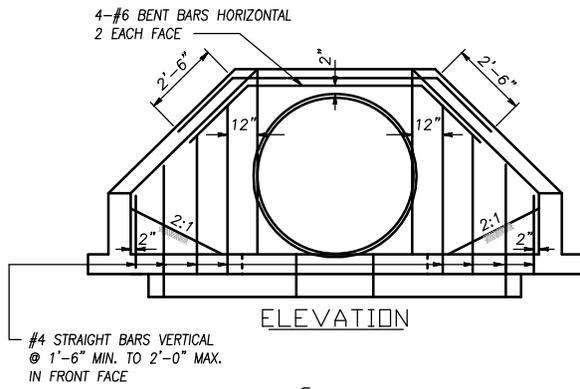


Department of Public Works

45° Standard Headwall (48", 54" & 60" Pipe)

Storm Drain Details

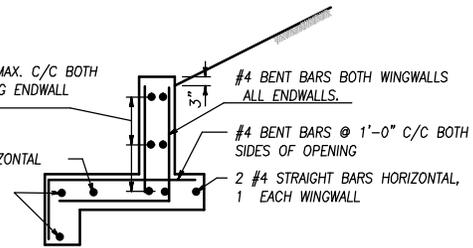
Standard No. D-18



DISPOSITION OF BARS DETAIL

#4 BARS HORIZONTAL @ 1'-7" MAX. C/C BOTH
FACES BOTTOM BARS BENT ALONG ENDWALL
OTHERS STRAIGHT.

1 #4 BENT BAR HORIZONTAL
2 #4 BENT BARS HORIZONTAL



NOTES

SPECIFICATIONS: LATEST TOWN OF SMYRNA
CONCRETE SHALL BE CLASS B
REINFORCING: DEFORMED STEEL BARS #4 & #6
CHAMFER: ALL EXPOSED EDGES 1"x1" OR AS DIRECTED
SAFETY GRATING REQUIRED IN RESIDENTIAL AREAS ON UPSTREAM HEADWALLS

OPENING		DIMENSIONS													VOL. CONC. C.Y.	STEEL LBS.
D INCHES	AREA SQ.FT.	B	C	E	F	G	H	J	K	L	M	N	O	P		
66	23.80	2'-6"	1'-3"	4'-9"	3'-0"	11'-2 1/2"	6'-8 1/2"	6'-4"	10'-3 1/4"	10'-8 1/2"	9'-3"	3'-5"	7'-4 1/2"	2'-0"	9.7	585
72	28.27	2'-6"	1'-3"	4'-9"	3'-3"	12'-1"	7'-3"	6'-10"	11'-1 3/4"	11'-6 3/4"	10'-1 1/4"	3'-11"	7'-10 1/2"	2'-0"	10.9	645
78	33.20	3'-0"	1'-6"	5'-6"	3'-6"	13'-0 1/2"	7'-9 1/2"	7'-4"	12'-0"	12'-5"	10'-9"	4'-0"	8'-6 3/4"	2'-6"	13.3	865
84	38.48	3'-0"	1'-6"	5'-6"	3'-9"	13'-10"	8'-4"	7'-10"	12'-9 1/2"	13'-2 1/2"	11'-6 1/2"	4'-6"	9'-0 3/4"	2'-6"	14.7	984

QUANTITIES IN TABLE TO BE USED FOR ESTIMATING ONLY

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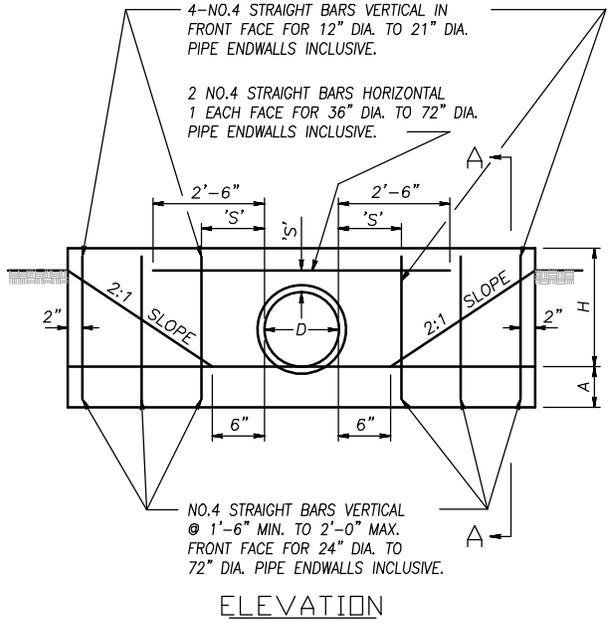
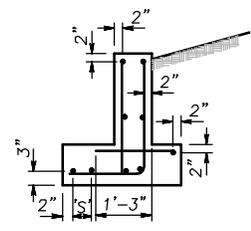
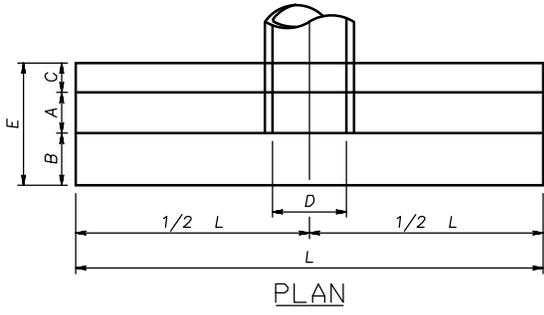


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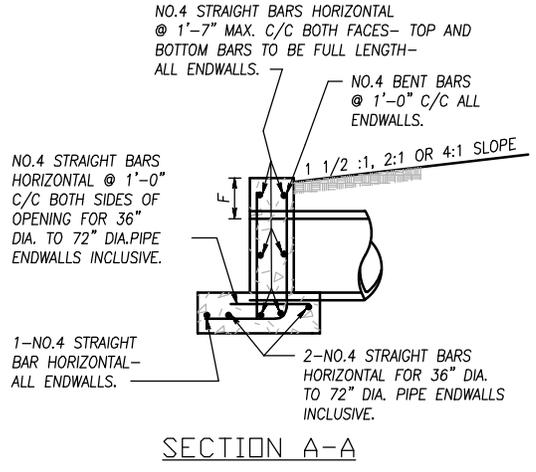
45° Standard Headwall (66" To 84" Pipe)

Storm Drain Details

Standard No. D-19



DISPOSITION OF BARS DETAIL



QUANTITIES FOR ESTIMATING PURPOSES ONLY

OPENING		DIMENSIONS							QUANTITIES	
D	AREA	A	B	C	E	F	H	L	CONC. C.Y.	STEEL LBS.
INCHES	SQ.FT.									
12	0.79	9"	6"	6"	1'-9"	9"	1'-9"	6'-6"	0.61	41
15	1.23	9"	6"	6"	1'-9"	9"	2'-0"	7'-9"	0.77	47
18	1.77	9"	6"	6"	1'-9"	9"	2'-3"	9'-0"	0.95	54
21	2.40	9"	6"	6"	1'-9"	9"	2'-6"	10'-3"	1.14	70
24	3.14	9"	14"	6"	2'-5"	9"	2'-9"	11'-6"	1.56	80
27	3.98	9"	14"	6"	2'-5"	9"	3'-0"	12'-10"	1.82	88
30	4.91	9"	14"	6"	2'-5"	12"	3'-6"	14'-2"	2.22	98
33	5.94	9"	14"	6"	2'-5"	12"	3'-9"	15'-5"	2.48	105
36	7.07	12"	16"	10"	3'-2"	12"	4'-0"	16'-8"	4.16	182
42	9.62	12"	16"	10"	3'-2"	12"	4'-6"	19'-2"	5.07	206
48	12.57	12"	16"	10"	3'-2"	12"	5'-0"	21'-8"	6.09	244
54	15.90	12"	20"	12"	3'-8"	12"	5'-6"	24'-2"	7.62	275
60	19.64	12"	20"	12"	3'-8"	12"	6'-0"	26'-8"	8.82	304
72	28.27	12"	20"	12"	3'-8"	12"	7'-0"	31'-8"	11.46	377

'S' DISTANCES

- 4" FOR 12" DIA. TO 21" DIA. PIPES INCLUSIVE.
- 6" FOR 24" DIA. TO 36" DIA. PIPES INCLUSIVE.
- 8" FOR 42" DIA. TO 72" DIA. PIPES INCLUSIVE.

GENERAL NOTES

- SPECIFICATIONS: LATEST TOWN OF SMYRNA
- CONCRETE SHALL BE CLASS B
- REINFORCING: DEFORMED STEEL BARS-NO.4
- CHAMFER: ALL EXPOSED EDGES 1"x1" OR AS DIRECTED
- SAFETY GRATING REQUIRED IN RESIDENTIAL AREAS ON UPSTREAM HEADWALLS

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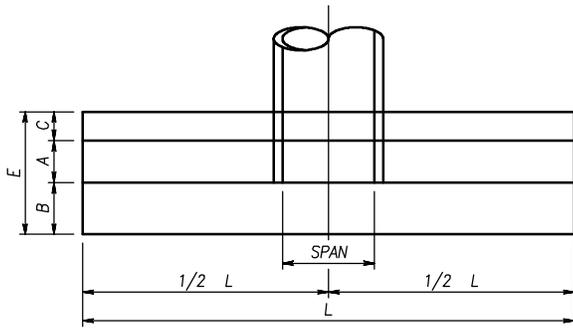


Department of Public Works

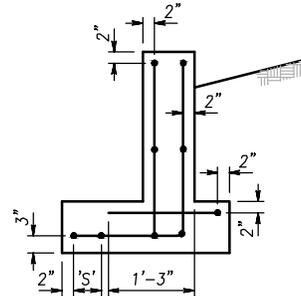
Straight Type Headwall

Storm Drain Details

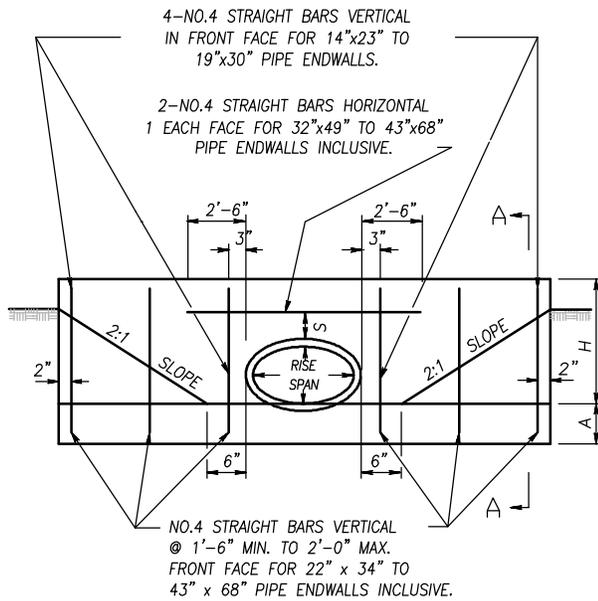
Standard No. D-20



PLAN



DISPOSITION OF BARS DETAIL



ELEVATION

NO.4 STRAIGHT BARS HORIZONTAL @ 1'-7" MAX. C/C BOTH FACES- TOP AND BOTTOM BARS TO BE FULL LENGTH- ALL ENDWALLS.

NO.4 STRAIGHT BARS HORIZONTAL @ 1'-0" C/C BOTH SIDES OF OPENING FOR 32"x49" TO 43"x64" PIPE ENDWALLS INCLUSIVE.

1-NO.4 STRAIGHT BAR HORIZONTAL ALL ENDWALLS.

NO.4 BENT BARS @ 1'-0" C/C ALL ENDWALLS.

2:1 OR 4:1 SLOPE

2-NO.4 STRAIGHT BARS HORIZONTAL FOR 32"x49" TO 43"x68" PIPE ENDWALLS INCLUSIVE.

SECTION A-A

QUANTITIES FOR ESTIMATING PURPOSES ONLY

OPENING		DIMENSIONS							QUANTITIES	
D	AREA	A	B	C	E	F	H	L	CONC. C.Y.	STEEL LBS.
RISE x SPAN INCHES	SQ.FT.									
14X23	1.8	9"	8"	6"	1'-11"	12"	2'-2"	8'-7"	0.88	56
19X30	3.3	9"	8"	6"	1'-11"	12"	2'-6"	10'-6"	1.15	63
22X34	4.1	9"	14"	6"	2'-5"	13"	2'-11"	12'-6"	1.74	100
24X38	5.1	9"	14"	6"	2'-5"	13"	3'-1"	13'-6"	1.92	116
27X42	6.3	9"	14"	6"	2'-5"	13"	3'-4"	14'-10"	2.19	124
29X45	7.4	9"	14"	10"	2'-9"	14"	3'-7"	16'-0"	2.61	141
32X49	8.8	12"	16"	10"	3'-2"	14"	3'-10"	17'-0"	4.08	202
34X53	10.2	12"	16"	10"	3'-2"	14"	4'-0"	18'-0"	4.40	210
38X60	12.9	12"	16"	10"	3'-2"	15"	4'-5"	20'-4"	5.23	266
43X68	16.6	12"	20"	12"	3'-8"	15"	4'-10"	22'-8"	6.52	307

'S' DISTANCES

6" FOR 14" x 23" TO 27" x 42" INCLUSIVE.
8" FOR 29" x 45" TO 43" x 68" INCLUSIVE.

GENERAL NOTES

SPECIFICATIONS: LATEST TOWN OF SMYRNA
CONCRETE: SHALL BE CLASS B
REINFORCEMENT: DEFORMED STEEL BARS NO.4
CHAMFER: ALL EXPOSED EDGES 1"x1" OR AS DIRECTED.
SAFETY GRATING REQUIRED IN RESIDENTIAL AREAS ON UPSTREAM HEADWALLS

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Source	MDSHA

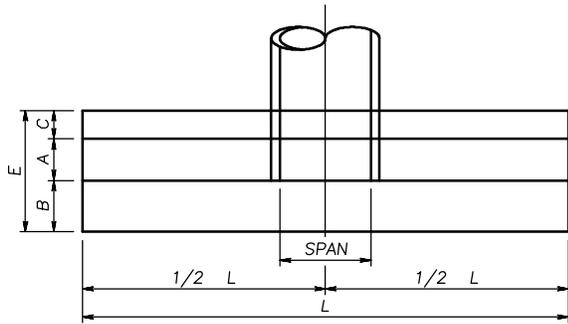


Department of Public Works

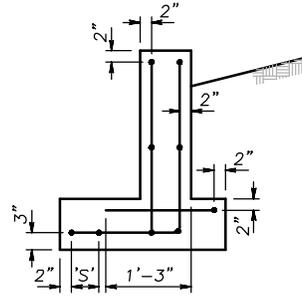
**Straight Type Headwall
(Horizontal Elliptical Concrete Pipe)**

Storm Drain Details

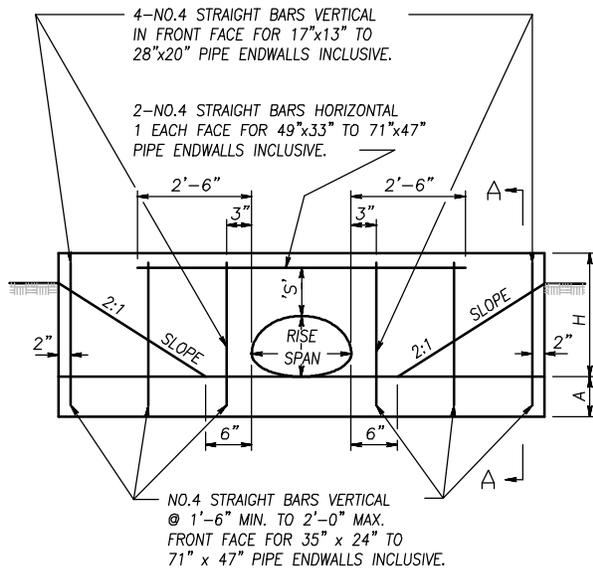
Standard No. **D-21**



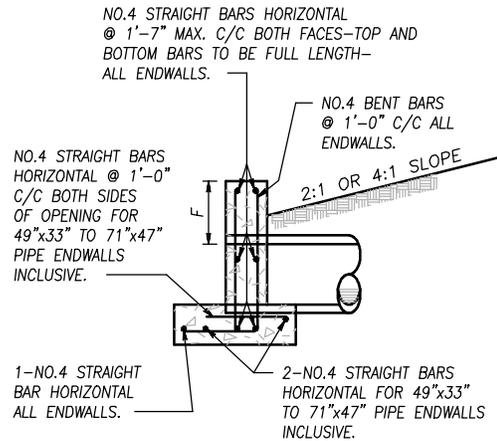
PLAN



DISPOSITION OF BARS DETAIL



ELEVATION



SECTION A-A

QUANTITIES FOR ESTIMATING PURPOSES ONLY

OPENING		DIMENSIONS							QUANTITIES	
D	AREA	A	B	C	E	F	H	L	CONC. C.Y.	STEEL LBS.
INCHES SXR	SQ.FT.									
17X13	1.23	9"	6"	6"	1'-9"	9"	1'-10"	6'-3"	0.54	38
21X15	1.77	9"	6"	6"	1'-9"	9"	2'-0"	9'-6"	0.98	56
24X18	2.40	9"	6"	6"	1'-9"	9"	2'-3"	9'-6"	0.96	55
28X20	3.14	9"	6"	6"	1'-9"	9"	2'-5"	9'-6"	0.96	55
35X24	4.91	9"	14"	6"	2'-5"	12"	2'-9"	13'-8"	1.98	96
42X29	7.07	9"	14"	6"	2'-5"	12"	3'-2"	13'-8"	1.92	95
49X33	9.62	12"	16"	10"	3'-2"	12"	3'-9"	17'-11"	4.34	186
57X38	12.57	12"	16"	10"	3'-2"	12"	4'-2"	17'-11"	4.73	186
64X43	15.90	12"	20"	12"	3'-8"	12"	4'-7"	21'-9"	6.27	243
71X47	19.64	12"	20"	12"	3'-8"	12"	4'-11"	21'-9"	6.05	243

'S' DISTANCES

4" FOR 17" x 13" TO 24" x 18" INCLUSIVE.
 6" FOR 28" x 20" TO 42" x 29" INCLUSIVE.
 8" FOR 49" x 33" TO 71" x 47" INCLUSIVE.

GENERAL NOTES

SPECIFICATIONS: LATEST TOWN OF SMYRNA
 CONCRETE SHALL BE CLASS B
 REINFORCING: DEFORMED STEEL BARS NO.4
 CHAMFER: ALL EXPOSED EDGES 1"x1" OR AS DIRECTED.
 SAFETY GRATING REQUIRED IN RESIDENTIAL AREAS ON UPSTREAM HEADWALLS

Issued	08/04
Revised	
Source	MDSHA

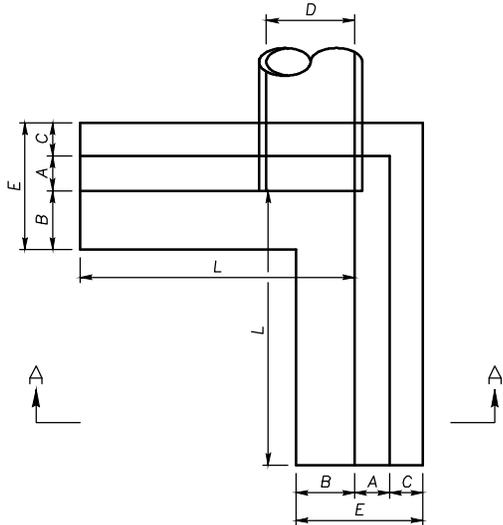


Department of Public Works

Straight Type Headwall (Metal Arch Pipe)

Storm Drain Details

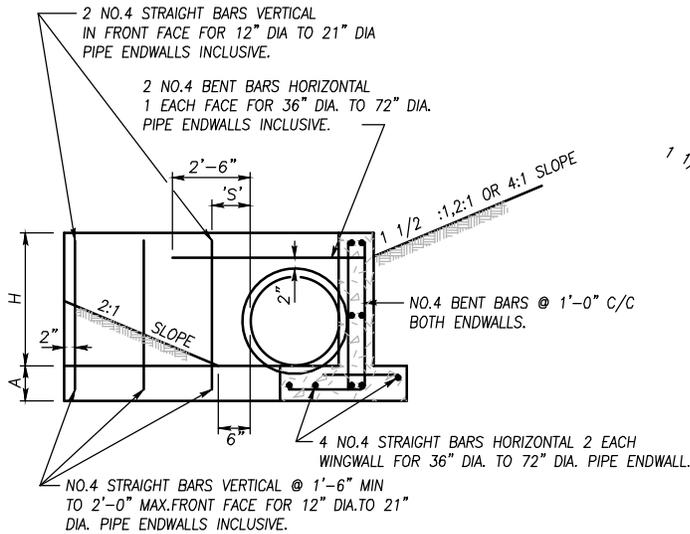
Standard No. D-22



PLAN

QUANTITIES FOR ESTIMATING PURPOSES ONLY

OPENING		DIMENSIONS						QUANTITIES	
D	AREA	A	B	C	E	H	L	CONC. C.Y.	STEEL LBS.
INCHES	SQ.FT								
12	0.79	9"	6"	6"	1'-9"	1'-9"	3'-6"	0.76	55
15	1.23	9"	6"	6"	1'-9"	2'-0"	4'-3"	0.99	61
18	1.77	9"	6"	6"	1'-9"	2'-3"	5'-0"	1.17	68
21	2.40	9"	6"	6"	1'-9"	2'-6"	5'-9"	1.38	77
24	3.14	9"	14"	6"	2'-5"	2'-9"	6'-6"	1.84	106
27	3.98	9"	14"	6"	2'-5"	3'-0"	7'-3"	2.11	115
30	4.91	9"	14"	6"	2'-5"	3'-6"	8'-0"	2.57	140
33	5.94	9"	14"	6"	2'-5"	3'-9"	8'-9"	2.92	148
36	7.07	12"	16"	10"	3'-2"	4'-0"	9'-6"	4.99	235
42	9.62	12"	16"	10"	3'-2"	4'-6"	11'-0"	6.12	303
48	12.57	12"	16"	10"	3'-2"	5'-0"	12'-6"	7.34	341
54	15.90	12"	20"	12"	3'-8"	5'-6"	14'-0"	9.17	438
60	19.64	12"	20"	12"	3'-8"	6'-0"	15'-6"	10.86	496
72	28.27	12"	20"	12"	3'-8"	7'-0"	17'-0"	12.69	597



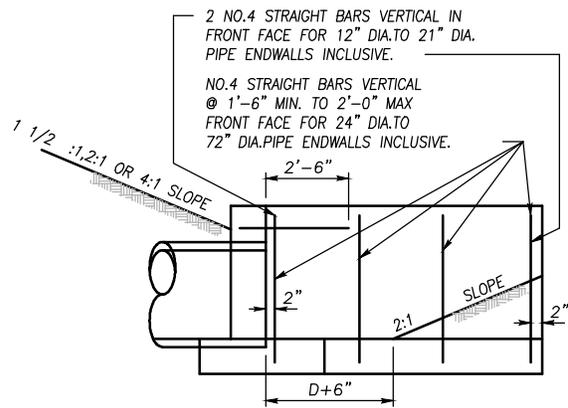
SECTION A-A

'S' DISTANCES

- 4" FOR 12" DIA. TO 21" DIA. PIPES INCLUSIVE.
- 6" FOR 24" DIA. TO 36" DIA. PIPES INCLUSIVE.
- 8" FOR 42" DIA. TO 72" DIA. PIPES INCLUSIVE.

GENERAL NOTES

- SPECIFICATIONS: LATEST TOWN OF SMYRNA
- CONCRETE SHALL BE CLASS B
- REINFORCING: DEFORMED STEEL BARS - NO.4
- CHAMFER: ALL EXPOSED EDGES 1"x 1" OR AS DIRECTED.
- SAFETY GRATING REQUIRED IN RESIDENTIAL AREAS ON UPSTREAM HEADWALLS

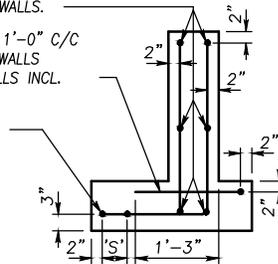


END VIEW

NO.4 STRAIGHT BARS HORIZONTAL @ 1'-7" MAX C/C BOTH FACES-LAP 1'-3" TOP & BOTTOM BARS @ CORNER- BOTH WINGWALLS-ALL ENDWALLS.

NO.4 STRAIGHT BARS HORIZONTAL @ 1'-0" C/C BOTH SIDES OF OPENING BOTH WINGWALLS FOR 36" DIA. TO 72" DIA. PIPE ENDWALLS INCL.

2 NO.4 STRAIGHT BARS HORIZONTAL 1 EACH WINGWALL- ALL ENDWALLS.



DISPOSITION OF BARS DETAIL

Issued	08/04
Revised	
Source	MDSHA

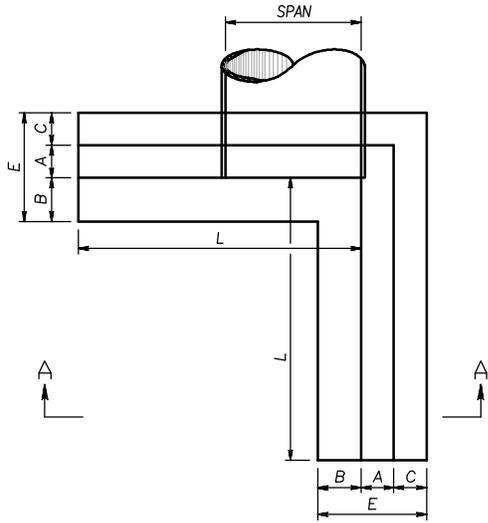


Department of Public Works

"L" Type Headwall

Storm Drain Details

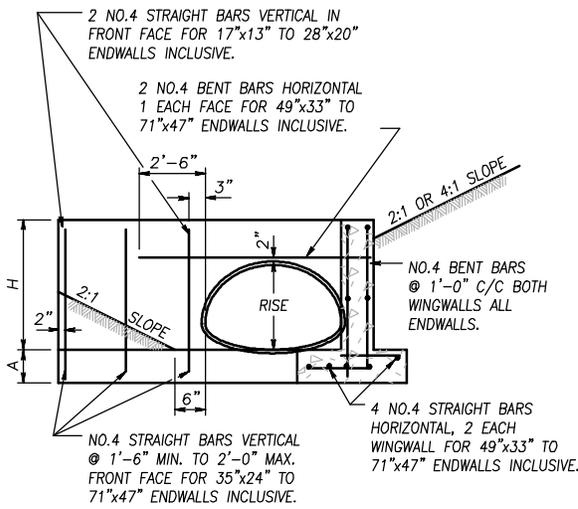
Standard No. D-23



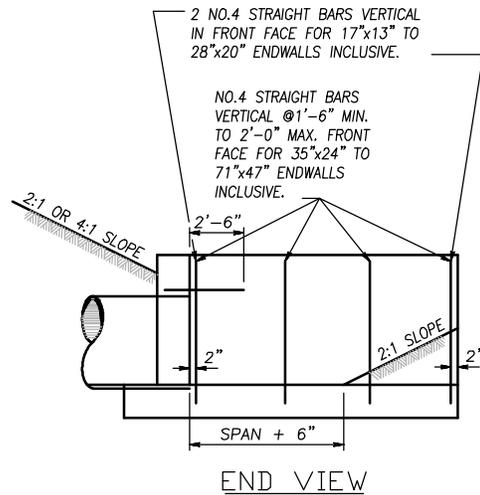
PLAN

QUANTITIES FOR ESTIMATING PURPOSES ONLY

OPENING		DIMENSIONS						QUANTITIES	
SIZE	AREA	A	B	C	E	H	L	CONC. C.Y.	STEEL LBS.
INCHES SxR	SQ. FT.								
17x13	1.23	9"	6"	6"	1'-9"	1'-7"	3'-9"	.73	53
21x15	1.77	9"	6"	6"	1'-9"	2'-2"	5'-10"	1.30	75
24x18	2.40	9"	6"	6"	1'-9"	2'-2"	5'-10"	1.28	75
28x20	3.14	9"	6"	6"	1'-9"	2'-2"	5'-10"	1.26	74
35x24	4.91	9"	14"	6"	2'-5"	3'-2"	8'-6"	2.57	118
42x29	7.07	9"	14"	6"	2'-5"	3'-2"	8'-6"	2.52	117
49x33	9.62	12"	16"	10"	3'-2"	3'-11"	11'-3"	5.80	271
57x38	12.57	12"	16"	10"	3'-2"	3'-11"	11'-3"	5.65	261
64x43	15.90	12"	20"	12"	3'-8"	4'-8"	13'-9"	8.12	366
71x47	19.64	12"	20"	12"	3'-8"	4'-8"	13'-9"	7.98	355



SECTION A-A



END VIEW

'S' DISTANCES

- 4" FOR 17x13 TO 24x18 INCLUSIVE.
- 6" FOR 28x20 TO 42x29 INCLUSIVE.
- 8" FOR 49x33 TO 71x47 INCLUSIVE.

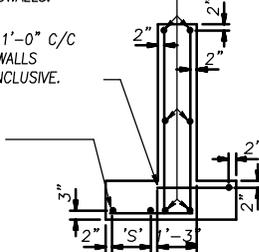
GENERAL NOTES

- SPECIFICATIONS: LATEST TOWN OF SMYRNA CONCRETE SHALL BE CLASS B
- REINFORCING: DEFORMED STEEL BARS- NO. 4
- CHAMFER: ALL EXPOSED EDGES 1"x1" OR AS DIRECTED.
- SAFETY GRATING REQUIRED IN RESIDENTIAL AREAS ON UPSTREAM HEADWALLS

NO.4 STRAIGHT BARS HORIZONTAL @ 1'-7" MAX. C/C BOTH FACES- LAP 1'-3" TOP & BOTTOM BARS @ CORNER- BOTH WINGWALLS- ALL ENDWALLS.

NO.4 STRAIGHT BARS HORIZONTAL @ 1'-0" C/C BOTH SIDES OF OPENING BOTH WINGWALLS FOR 49x33 TO 71x47 ENDWALL INCLUSIVE.

2 NO.4 STRAIGHT BARS HORIZONTAL, 1 EACH WINGWALL- ALL ENDWALLS.



DISPOSITION OF BARS DETAIL

Issued	08/04
Revised	
Source	MDSHA



Department of Public Works

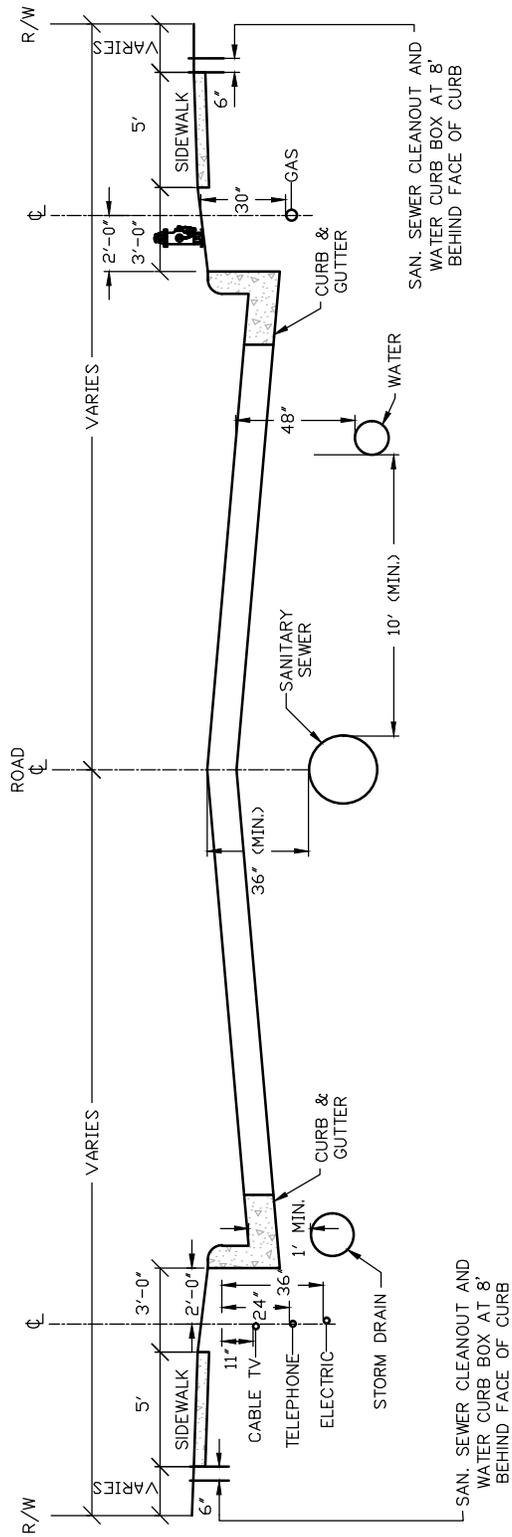
"L" Type Headwall (Metal Arch Pipe)

Storm Drain Details

Standard No. D-24

Category R

Roadways



- NOTES:
1. THE DEPARTMENT OF PUBLIC WORKS SHALL BE CONSULTED PRIOR TO THE PLACEMENT OF ANY UTILITY.
 2. ELECTRIC 36" OF COVER.
 3. TELEPHONE MAIN SERVICE MIN. 24" COVER.
 4. RESIDENTIAL PHONE LINE 11" MIN. COVER.
 5. CABLE TV 11" MIN. COVER.
 6. SANITARY SEWER CLEAN-OUT LOCATED 8' BEHIND FACE OF CURB AND INSTALLED VERTICALLY.

Issued	08/04
Revised	10/12
Source	

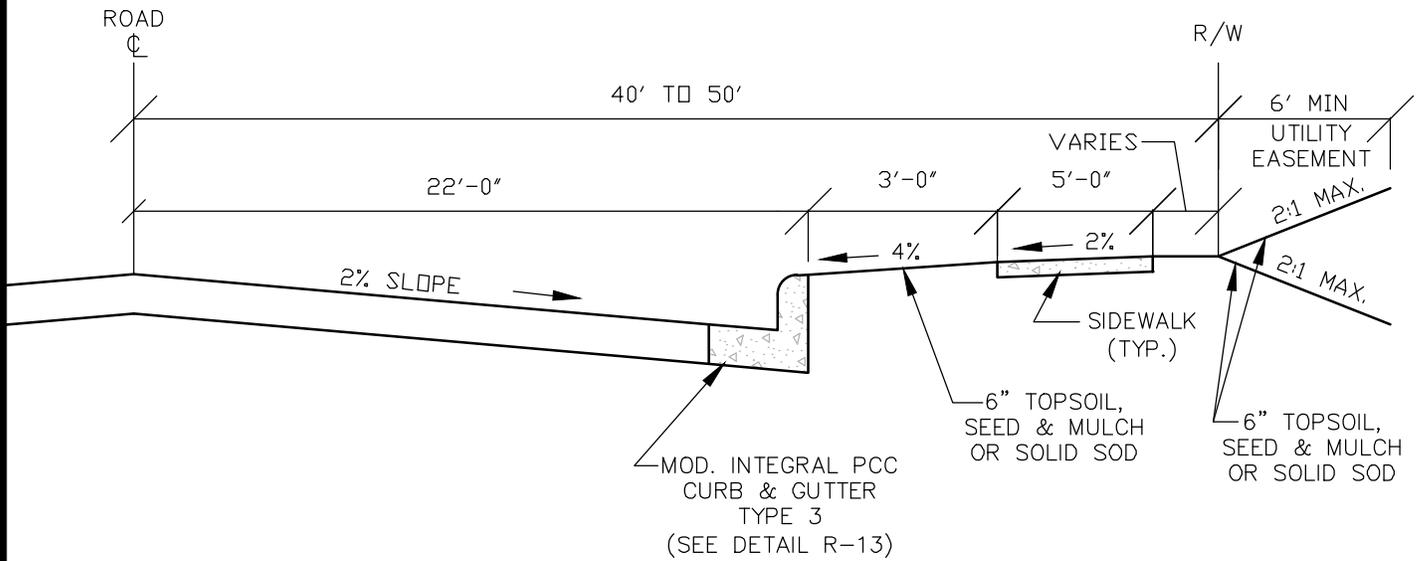


Department of Public Works

Normal Location of Public Utilities

Street & Road Details

Standard No. **R-1**



Issued	08/04
Revised	
Source	

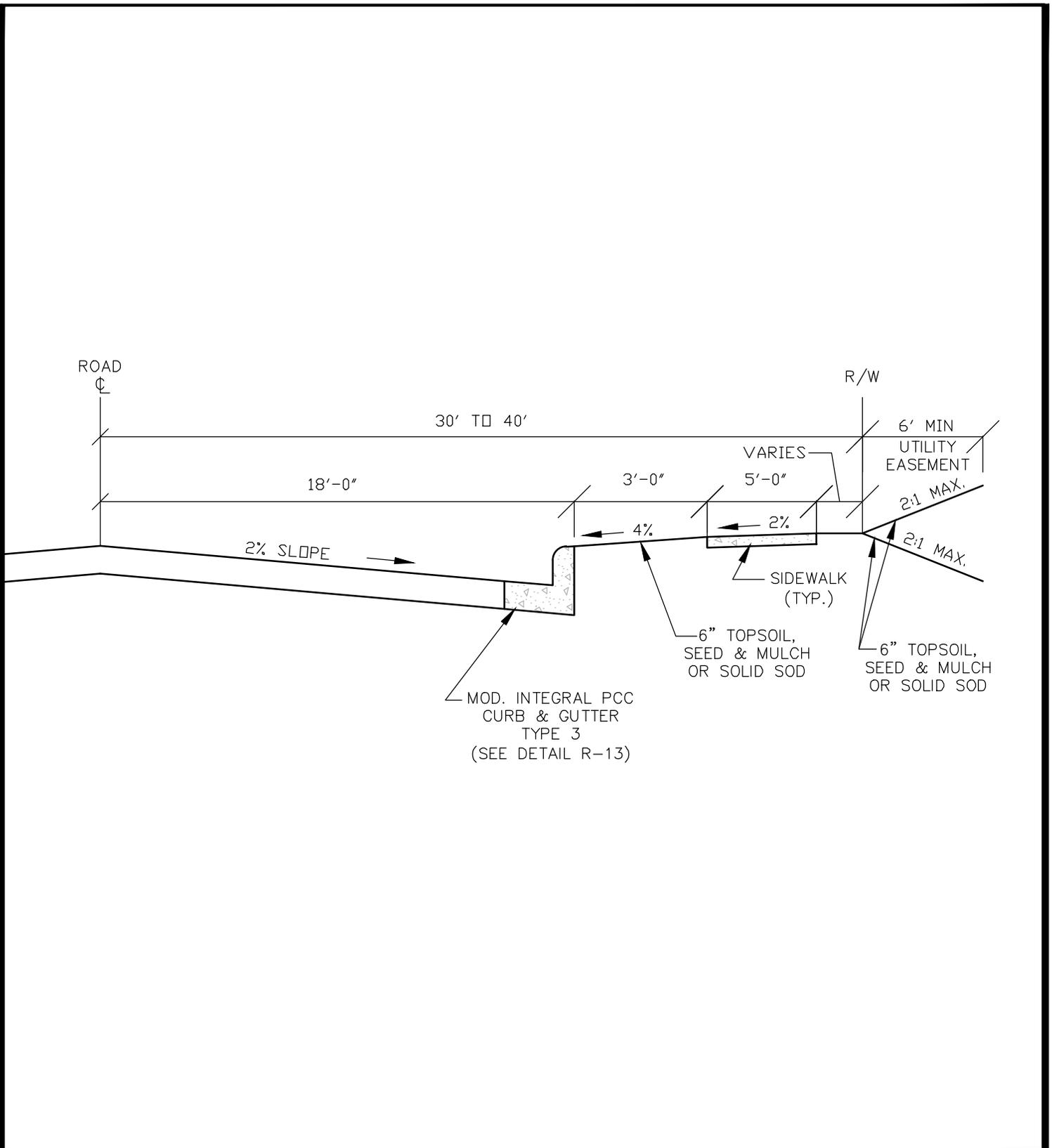


**Department of
Public Works**

**ARTERIAL ROADWAY
(80'-100' R.O.W.)**

Street & Road Details

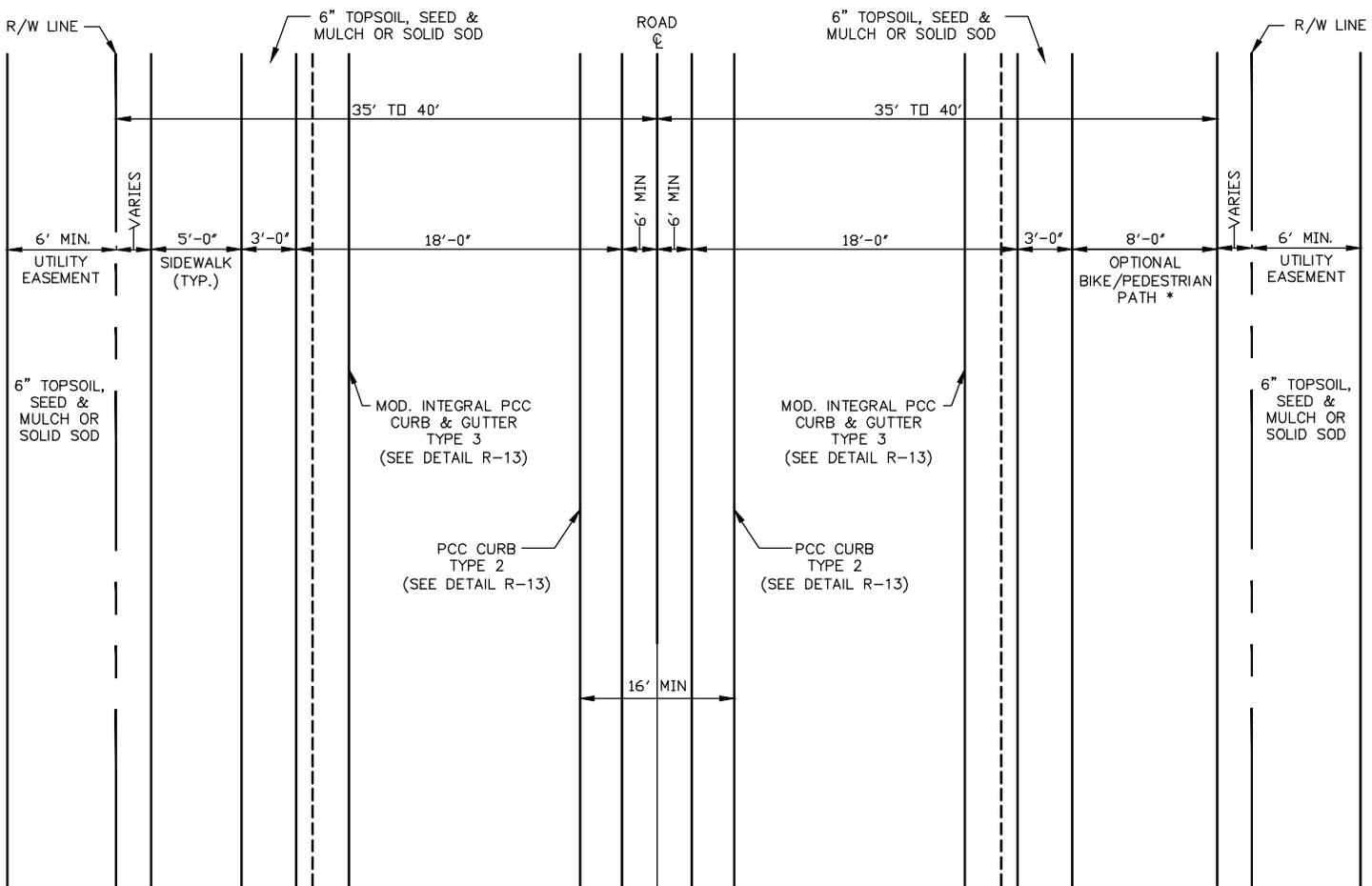
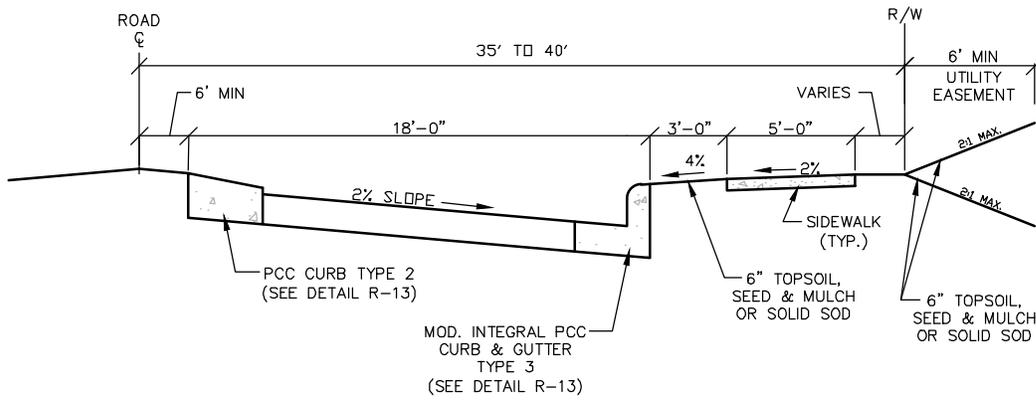
Standard No. **R-2**



Issued	08/04
Revised	
Source	



COLLECTOR ROADWAY (60'-80' R.O.W.)	
Street & Road Details	
Standard No.	R-3



* MIN. 5' WIDE SIDEWALK IS REQUIRED UNLESS 8' WIDE BIKE/PEDESTRIAN PATH OPTION IS CHOSEN.

Issued	08/04
Revised	
Source	

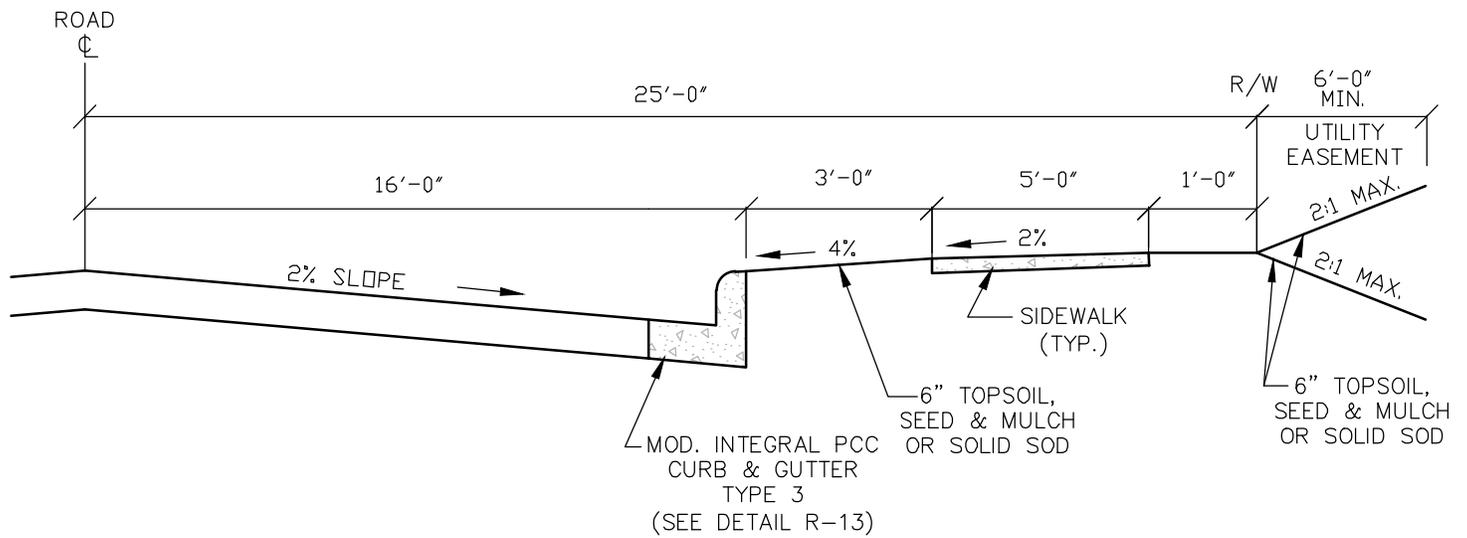


Department of Public Works

Boulevard Roadway (70' - 80' R.O.W.)

Street & Road Details

Standard No. **R-4**



Issued	08/04
Revised	10/12
Source	

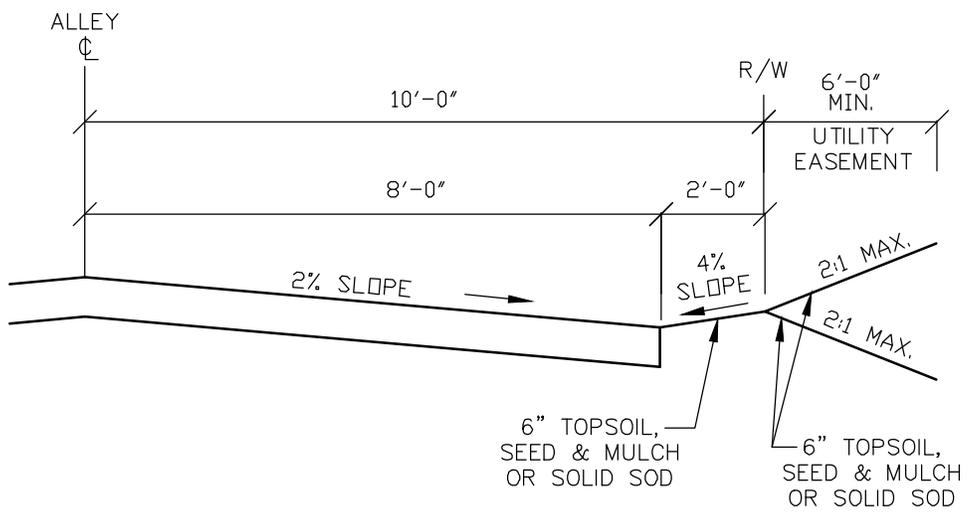


**Department of
Public Works**

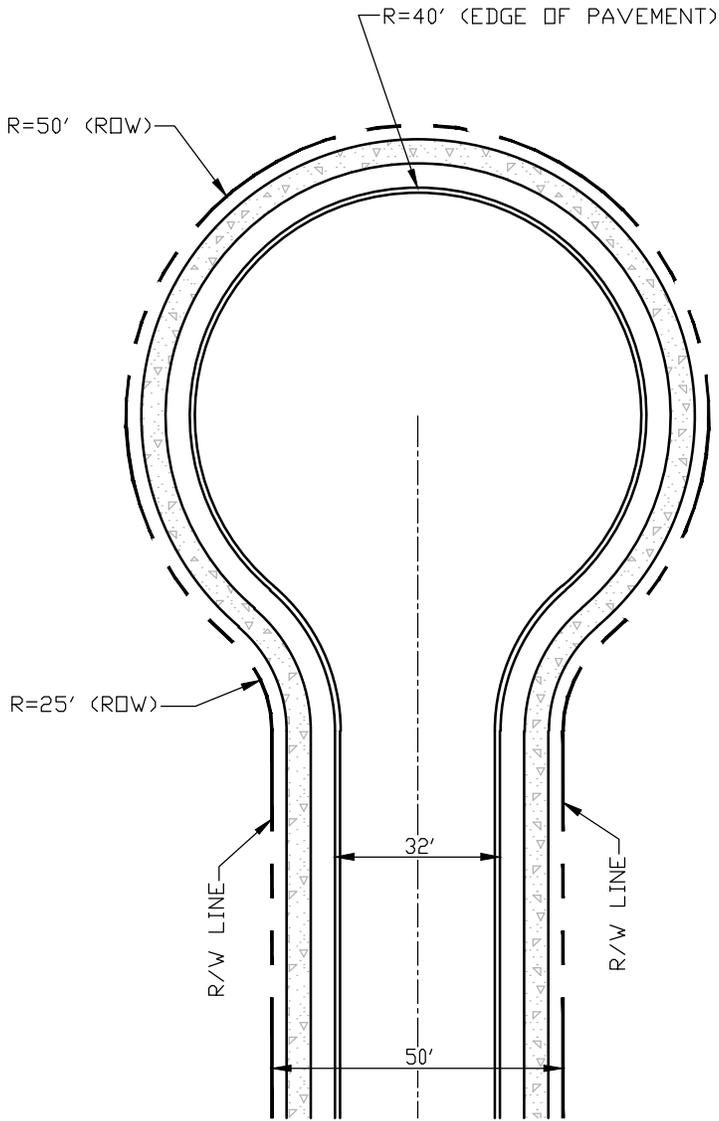
Residential (Minor) Roadway (50' R.O.W.)

Street & Road Details

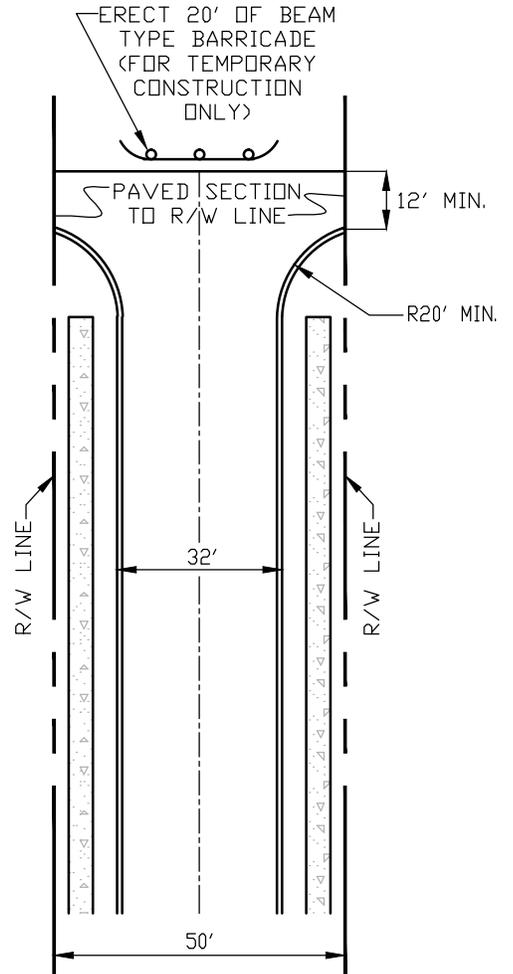
Standard No. **R-5**



Issued	08/04	 <p>Department of Public Works</p>	Alley (20' R.O.W.)
Revised			Street & Road Details
			Standard No. R-6
Source			



CUL-DE-SAC



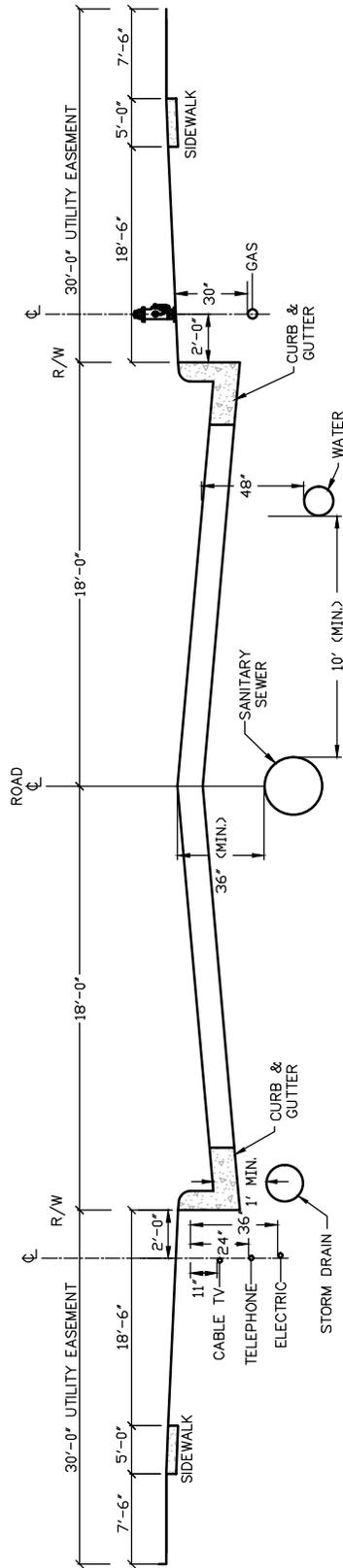
"T" TURNAROUND

Issued	08/04
Revised	
Source	



**Department of
Public Works**

Cul-De-Sac / Turnaround
Street & Road Details
Standard No. R-7



- NOTES:**
1. THE DEPARTMENT OF PUBLIC WORKS SHALL BE CONSULTED PRIOR TO THE PLACEMENT OF ANY UTILITY.
 2. ELECTRIC 36" OF COVER.
 3. TELEPHONE MAIN SERVICE MIN. 24" COVER.
 4. RESIDENTIAL PHONE LINE 11" MIN. COVER.
 5. CABLE TV 11" MIN. COVER.
 6. SANITARY SEWER CLEAN-OUT AND WATER CURB BOX TO BE LOCATED IN SIDEWALK BEHIND PARKING BAYS.
 7. EMOSS "S" & "W" ON FACE OF CURB (2" MIN.).
 8. FOR TOWNHOUSES WITH DRIVEWAYS USE STANDARD RESIDENTIAL ROADWAY SECTION.

Issued	08/04
Revised	10/12
Source	

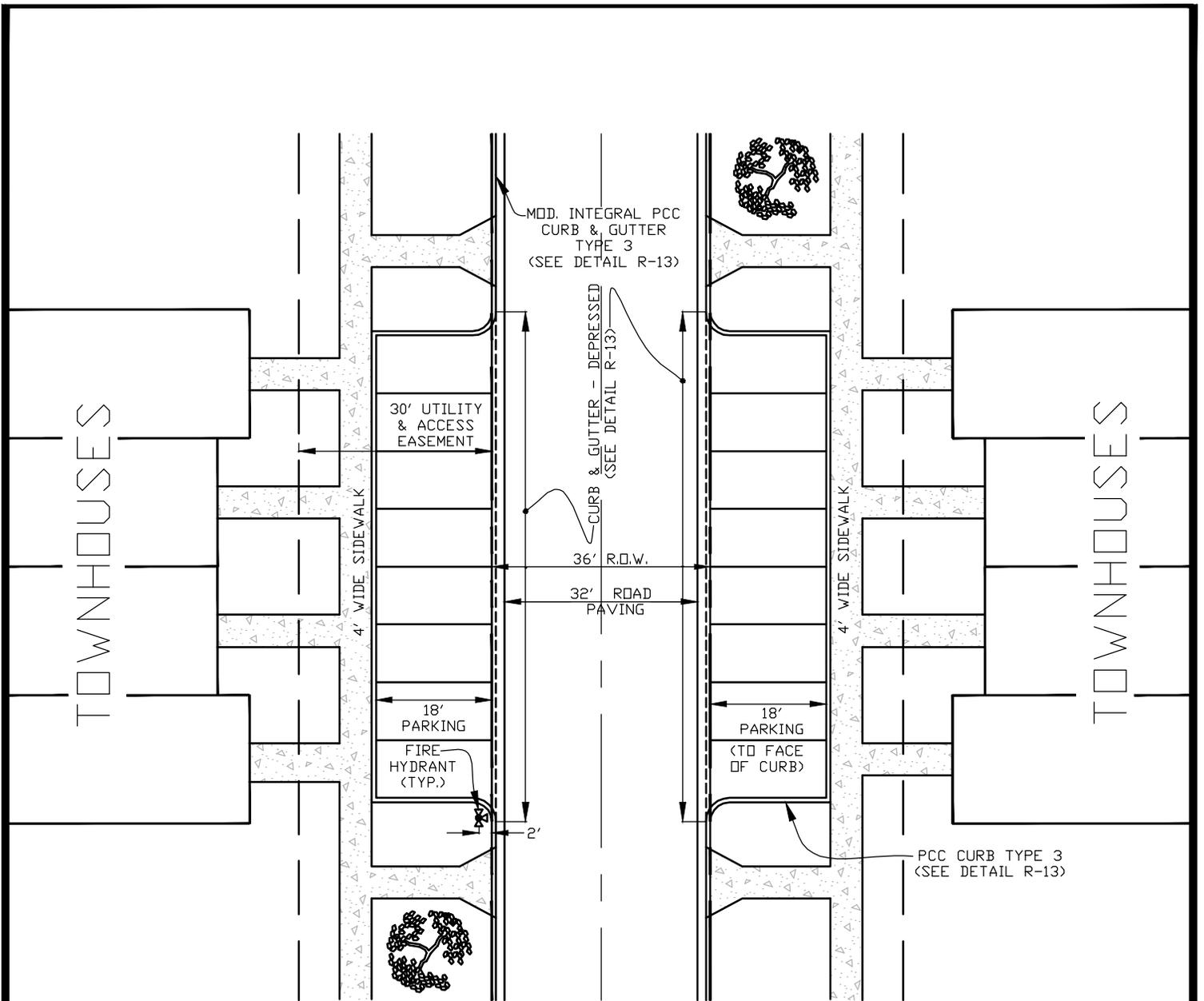


**Department of
Public Works**

Normal Location of Public Utilities Townhouse Section with Parking Bays

Street & Road Details

Standard No. **R-8**



NOTES:

1. NO PARKING SIGN MUST BE POSTED BETWEEN PARKING BAYS ON ANY TOWNHOUSE STREET SERVING MORE THAN 50 UNITS.
2. FOR TOWNHOUSES WITH DRIVEWAYS USE STANDARD RESIDENTIAL ROADWAY SECTION.

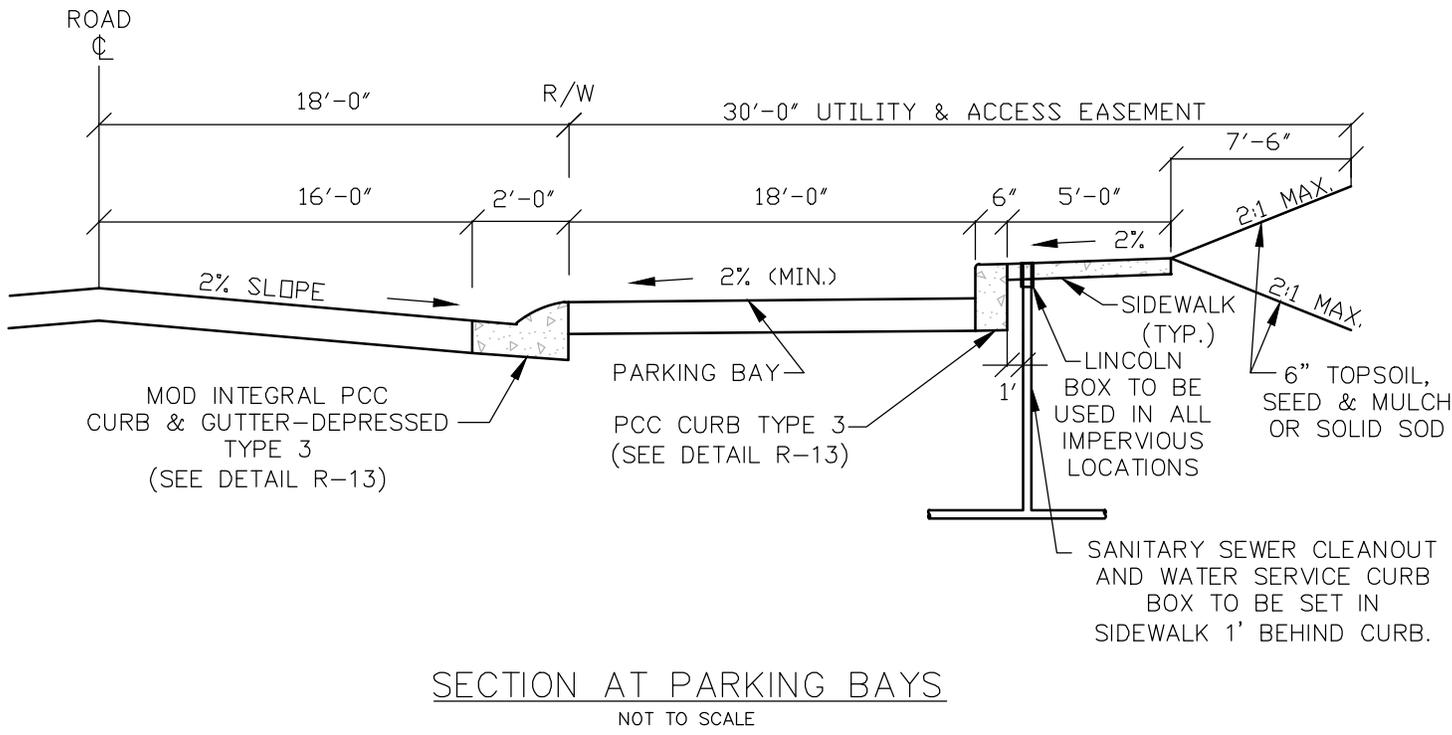
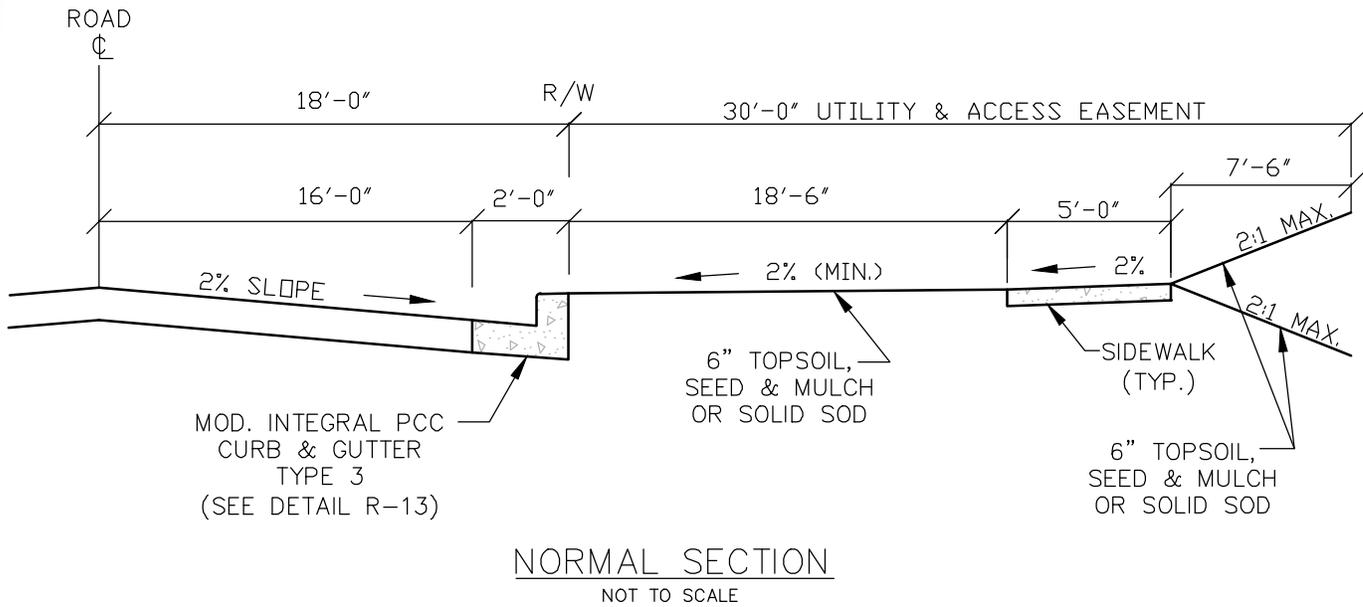
Issued	08/04
Revised	
Source	



**Typical Townhouse Street Layout
with Parking Bays**

Street & Road Details

Standard No. **R-9**



Issued	08/04
Revised	10/12
Source	

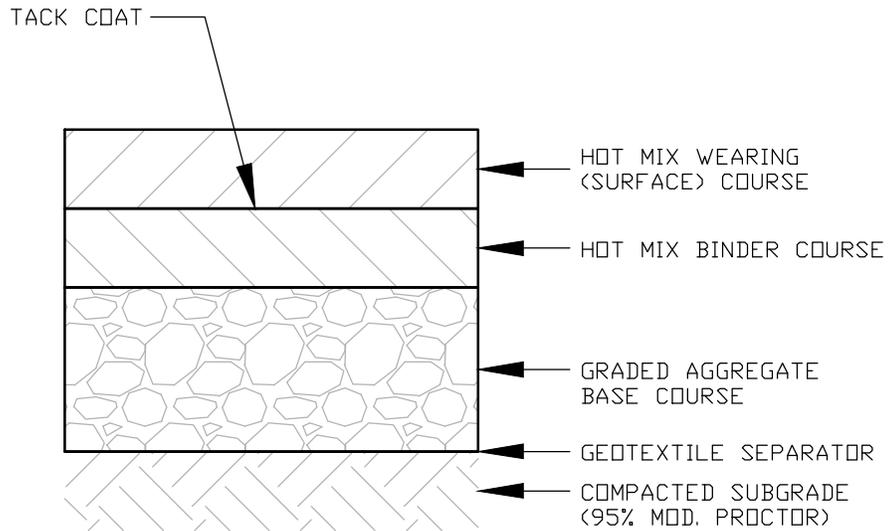


Department of Public Works

Townhouse Roadway (36' R.O.W. - Reduced)

Street & Road Details

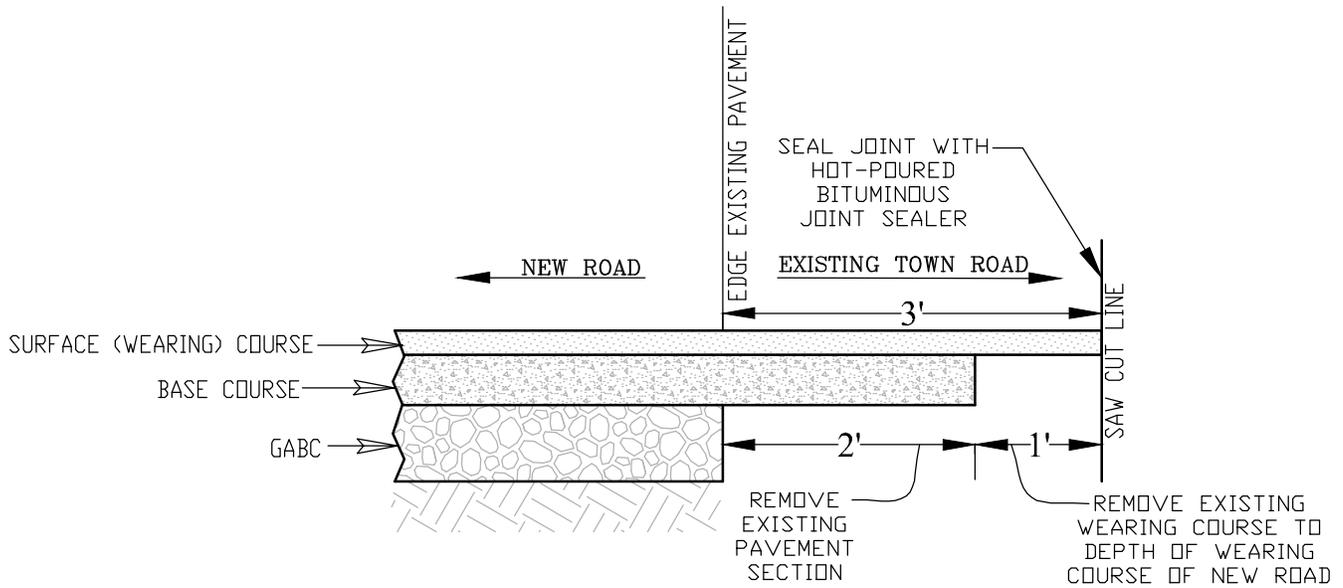
Standard No. **R-10**



NOTES:

1. PAVEMENT SECTION SHALL BE PER SECTION S410 OF THE TOWN OF SMYRNA CONSTRUCTION SPECIFICATIONS.
2. MINIMUM THICKNESS FOR HOT MIX SHALL BE 4 INCHES.
3. WEARING (SURFACE) COURSE SHALL BE HOT MIX ASPHALT SUPERPAVE - 9.5 mm AND BINDER COURSE SHALL BE HOT MIX ASPHALT SUPERPAVE - 12.5 OR 19.0 mm, UNLESS SPECIFIED AND APPROVED ON THE PLANS.
4. DEVELOPMENT MUST BE 75% COMPLETE PRIOR TO PLACEMENT OF WEARING (SURFACE) COURSE.

Issued	08/04	 <p>Department of Public Works</p>	<p align="center">Pavement Section New Construction</p>	
Revised				Street & Road Details
				Standard No. R-11
Source				



Issued	08/04
Revised	
Source	

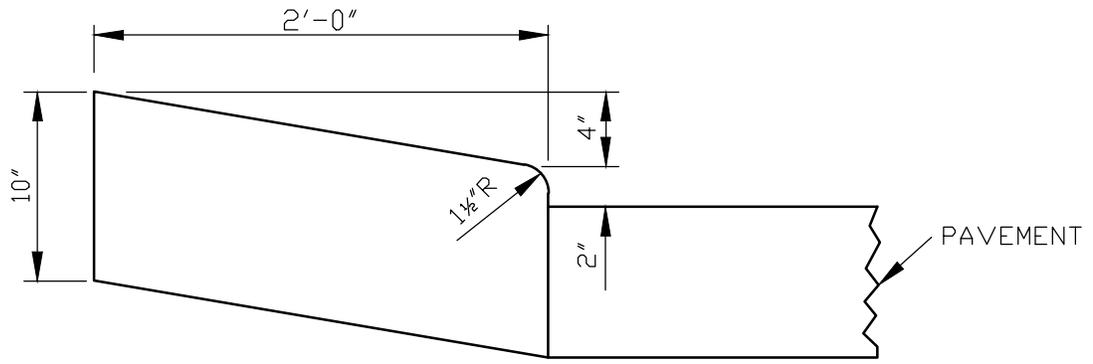


Department of
Public Works

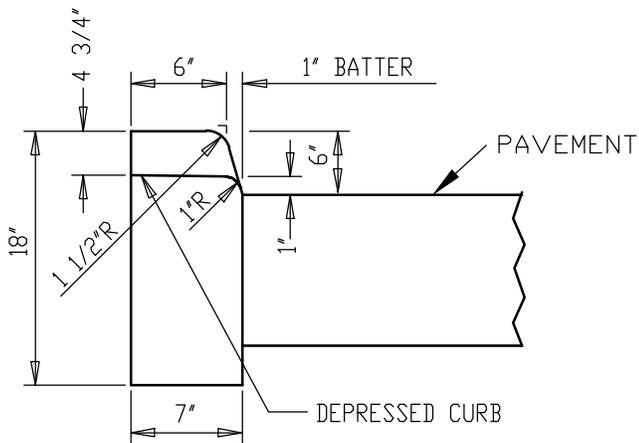
Pavement Tie-in Section

Street & Road Details

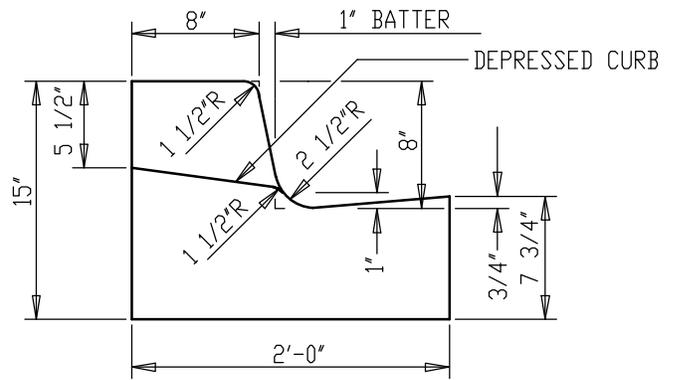
Standard No. R-12



P.C.C. CURB
TYPE 2



MOD. P.C.C. CURB
TYPE 3



MOD. INTEGRAL P.C.C. CURB AND GUTTER
TYPE 3

NOTES: 1. WHEN P.C.C. CURB OR INTEGRAL P.C.C. CURB AND GUTTER IS PLACED ADJACENT TO PORTLAND CEMENT CONCRETE PAVEMENT AND THERE IS A SEPARATION , USE APPROVED JOINT FILLER. TO BE PAID UNDER RESPECTIVE CURB AND GUTTER ITEM.

2. DEPRESS CURB AT DRIVEWAYS.

3. DEPRESS CURB FLUSH WITH PAVEMENT AT CURB RAMPS.

Issued	08/04
Revised	
Source	DELDOT

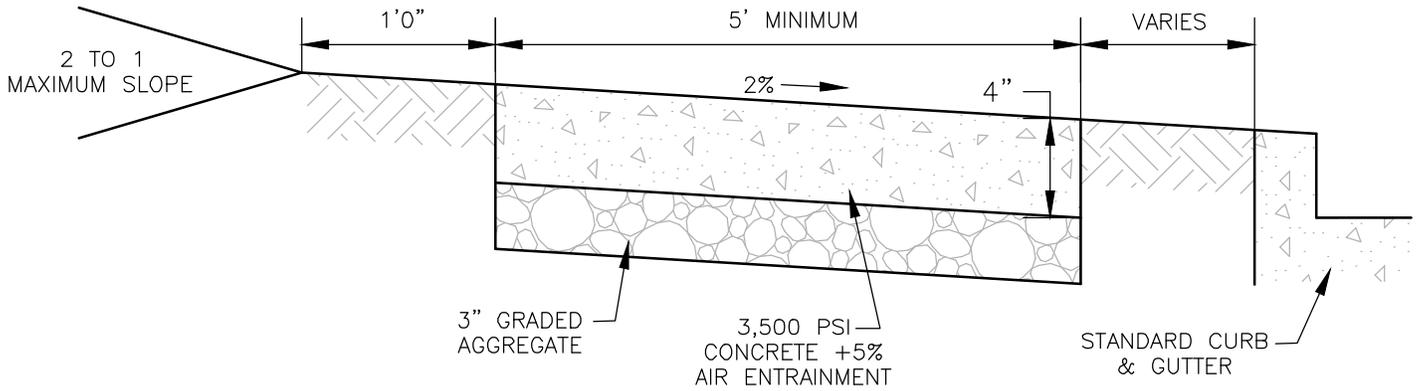


**Department of
Public Works**

CURB DETAIL

Street & Road Details

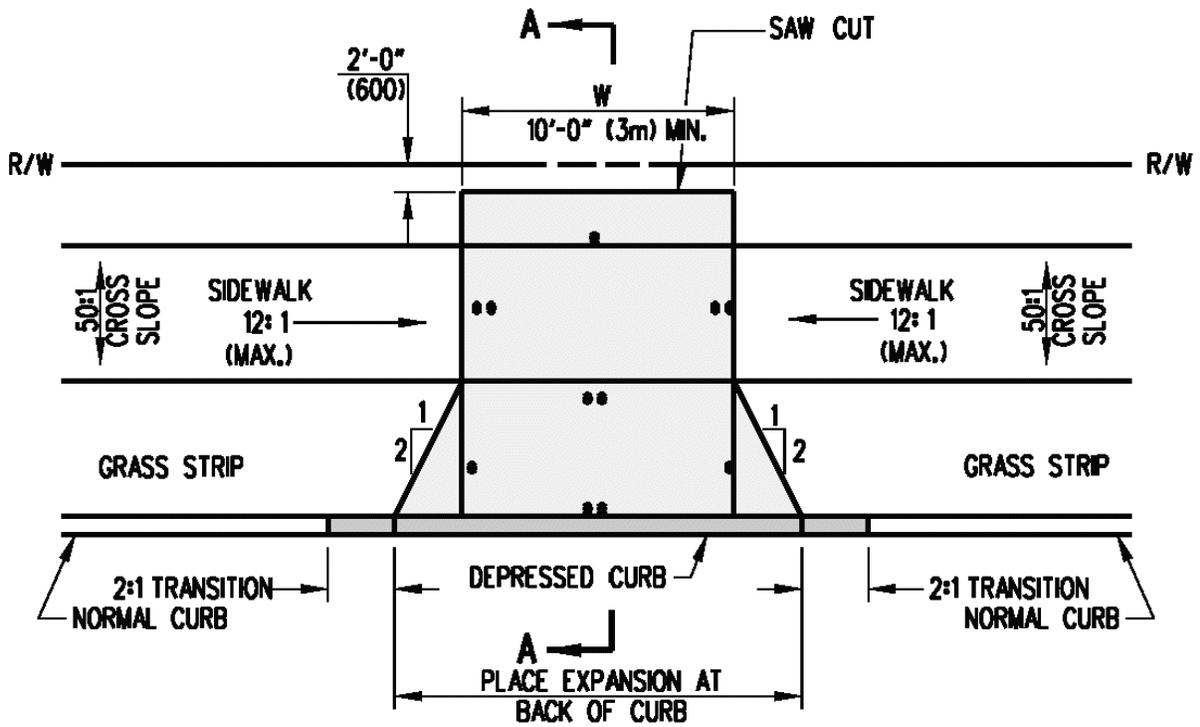
Standard No. **R-13**



NOTES:

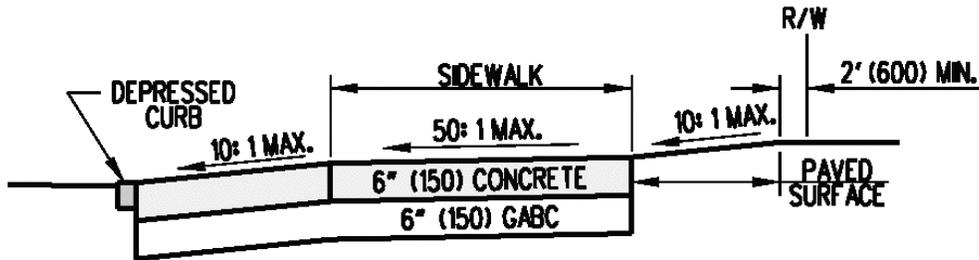
1. TWENTY-EIGHT (28) DAY SPECIFIED COMPRESSIVE STRENGTH FOR CONCRETE MIX @3,500 PSI.
2. ALL SIDEWALK SHALL BE FOUR INCHES (4") MINIMUM THICKNESS, UNLESS OTHERWISE NOTED.
3. SIDEWALK ACROSS DRIVEWAYS AND DRIVEWAY APRONS SHALL BE SIX INCHES (6") MINIMUM THICKNESS OVER 6" GRADED AGGREGATE, UNLESS OTHERWISE NOTED.
4. SIDEWALKS SHALL HAVE DUMMY JOINTS EVERY FOUR FEET (4') AND SHALL HAVE EXPANSION JOINTS INSTALLED EVERY SIXTEEN FEET (16').
5. A PVC SLEEVE OF FOUR INCHES (4") IN DIAMETER, INSTALLED TO A DEPTH OF A LEAST TWELVE INCHES (12") BELOW FINISHED GRADE AND INTO SOIL, SHALL BE PROVIDED FOR EACH SIGN POST LOCATED WITHIN THE SIDEWALK PRIOR TO INSTALLATION OF CONCRETE MIX.
6. ALL UNPAVED AREAS WITHIN RIGHT-OF-WAY SHALL BE SEEDED AND MULCHED WITH A MINIMUM OF SIX INCHES (6") OF TOP SOIL OR SODDED TO OBTAIN A THICK STAND OF GRASS.
7. SIDEWALKS ALONG ARTERIAL, COLLECTOR AND BOULEVARD ROADWAYS SHALL BE A MINIMUM OF FIVE (5) FEET WIDE.

Issued	08/04	 <p>Department of Public Works</p>	SIDEWALK
Revised	10/12		
			Standard No. R-14
Source			



**ENTRANCE WITH SIDEWALK
AND GRASS STRIP**

- - JOINT
- - EXPANSION MATERIAL



SECTION A-A

Issued	08/04
Revised	10/12
Source	DELDOT

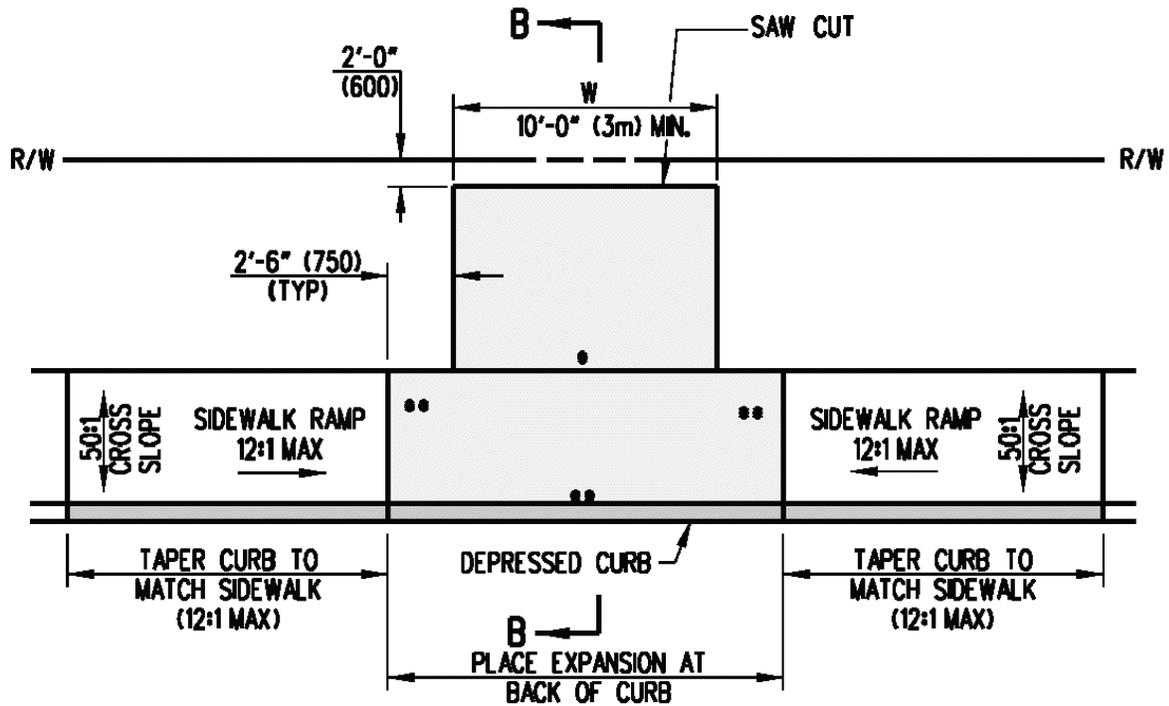


**Department of
Public Works**

**RESIDENTIAL ENTRANCE
(WITH LAWN STRIP)**

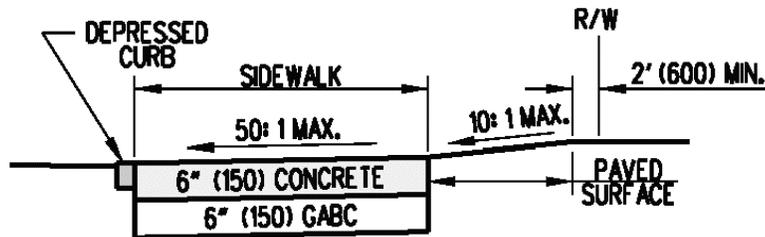
Street & Road Details

Standard No. **R-15**



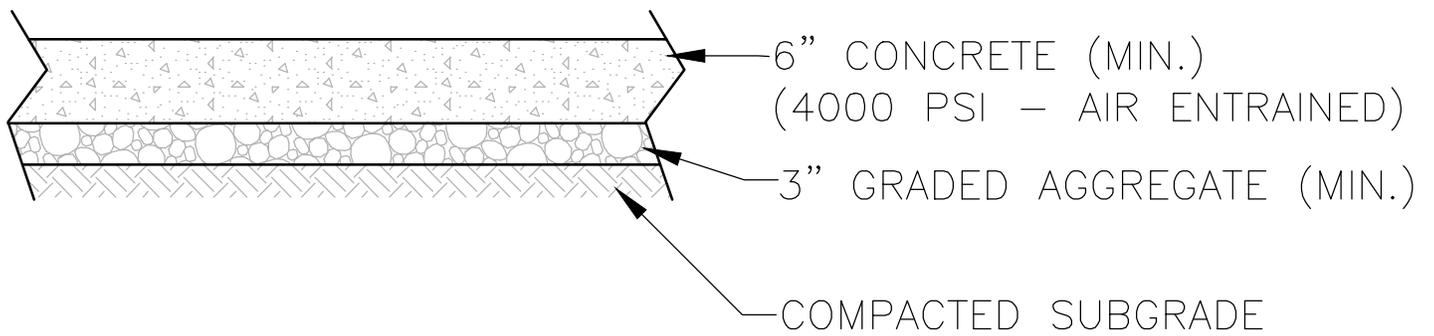
**ENTRANCE WITH SIDEWALK
AND NO GRASS STRIP**

- - JOINT
- - EXPANSION MATERIAL

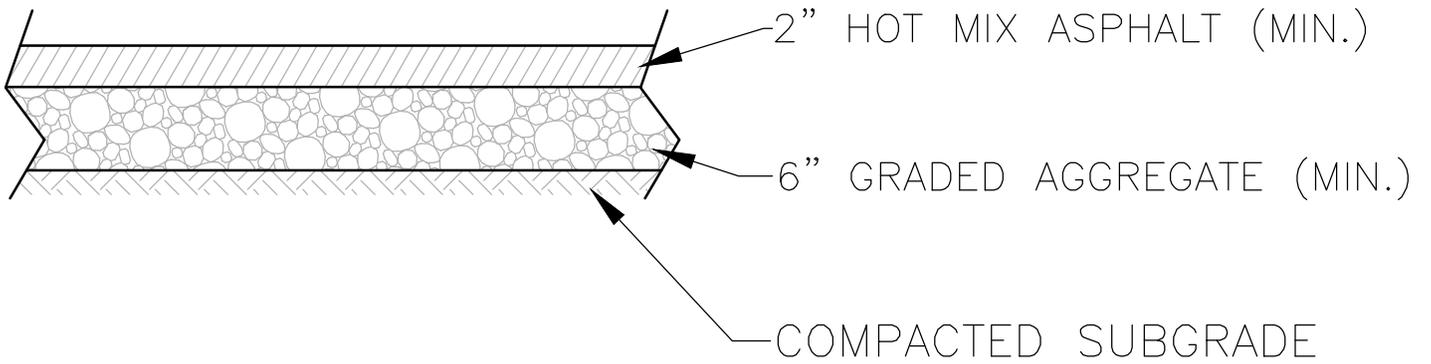


SECTION B-B

Issued	08/04		RESIDENTIAL ENTRANCE (WITHOUT LAWN STRIP)
Revised	10/12		
Source	DELDOT		Department of Public Works



Issued	08/04	 <p>Department of Public Works</p>	<p>RESIDENTIAL DRIVEWAY PAVEMENT SECTION (CONCRETE)</p>
Revised			
			Standard No. R-17
Source			

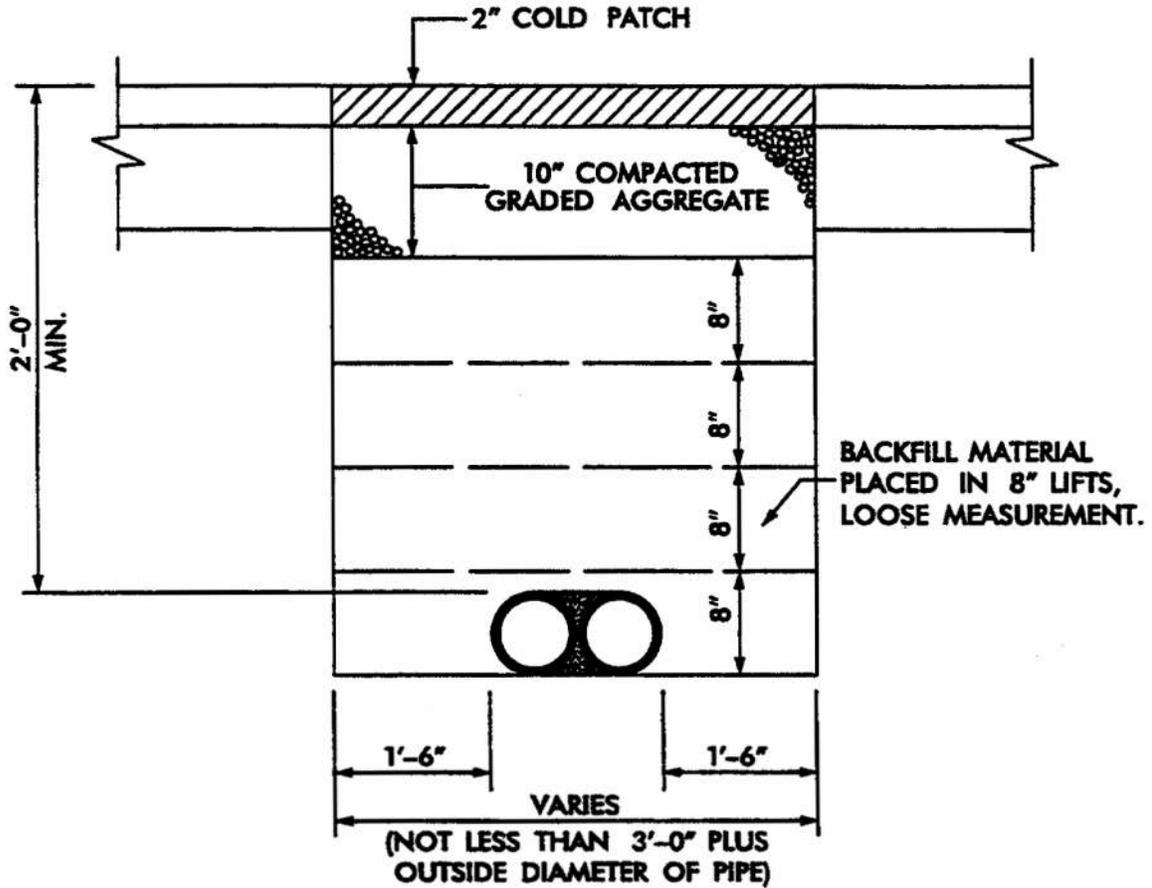


Issued	08/04
Revised	
Source	



RESIDENTIAL DRIVEWAY PAVEMENT SECTION (ASPHALT)
Street & Road Details
Standard No. R-18

**MINIMUM DESIGN REQUIREMENTS
(PUBLIC WORKS DEPARTMENT MAY CHANGE REQUIREMENTS IN SPECIAL CASES)**

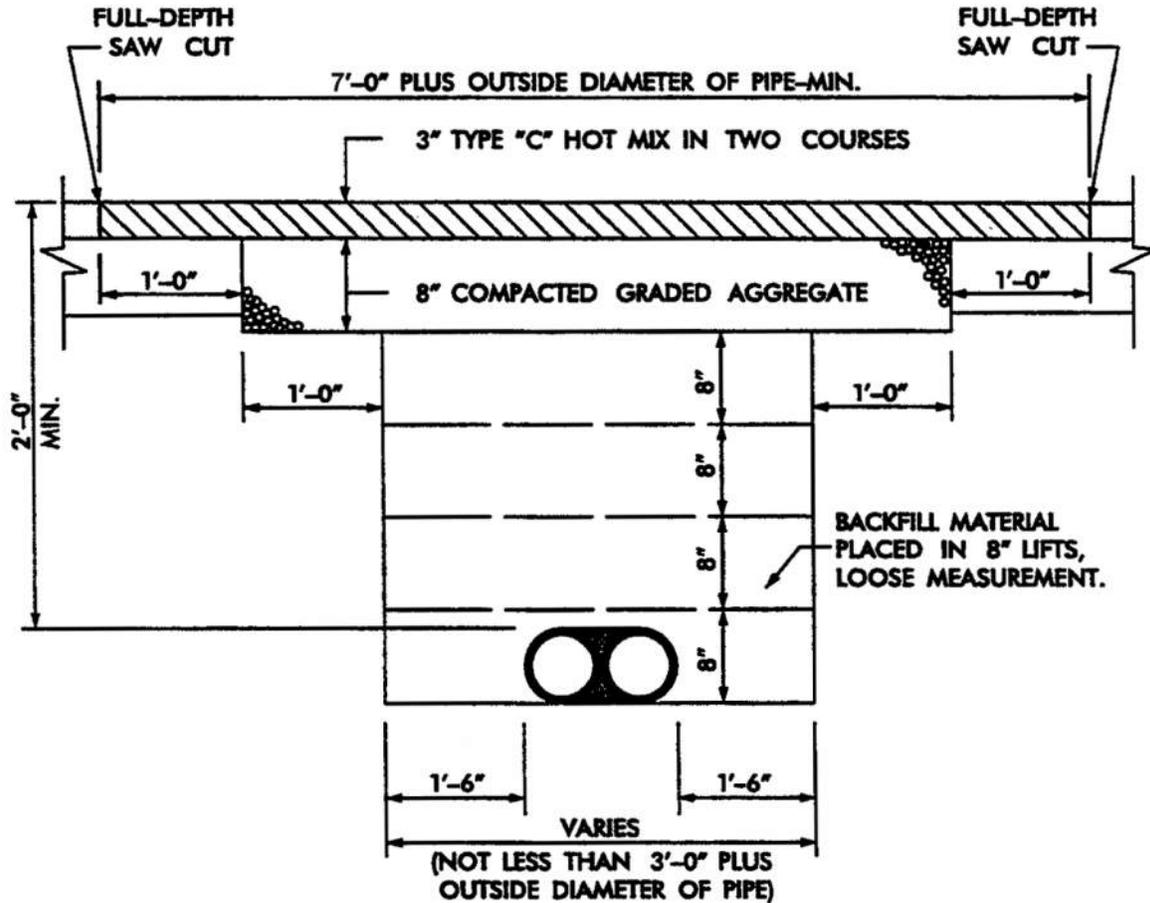


NOTES:

1. ALL MATERIALS AND METHODS OF CONSTRUCTION SHALL MEET THE REQUIREMENTS SET FORTH IN THE CURRENT TOWN OF SMYRNA STANDARD SPECIFICATIONS AND DETAILS FOR STREETS AND ROAD.

Issued	08/04	 <p>Department of Public Works</p>	Temporary Patch
Revised			
			Street & Road Details
Source	DELDOT		Standard No. R-19

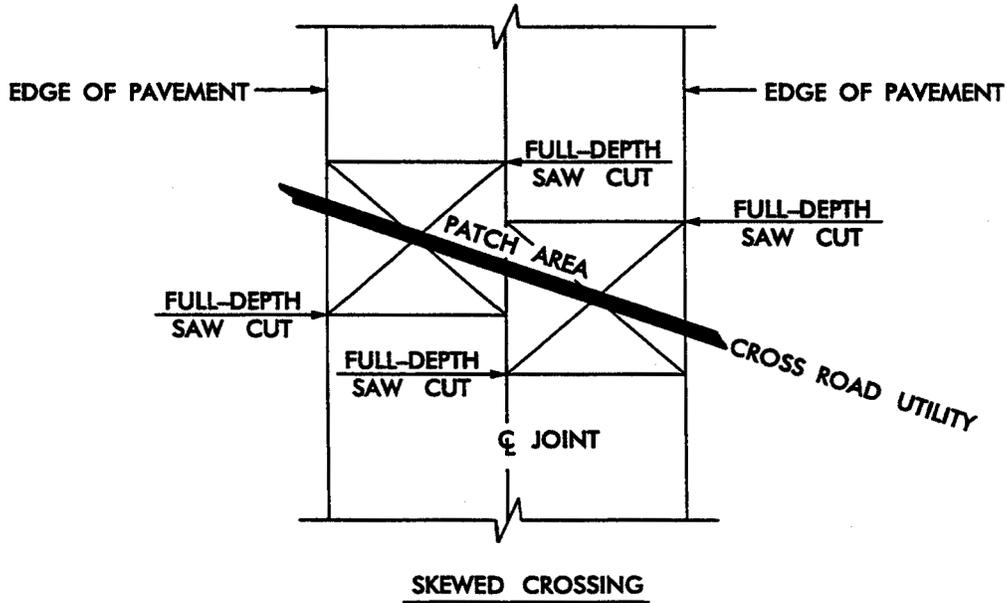
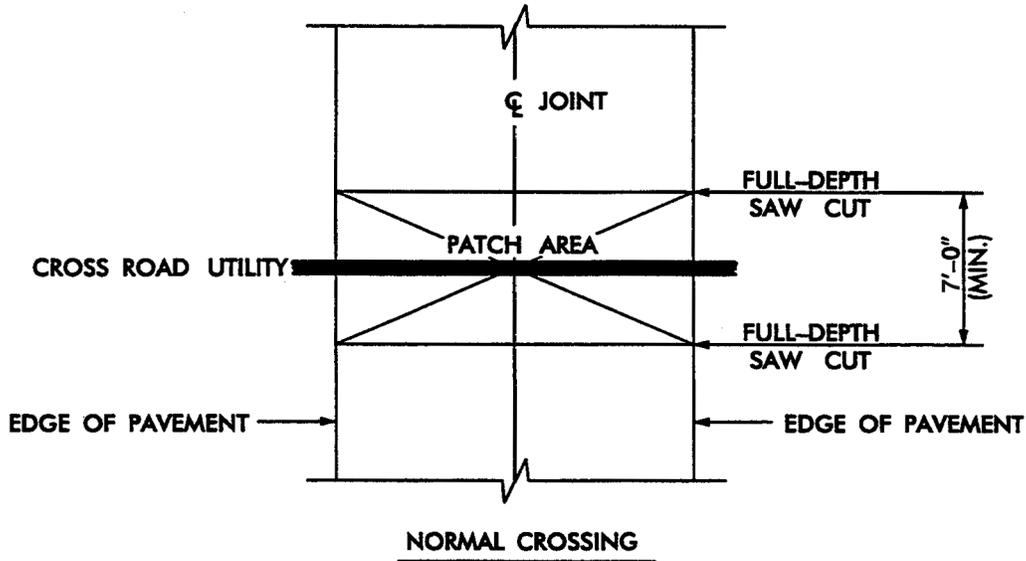
PATCHES MUST HAVE A MINIMUM LENGTH OF 7 FEET PLUS OUTSIDE DIAMETER OF PIPE (AS MEASURED ALONG THE ROADWAY CENTERLINE) AND THE WIDTH OF THE LANE OR LANES DISTURBED.



NOTES:

1. THIS IS A MINIMUM PATCH. IF THE EXISTING ROADWAY HAS A HEAVIER CROSS SECTION THAN SHOWN HERE, IT WILL BE REPLACED WITH THAT CROSS SECTION, OR AS DIRECTED BY THE PUBLIC WORKS DIRECTOR.
2. ALL MATERIALS AND METHODS OF CONSTRUCTION SHALL MEET THE REQUIREMENTS SET FORTH IN THE CURRENT TOWN OF SMYRNA STANDARD SPECIFICATIONS AND DETAILS FOR STREETS AND ROADS.

Issued	08/04		<p align="center">Minimum Permanent Cross-Road or Longitudinal Patch for Surface Treatments or Hot Mix Pavements</p>
Revised			
Source	DELDOT		<p>Department of Public Works</p>



NOTES:

1. ALL SAW CUTS ARE TO BE FULL DEPTH, PERPENDICULAR TO THE LONGITUDINAL CENTERLINE OF THE TRAVELED WAY, AND PERPENDICULAR TO THE PLANE OF THE FINISHED SUBGRADE.
2. PATCHES ARE TO BE A MINIMUM OF 7 FEET LONG AS MEASURED ALONG THE ROADWAY CENTERLINE (AS INDICATED BY DETAIL R-20).
3. SKEWED CROSSING PERMITTED ONLY BY EXCEPTION.

Issued	08/04
Revised	
Source	DELDOT

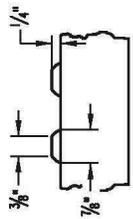
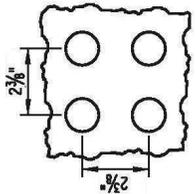
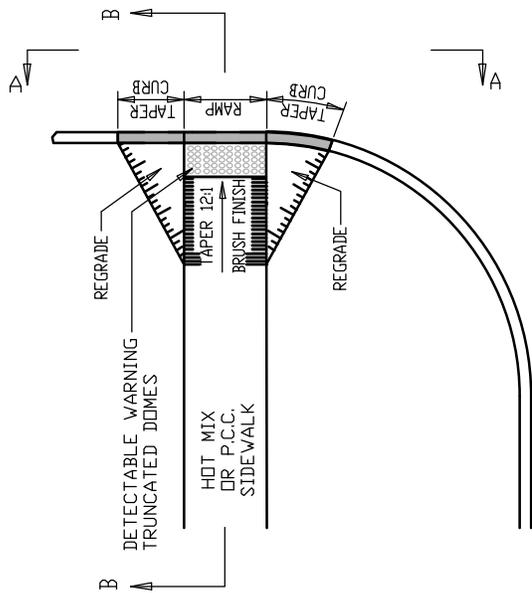


**Department of
Public Works**

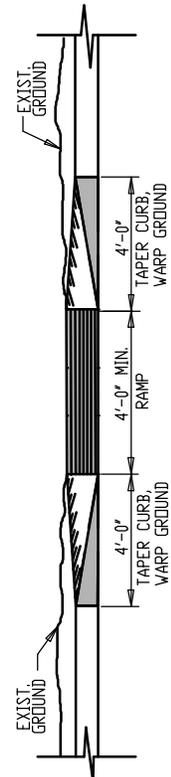
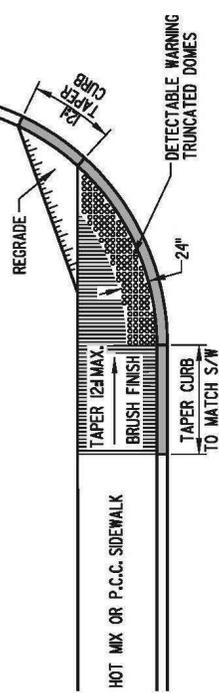
Cross-road Cuts for Utilites

Street & Road Details

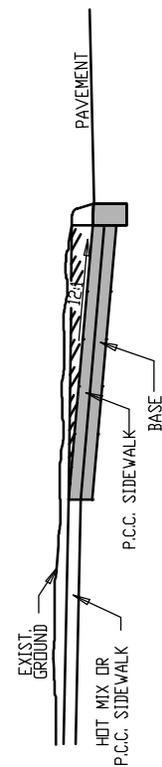
Standard No. **R-21**



DETECTABLE WARNINGS - TRUNCATED DOME DETAILS
 NOTE: SEE SPECIFICATION FOR ADDITIONAL INFORMATION



SECTION A-A
 N.T.S.



SECTION B-B
 N.T.S.

Issued	08/04
Revised	
Source	DELDOT

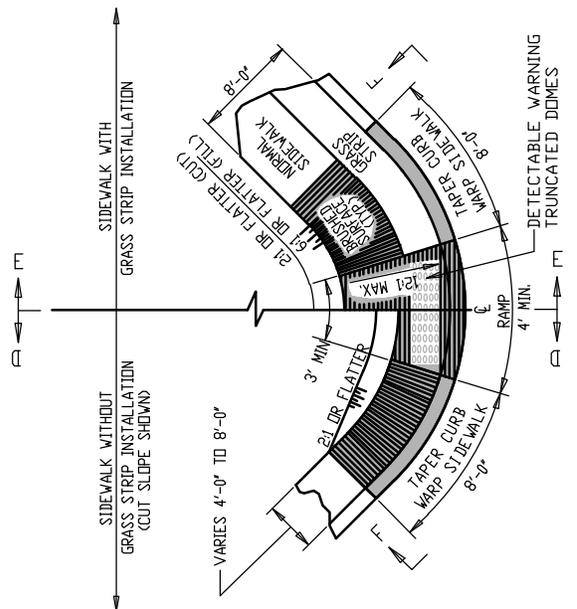


Department of Public Works

Curb Ramp - (Type 1)

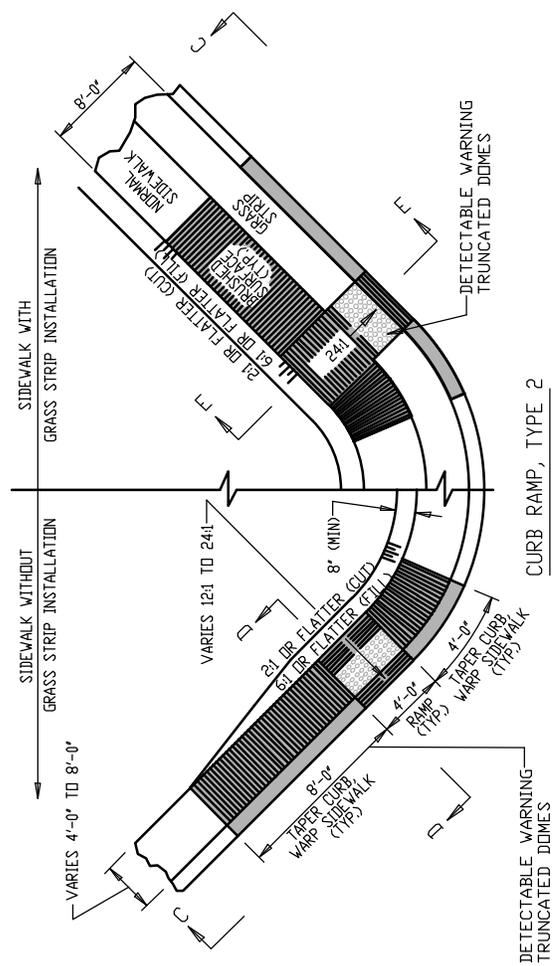
Street & Road Details

Standard No. R-22

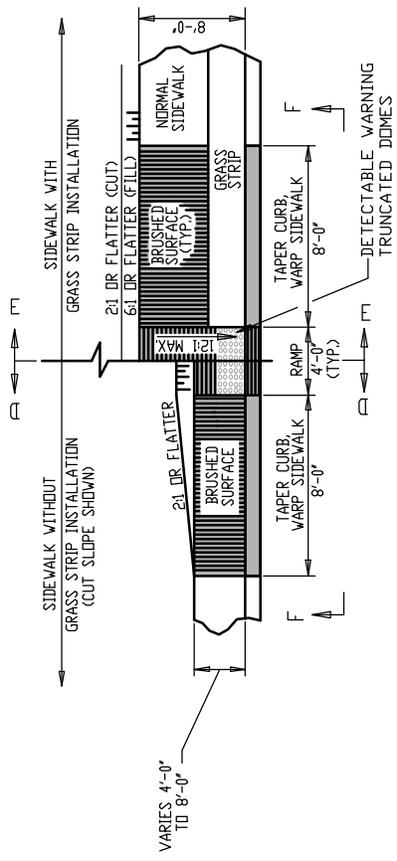


CURB RAMP, TYPE 3

NOTE: THE INSTALLATION SHOWN IS FOR 8" CURB. FOR 4" CURB AND LESS, HOLD THE BACK EDGE OF THE SIDEWALK LEVEL AND DEPRESS ALONG THE FRONT EDGE.



CURB RAMP, TYPE 2



CURB RAMP, TYPE 4

Issued	08/04
Revised	
Source	DELDOT

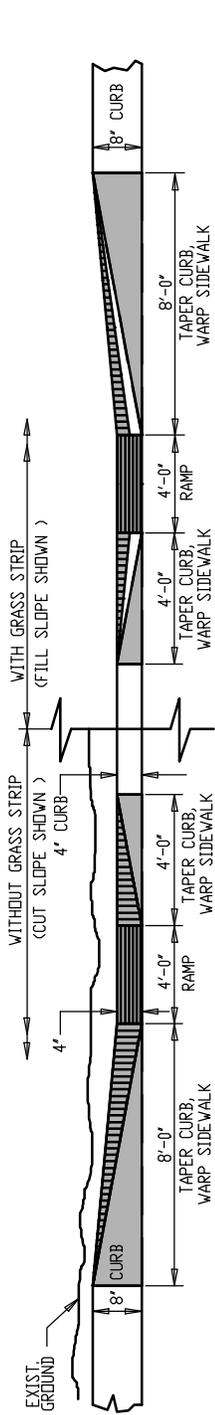


Department of Public Works

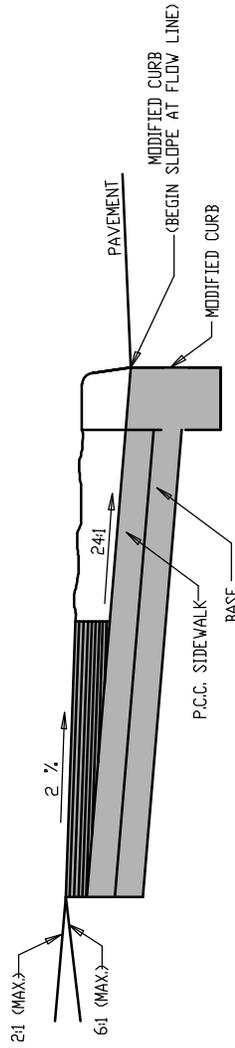
Curb Ramp - (Types 2, 3 and 4)

Street & Road Details

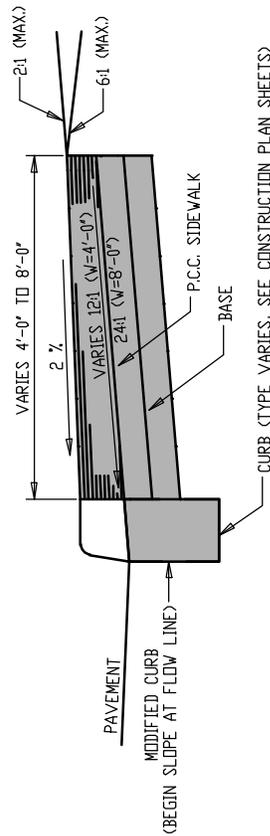
Standard No. R-23



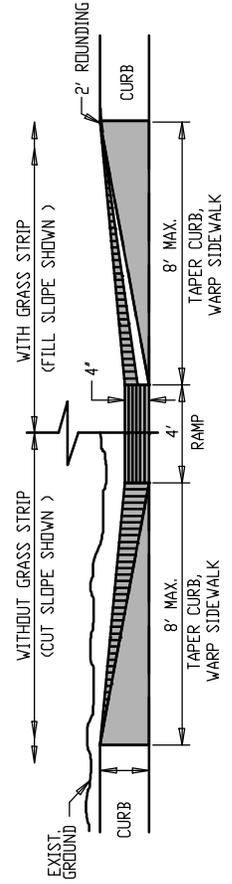
SECTION C-C



SECTION E-E



SECTION D-D



SECTION F-F

Issued	08/04
Revised	
Source	DELDOT

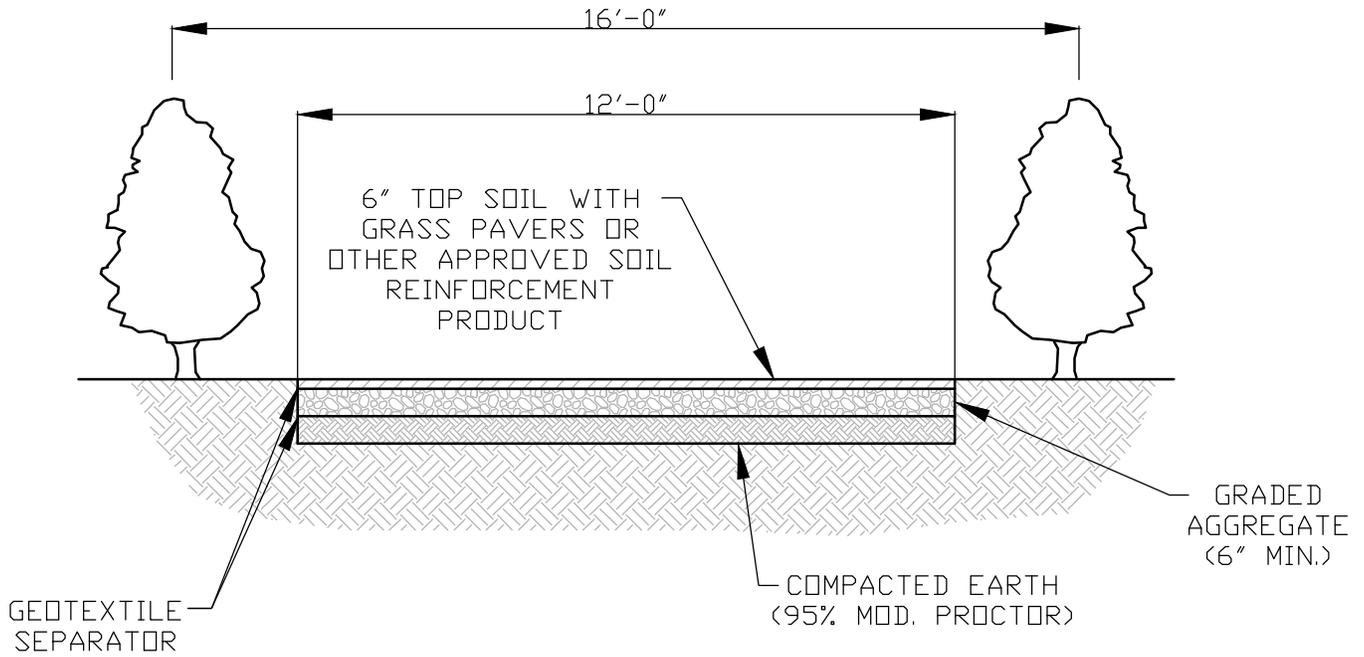


Department of Public Works

Curb Ramp - Sections for (Types 2, 3 and 4)

Street & Road Details

Standard No. R-24



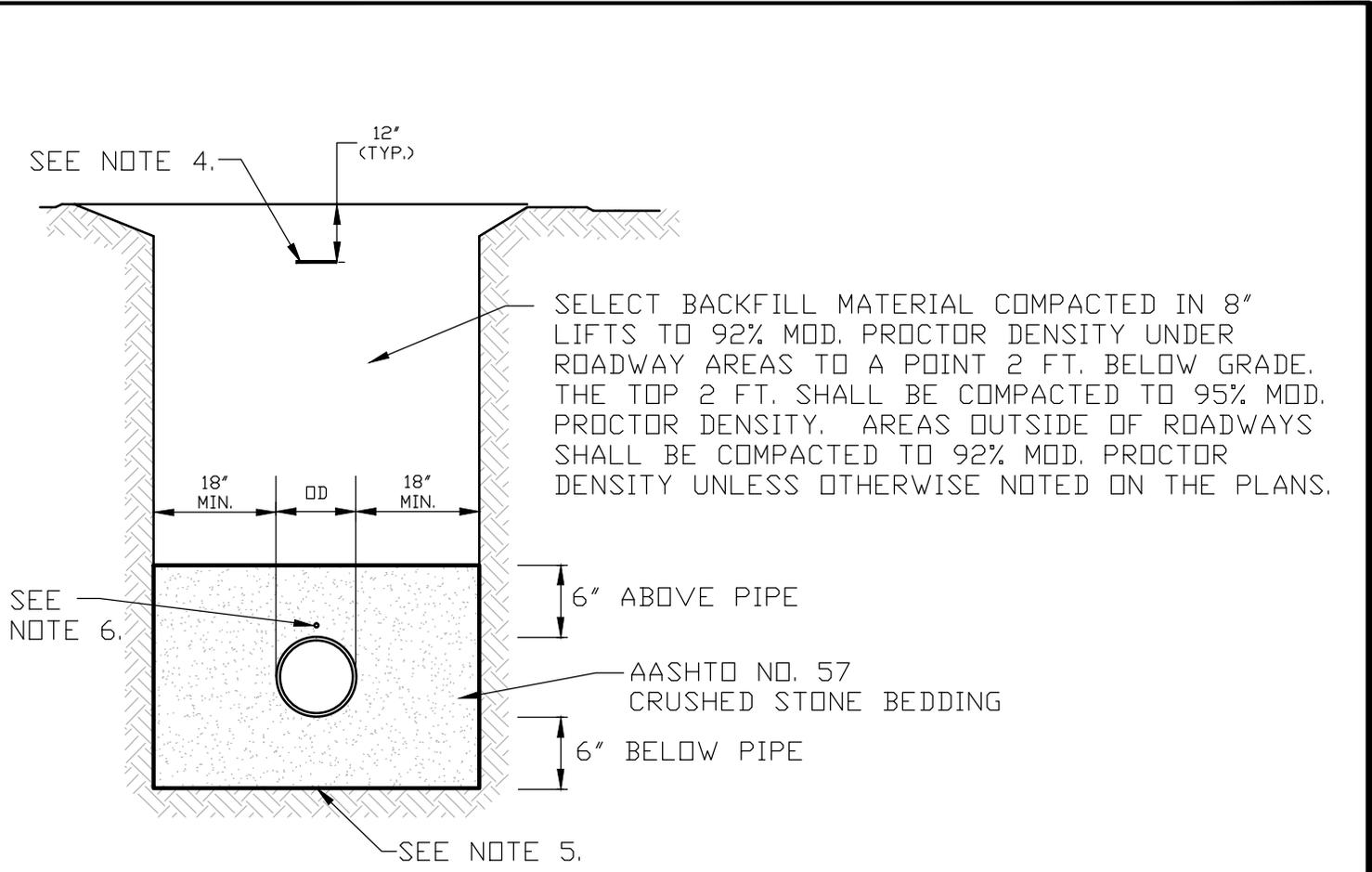
NOTES:

1. MINIMUM WIDTH: 16'-0"
2. TREES/SHRUBS: MINIMUM 3'-0" MAXIMUM 5'-0" IN HEIGHT AT 20'-0" O.C.
3. REFER TO DELAWARE STATE FIRE PREVENTION REGULATIONS FOR ALL REQUIREMENTS.
4. GEOTEXTILE SEPARATOR TO BE INSTALLED BOTH ABOVE AND BELOW GRADED AGGREGATE BASE.

Issued	08/04	 <p>Department of Public Works</p>	Forestry Lane
Revised			Street & Road Details
Source	DELDOT		Standard No. R-26

Category S

Sanitary Sewer Systems



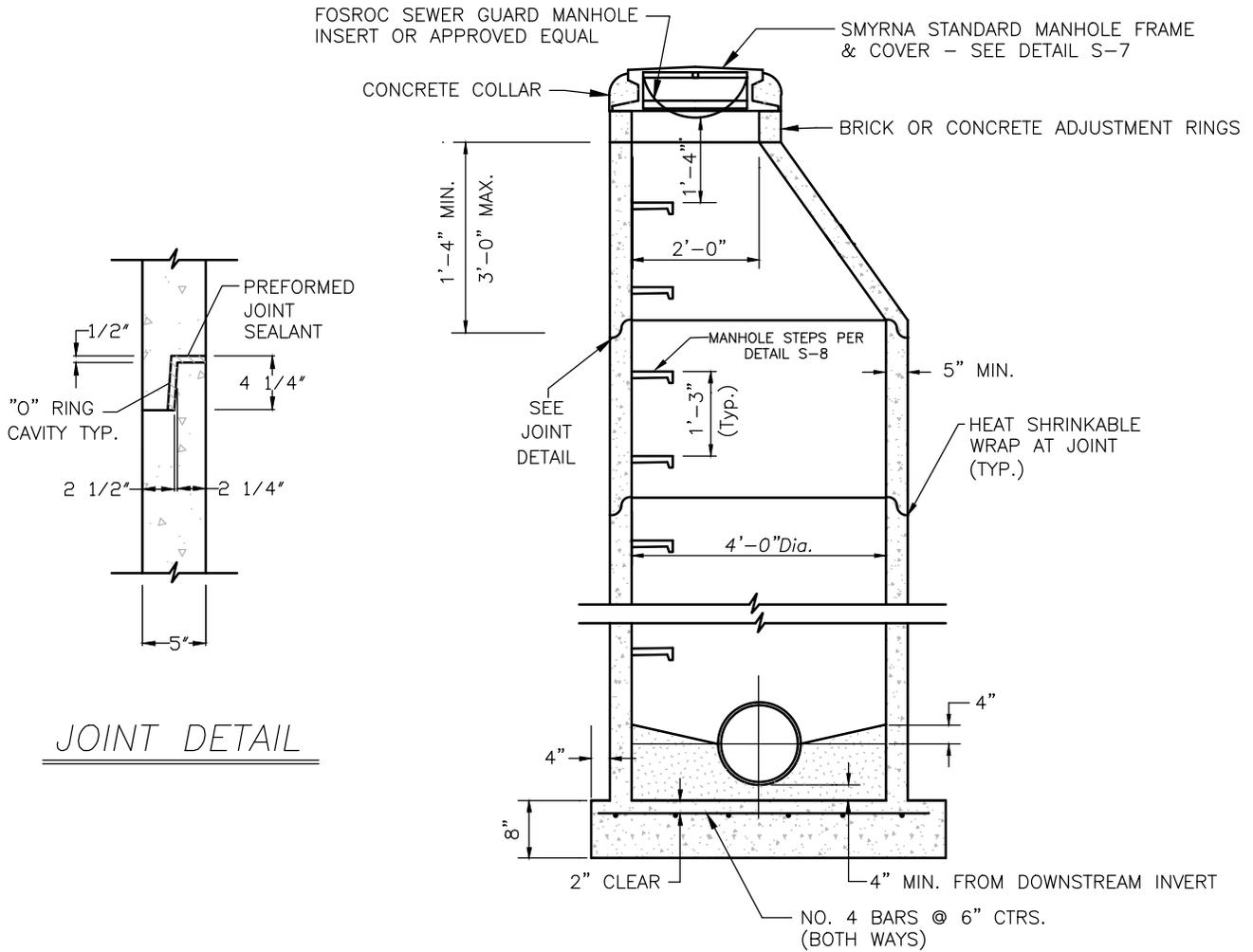
NOTES:

1. TRENCH SHALL BE BRACED OR SHEETED IN ACCORDANCE WITH OSHA REGULATIONS.
2. PROVIDE BEARING FULL LENGTH OF BARREL.
3. DIG BELL HOLES.
4. INSTALL METALLIC DETECTOR TAPE FOR GRAVITY MAINS AND LATERALS LOCATED OUTSIDE THE ROAD RIGHT-OF-WAY AND FORCEMAINS PER SPECS AT 1' BELOW FINISHED GRADE.
5. GEOTEXTILE FABRIC (MIRAFI 600X OR APPROVED EQUAL) TO SURROUND STONE BEDDING. OVERLAP A MINIMUM OF 12".
6. INSTALL INSULATED COPPER AWG #10 DETECTOR WIRE ON TOP OF PIPE. (PROVIDE ACCESS FOR MONITORING AS PER SPECIFICATIONS.)

Issued	08/04
Revised	10/12
	06/17
Source	



Pipe Bedding and Trench Detail
Sanitary Sewer Details
Standard No. S-1



JOINT DETAIL

PRECAST MANHOLE NOTES

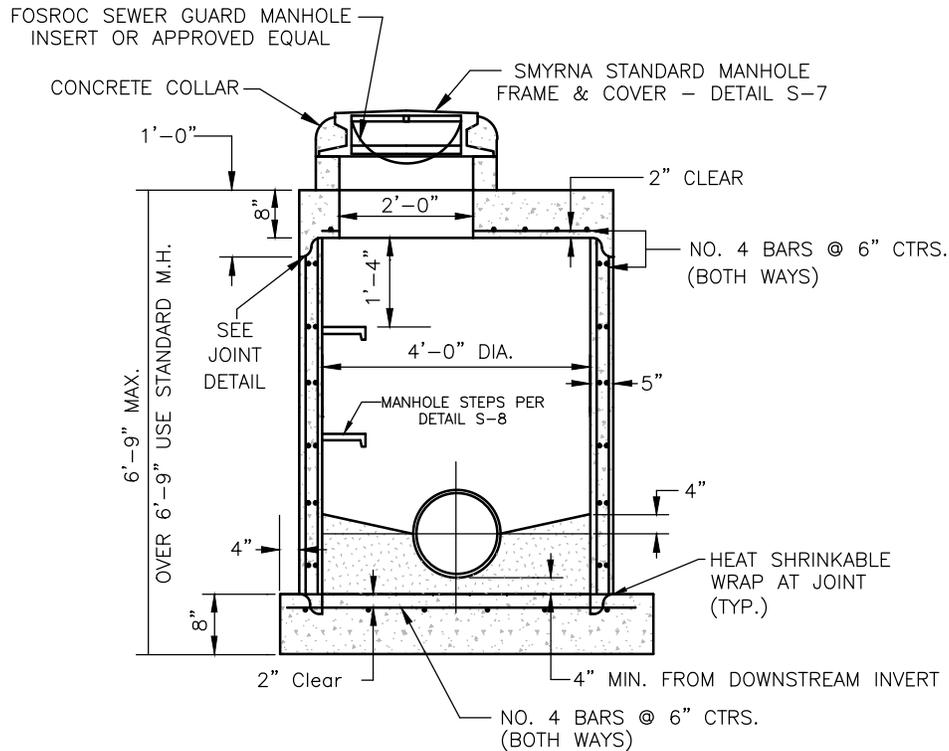
1. THE INSIDE DIAMETER OF THE MANHOLE SHALL BE 4'-0" FOR PIPE DIAMETERS FROM 8" THRU 24".
2. THE MANHOLE SHALL BE 4,000 PSI CONCRETE MINIMUM.
3. WHERE PIPE COVER IS MORE THAN 4.5' USE STANDARD MANHOLE (DETAIL S-2). 4.5' OR LESS, USE SHALLOW MANHOLE. (DETAIL S-3)
4. REINFORCEMENT IN ALL SECTIONS SHALL EQUAL OR EXCEED A.S.T.M. C-478 SPECIFICATIONS. (MIN. YIELD STRENGTH OF 60 KSI)
5. PROVIDE PIPE TO MANHOLE SEAL: A-LOK GASKET (OR APPROVED EQUAL) PER A.S.T.M. SPEC. C443, CAST INTEGRALLY IN MANHOLE WALL AND LOCATED AS DIRECTED. GASKET DESIGNED TO MEET TEST AND PERFORMANCE REQUIREMENTS OF A.S.T.M. SPEC. C425.
6. MANHOLE BENCH SHALL BE SHOP CAST OR FIELD POURED CONCRETE - 4,000 PSI MIN.
7. JOINT SEALANT SHALL BE BUTYL RUBBER PER A.S.T.M. C-990.

Issued	08/04
Revised	10/12
	06/17
Source	



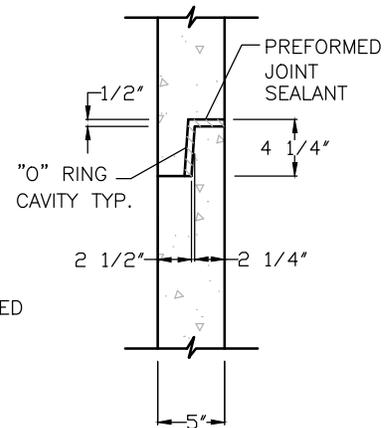
Department of Public Works

Standard Precast Concrete Manhole
Sanitary Sewer Details
Standard No. S-2



Precast Manhole Notes

1. THE INSIDE DIAMETER OF THE MANHOLE SHALL BE 4'-0" FOR PIPE DIAMETERS FROM 8" THRU 24".
2. THE MANHOLE SHALL BE 4,000 PSI CONCRETE MINIMUM.
3. WHERE PIPE COVER IS MORE THAN 4.5' USE STANDARD MANHOLE (DETAIL S-2). 4.5' OR LESS, USE SHALLOW MANHOLE. (DETAIL S-3)
4. REINFORCEMENT IN ALL SECTIONS SHALL EQUAL OR EXCEED A.S.T.M. C-478 SPECIFICATIONS. (MIN. YIELD STRENGTH OF 60 KSI)
5. PROVIDE PIPE TO MANHOLE SEAL: A-LOK GASKET (OR APPROVED EQUAL) PER A.S.T.M. SPEC. C443, CAST INTEGRALLY IN MANHOLE WALL AND LOCATED AS DIRECTED. GASKET DESIGNED TO MEET TEST AND PERFORMANCE REQUIREMENTS OF A.S.T.M. SPEC. C425. JOINT TO ALLOW 10" OMNIDIRECTIONAL DEFLECTION.
6. MANHOLE BENCH SHALL BE SHOP CAST OR FIELD POURED CONCRETE - 4,000 PSI MIN.
7. JOINT SEALANT SHALL BE BUTYL RUBBER PER A.S.T.M. C-990.



JOINT DETAIL

Issued	08/04
Revised	10/12
	06/17
Source	



Department of Public Works

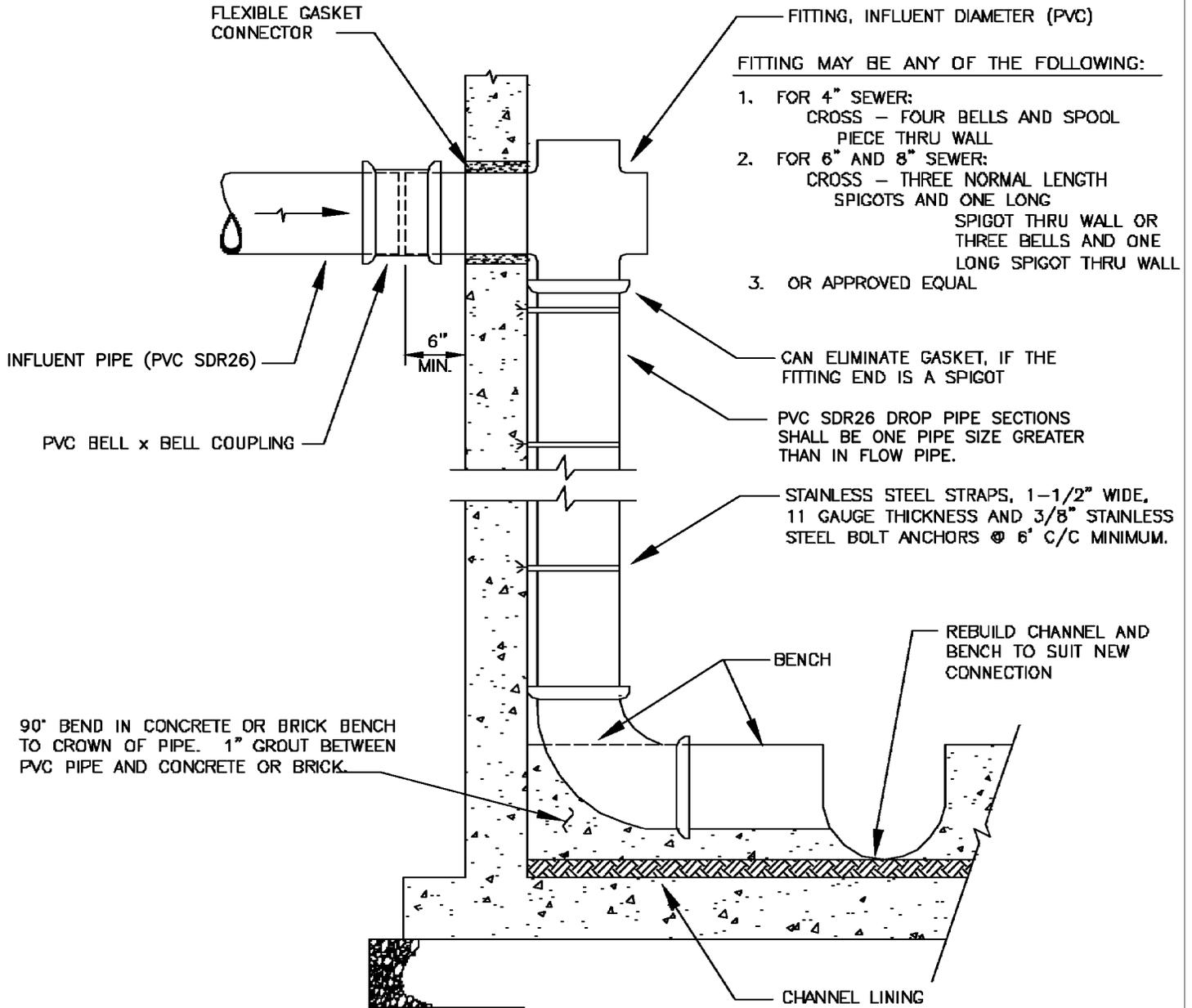
Shallow Precast Concrete Manhole

Sanitary Sewer Details

Standard No. **S-3**

NOTES:

1. ONLY ONE INSIDE DROP CONNECTION PER MANHOLE WILL BE ALLOWED, UNLESS APPROVED BY THE TOWN.
2. THE DROP FITTING SHALL NOT EXTEND INTO THE AREA THAT IS DEFINED BY THE PROJECTION OF THE MANHOLE ENTRANCE VERTICALLY DOWN TO THE MANHOLE BOTTOM. IF NECESSARY, MANHOLE FRAME, COVER, CONE SECTION, AND STEPS SHALL BE REMOVED AND PLACED TO ALLOW FOR UNOBSTRUCTED ENTRY AND EXIT.
3. INFLUENT PIPE SLOPE SHALL NOT EXCEED 5%.
4. FOR INFLUENT PIPE DIAMETER OVER 10", CONSULT THE TOWN FOR MINIMUM MANHOLE DIAMETER.
5. PROPOSED MANHOLE WITH INSIDE DROP MUST BE A MIN. OF 5' IN DIAMETER. INSIDE DROPS PROPOSED AT AN EXISTING MANHOLE OF LESS THAN 5' DIAMETER WILL BE REVIEWED ON A CASE BY CASE BASIS.



Issued	08/04
Revised	10/12
Source	

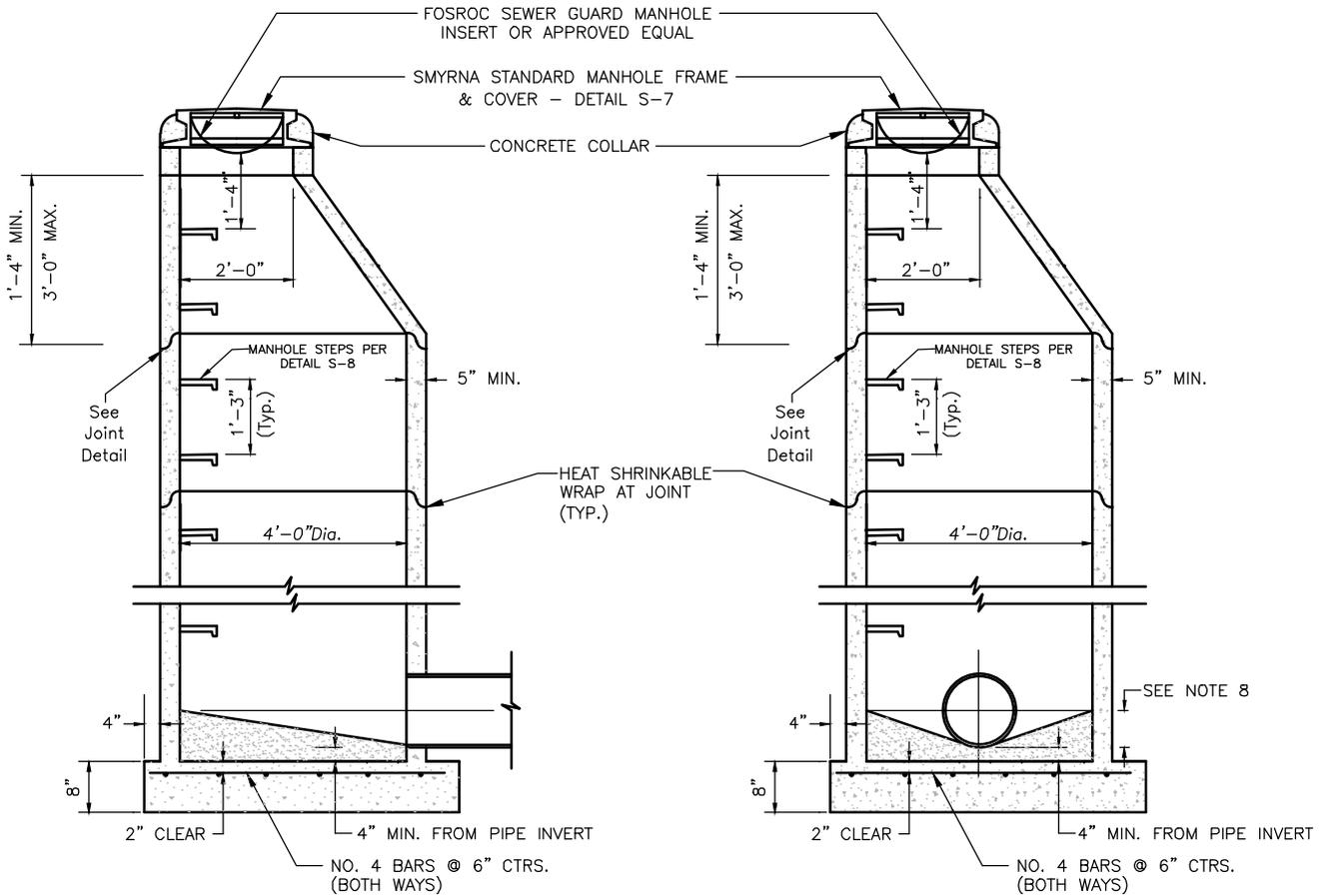


**Department of
Public Works**

Inside Drop Manhole Connection

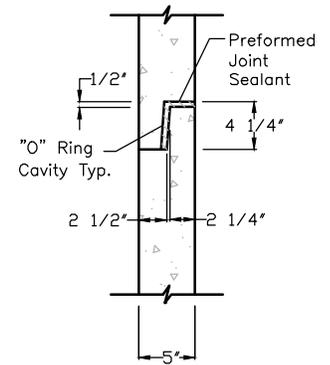
Sanitary Sewer Details

Standard No. S-4



PRECAST MANHOLE NOTES

1. THE INSIDE DIAMETER OF THE MANHOLE SHALL BE 4'-0" FOR PIPE DIAMETERS FROM 8" THRU 24".
2. THE MANHOLE SHALL BE 4,000 PSI CONCRETE MINIMUM.
3. WHERE PIPE COVER IS MORE THAN 4.5' USE STANDARD MANHOLE (DETAIL S-2). 4.5' OR LESS, USE SHALLOW MANHOLE (DETAIL S-3).
4. REINFORCEMENT IN ALL SECTIONS SHALL EQUAL OR EXCEED A.S.T.M. C-478 SPECIFICATIONS (MIN YIELD STRENGTH OF 60 KSI).
5. PROVIDE PIPE TO MANHOLE SEAL: A-LOK GASKET (OR APPROVED EQUAL) PER A.S.T.M. SPEC. C443, CAST INTEGRALLY IN MANHOLE WALL AND LOCATED AS DIRECTED. GASKET DESIGNED TO MEET TEST AND PERFORMANCE REQUIREMENTS OF A.S.T.M. SPEC. C425. JOINT TO ALLOW 10" OMNIDIRECTIONAL DEFLECTION.
6. MANHOLE BENCH SHALL BE SHOP CAST OR FIELD POURED CONCRETE - 4,000 PSI MIN.
7. JOINT SEALANT SHALL BE BUTYL RUBBER PER A.S.T.M. C-990.
8. MAXIMUM DROP ACROSS CHANNEL SHALL BE 4".



JOINT DETAIL

Issued	08/04
Revised	10/12
	06/17
Source	

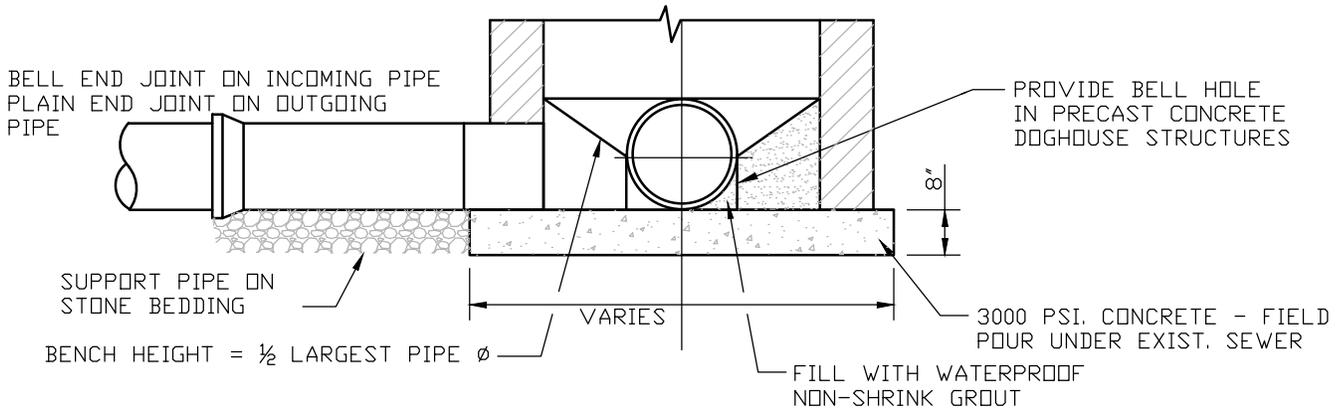
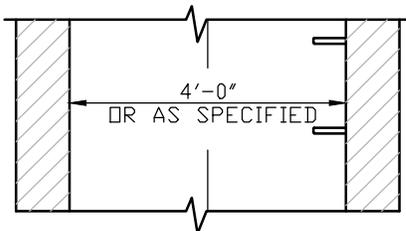
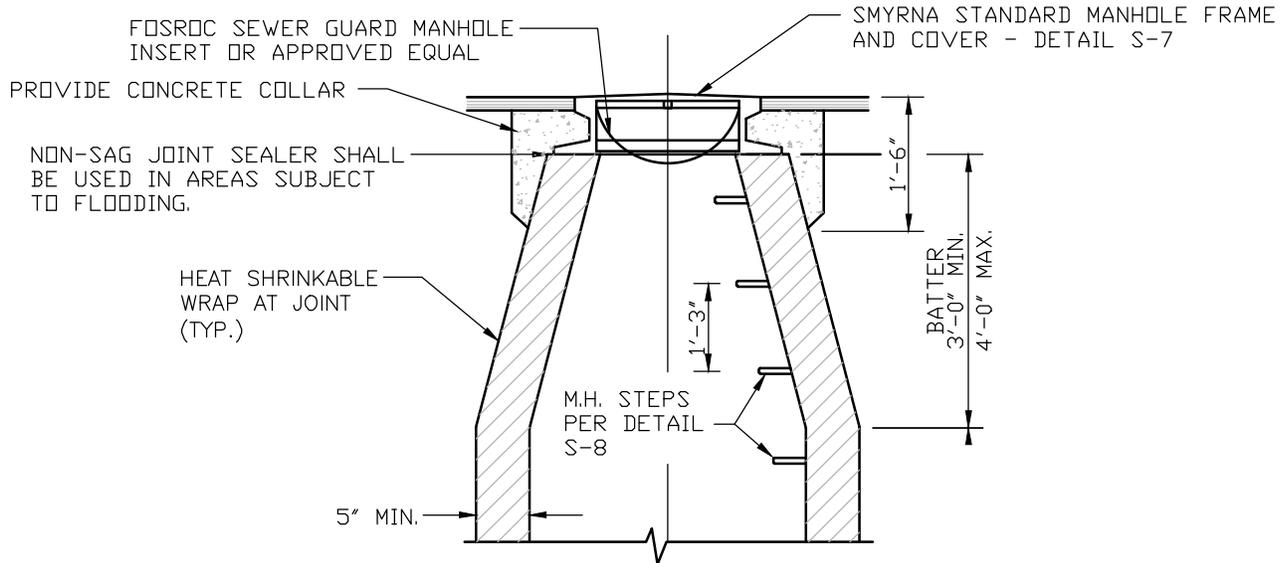


Department of Public Works

Terminal Manhole

Sanitary Sewer Details

Standard No. **S-5**



NOTES:

1. BENCH SHALL BE POURED IN PLACE CONCRETE, 4000 PSI MIN.
2. CHANNELS FOR RECEIVING AND PASSING WATER SHALL BE FORMED AS SHOWN OR DIRECTED. ALL SUCH CHANNELS SHALL BE LINED WITH BRICK OR SPLIT PIPE.
3. WHERE STUBS OR KNOCK-OUTS ARE PROVIDED FOR FUTURE CONNECTIONS, BENCH SHALL BE SO FORMED.
4. EXISTING FLOWS SHALL NOT BE INTERRUPTED.
5. CONSTRUCTION OF MANHOLE SHALL BE COMPLETED PRIOR TO THE CUTTING AND REMOVAL OF EXISTING PIPE.

Issued	08/04
Revised	10/12
	06/17
Source	



Department of Public Works

Precast Concrete Doghouse Manhole for Installation on Existing Sewer 8" through 24"

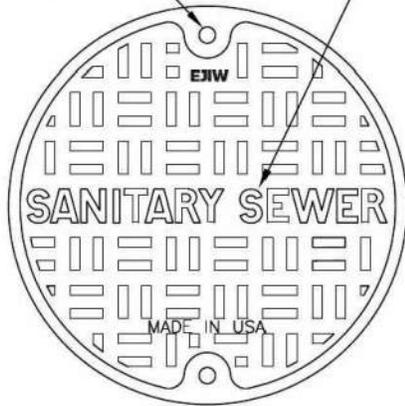
Sanitary Sewer Details

Standard No. **S-6**

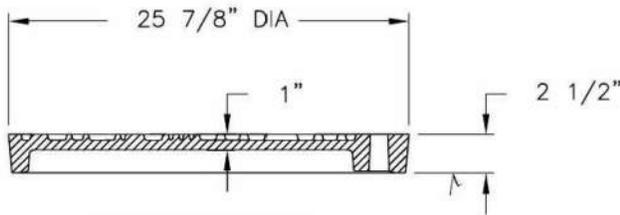
1544 Cover / Lid



1 1/8" DIA PICKHOLES 2" RAISED LETTERS



BOTTOM VIEW



COVER SECTION

Product Number
00154423

Design Features

- Materials
Gray Iron (CL35)
- Design Load
Heavy Duty
- Open Area
n/a
- Coating
Dipped
- Designates Machined Surface

Certification

- ASTM A48
-
- Country of Origin: USA

Drawing Revision

07/19/2005 Designer: JIJ
01/09/2012 Revised By: SDC

Disclaimer

Weights (lbs./kg) dimensions (inches/mm) and drawings provided for your guidance. We reserve the right to modify specifications without prior notice.

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Contact

800 626 4653
ejco.com

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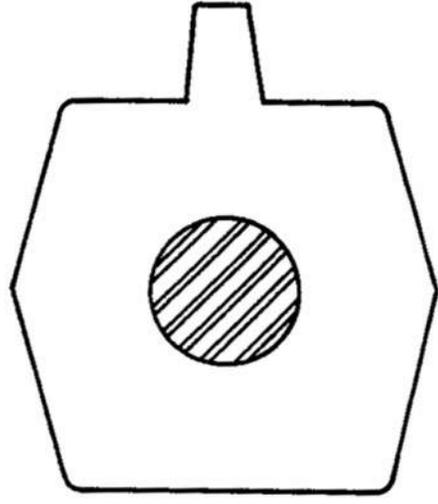
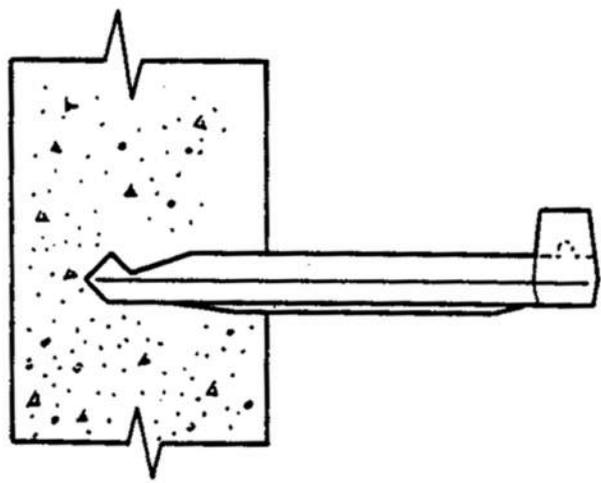
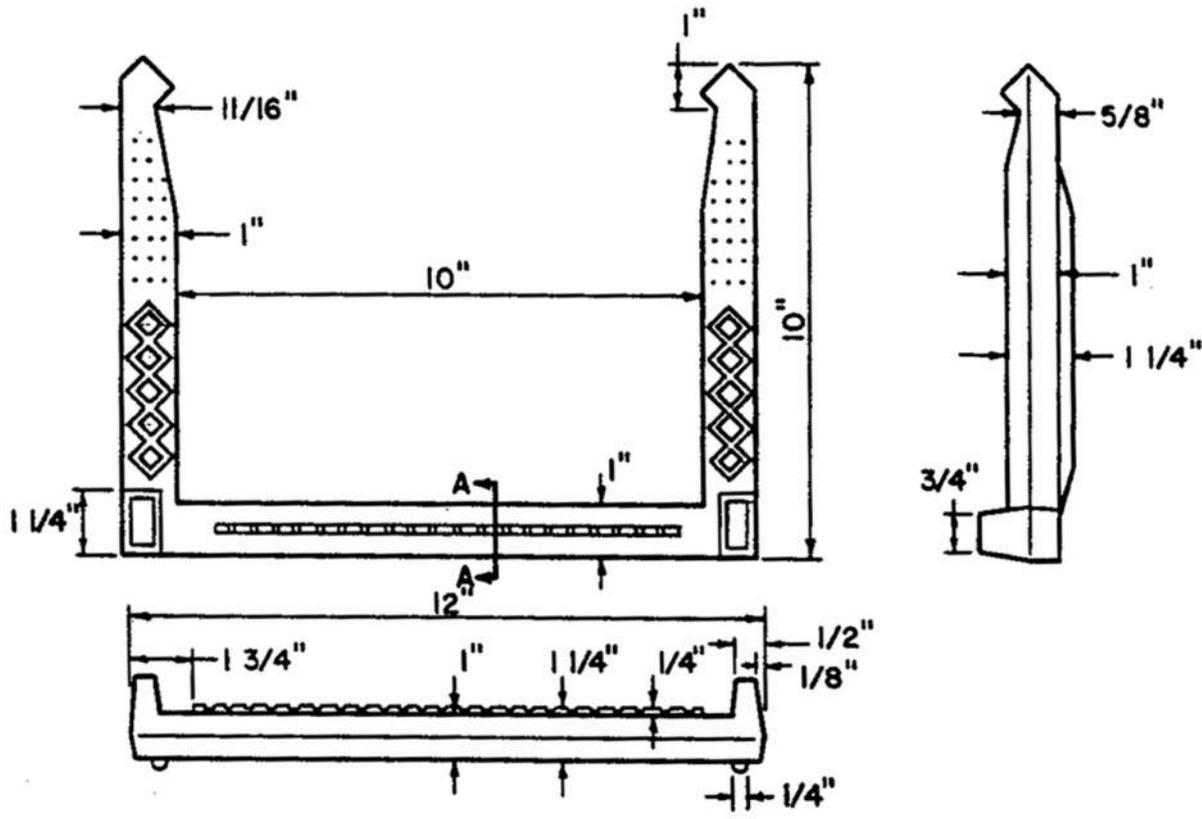


**Department of
Public Works**

Standard Manhole Frame and Cover

Sanitary Sewer Details

Standard No. **S-7**



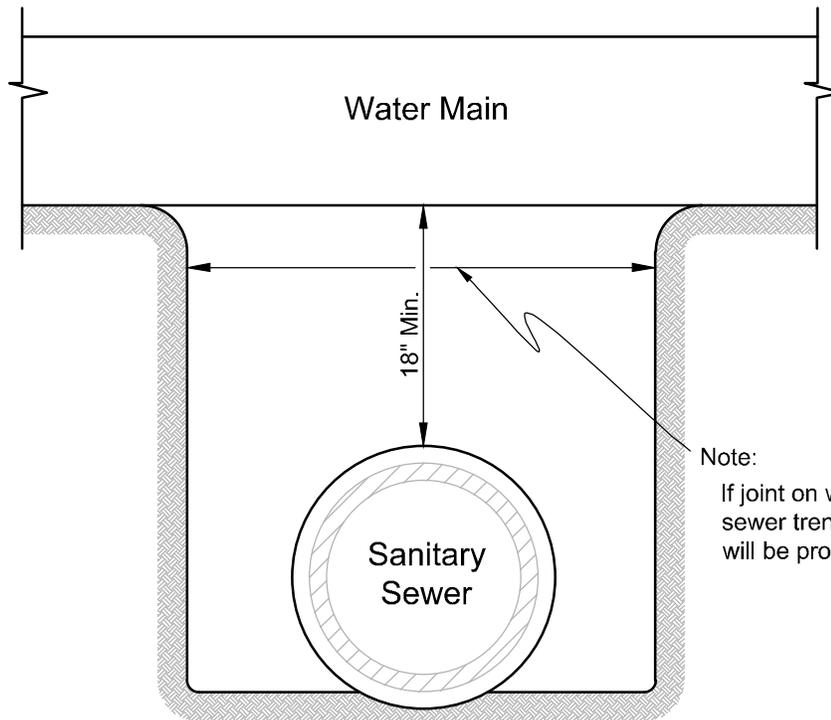
Steps shall be placed into wet concrete wall during manufacture or mortared into holes after concrete has set.

SECTION A-A
Polypropylene Plastic
No. 3 Deformed Steel Rod

Issued	08/04
Revised	
Source	



Standard Manhole Steps	
Sanitary Sewer Details	
Standard No.	S-8



Note:
 If joint on water main is within limits of sewer trench, mechanical bell joint clamp will be provided on water main joint.

Issued	08/04
Revised	10/12
Source	

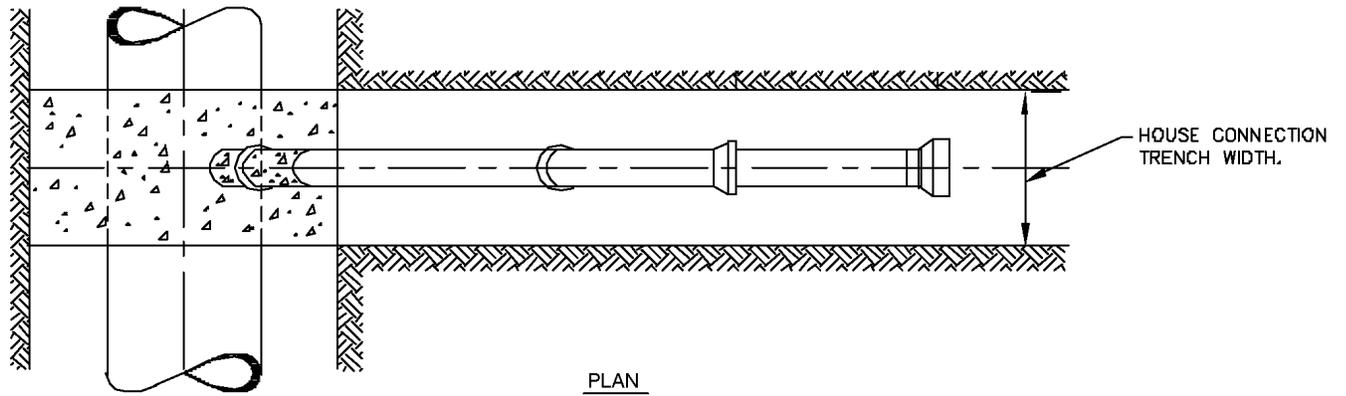


**Department of
 Public Works**

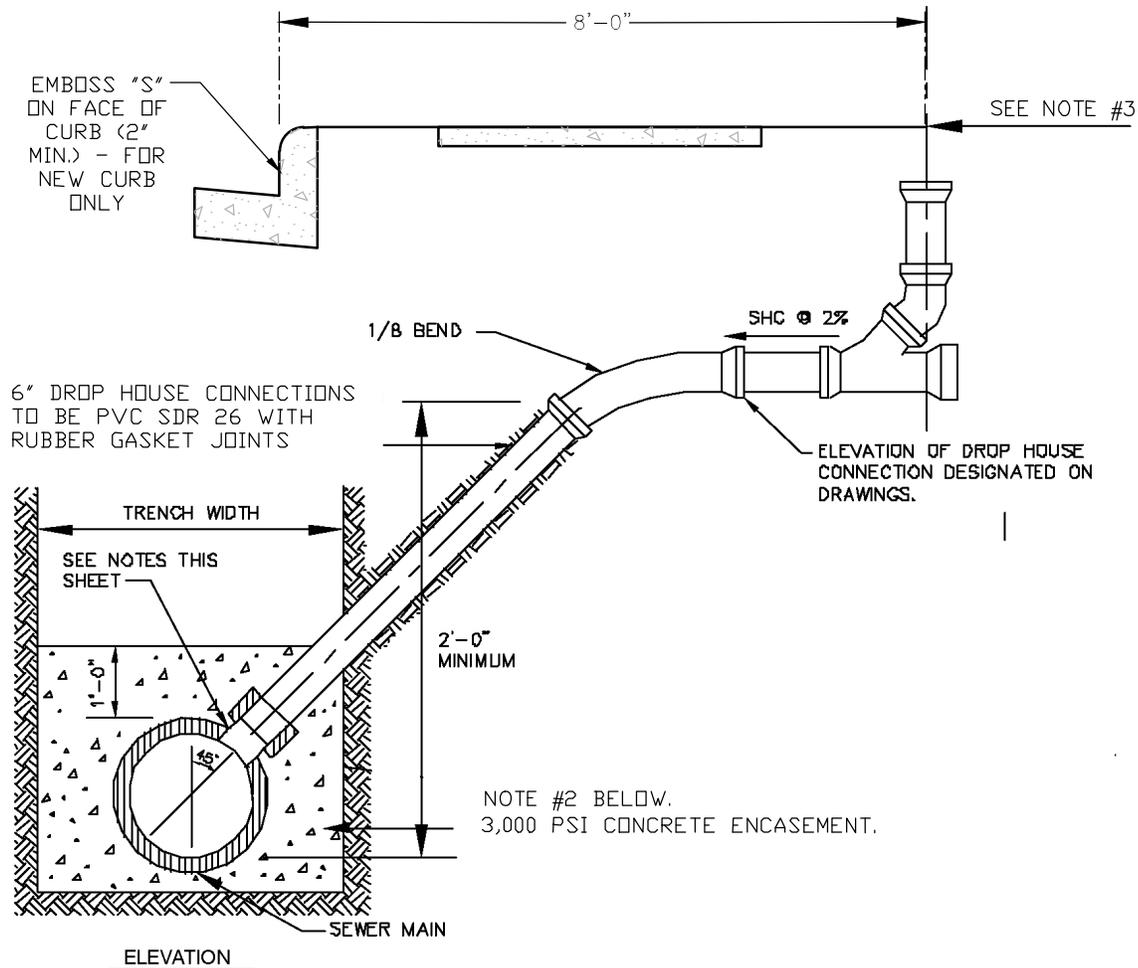
Water Main Clearance

Sanitary Sewer Details

Standard No. **S-9**



PLAN



ELEVATION

NOTES:

1. S.H.C. TO NEW MAIN USES STANDARD "Y" BRANCH.
2. S.H.C. TO EXISTING MAIN USES GENECO SEALITE TYPE "E" WYE SEWER PIPE SADDLE OR EQUAL STAINLESS STEEL STRAPS.
3. CLEAN OUT TO BE LOCATED 8' FROM FACE OF CURB.
4. CLEANOUTS LOCATED IN PAVED AREAS REQUIRE A LINCOLN BOX. EAST JORDAN IRONWORKS #1566 OR APPROVED EQUAL.
5. CLEANOUTS SHALL BE LOCATED BEHIND PARKING BAYS FOR TOWNHOUSE UNITS.

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Revised	10/12
Source	

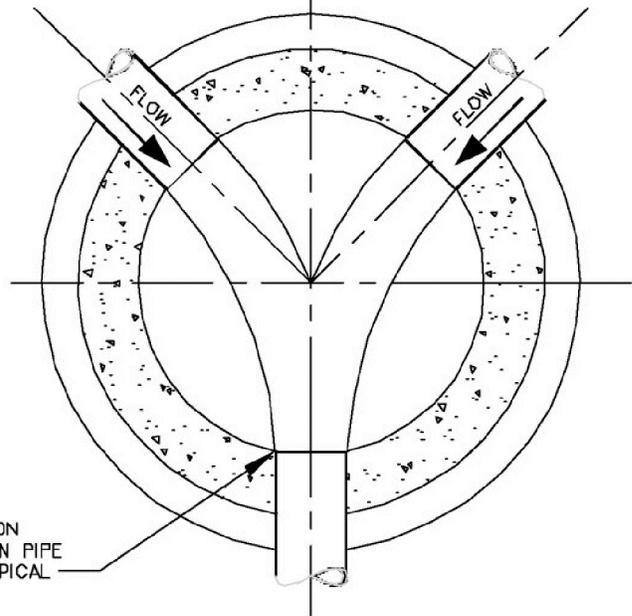
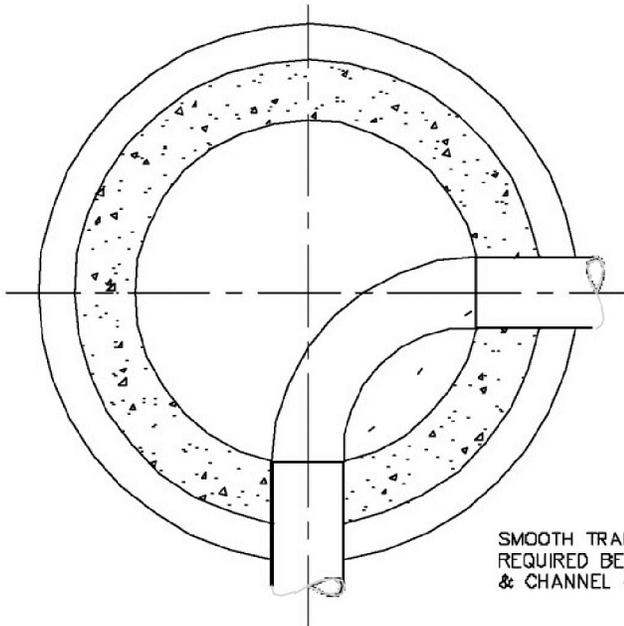


Department of
Public Works

4" and 6" Drop House Connection (New Construction)

Sanitary Sewer Details

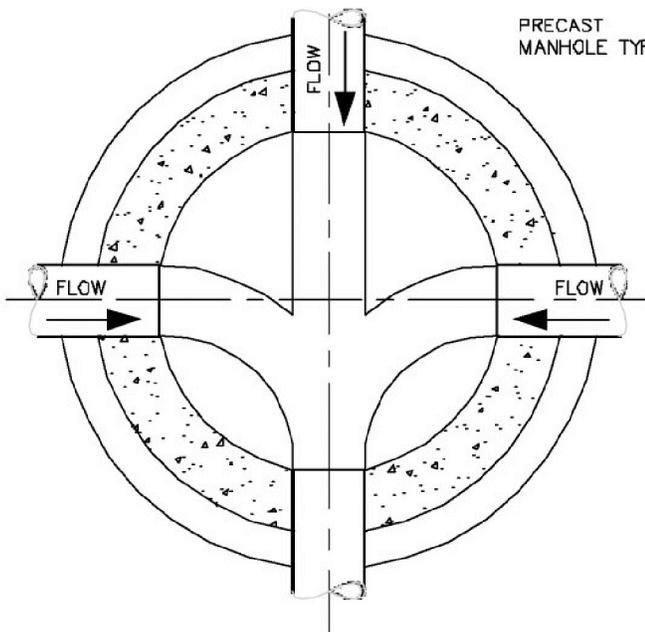
Standard No. S-10



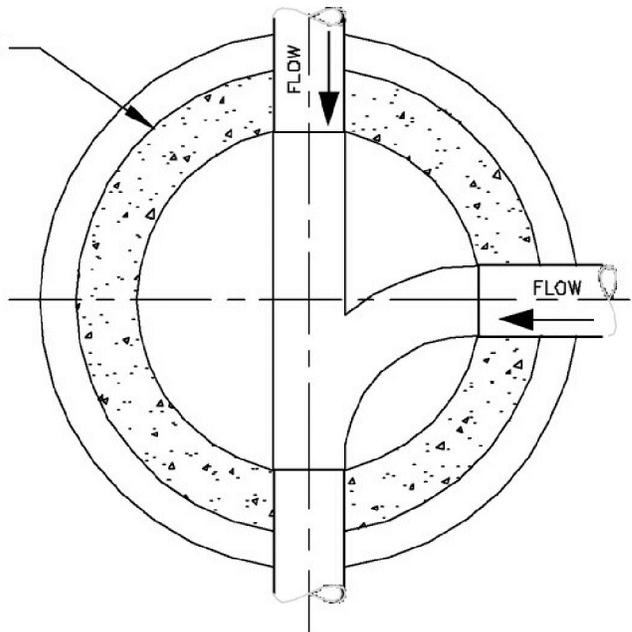
SMOOTH TRANSITION
REQUIRED BETWEEN PIPE
& CHANNEL - TYPICAL

CHANNEL LINING NOTES:

1. CHANNEL LINING SHALL BE CONCRETE, MINIMUM 4" THICK.
2. WIDTH OF CHANNEL SHALL MATCH INSIDE DIAMETER OF INCOMING AND OUTGOING PIPES. BLEND CHANNEL LINING FOR SMOOTH CONTOUR BETWEEN PIPES.
3. CONCRETE CHANNELS SHALL BE FORMED AS SHOWN. F'c FOR CAST-IN-PLACE CHANNELS AND BENCHES SHALL BE 4000 PSI @ 28 DAYS. FOR PRECAST CHANNELS AND BENCHES, F'c = 4000 PSI MINIMUM.
4. ALL INVERT ELEVATIONS SHALL BE AS SHOWN ON THE CONTRACT DRAWINGS.



PRECAST
MANHOLE TYPICAL



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Revised	
Source	

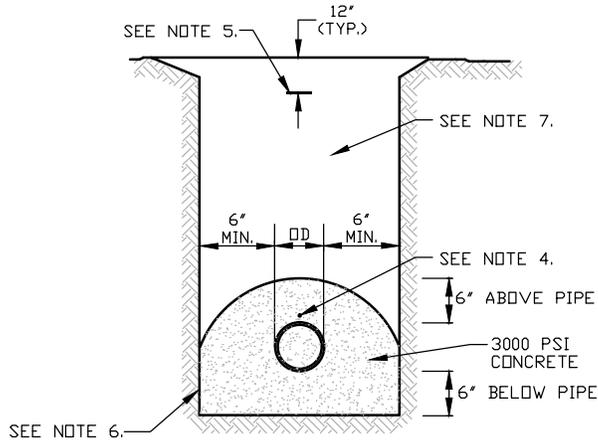


**Department of
Public Works**

**Typical Channelization of
Mainline Sewer Manholes**

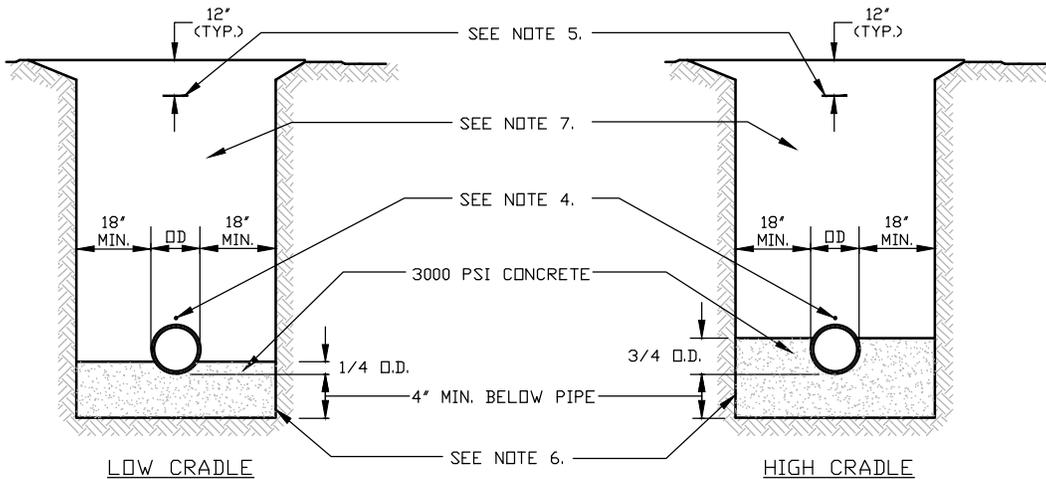
Sanitary Sewer Details

Standard No. S-11



ENCASEMENT DETAILS

NORMAL PIPE DIAMETER	MAXIMUM PAYMENT CU. FT. PER LIN FT. CONC. ENCASEMENT
6"	1.53
8"	2.55
10"	2.95
12"	3.63
15"	4.20
18"	5.71
21"	6.35
24"	8.22
27"	8.94
30"	9.83
33"	12.16
36"	13.09
42"	15.22
48"	19.83
54"	22.97
60"	24.95
66"	27.71



CRADLE DETAILS

NORMAL PIPE DIAMETER	MAXIMUM PAYMENT CU. FT. PER LIN FT.	
	HIGH CRADLE	LOW CRADLE
6"	1.28	0.90
8"	1.58	1.03
10"	1.86	1.22
12"	2.33	1.51
15"	2.82	1.73
18"	4.02	2.35
21"	4.52	2.62
24"	5.95	3.34
27"	6.58	3.70
30"	7.42	4.18
33"	9.42	5.08
36"	10.53	5.65
42"	12.30	6.64
48"	16.25	8.49
54"	18.46	9.64
60"	20.80	10.95
66"	23.08	12.25

NOTES:

- TRENCH SHALL BE BRACED OR SHEETED AS REQUIRED.
- PROVIDE BEARING FULL LENGTH OF BARREL.
- DIG BELL HOLES.
- INSTALL INSULATED COPPER AWG #10 DETECTOR WIRE ON TOP OF PIPE. PROVIDE ACCESS FOR MONITORING AT 400' (MAX.) INTERVAL PER SPECS.
- INSTALL METALLIC DETECTOR TAPE PER SPECS.
- POUR CONCRETE AGAINST UNDISTURBED EARTH, REMOVE SHEETING BEFORE POURING CONCRETE OR LEAVE LOWER PORTION OF SHEETING IN PLACE.
- SELECT BACKFILL MATERIAL COMPACTED IN 8' LIFTS TO 95% MOD. PROCTOR DENSITY WITHIN ROADWAY AREAS, 92% MOD. PROCTOR DENSITY OUTSIDE ROADWAY AREAS.

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Source	

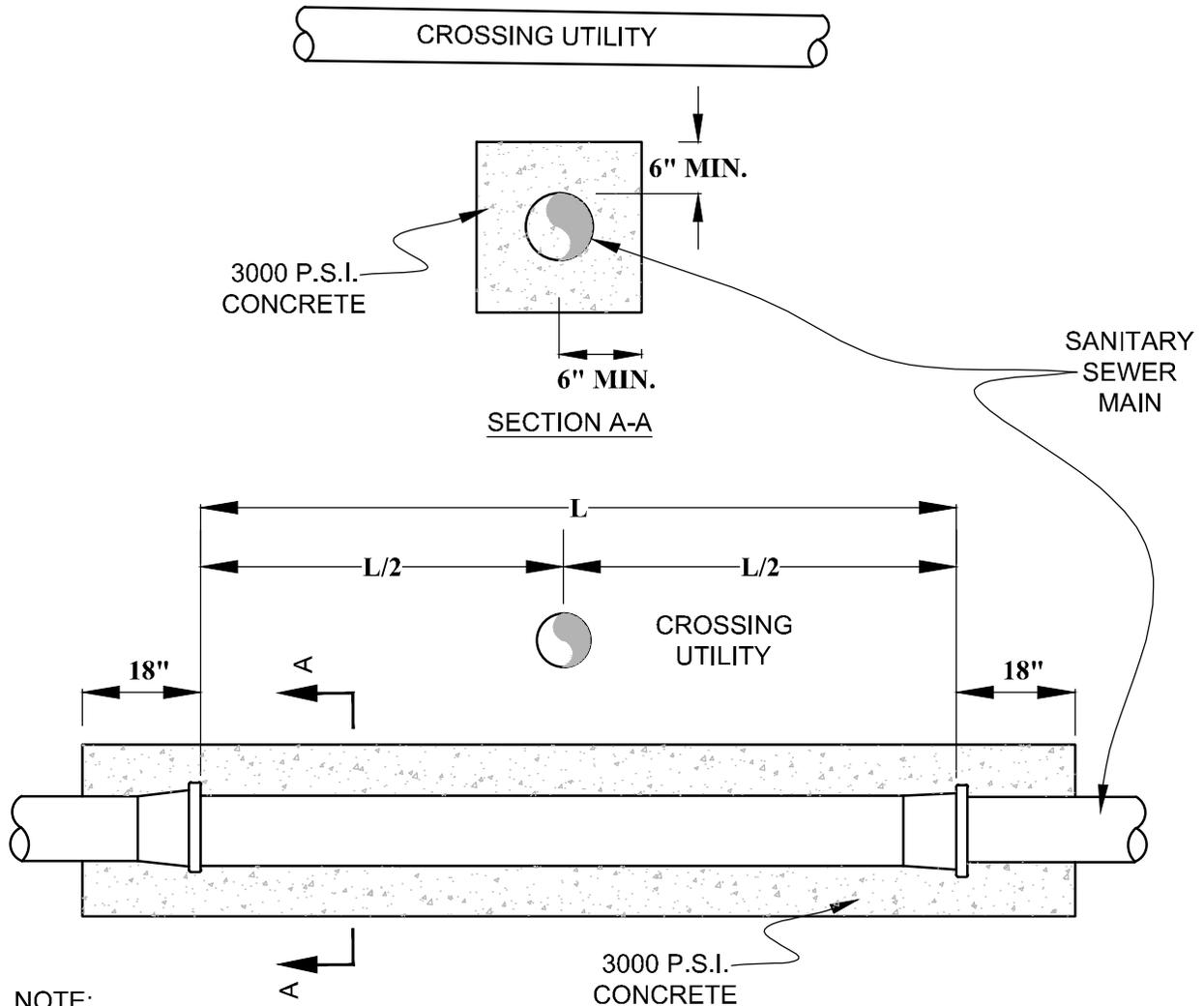


Department of Public Works

Concrete Encasement and Cradle

Sanitary Sewer Details

Standard No. S-12



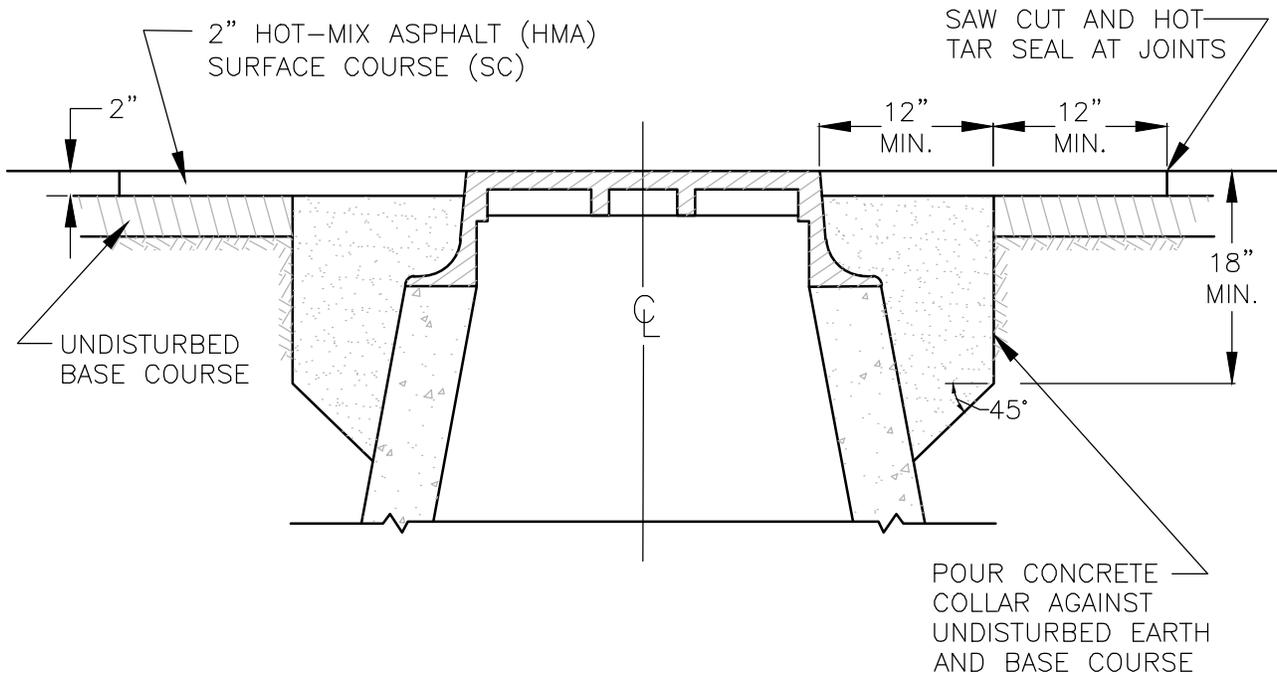
NOTE:

SANITARY SEWER MAINS SHALL BE ENCASED AS SHOWN WHEN LESS THAN 12" OF SEPARATION EXISTS BETWEEN THE SANITARY SEWER MAIN AND OTHER UTILITIES (EXCEPT WATER MAIN) THE ENCASEMENT LENGTH SHALL BE A MINIMUM OF FIVE FEET (5') EITHER SIDE OF CROSSING UTILITY. REFER TO STANDARD DETAIL NO. S-9 FOR WATER MAIN CROSSINGS.

L = LAYING LENGTH OF SANITARY SEWER PIPE.

CONCRETE ENCASEMENT DETAIL
N.T.S

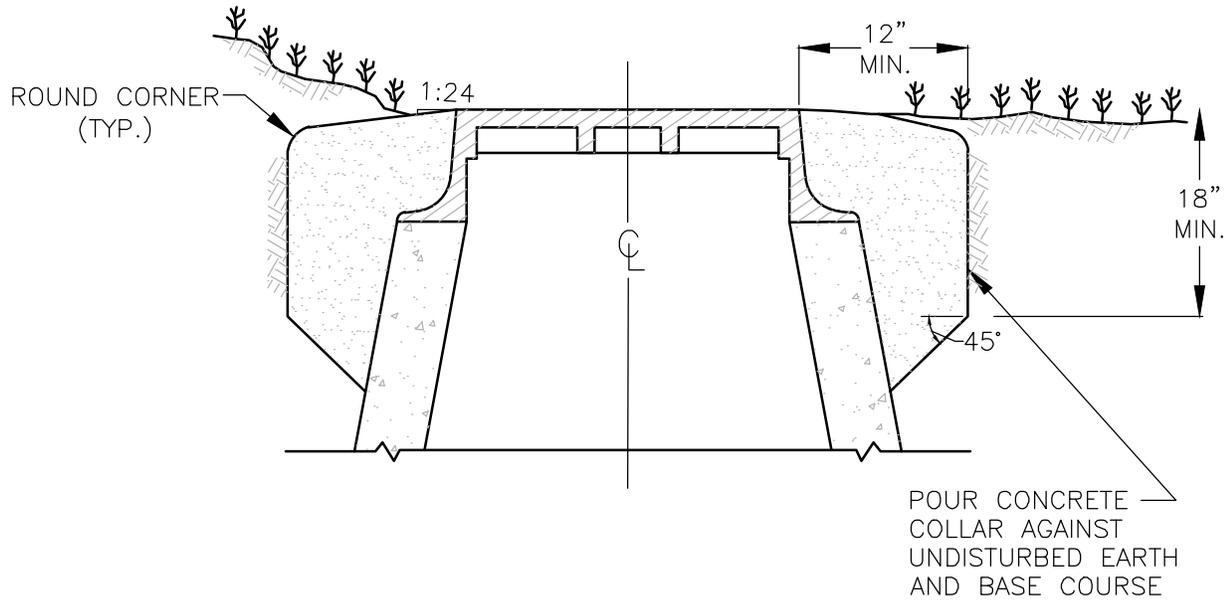
Issued	08/04	 Department of Public Works	Concrete Encasement at Utility Crossings
Revised	10/12		
			Sanitary Sewer Details
Source			Standard No. S-13



NOTES:

1. USE 3000 LB MIX PORTLAND CEMENT CONCRETE.
2. FOR NEW INSTALLATION USE FORMWORK. DO NOT REMOVE FORMS FOR A MIN. OF 24 HOURS AFTER POUR. COMPACT FILL AROUND COLLAR AFTER 48 HOURS. PAVEMENT MAY BE PLACED AFTER 72 HOURS.
3. DO NOT ALLOW TRAFFIC ON CONCRETE FOR 48 HOURS UNLESS HIGH EARLY ADDITIVE IS USED.

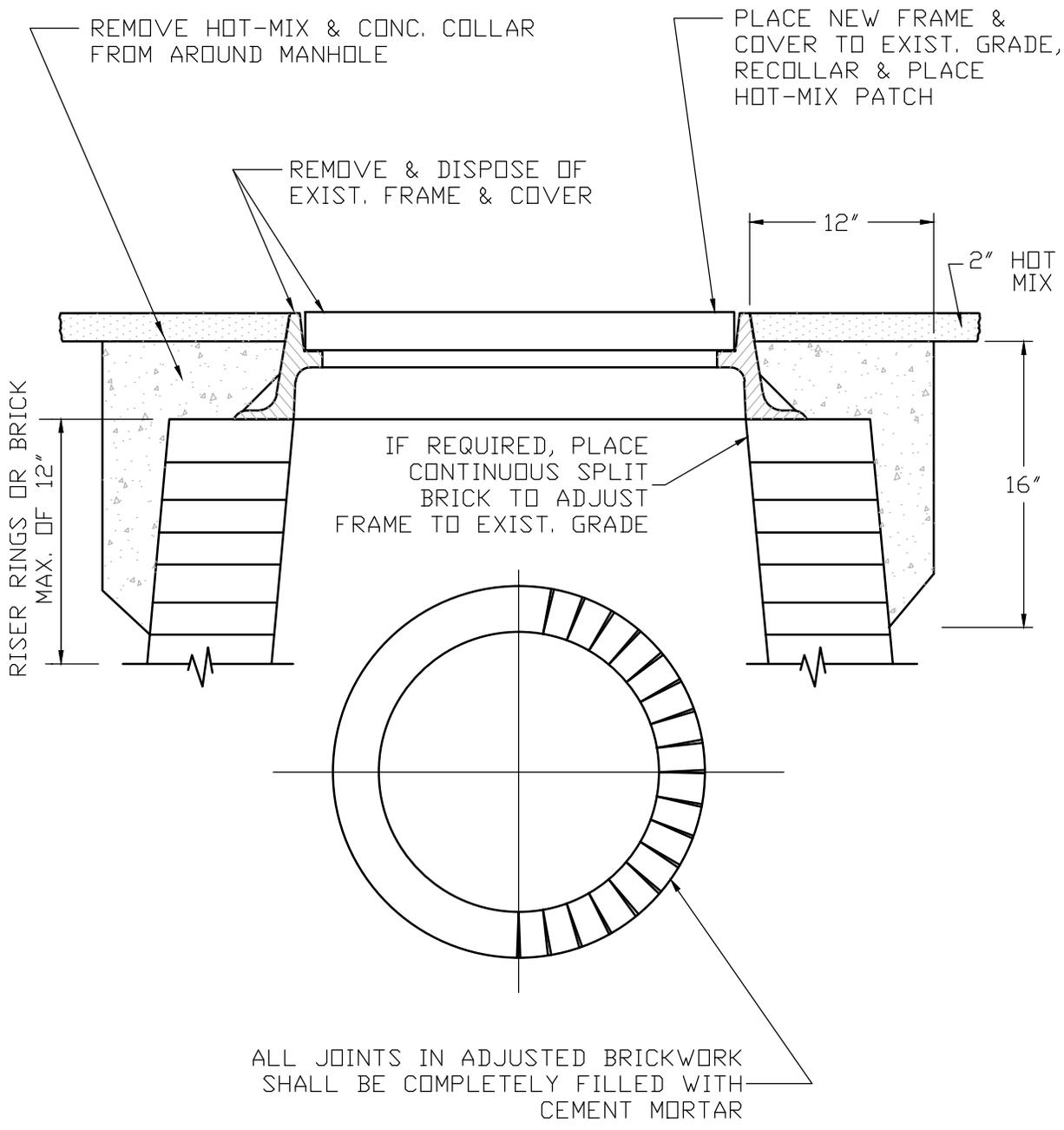
Issued	08/04	 <p>Department of Public Works</p>	<p align="center">Concrete Manhole Collar (Paved Areas)</p>	
Revised				Sanitary Sewer Details
				Standard No. S-14
Source				



NOTES:

1. USE 3000 LB MIX PORTLAND CEMENT CONCRETE.
2. FOR NEW INSTALLATION USE FORMWORK. DO NOT REMOVE FORMS FOR A MIN. OF 24 HOURS AFTER POUR. COMPACT FILL AROUND COLLAR AFTER 48 HOURS. PAVEMENT MAY BE PLACED AFTER 72 HOURS.
3. TOP SOIL, SEED AND MULCH ENTIRE DISTURBED AREA.

Issued	08/04	 <p>Department of Public Works</p>	<p align="center">Concrete Manhole Collar (Non-Paved Areas)</p>
Revised			
			Standard No. S-15
Source			



Issued	08/04
Revised	
Source	

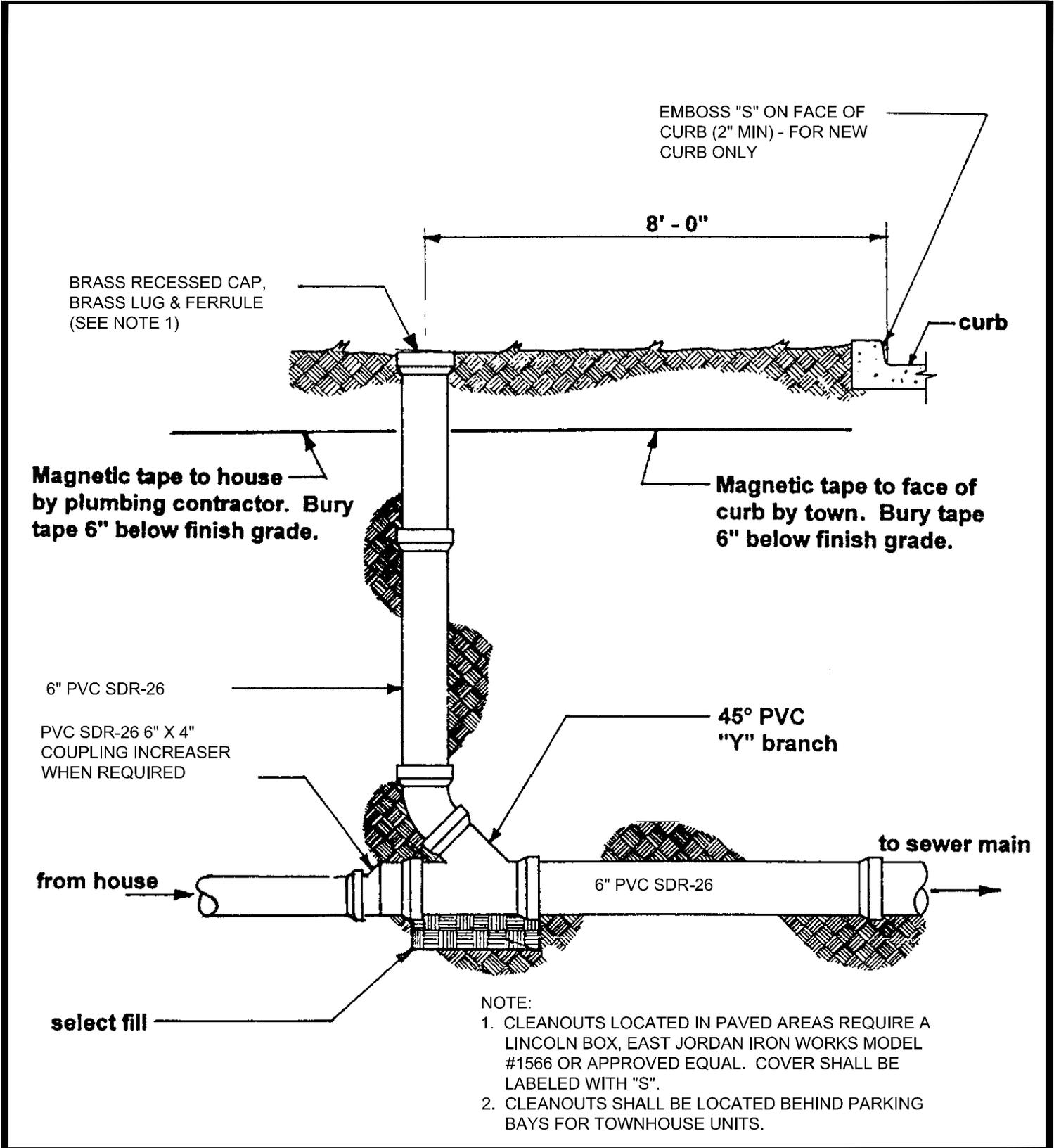


**Department of
Public Works**

Manhole Frame Replacement

Sanitary Sewer Details

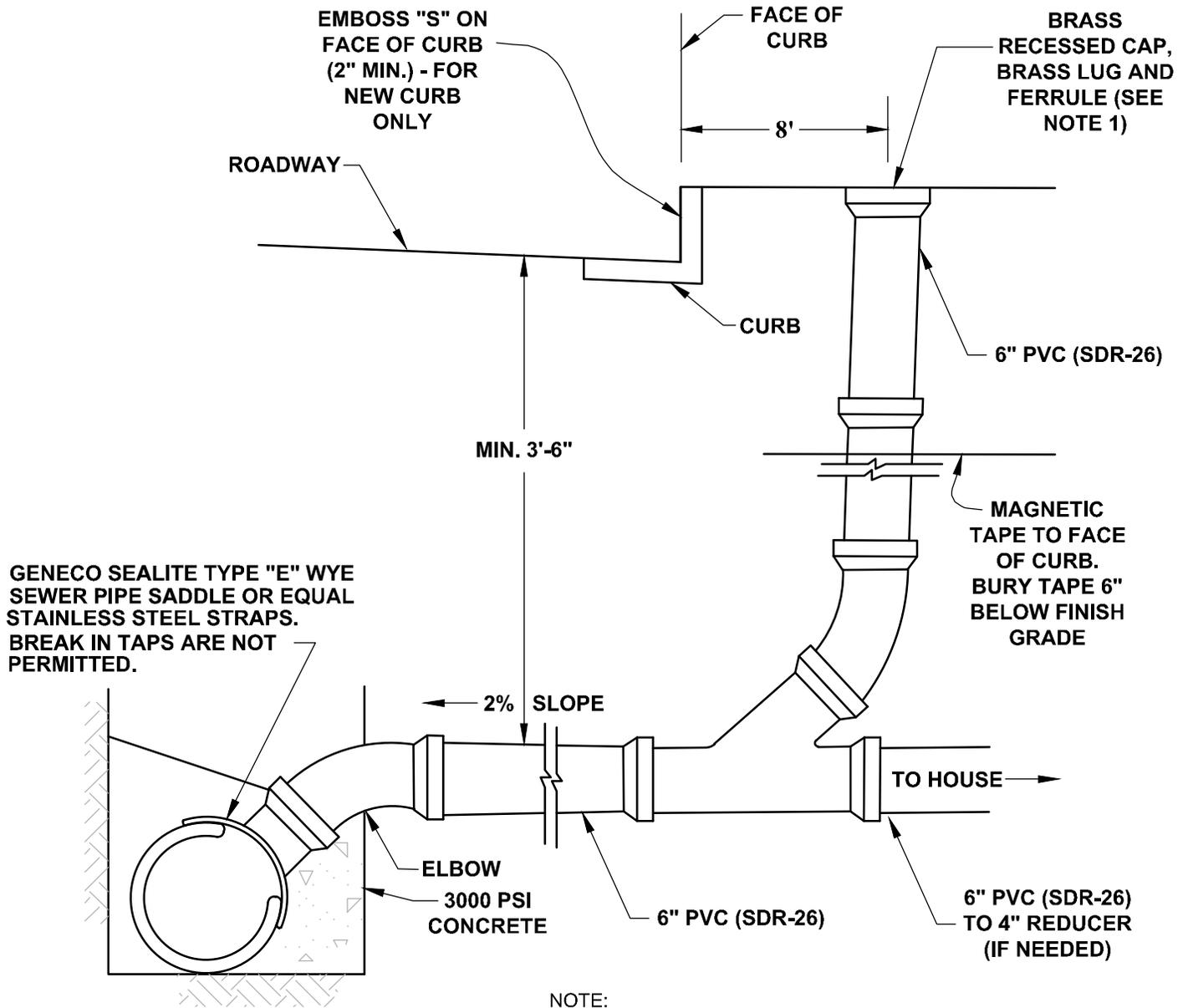
Standard No. **S-16**



Issued	08/04
Revised	10/12
Source	



Typical Cleanout
Sanitary Sewer Details
Standard No. S-17



NOTE:

1. CLEANOUTS LOCATED IN PAVED AREAS REQUIRE A LINCOLN BOX, EAST JORDAN IRON WORKS MODEL #1566 OR APPROVED EQUAL. COVER SHALL BE LABELED WITH "S".
2. CLEANOUTS SHALL BE LOCATED BEHIND PARKING BAYS FOR TOWNHOUSE UNITS.

Issued	08/04
Revised	10/12
Source	

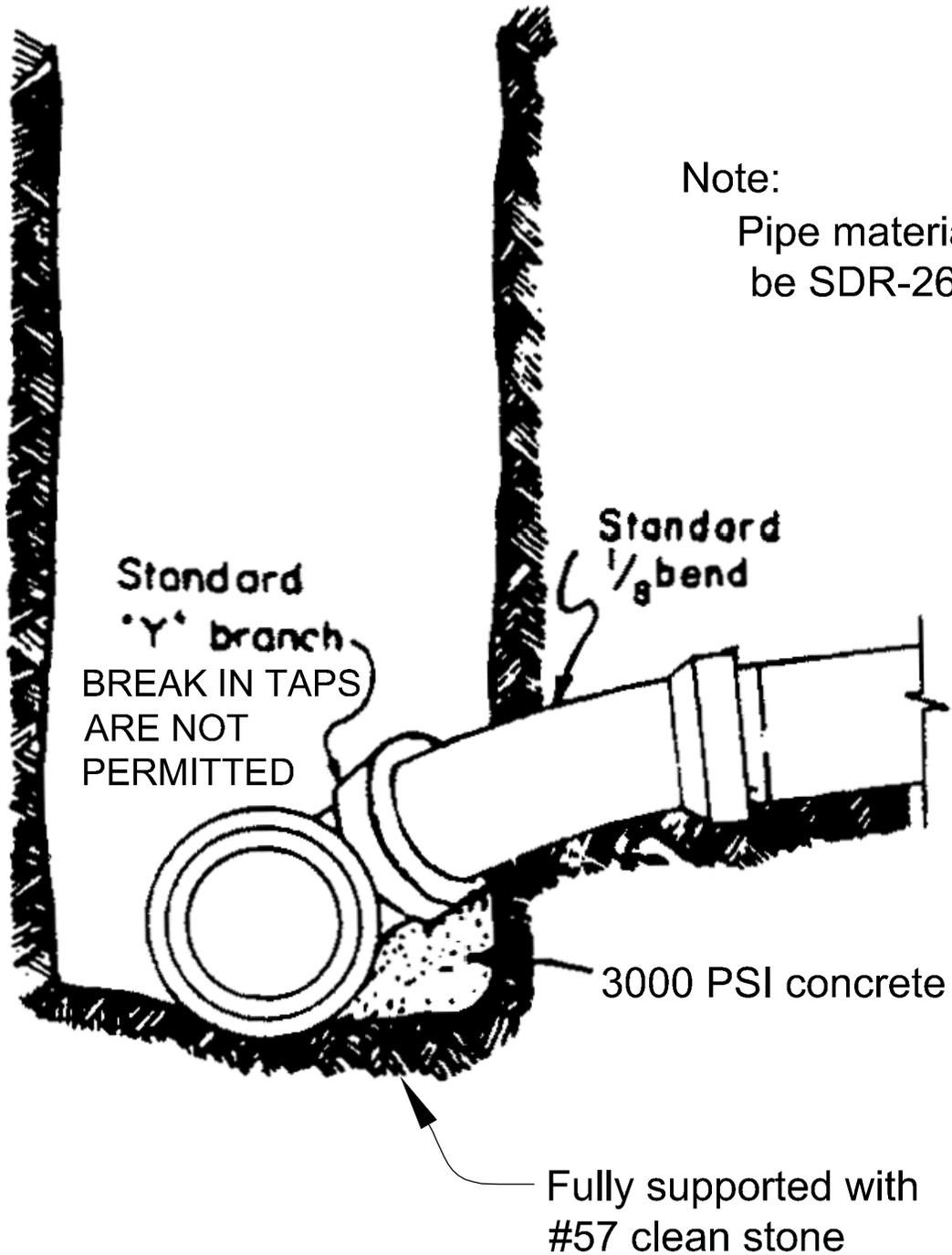


Department of Public Works

Sewer House Connection (Existing Sewer Main)

Sanitary Sewer Details

Standard No. S-18

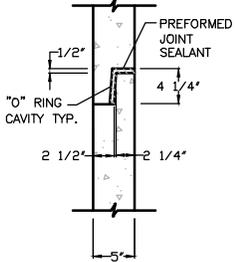
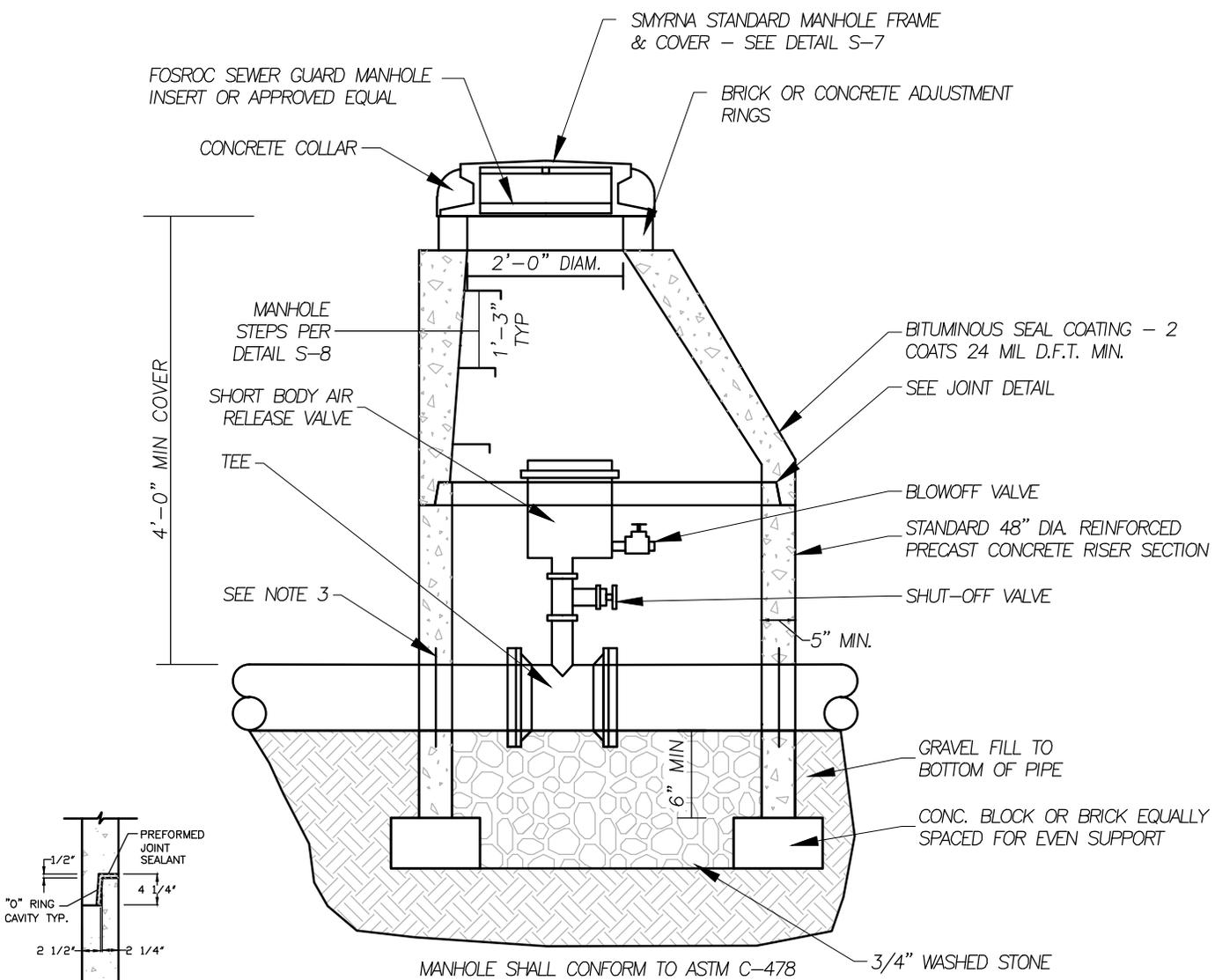


Issued	08/04
Revised	10/12
Source	



Department of Public Works

Standard House Connection (New Construction)
Sanitary Sewer Details
Standard No. S-19



JOINT DETAIL

PRECAST MANHOLE NOTES

1. THE INSIDE DIAMETER OF THE MANHOLE SHALL BE 4'-0" FOR PIPE DIAMETERS FROM 8" THRU 24".
2. THE MANHOLE SHALL BE 4,000 PSI CONCRETE MINIMUM
3. PROVIDE PIPE TO MANHOLE SEAL: A-LOK GASKET (OR APPROVED EQUAL) PER A.S.T.M. SPEC. C443, CAST INTEGRALLY IN MANHOLE WALL AND LOCATED REQUIREMENTS OF A.S.T.M. SPEC. C425.
4. JOINT SEALANT SHALL BE BUTYL RUBBER PER A.S.T.M. C-990.

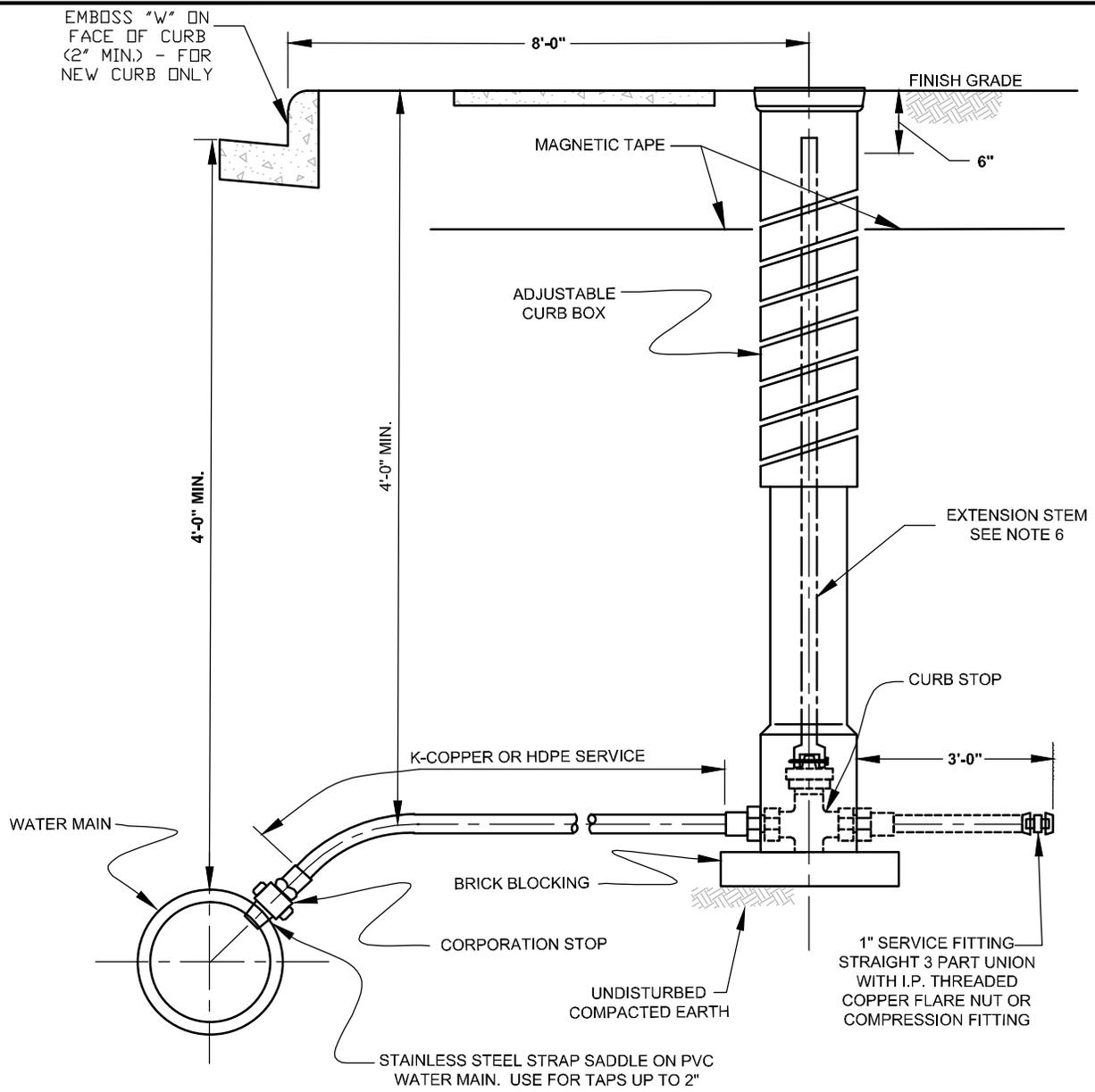
Issued	10/12
Revised	
Source	



Blow-off Valve Manhole
Sanitary Sewer Details
Standard No. S-20

Category W

Water Systems



NOTES:

1. INSTALL ALL ITEMS AS SHOWN OR APPROVED EQUAL.
2. NO GALVANIZED PIPING OR FITTINGS TO BE USED.
3. MAGNETIC TAPE TO BE INSTALLED ABOVE PIPING, BURIED 6" BELOW GRADE.
4. CURB BOXES IN PAVED AREAS REQUIRE A LINCOLN BOX, EAST JORDAN IRON WORKS MODEL. #1566 OR APPROVED EQUAL. COVER SHALL BE LABELED WITH "W".
5. CURB BOXES SHALL BE LOCATED BEHIND PARKING BAYS FOR TOWN HOUSE UNITS.
6. EXTENSION STEM NOT REQUIRED FOR VALVES LESS THAN 5' BELOW FINISHED GRADE.
7. HDPE SERVICE PIPE IS TO BE INSTALLED WITH TRACER WIRE FROM MAIN TO CURB STOP VALVE BOX.
(COPPER AWG. #10 INSULATED DETECTOR WIRE)

Issued	08/04
Revised	10/12
	06/17
Source	

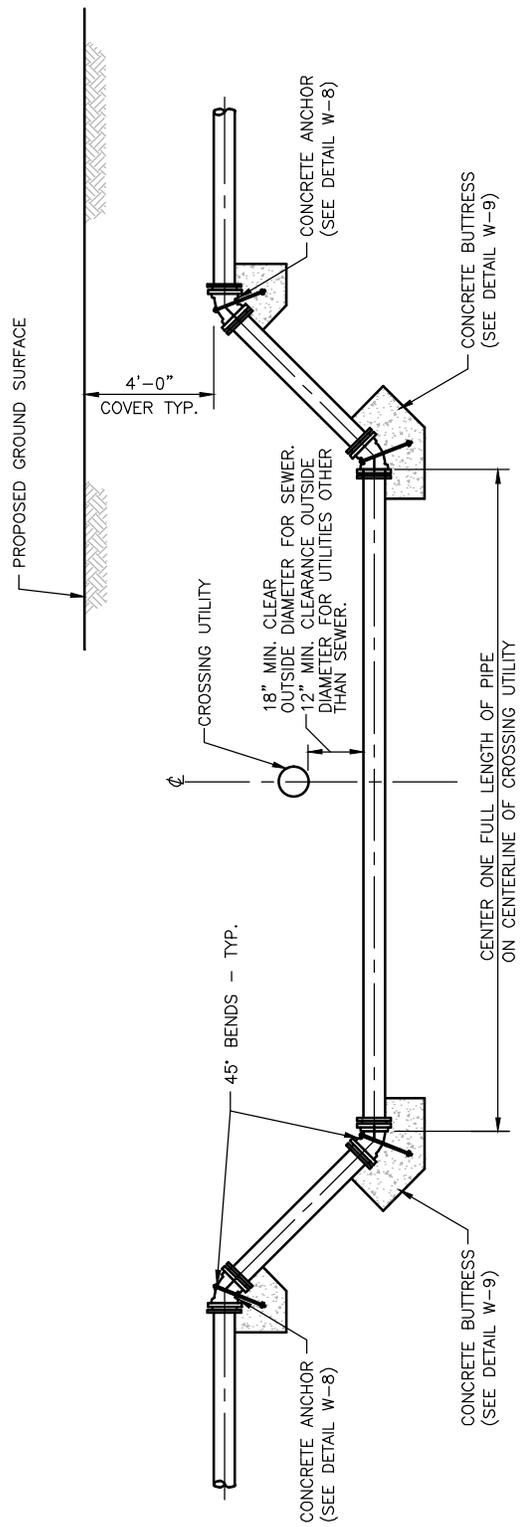


**Department of
Public Works**

Standard Service Connection with Curb Box

Water Details

Standard No. W-1



Issued	08/04
Revised	10/12
Source	

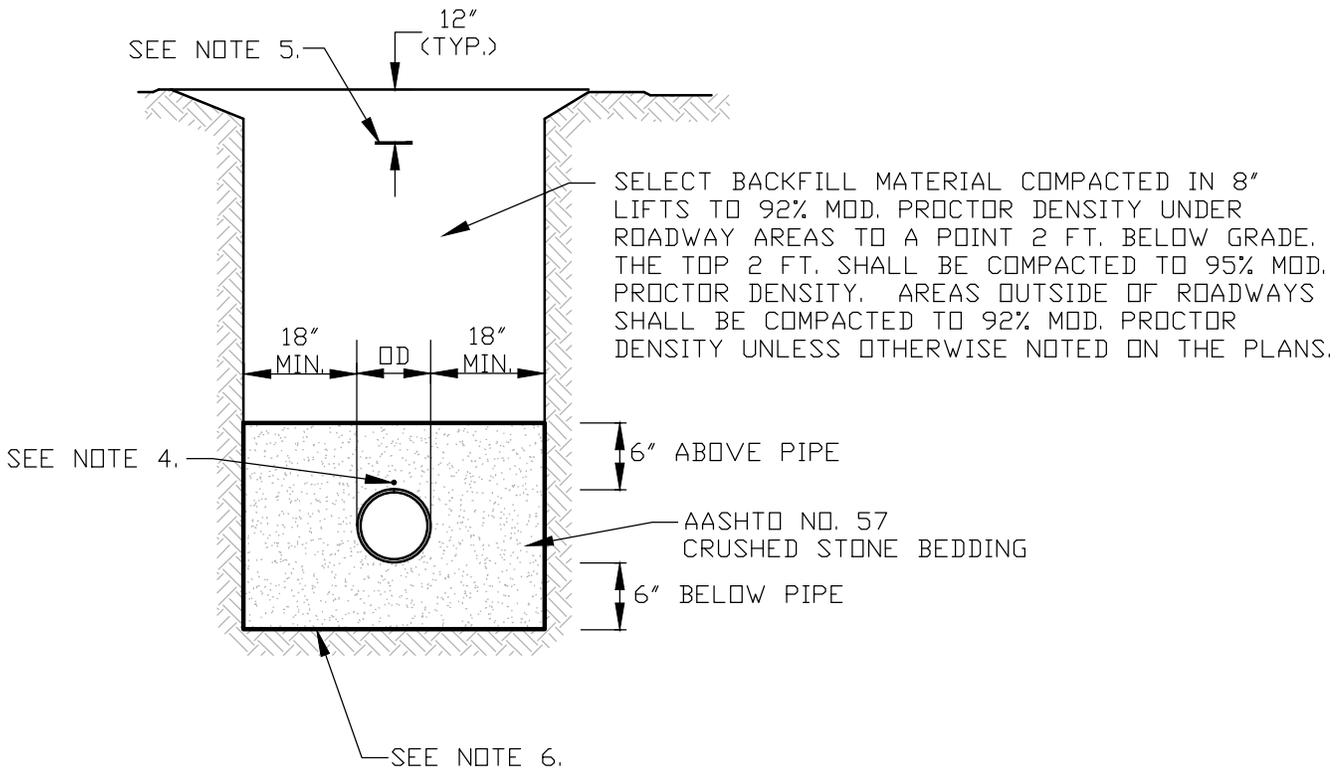


**Department of
Public Works**

Water Main Crossing Storm and Sanitary Sewer

Water Details

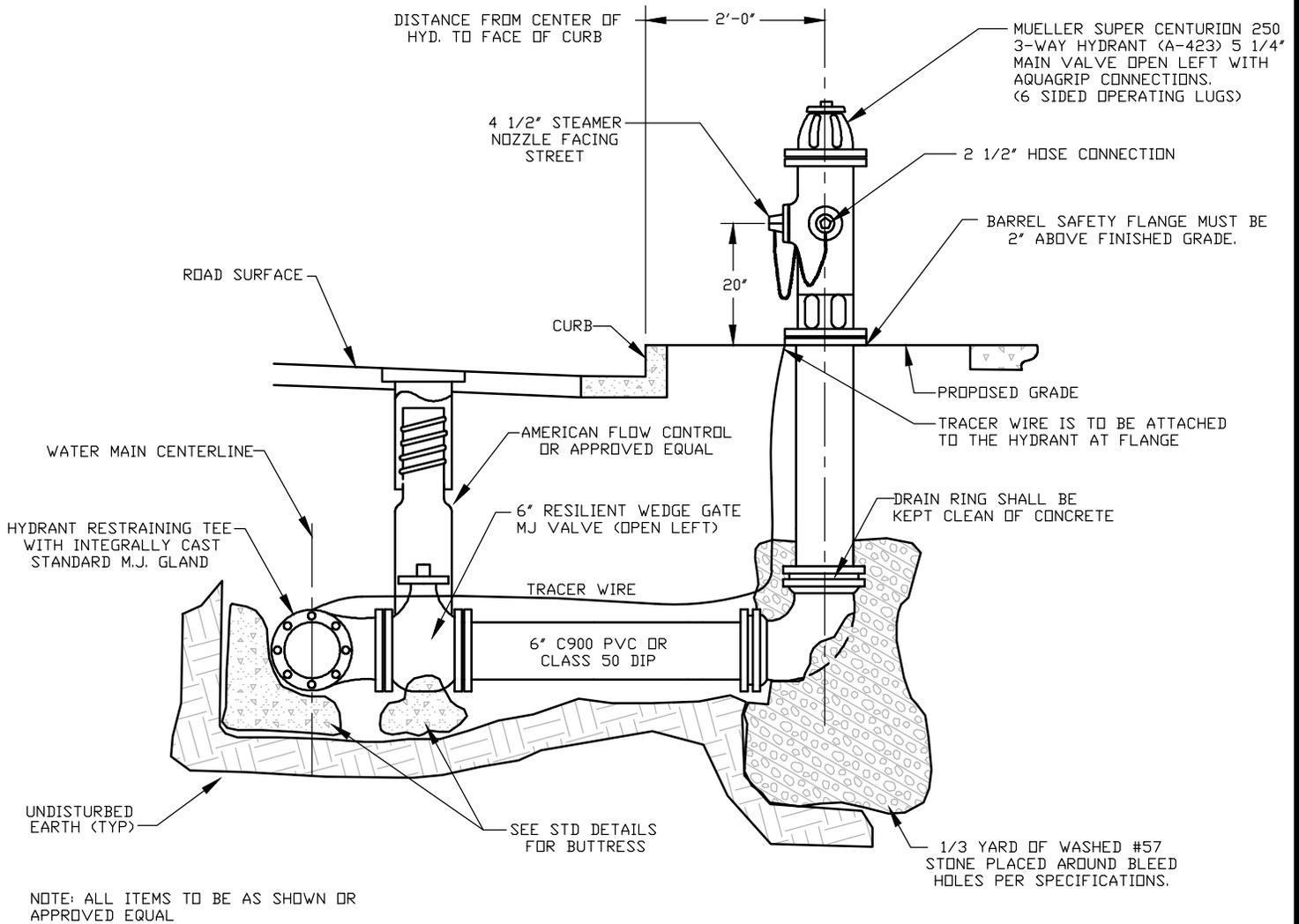
Standard No. W-2



NOTES:

1. TRENCH SHALL BE BRACED OR SHEETED IN ACCORDANCE WITH OSHA REGULATIONS.
2. PROVIDE BEARING FULL LENGTH OF BARREL.
3. DIG BELL HOLES.
4. INSTALL INSULATED COPPER 10 GA DETECTOR WIRE ON TOP OF PIPE. PROVIDE ACCESS FOR MONITORING AT 400' (MAX.) INTERVAL PER SPECS AT VALVE BOXES.
5. INSTALL METALLIC DETECTOR TAPE PER SPECS.
6. GEOTEXTILE FABRIC (MIRAFI 600X OR APPROVED EQUAL) TO SURROUND STONE BEDDING. OVERLAP A MINIMUM OF 12".

Issued	08/04	 <p>Department of Public Works</p>	<h2>Pipe Bedding and Trench Detail</h2>
Revised	10/12		
	06/17		Water Details
Source			Standard No. W-3



NOTES:

1. ALL ITEMS TO BE AS SHOWN OR APPROVED EQUAL.
2. HYDRANT MUST BE STRAPPED AND MECHANICALLY RESTRAINED (I.E. MEGA LUG).
3. ALL HYDRANTS SHALL BE PAINTED RED.

Issued	08/04
Revised	10/12
	06/17
Source	

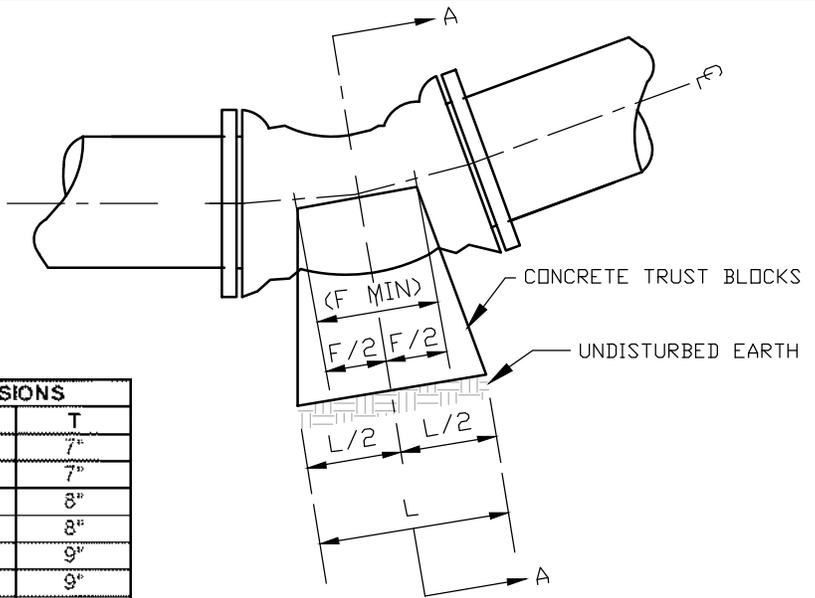


**Department of
Public Works**

Standard Fire Hydrant Installation

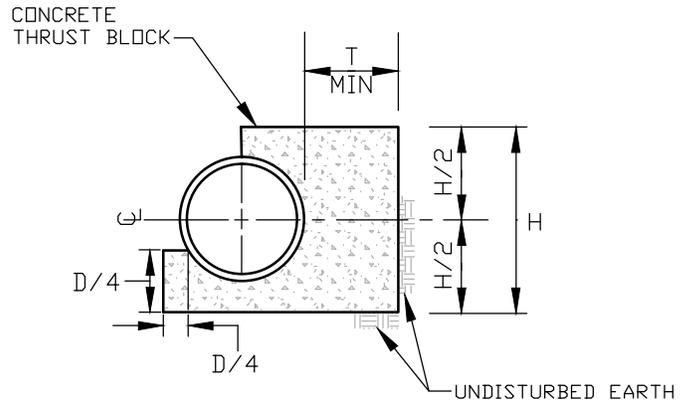
Water Details

Standard No. W-4



ELEVATION

BEND TYPE	PIPE DIAMETER	THRUST BLOCK DIMENSIONS			
		L	H	F	T
1/32	6"	1' - 0"	1' - 2"	8"	7"
	8"	1' - 4"	1' - 4"	8"	7"
	10"	1' - 8"	1' - 6"	8"	8"
	12"	2' - 0"	1' - 8"	8"	8"
	14"	2' - 4"	1' - 10"	10"	9"
1/16	6"	1' - 6"	1' - 2"	8"	8"
	8"	2' - 0"	1' - 4"	8"	9"
	10"	3' - 0"	1' - 6"	8"	10"
	12"	3' - 6"	1' - 8"	8"	11"
	14"	4' - 0"	1' - 10"	10"	1' - 0"
1/8	6"	1' - 6"	2' - 0"	11"	1' - 2"
	8"	1' - 3"	1' - 2"	8"	8"
	8"	1' - 8"	1' - 4"	8"	9"
	10"	2' - 1"	1' - 6"	8"	10"
	12"	2' - 6"	1' - 10"	8"	11"
1/4	14"	2' - 9"	2' - 2"	10"	1' - 0"
	16"	3' - 4"	2' - 6"	11"	1' - 2"
	6"	1' - 0"	1' - 2"	8"	1' - 8"
	8"	1' - 4"	1' - 6"	8"	1' - 7"
	10"	1' - 6"	2' - 1"	8"	1' - 7"
1/4	12"	1' - 8"	2' - 6"	8"	1' - 6"
	14"	2' - 1"	2' - 6"	10"	1' - 8"
	16"	2' - 5"	3' - 0"	11"	1' - 8"



SECTION A-A

NOTES:

1. CONCRETE STRENGTH -MIN.=3000 PSI AT 28 DAYS.
2. STANDARD THRUST BLOCKING IS BASED ON THE FOLLOWING ASSUMPTIONS AND LIMITATIONS, IF THESE CONDITIONS ARE NOT MET, SPECIAL DESIGN IS REQUIRED:
 - A) STATIC PRESSURE IS 150 PSI OR LOWER.
 - B) DEPTH FROM FINISHED GRADE TO TOP OF PIPE ASSUMED TO EQUAL 3'-6" OR DEEPER.
 - C) ELEVATION OF GROUNDWATER TABLE ASSUMED TO BE BELOW BOTTOM OF THE BLOCK.
3. IF SOIL CONDITIONS ARE SOFT OR ORGANIC SPECIAL DESIGN IS REQUIRED (MIN. SOIL BEARING PRESSURE OF 3,000 PSF).
4. FOR LARGER PIPE DIAMETER, SEE DRAWINGS FOR SPECIAL DETAILS.
5. ALL DIMENSIONS ARE MINIMUMS EXCEPT WHERE LARGER DIMENSIONS WILL INTERFERE WITH THE PIPE JOINTS OF NOT FACILITATE BOLT REMOVAL ON MECHANICAL JOINT FITTINGS.
6. MECHANICAL JOINTS (i.e. MEGA LUGS) MAY BE USED IN LIEU OF THRUST BLOCKS FOR HORIZONTAL BENDS.

Issued	08/04
Revised	
Source	

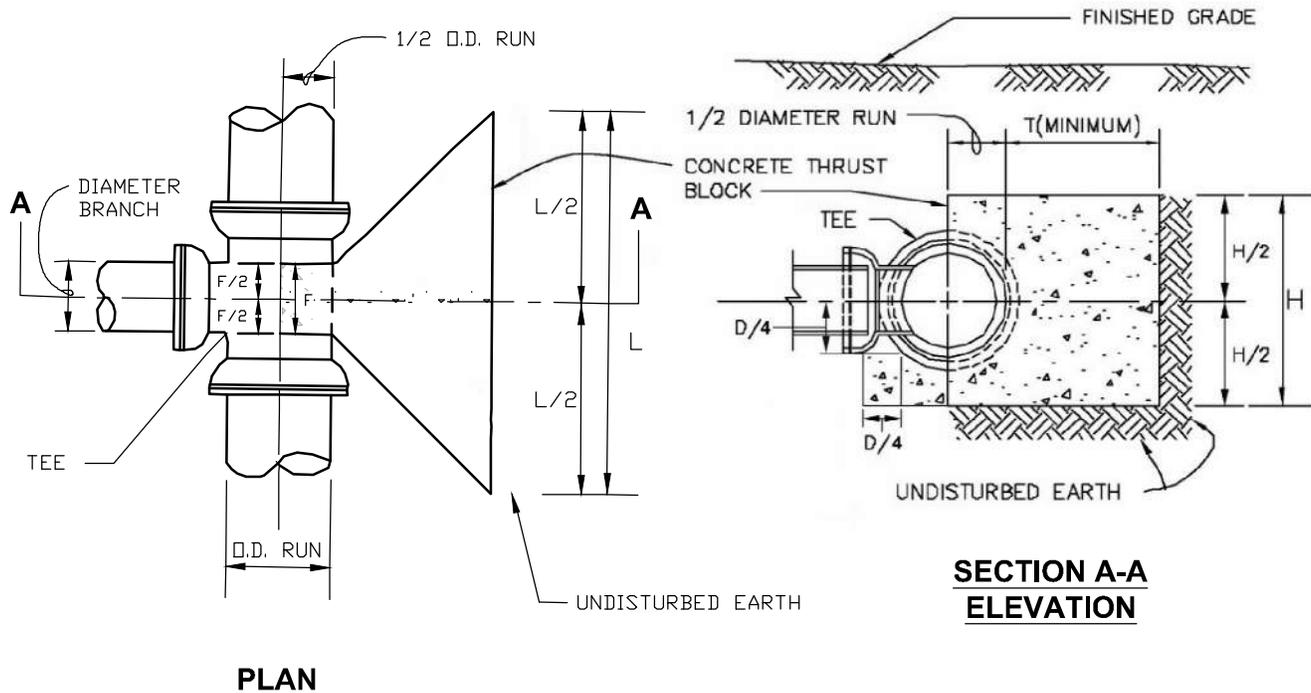


Department of Public Works

Thrust Blocks for Horizontal Bends

Water Details

Standard No. **W-5**

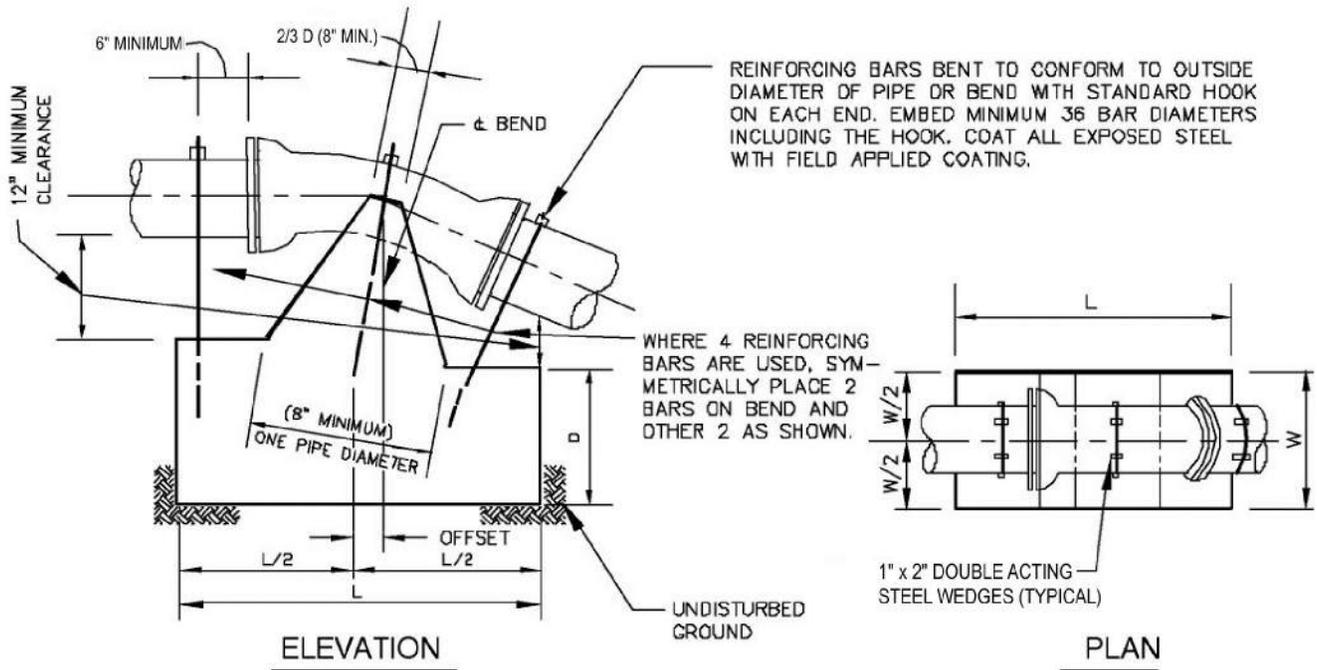


	Nominal Diameter of Branch					
	6"	8"	10"	12"	14"	16"
L	1' - 0"	1' - 4"	2' - 0"	2' - 0"	2' - 4"	2' - 8"
H	1' - 4"	1' - 8"	2' - 0"	2' - 6"	3' - 0"	3' - 4"
T	8"	9"	10"	1' - 0"	1' - 1"	1' - 2"
F	1' - 0"	1' - 4"	1' - 4"	1' - 4"	1' - 6"	1' - 8"

NOTES:

1. SEE BLOCKING DESIGN REQUIREMENT NOTES, STANDARD DETAIL W-5.
2. MECHANICAL JOINTS (i.e. MEGA LUGS) MAY BE USED IN LIEU OF THRUST BLOCKS FOR HORIZONTAL BENDS.

Issued	08/04	 <p>Department of Public Works</p>	<p>Thrust Blocks for Tees and Tapping Sleeves</p>
Revised			
Source			Standard No. W-6



BEND		SIZE					
		6"	8"	10"	12"	14"	16"
1/32	L	2' - 0"	2' - 6"	2' - 9"	3' - 0"	3' - 6"	4' - 0"
	W	1' - 6"	1' - 6"	2' - 5"	3' - 0"	3' - 3"	3' - 6"
	D	1' - 3"	1' - 9"	1' - 9"	2' - 0"	2' - 0"	2' - 0"
	OFFSET	0' - 6"	0' - 6"	0' - 6"	0' - 6"	0' - 6"	0' - 6"
	REBAR	3 - #6	3 - #6	3 - #6	3 - #6	3 - #6	3 - #6
1/16	L	2' - 6"	2' - 8"	3' - 10"	4' - 0"	4' - 8"	5' - 6"
	W	2' - 0"	3' - 4"	3' - 8"	4' - 0"	4' - 2"	4' - 4"
	D	1' - 9"	2' - 3"	2' - 6"	2' - 6"	2' - 6"	2' - 6"
	OFFSET	1' - 0"	1' - 0"	1' - 0"	1' - 0"	1' - 0"	1' - 0"
	REBAR	3 - #6	3 - #6	3 - #6	3 - #6	3 - #6	3 - #6
1/8	L	3' - 0"	4' - 0"	4' - 6"	4' - 9"	5' - 6"	6' - 6"
	W	2' - 6"	3' - 0"	4' - 0"	4' - 6"	4' - 10"	5' - 2"
	D	2' - 6"	2' - 9"	3' - 0"	3' - 6"	3' - 9"	4' - 0"
	OFFSET	1' - 3"	1' - 6"	1' - 9"	2' - 0"	2' - 3"	2' - 6"
	REBAR	3 - #6	3 - #6	3 - #6	3 - #6	3 - #6	3 - #6

NOTES:

1. SEE BLOCKING DESIGN REQUIREMENT NOTES, STANDARD DETAIL W-5.

Issued	08/04
Revised	
Source	

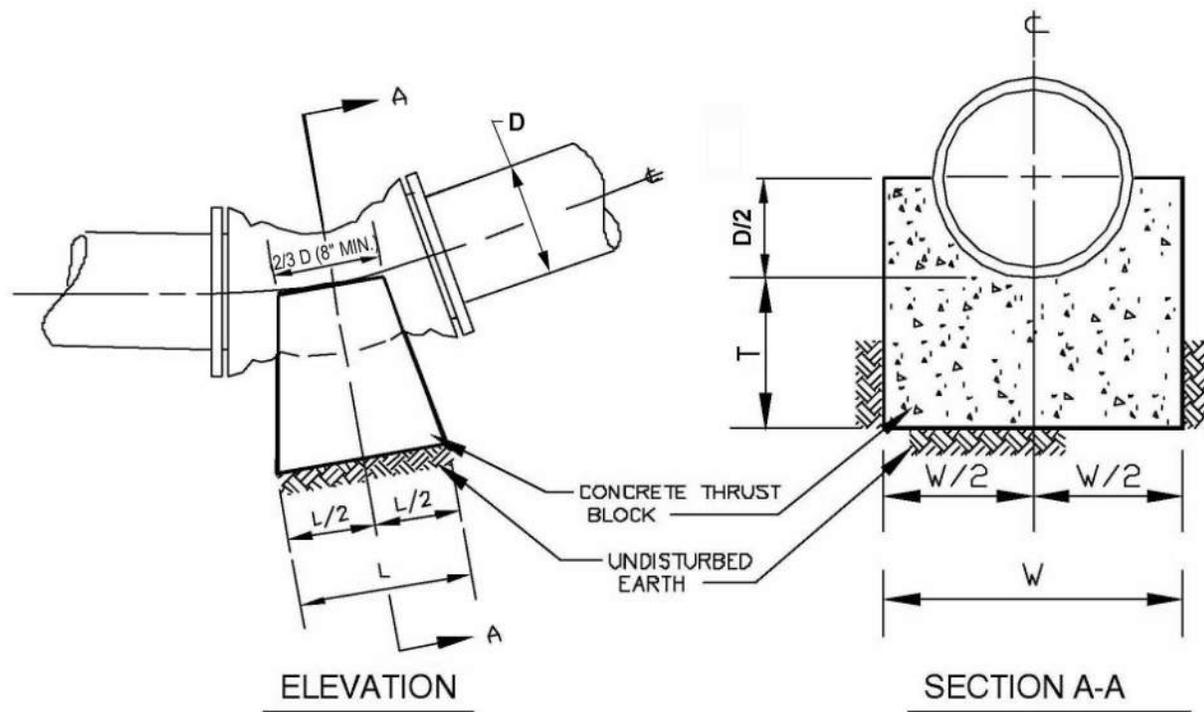


Department of
Public Works

**Anchorage for 1/32, 1/16, and 1/8
Upper Vertical Bends**

Water Details

Standard No. W-8

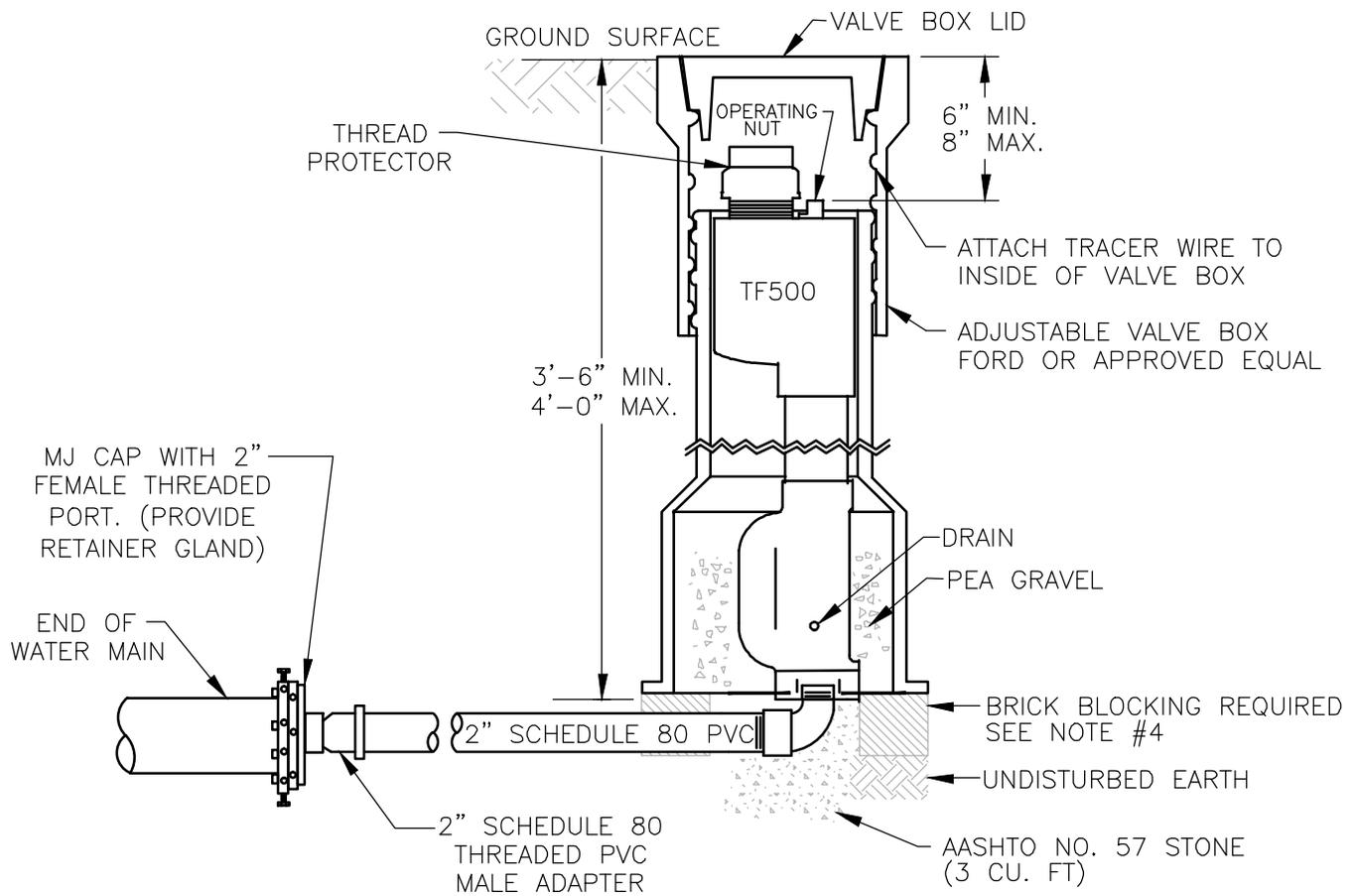


BEND		SIZE					
		6"	8"	10"	12"	14"	16"
1/32	L	8"	8"	10"	10"	1'-2"	1'-4"
	W	1'-2"	1'-4"	1'-6"	1'-8"	1'-10"	2'-0"
	T	0'-7"	0'-7"	0'-8"	0'-8"	0'-9"	0'-9"
1/16	L	9"	1'-0"	1'-6"	1'-9"	2'-0"	2'-3"
	W	1'-2"	1'-4"	1'-6"	1'-8"	1'-10"	2'-0"
	T	0'-7"	0'-7"	0'-8"	0'-8"	0'-9"	0'-9"
1/8	L	1'-3"	1'-8"	2'-1"	2'-6"	3'-0"	3'-4"
	W	1'-2"	1'-4"	1'-6"	1'-10"	2'-2"	2'-6"
	T	0'-7"	0'-8"	0'-10"	0'-11"	1'-1"	1'-3"

NOTES:

1. SEE BLOCKING DESIGN REQUIREMENT NOTES, STANDARD DETAIL W-5.

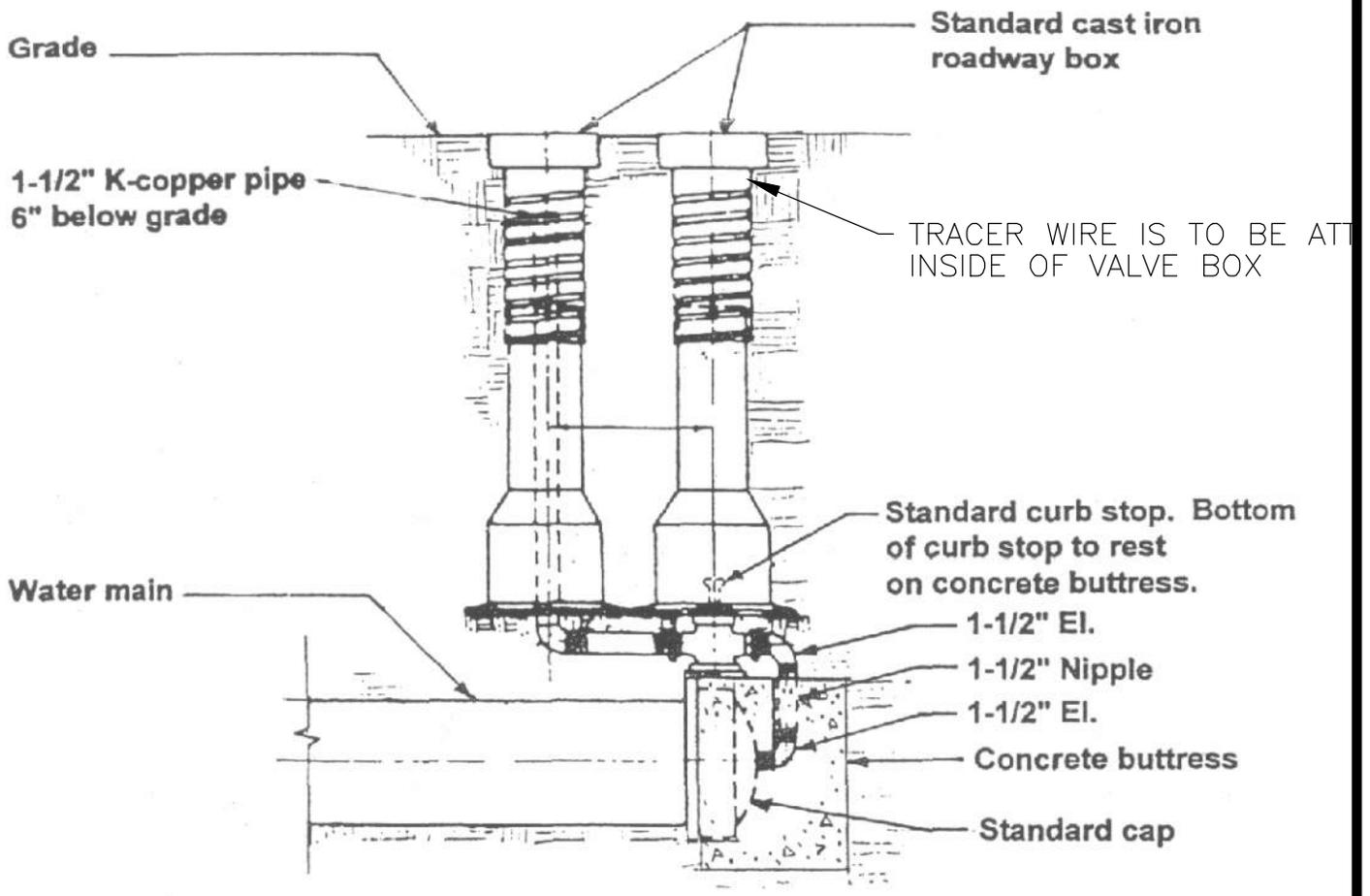
Issued	08/04		<p align="center">Thrust Blocks for $\frac{1}{32}$, $\frac{1}{16}$ and $\frac{1}{8}$ Lower Vertical Bends</p>	
Revised				Water Details
			Department of Public Works	Standard No. W-9
Source				



NOTES:

1. Flushing Hydrant shall be Model No. TF-500 as manufactured by the John C. Kupferle Foundry Co., St. Louis, Mo. or approved equal.
2. Hydrants shall be compression type closing with the pressure and furnished with a 2" FIP inlet. Water pressure alone shall close the valve. Hydrants shall be operated by use of a portable top stock coupling with the hydrant at or near the ground line.
3. Hydrants shall be arranged for depth of bury suitable for water main design depth of cover. Working parts, thread protector and operating rod shall be brass and removable from the hydrant without the need for excavation. Brass thread protector shall have a 2" square nut.
4. Brick blocking shall be provided as shown as well as parallel to the 2" Schedule 80 pipe to fully support the valve box.

Issued	08/04	 <p>Department of Public Works</p>	<h2>Standard Flushing Hydrant</h2>
Revised	06/17		
			Standard No. W-10
Source			



NOTES

1. All 1-1/2" fittings to be copper or brass with flare or compression connections.
2. All 1-1/2" piping to be K-copper.

Issued	08/04
Revised	06/17
Source	

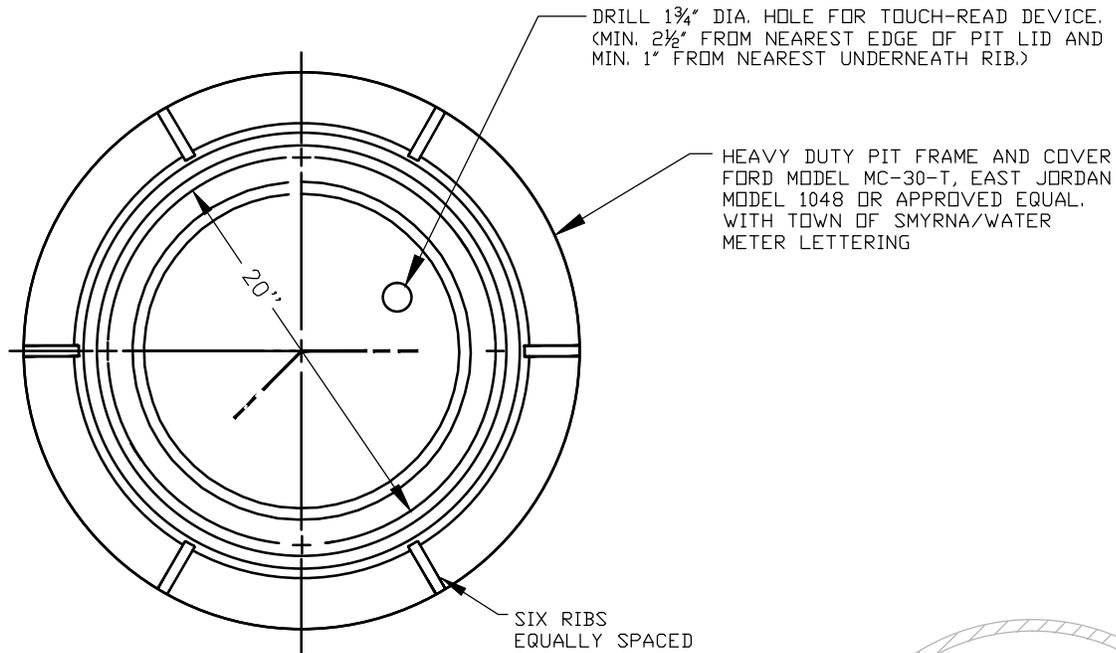


**Department of
Public Works**

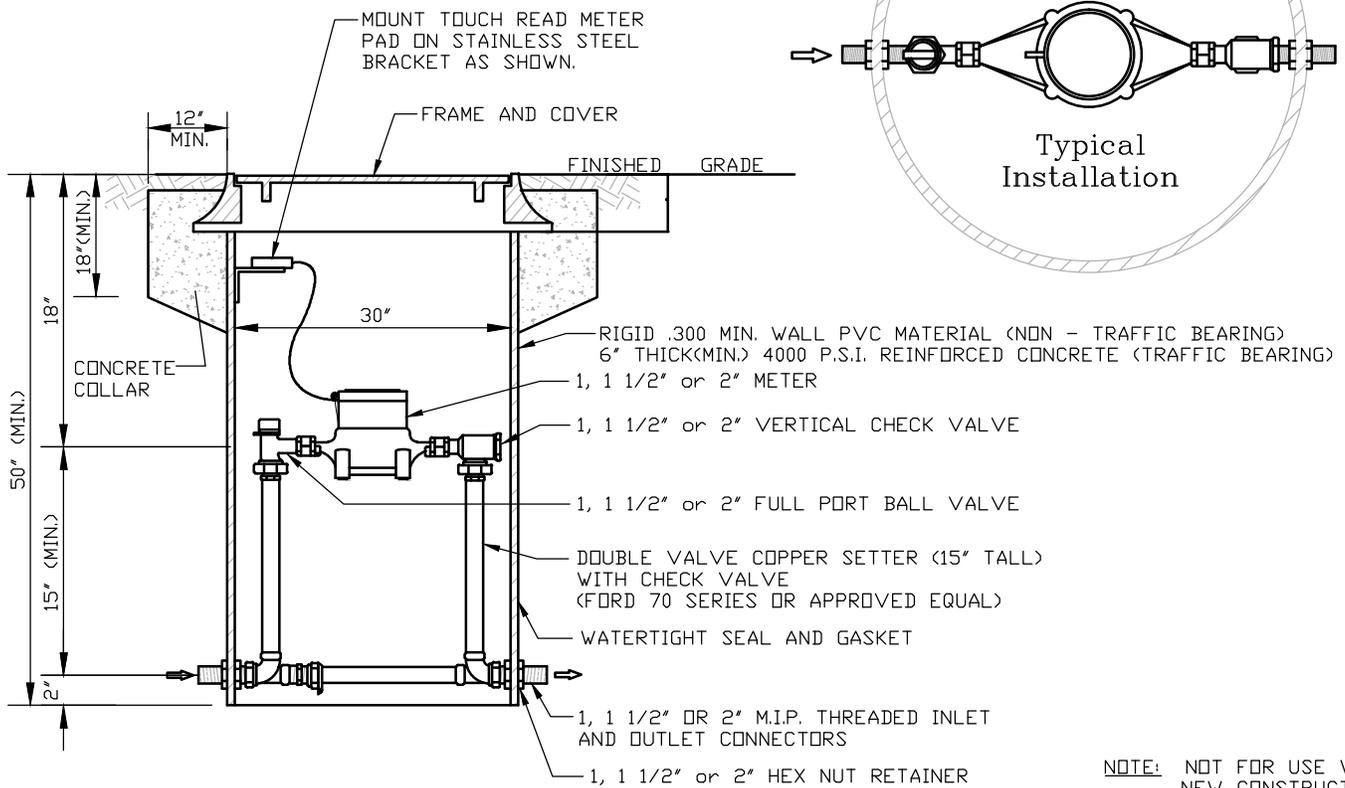
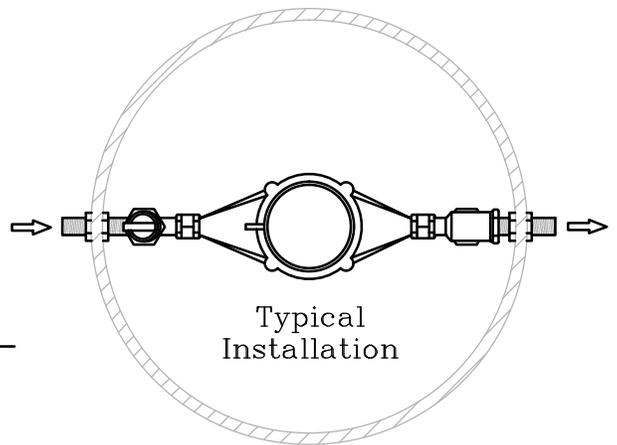
Temporary Cap and Blow-Off

Water Details

Standard No. W-11



FRAME & COVER
PLAN VIEW



NOTE: NOT FOR USE WITH
NEW CONSTRUCTION.

Issued	08/04
Revised	10/12
Source	



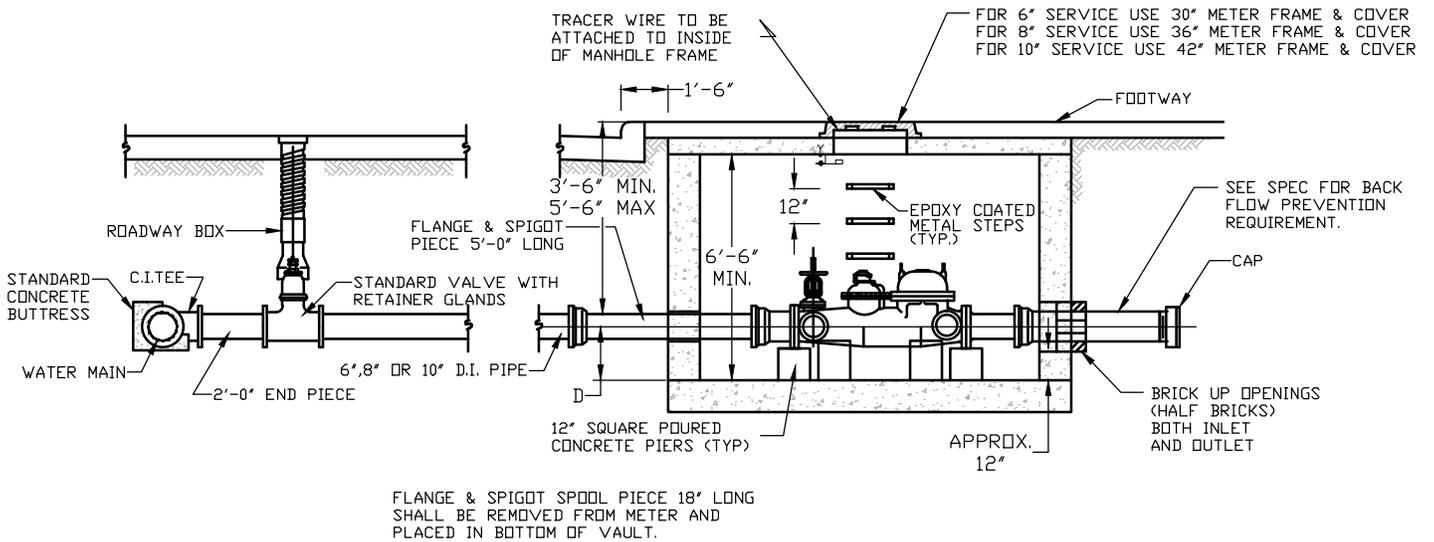
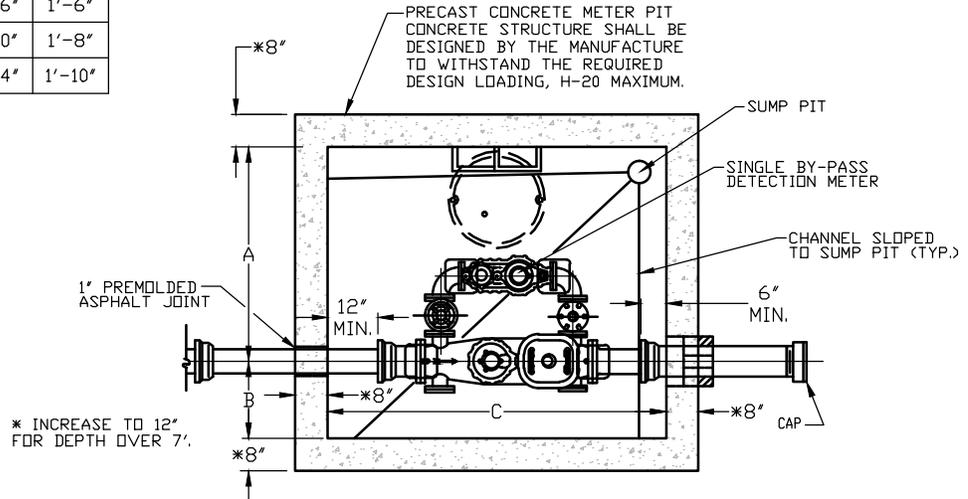
Department of
Public Works

Meter Pit Setter (1", 1 1/2" and 2")

Water Details

Standard No. W-12

METER SIZE	A	B	C	D
6" & SMALLER	4'-10"	2'-8"	7'-6"	1'-6"
8"	5'-8"	2'-10"	8'-0"	1'-8"
10"	6'-4"	3'-2"	9'-4"	1'-10"



Issued	08/04
Revised	10/12
	06/17
Source	

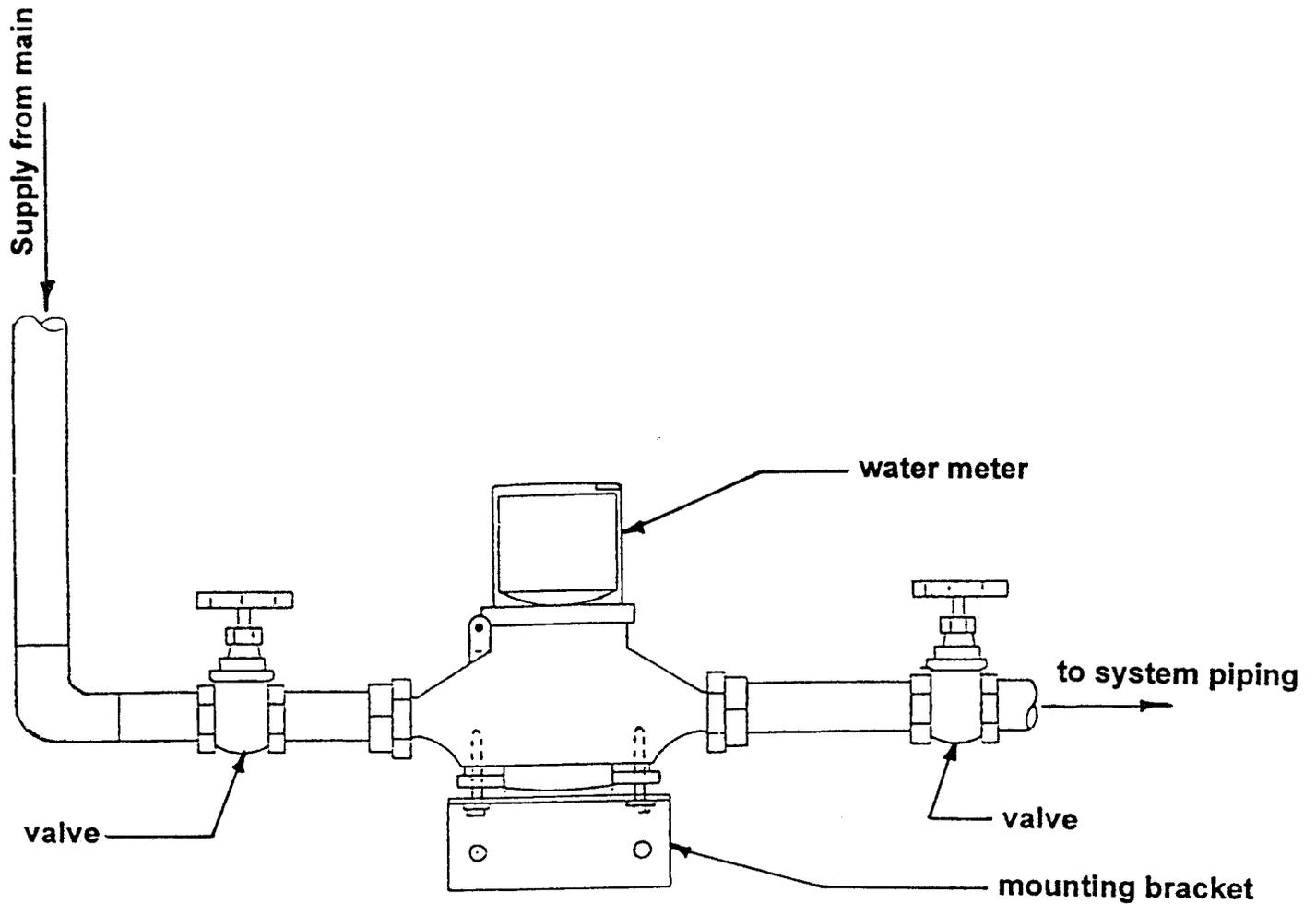


**Department of
Public Works**

Meter Pit Setter (3" and Above)

Water Details

Standard No. **W-13**



NOTES:

1. WATER METERS MUST BE INSTALLED INSIDE STRUCTURE TO PREVENT FREEZING, IN A HORIZONTAL POSITION AS SHOWN.
2. VALVES AND MOUNTING BRACKETS ARE NOT FURNISHED WITH METERS.
3. COMMERCIAL INSTALLATIONS MUST INSTALL A CHECK VALVE ON THE STREET SIDE OF THE METER.
4. THE TOWN OF SMYRNA MUST BE NOTIFIED AFTER INSTALLATION TO CALIBRATE THE METER.
5. VALVES SHALL BE 1/4 TURN FULL FLOW BALL VALVES.

Issued	08/04
Revised	10/12
Source	

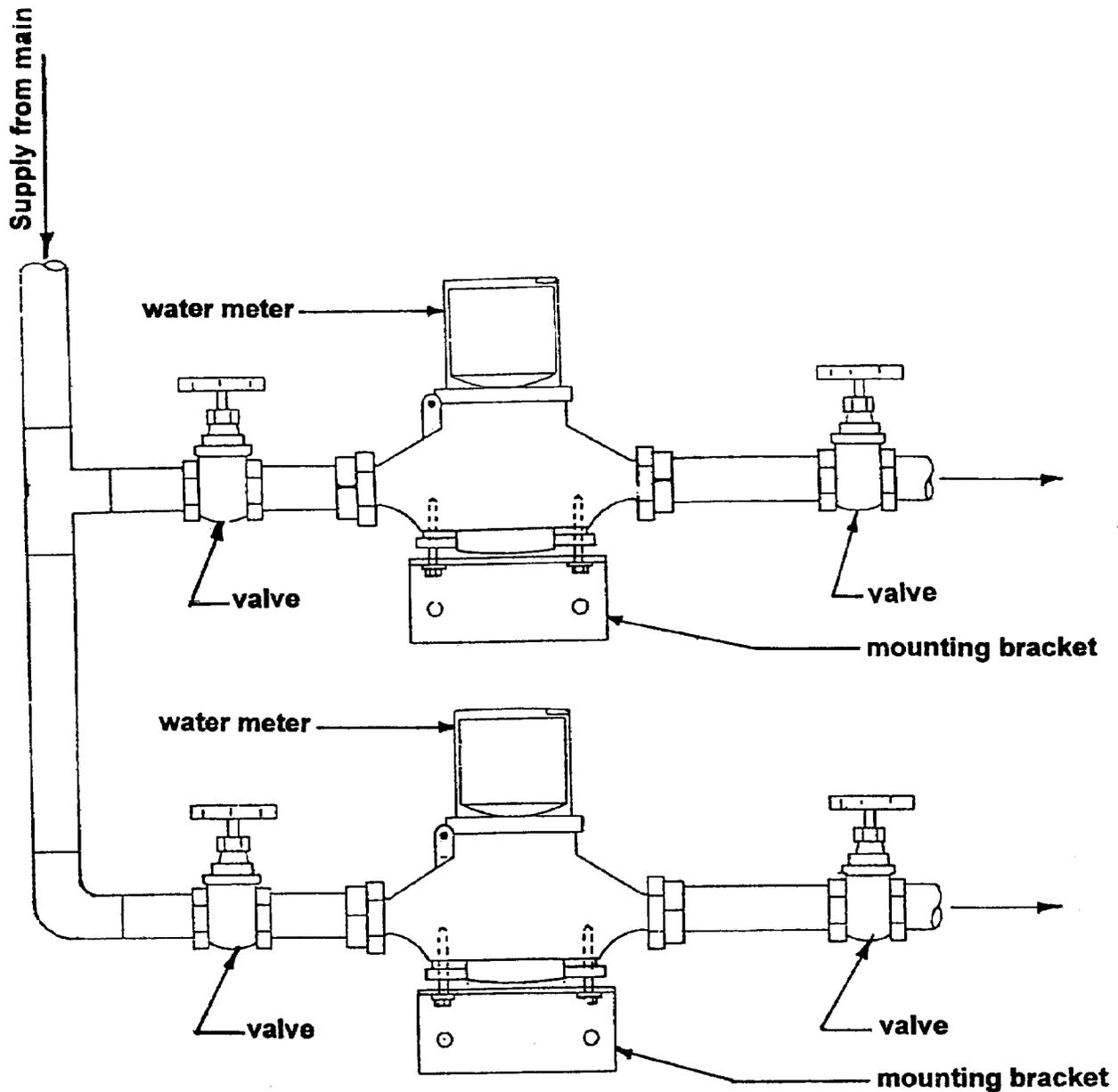


**Department of
Public Works**

Interior Water Meter Installation

Water Details

Standard No. **W-14**



NOTES:

1. WATER METERS MUST BE INSTALLED INSIDE STRUCTURE TO PREVENT FREEZING, IN A HORIZONTAL POSITION AS SHOWN.
2. SECONDARY METERS MUST SUPPLY ONLY NON-SEWER RELATED WATER AND MUST BE LABELED AS "METER #2" (METER AND REMOTE) AND HAVE A CHECK VALVE INSTALLED.
3. VALVES AND MOUNTING BRACKETS ARE NOT FURNISHED WITH METERS.
4. COMMERCIAL INSTALLATIONS MUST INSTALL A CHECK VALVE ON THE STREET SIDE OF THE METER.
5. THE TOWN OF SMYRNA MUST BE NOTIFIED AFTER INSTALLATION TO CALIBRATE THE METER.
6. VALVES SHALL BE 1/4 TURN FULL FLOW BALL VALVES.

Issued	08/04
Revised	10/12
Source	



**Department of
Public Works**

Interior Dual Water Meter Installation

Water Details

Standard No. W-15

Section C

Checklists, General Notes, and Certifications

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Road Plan

General Grading Plan

Sanitary Sewer Plan

Water Plan

As-Built Plan

GENERAL NOTES AND CERTIFICATIONS

Record and Construction Plan Notes

Additional Construction Plan Notes

Construction Plan Certifications

Record Plan Certifications

Checklists

**TOWN OF SMYRNA
SUBDIVISION / LAND DEVELOPMENT PLAN CHECKLIST**

Checklist:

The following is the minimum information required:

- _____ Scale at 1' = 50' (max)
- _____ Sheet size not to exceed 24"x 36"
- _____ Key map (if plan is more than one sheet.)
- _____ Title Block with type of application, name, address and phone number of the firm responsible for the plan preparation, location and area of subdivision, date, and scale (written and graphic.)
- _____ Tract or parcel boundaries and interior lot lines described with bearings and distances and curve data in accordance with professional Delaware State surveying standards.
- _____ Location map with site and major streets labeled.
- _____ North Arrow.
- _____ Owner names, parcel numbers and zoning of all adjacent properties.
- _____ Name and location of existing streets with right-of-way and cart way widths labeled.
- _____ Location and size of existing utilities, (sanitary sewer, storm sewer, water mains) watercourses and drainage ways on or adjacent to the subject parcel.
- _____ Contours at intervals of one foot.
- _____ Layout of proposed streets, including names, right-of-way and paving widths and widths of alleys.
- _____ Layout and dimensions of proposed lots and lot areas, including areas intended to be dedicated, and the conditions, if any, of such dedication or reservation.
- _____ Location, width and purpose of existing and proposed easements.
- _____ Tentative grades of proposed streets shown a percent (%) grade with arrows to designate direction of fall.
- _____ Location of proposed stormwater management facilities.
- _____ Tentative location and size of proposed sanitary sewer main at the point of connection to the existing sanitary sewer system.
- _____ Tentative location and size of proposed water main at the point of connection to the existing water system.
- _____ Tentative location and size of proposed storm sewer pipe or drainage swale at the point of connection to the existing storm sewer system, drainage ditch or watercourse.
- _____ Delineation of the 100-year flood plain.
- _____ Delineation of wetlands – labeled with metes and bounds on the plan or in the wetlands report.
- _____ Delineation of proposed active recreation areas.
- _____ Location of proposed structures with the proposed use, gross floor area and number of stories labeled.
- _____ Dimensions (minimum of two per building) to locate each proposed structure to the parcel boundary.
- _____ Smyrna General Notes and Certifications.
- _____ Setback lines with dimensions labeled.
- _____ Location of required landscape buffers with dimensions labeled.

- _____ Location of project benchmark with elevation labeled – to be graphically shown on the plan or the location map.
- _____ Legend
- _____ Parking spaces, including handicapped parking to meet ADA standards, with typical dimensions labeled.
- _____ Widths of all aisle ways, driveways and loading spaces.
- _____ Location of proposed sidewalks and access ramps.
- _____ Location and demarcation of required fire lanes.
- _____ Location of proposed dumpster pad(s) and the type of screening.
- _____ Phase lines.
- _____ Lot numbers.
- _____ Postal Addresses.
- _____ Total number of lots.
- _____ Existing and Proposed Street Names.

In addition, the record plan shall be accompanied by the following:

- _____ PLUS comment letter.
- _____ Existing Infrastructure Evaluation Report in accordance with Section 4.05 of the Subdivision and Land Development Ordinance.
- _____ Wetlands delineation letter/report (existing or non-existing)
- _____ Fire Marshal plan approval letter
- _____ Letter of no objection from DelDOT - if subdivision fronts on a state highway and an entrance is proposed.
- _____ Landscape plan (if required.)
- _____ Maintenance declaration (if necessary) referencing the record plan.
- _____ Deed of restrictions (if required.)
- _____ Electronic copy of the project in an AutoCAD compatible format in the Delaware State Plane Coordinate System (NAD 83.)

**TOWN OF SMYRNA
ROAD PLAN CHECKLIST**

The following is the minimum information required:

Title Sheet:

- ___ Name of Subdivision
- ___ Section of the Subdivision or name of the streets to be considered by this plan
- ___ General Location Map w/ North Arrow, 1"=2000' scale
- ___ Plan view of entire Subdivision indicating streets to be constructed by this plan and their relation to all other streets within the Subdivision (indicated by hatching)
- ___ North Arrow
- ___ Index of Sheets
- ___ Legend
- ___ Revision Block
- ___ 24"x36" Sheet Size
- ___ Drafting is neat and legible and suitable for half size reproduction
- ___ Signature Block for signature and seal DE Professional Engineer
- ___ Scale

Plan/Profile Sheets: (Horizontal Scale – 1" = 40' Vertical Scale – 1" = 4')

(PLAN VIEW)

- ___ Centerline Stationing.
- ___ Stationing at Intersections.
- ___ PC and PT Stationing.
- ___ Bearings of Centerline Tangents.
- ___ Centerline Curve Data.
- ___ Limits of Construction.
- ___ North arrow on each plan sheet.
- ___ Revision block and date.
- ___ Lot numbers and lot lines.
- ___ Utilities (storm sewer, sanitary sewer, water line) with structures (manholes, inlets, junction boxes) labeled with a unique identifier.
- ___ Match lines.
- ___ Street Names.
- ___ Drainage flow arrows.
- ___ Location of culverts with invert elevations at inlet and outlet.
- ___ Drainage data for culvert or storm sewer outfall to include:
 - ___ Drainage Area
 - ___ Estimated flow for design storm
 - ___ Estimated velocity of design storm
 - ___ Outlet Protection (location, dimensions, D₅₀ stone size, blanket thickness, underlain with filter fabric.)
- ___ Notes for curb line transitions (i.e. 60' R/W to 50' RW)
- ___ Right-of-way and curb lines.
- ___ Existing and proposed sidewalk locations including access ramps and crosswalks.
- ___ Location of Soil Borings – if applicable.
- ___ Location and description of existing and proposed monuments.

(PROFILE VIEW)

- On same sheet as Plan View
- Vertical curve data
 - PVI PVI elevation
 - PVC Length of Curve
 - PVT Station and Elevation of High or Low Point
- Soil Boring information – if applicable.
- Storm Sewer Profile
- Storm Drain System Information:
 - Structure #.
 - Structure Type.
 - Top and Invert Elevations.
 - Structure location based on road centerline station and distance right or left.
 - Length, size, type, and slope of pipes.
- Existing Grade at centerline of road.
- Proposed Grade at centerline of road.
- Street Centerline Stationing and Elevation
 - Every 50'
 - Every 25' on vertical curve
- Road grade clearly labeled as a percentage or in ft/ft.
- Utility Crossings of the Storm Drain System with dimensions showing vertical separation.
 - Water
 - Sanitary Sewer
 - Concrete encasements where less than 12" of vertical separation is provided between storm sewer and sanitary sewer.
- Location and Station of intersecting streets
- Match lines

Off-Road Storm Drain Profiles: (Horizontal Scale – 1" = 40' Vertical Scale – 1" = 4')

- Storm Sewer Profile
- Storm Drain System Information:
 - Structure #.
 - Structure Type.
 - Top and Invert Elevations.
 - Structure location based on road centerline station and distance right or left.
 - Length, size, type, and slope of pipes.
- Existing Grade at centerline of pipe.
- Proposed Grade at centerline of pipe.
- Utility Crossings of the Storm Drain System with dimensions showing vertical separation.
 - Water
 - Sanitary Sewer
 - Concrete encasements where less than 18" of vertical separation is provided between storm sewer and water, and where less than 12" of vertical separation is provided between storm sewer and sanitary sewer.
- Match lines
- Reference to sheet where plan view of storm sewer can be found (if plan view not provided with the profile.)
- Drainage data for storm sewer outfall to include:
 - Drainage Area
 - Estimated flow for design storm
 - Estimated velocity of design storm

- ___ Outlet Protection (location, dimensions, D₅₀ stone size, blanket thickness, underlain with filter fabric.)

Intersection Detail Sheets:

- ___ Plan view of all intersections at a scale of 1" = 30'
- ___ Street Names
- ___ Location and types of handicapped ramps and crosswalks.
- ___ Centerline stationing of both streets.
- ___ Stations of both street at the point of intersection.
- ___ Flow arrows with street grade for each branch of the intersection
- ___ Storm Drain Inlets:
 - ___ Structure #
 - ___ Top Elevation
- ___ Radius of curb
- ___ Proposed spot elevations (and flow arrows) along face of curb at 25' intervals and as necessary to demonstrate proposed drainage patterns thru the intersection or to an inlet.
- ___ Legend

Interior Signage Plan:

- ___ Scale (1"=100' or 1"=200', typical)
- ___ Legend
- ___ Subdivision layout
 - ___ Streets
 - ___ Lots
 - ___ Street Names
- ___ Sign locations (Stop signs, street name signs, entrance/monument signs) Where feasible, stop signs and street name signs shall be located such that they can be located on the same pole.
- ___ Phasing
- ___ North Arrow

Detail Sheets:

- ___ Typical roadway cross-sections.
- ___ Pavement sections for each roadway.
- ___ Misc. Details:

___ Sidewalk	___ Inlets/Manholes
___ Curbing	___ Temporary Barricades
___ Handicap Ramps	___ Pavement Tie-In

Storm Drain System Design Requirements:

- ___ 15" minimum size storm pipe.
- ___ Pipe systems shall be designed using 10-yr storm event and all sumps and pipes downstream of a sump shall be designed for the 25-yr storm.
- ___ All bridges and culverts shall be designed for 50-yr storm event
- ___ Drainage swales shall have a minimum flow velocity of 2.0 fps during 10-yr storm
- ___ Manholes or inlets shall be spaced no more than 300 ft apart for pipes up to 24 inches and not more than 450 ft apart on pipes greater than 24 inches.
- ___ Roof drains shall not discharge water over a sidewalk; instead roof drains should extend under the sidewalk to the gutter or be connected to the storm sewer system.
- ___ Storm Sewer design calculations are to be submitted with the road plans.

**TOWN OF SMYRNA
GENERAL GRADING PLAN CHECKLIST**

Index Sheet:

- _____ Title block.
- _____ Owner/Developer – name, address.
- _____ Engineer – name, address, phone #, fax #.
- _____ Revision block.
- _____ Index of sheets.
- _____ Scale (written and graphic).
- _____ Date.
- _____ North arrow.
- _____ Location Map.
- _____ Legend.
- _____ Smyrna General Notes and Certifications.

All other sheets:

- _____ North arrow.
- _____ Title block.
- _____ Engineer – name, address, phone #, fax #.
- _____ Revision block.
- _____ Scale.
- _____ Date.
- _____ Legend.
- _____ Existing contours at one (1) foot intervals.
- _____ Proposed contours at one (1) foot intervals.
- _____ Spot grades and flow arrows at all existing and proposed high and low points and as necessary to illustrate drainage patterns.
- _____ Parcel boundaries.
- _____ Proposed lots with lot numbers.
- _____ Existing building(s) and their use.
- _____ Proposed buildings and their use; F.F elevations, corner elevations, basement elevations (indicate if basement it to be sewerred.)
- _____ Lowest sewerred floor elevations must be at least 5' higher than the corresponding sewer lateral invert elevation at the main.
- _____ Outside grade elevations at corners of all structures and at other locations as necessary to illustrate drainage patterns.
- _____ Sufficient demonstration of protective slopes around structures per BOCA Code.
- _____ Dimensioned building restriction lines.
- _____ Delineate wetlands, floodplains, steep slopes, etc. and the extent of disturbance in these areas. (a buffer of an adequate width must be provided between the limits of grading and the extent of disturbance).
- _____ Delineate open space areas.
- _____ Cross-sectional details of all proposed swales with construction specification if not provided on stormwater management/drainage plans.
- _____ Existing and proposed street names, right-of-way widths and cartway widths.

- _____ Street centerline stations.
- _____ Street station and elevation at high and low points.
- _____ Proposed curbing.
- _____ Proposed sidewalks and access ramps.
- _____ Proposed driveways.
- _____ Proposed entrances.
- _____ Location, width and purpose of existing and proposed easements.
- _____ Proposed water mains and services. (including location of valves, hydrants, reducers, blowoffs, etc.)
- _____ Proposed sanitary sewer mains and services.
- _____ Proposed sanitary sewer clean-outs located 8' behind face of curb. Label the invert at the main for all services either on the plan or in a separate lateral table.
- _____ Proposed storm sewer.
- _____ Proposed manholes.
- _____ Proposed catch basins.
- _____ Directional arrows to show flow direction for sanitary sewer and storm sewer lines.
- _____ Construction Details.

**TOWN OF SMYRNA
SANITARY SEWER PLAN CHECKLIST**

The following is the minimum information required:

Title Sheet/Index Plan:

- ___ Title Block (All Plans)
 - ___ Engineering firm name, address, telephone # and fax #
 - ___ Subdivision name and phase (if applicable)
 - ___ Owner's name and address
 - ___ Scale (written and graphic)
 - ___ Date
 - ___ Sheet number
 - ___ Revision Block
- ___ Location Map
- ___ Overall Site Plan showing the entire sanitary sewer system to the point of connection to the existing sanitary sewer system, with street names, lot numbers and manhole numbers labeled. (max scale - 1" = 200')
- ___ General Notes:
 - ___ Design Flow (Average and Peak Flows)
 - ___ Number and type of units
 - ___ Number of Manholes
 - ___ Number and size of sewer laterals
 - ___ Linear feet of each size of pipe
- ___ North Arrow
- ___ Signature Block for signature and seal DE Professional Engineer
- ___ Note requiring magnetic indicator tape 12" below grade for both forcemains and gravity mains.

Plan/Profile Sheets: (Horizontal Scale – 1" = 40' Vertical Scale – 1" = 4')

(PLAN VIEW)

- ___ Utilities (storm sewer, sanitary sewer, waterline) with structures (manholes, inlets, junction boxes) labeled with a unique identifier.
- ___ Limits of Construction.
- ___ North arrow on each plan sheet.
- ___ Revision block and date.
- ___ Lot numbers and lot lines.
- ___ Match lines.
- ___ Street Names.
- ___ Right-of-way and curb lines.
- ___ Existing and proposed sidewalk locations.
- ___ Existing and proposed easements (min 20' wide)
- ___ Location of laterals and cleanouts
- ___ Road Centerline Stationing for identifying location of manholes.
- ___ Angular dimensions between pipes at each manhole.
- ___ Arrows to designate direction of flow in the sanitary sewer system.

(PROFILE VIEW)

- ___ On same sheet as Plan View
- ___ Profile of existing and proposed ground surface along centerline of pipe
- ___ Complete profile of sanitary sewer main to point of connection to existing main:

- ___ Manholes #.
- ___ Manhole Type (Standard, Shallow, Drop, Terminal, etc.).
- ___ Rim Elevation (For manholes in unpaved areas, the rim elevation shall be at least 6” higher than the proposed ground and in floodplains, at least 1’ above the 100-year floodplain.)
- ___ Invert Elevations.
- ___ Manhole location based on road centerline station and distance right or left.
- ___ Length, size, type, and slope of pipes. Slopes shall be listed as ft/ft and carried out to 5 decimal places.
- ___ Matchlines
- ___ Utility Crossings of the Sanitary Sewer System with dimensions showing vertical separation.
 - ___ Water
 - ___ Storm Sewer
- ___ Concrete encasements where less than 12” of vertical separation is provided between storm sewer and sanitary sewer.
- ___ Stationing along the pipe.
- ___ Maximum plumbing fixture depth line (5’ above the sanitary sewer main invert.)

Detail Sheet: (as applicable)

- ___ Manholes
- ___ Cleanout
- ___ Concrete encasement
- ___ Pipe bedding
- ___ Separation Detail
- ___ Lateral Detail
- ___ Road Crossing Detail when crossing existing roads.
- ___ Lateral Table: Lot number, lateral station, lateral size, and lateral invert at sewer main (if not labeled on the plan.)

Sanitary Sewer System Design Requirements:

- ___ Gravity sewer mains/laterals that are PVC shall have a minimum Standard Dimension Ratio (SDR) of 26
- ___ Gravity sewer mains installed a depth in excess of eighteen (18) feet shall be Ductile Iron, Class 52
- ___ Drop manholes shall be a minimum of 60” in diameter
- ___ Sewer mains should be located within the street right-of-way wherever practical, and as close to the centerline of the road as possible. Curb crossings are unacceptable.
- ___ Acute flow angles are unacceptable
- ___ Maximum length of pipe between manholes is 300’
- ___ Manholes shall be numbered consecutively.
- ___ Minimum cover required over the sanitary sewer shall be 3’-0”.
- ___ Water line crossing shall have a minimum of 18” vertical separation between pipes
- ___ Provide a minimum 10’ horizontal separation between sanitary sewer and watermain
- ___ Appropriate details shall be shown on the submission
- ___ Pumps shall include complete details, design charts and computations shown on the plan
- ___ Min. main size 8”, with slope of 0.50%
- ___ Min lateral size 6”, with slope of 2.00%
- ___ Cleanouts are to be located 8’ behind face of curb which is to be stamped with an “S”
- ___ On forcemains, indicate operating pressure and maximum allowable pipe pressure
- ___ Forcemains in profile and plan are treated the same as gravity lines, show all cleanouts instead of manholes
- ___ Design shall conform to 10 States Standards for Sewage Works and Town of Smyrna Code

**TOWN OF SMYRNA
WATER DISTRIBUTION PLAN CHECKLIST**

The following is the minimum information required:

Title Sheet/Index Plan:

- ___ Title Block (All Plans)
 - ___ Engineering firm name, address, telephone # and fax #
 - ___ Subdivision name and phase (if applicable)
 - ___ Owner's name and address
 - ___ Scale (written and graphic)
 - ___ Date
 - ___ Sheet number
 - ___ Revision Block
- ___ Location Map
- ___ Overall Site Plan showing the entire water distribution system to the point of connection to the existing water system, with street names, lot numbers, fire hydrants and water main sizes labeled. (max scale - 1" = 200')
- ___ North Arrow
- ___ General Notes/Data:
 - ___ Linear feet of each size and type of pipe.
 - ___ Number of existing and proposed fire hydrants.
 - ___ Note indicating Construction and Materials in accordance with Town of Smyrna Construction and Specifications
 - ___ Miss Utility Note
 - ___ Note for notification of Town of Smyrna 48 hours prior to commencement of work

Plan/Profile Sheets: (Horizontal Scale – 1" = 40' Vertical Scale – 1" = 4')

(PLAN VIEW)

- ___ North Arrow
- ___ Location, type, and size of mains, with stations corresponding to profiles
- ___ Show plan and profile on the same sheet for the section of line shown
- ___ Location of valves, fittings, depressions, hydrants, horizontal bends and other appurtenances
- ___ Location of service lines.
- ___ Lot lines and numbers
- ___ Phasing
- ___ Street Locations, Width, and Name
- ___ Location and size of all other public utility crossings
- ___ Matchlines
- ___ Easements shall be labeled and dimensioned (20' wide minimum)
- ___ Legend

(PROFILE VIEW)

- ___ Existing and Proposed Grade at centerline of water main.
- ___ Profile of watermain with depth of main labeled (min 48".)
- ___ Location of vertical bends and water main depressions with depth or invert of pipe at the depression labeled.

- ___ Crossing utilities with vertical separation labeled.
- ___ Concrete encasements
- ___ Matchlines

Detail Sheet:

- ___ Buttresses
- ___ Hydrant
- ___ House Service
- ___ Typical Street Section with location of waterline
- ___ Concrete encasement/separation

Water Distribution System Design Requirements:

- ___ Minimum cover of 48" required over the water main.
- ___ Minimum main size of 6".
- ___ Minimum of 18" vertical separation required between water mains and sanitary sewer/storm sewer pipes.
- ___ Minimum 10' horizontal separation required between sanitary sewer and water mains.
- ___ Max. 600' spacing between fire hydrants as measured along curb lines.
- ___ Dead end mains should be avoided. Blow off valves required at all temporary dead end lines. Flushing hydrant or fire hydrant required at all permanent dead end lines.
- ___ Water main shall be within the paved roadway located so as to provide the required horizontal separation from sanitary sewer mains and to minimize conflicts with storm sewer and other utilities.
- ___ All mains to be Class 50 Ductile Iron Pipe conforming to AWWA C151, cement lined and bituminous coated inside and out in accordance with AWWA C104, or C900 PVC pipe.
- ___ Minimum diameter of house connection is one inch.
- ___ Service connections up to two inches in diameter shall be Type K copper tubing; over two inches shall be cast or ductile iron pipe.
- ___ Valves shall be installed at all main branch connections with a maximum spacing of 800 feet apart.
- ___ Curb stops are to be located 8' behind face of curb with curb stamped "W"

**TOWN OF SMYRNA
AS-BUILT PLAN CHECKLIST**

The following is the minimum information required:

GENERAL:

- ___ Name of Subdivision
- ___ Section of the Subdivision or name of the streets to be considered by this plan
- ___ Name, address, telephone # and fax of Firm preparing drawings
- ___ General Location Map w/ North Arrow, 1"=2000' scale
- ___ Revision Block
- ___ 24"x36" Size Sheet
- ___ Scale (written and graphic)
- ___ Surveyor's/Engineer's statement (with seal and original signature on each sheet) shall verify that As-Built drawings reflect the true conditions in the field.
- ___ "AS-BUILT" shall be labeled on each sheet
- ___ Street names labeled on all streets
- ___ As-Built drawings shall be prepared as revisions to the original Engineering Plan or a mylar copy of the original. As-Built drawings will have the original data lined through and the As-Built data added to the drawing or check marked to indicate item is as designed. Upon approval of the As-Built drawings – three (3) paper sets of signed drawings will be delivered to the Town of Smyrna. The As-Built Plans shall also be provided in electronic form (AutoCAD, pdf or jpg format) on a CD.
- ___ Benchmark location and elevation referenced with location shown graphically on the plan or on the location map if not within the project limits.
- ___ All horizontal distances shall be shown to the nearest foot. All vertical distances shall be shown to the nearest tenth of a foot.
- ___ If the as-built location of an item is more than five (5) feet from the design location, the as-built location must be shown on the plan with a dimension to locate it from the design location.

WATER SYSTEM AS-BUILT:

- ___ Location of valves, services, fire hydrants, flushing hydrants and blowoffs.
- ___ Verify size and type of pipe installed.
- ___ Special detail drawings may be required where installations are not shown on contract drawings for whatever reason or where required for clarity.

SANITARY SEWER SYSTEM AS-BUILT:

- ___ Locate all manholes and cleanouts.
- ___ Horizontal scale same as plan view (1"=40')
- ___ Vertical scale (1"=4')
- ___ Verify length, size, type and slope of pipes.
- ___ Elevations shall be given for the top of all manhole covers and for all inverts.
- ___ Manholes shall be identified by inside diameter and types (standard, inside drop, doghouse, etc.)
- ___ CCTV Inspection DVD of all sewer mains installed.

FORCE MAINS AS-BUILT:

- ___ Locate all valves, manholes, etc.
- ___ Locations of pipe shall be shown at all changes in direction
- ___ Verify size and type of valves, pipes, etc.

- ___ Special detail drawings will be required where installations were not as shown on original drawings or where changed due to field conditions or where required for clarity.

PUMP STATION AS-BUILT:

- ___ Wetwell size and location shall be shown.
- ___ Elevations for top, bottom, inverts, adjacent ground and type and size of lines and fittings for all lines entering or leaving the wetwell.
- ___ All schedules which show pump, motor and electrical data shall be amended and shall be submitted with wetwell drawings.
- ___ All improvements within the pump station boundaries shall be located horizontally and vertically to the nearest tenth of a foot (i.e., valve pit, pump-out, water spigot, wetwell, control panel, bends, fittings, etc.).

STORM SEWER SYSTEM AS-BUILT:

- ___ Locate all manholes, catch basins, junction boxes, culverts, headwalls, drainage swales, flared end sections and inlet/outlet protection.
- ___ Verify elevations for all drainage structures (top, invert, bottom, etc.)
- ___ Identify size, type, and slope of all piping.
- ___ Provide spot elevations and cross sectional information, as well as slope, on all ditches, swales, etc.
- ___ Verify dimensions (length and width) as well as D₅₀ stone size and blanket thickness of all rip-rap outlet protection areas.
- ___ CCTV Inspection DVD of all storm sewer installed.

Town of Smyrna General Notes

(Record and Construction Plan Notes)

1. Tax Map Parcel No.:
2. Existing Zoning:
3. Proposed Zoning:
4. Source Of Title:
5. Owner/Developer:
Address:
6. Datum:
7. Project Benchmark:
8. Gross Acreage:
9. Site Cover Breakdown (Area of lots, right-of-ways, open space, etc – **Subdivision plans**)
(Area of buildings, pavement, open areas, etc. – **Site plans**)
10. Proposed Land Use:
11. Total Number of Lots: (Listed by type.)
12. Purpose Of Plan:
13. Area Regulations:
14. Open Space Required:
Open Space Provided:
15. Parking Requirements:
16. Monumentation: Existing: (#) (symbol) – (description)
 Proposed: (#) (symbol) – (description)
17. Fire Hydrants: Existing: (#) (symbol)
 Proposed: (#) (symbol)
18. Projected Sanitary Sewer Flow Data (Average and Peak)
19. Utilities:
 - a. Water Supply: Town of Smyrna. Subject to the approval of the Delaware State Department of Natural Resources and Environmental Control, the Delaware State Division of Public Health and the Town of Smyrna.
 - b. Sanitary Sewer: Town of Smyrna. Subject to the approval of the Delaware State Department of Natural Resources and Environmental Control, the Delaware State Division of Public Health and the Town of Smyrna.
 - c. Storm Drainage: All on-site drainage facilities shall be privately owned and maintained. Drainage facilities shall be in accordance with the Town of Smyrna “Standard Specifications and Details” and the Delaware Sediment and Stormwater Regulations dated 1989 or as later amended. (**Commercial**)
 - d. Storm Drainage: Town of Smyrna. All on-site drainage facilities shall be publicly owned and maintained. Drainage facilities shall be in accordance with the Town of Smyrna “Standard Specifications and Details” and the Delaware Sediment and Stormwater Regulations dated 1989 or as later amended. (**Residential**)
 - e. Electric: Town of Smyrna. Subject to the Town's approval.

20. Delaware regulations prohibit the burial of construction/demolition debris, including trees and stumps on construction sites. Any solid waste found during excavation must be removed and properly discarded off-site at an approved landfill.
21. All fire lanes, fire hydrants, fire department connections, sprinklers, standpipe connections, and fire exits shall be marked and/or protected in accordance with the Delaware State Fire Regulations.
22. A 20' utility easement, 10' respectively, on each side of the centerline of the pipe, shall be created, wherever possible, where a sanitary sewer, storm sewer, water or electric is designated for public use and is outside of the dedicated public right-of-way.
23. In addition to easements shown on this plan, a six-foot strip is hereby reserved as an easement for utilities on each lot, around the entire perimeter of each lot.
24. Developer shall preserve all trees on this site, except where necessary to construct buildings, parking, accessways, recreational facilities and utilities, and selective thinning of existing trees. Specific species of plant materials as designated on this plan or the landscape plan (if such a plan is an integral part of this plan) shall be preserved and properly protected during construction.
25. Subdivision streets that are constructed within the limits of the right-of-way dedicated to the public use shown on this plan are to be maintained by the Town following the completion of the streets by the developer to the satisfaction of the Town. The Town assumes no maintenance responsibilities within the dedicated street right-of-way until the streets have been accepted by the Town.
26. All common facilities including, but not limited to, paved areas, sidewalks, curbing, landscaping, public open space, and/or drainage facilities shall be kept in good repair and maintained in a safe sanitary condition.
27. All proposed right-of-ways shown on this plan are hereby dedicated to public use. All rights-of-way shall be dedicated as public utility easements immediately upon recordation, regardless of status of dedication to the Town.
28. Street lights in residential areas are required to be installed at the cost of the developer.
29. All lot purchasers shall permit the developer, or his agents, temporary trespass upon the purchaser's lot to complete or repair the various improvement elements (grading, infiltration trenches, etc.) shown on the approved final plan for the period from the purchase of the lot to eighteen (18) months from the date of acceptance of public improvements by the Town of Smyrna.
30. All lot purchasers shall permit Town Officials temporary trespass upon the purchaser's lot to inspect the various improvement elements shown on the approval final plan for the period from the purchase of the lot to eighteen (18) months from the date of acceptance of public improvements by the Town of Smyrna.
31. All public utilities including, but not limited to, electric, gas, and telephone shall be placed underground within the subdivision and land development. Such utilities shall be installed in strict accordance with the prevailing standards and practices of the utility or other company providing service, except where it is demonstrated to the satisfaction of the Town of Smyrna that underground installations are not feasible because of physical conditions of the land.
32. A landscape plan prepared by (name of firm), last dated (xx/xx/xx) or as amended and approved in writing by the Town of Smyrna, is hereby considered a part of the record plan.
33. For maintenance declaration of open spaces, landscaping, and/or stormwater management facilities shown on this plan, see deed of restrictions, dated (xx/xx/xx), and of record in the Office of the Recorder of Deeds in and for Kent County, State of Delaware, deed record book _____, page _____(or microfilm/instrument no.).
34. Ground control survey by _____ of _____, _____. Vertical controls are referenced, benchmarks as noted on plans.
35. According to the Federal Emergency Management Agency Flood Insurance Rate Map No. _____, panel _____ of _____, effective date xx/xx/xx, this site falls within zone _____ which has been determined to be _____.

36. A wetland delineation was performed by _____, an Army Corps of Engineers and/or society of wetlands scientists certified delineator, during the month of _____, in accordance with the 1987 code delineation manual and associated guidance. The site is/is not impacted by federally regulated wetlands. The owner and/or developer submitted the delineation for jurisdictional determination to the appropriate federal agency on _____. The owner and/or developer shall obtain all necessary permits that may be required for construction on or near lands classified as wetlands regulated by the Army Corps of Engineers or the Natural Resources Conservation Service.
37. The developer shall construct concrete sidewalks as shown on this plan.
38. Owner and/or developer will be responsible for maintenance of sediment and stormwater controls during construction and for long-term maintenance of stormwater controls until all lots have been sold. At that time, responsibility for long-term maintenance of stormwater controls shall be assumed by the homeowners/commercial lot owners association.
39. All lots shall access internal subdivision streets only.
40. Upon completion of the development shown herein, the owner and/or developer shall convey unto homeowner's association, a Delaware corporation (hereinafter the "association"), for the association's perpetual ownership, (1) all common areas, (2) all open space, (3) all recreational areas, and (4) the stormwater management area. The association, upon receiving such title shall thereafter have full responsibility and expense for maintenance.
41. All lots and open space areas shall be provided with at least six inches of topsoil upon completion of grading and construction of individual lots and open space areas. All such areas shall be seeded, sodded or otherwise landscaped.
42. This plan supersedes, in part, the plan of _____ dated _____ and recorded on _____ in the Recorder of Deeds in and for Kent County, State of Delaware, Microfilm (Instrument) No. _____. **(If applicable.)**

(Additional Construction Plan Notes)

1. 48-hour notice must be given to the Town of Smyrna prior to any construction activity starting.
2. All construction and materials shall be in accordance with the Town of Smyrna's "Standard Specifications and Details."
3. All site improvements including landscaping, permanent site stabilization and permanent stormwater management facilities shall be in place and approved prior to issuance of a certificate of occupancy.
4. As-built plans are required to be submitted to the Town for review and approval before dedication of any improvements is accepted by the Town.
5. The Contractor is required to maintain a copy of the current Town of Smyrna Standard Specifications and Details Manual, and a set of the approved construction plans, on the site at all times during construction.

(Construction Plan Certifications)

1. Professional Engineer or Professional Land Surveyor Certification:

I, _____ hereby certify that these improvement construction plans have been prepared in accordance with the current, as of the date below zoning ordinance and subdivision and land development ordinance of the Town of Smyrna.

Name and Seal

Date

2. Owner and/or Developer Certification:

I (we), _____ hereby certify that these improvement construction plans were prepared at my (our) direction and that I (we) will construct the improvements as shown on these plans.

Name

Date

3. Town Engineer and Town Manager Certification:

These improvement construction plans conform to the applicable Town of Smyrna ordinances and standards.

Town Engineer

Date

Town Manager

Date

(Record Plan Certifications)

1. Professional Engineer or Professional Land Surveyor Certification: **(Subdivision and Site Plans)**

I, _____ hereby certify that the plan represents a survey made by me (or firm’s name), that the accuracy of the information shown is correct to acceptable surveying standards and practices, the monuments shown as existing are accurately shown and the plan complies with the applicable zoning and subdivision ordinances of the Town.

Name and Seal

Date

2. Owner Certification: **(Subdivision and Site Plans)**

I (we), _____ hereby certify that the final subdivision (site) plan was prepared at my (our) direction, the public improvements to be dedicated to the Town of Smyrna will be done upon acceptance by the Town, and that we have read and agree to the terms of section 3.06 sunseting of approved plans of the subdivision ordinance of the Town of Smyrna.

Name

Date

3. Town Engineer Certification: **(Major Subdivision Plans – Optional for Minor Subdivision Plans – To be determined by the Town)**

The final subdivision plan conforms to the applicable Town zoning and subdivision ordinances.

Town Engineer

Date

4. Signature of Town Manager: **(Major Subdivision Plans)**

Town council approved the final subdivision plan at a public meeting held on _____ and the construction activity must be started within one year of the approval date or this plan’s approval expires.

Name

Date

5. Signature of Town Manager: **(Minor Subdivision Plans)**

The final subdivision plan conforms to the applicable Town zoning and subdivision ordinances.

Town Manager

Date

6. Town Manager and Town Engineer Certification: **(Site Plans)**

The final site plan conforms to the applicable Town zoning and subdivision ordinances.

Town Manager

Date

Town Engineer

Date

