



STANDARD SPECIFICATIONS
AND DETAILS
FOR PUBLIC WORKS CONSTRUCTION

DEPARTMENT OF PUBLIC WORKS
TOWN OF LAUREL
201 MECHANIC STREET
LAUREL, DELAWARE

MAY 2008



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PREFACE

The Town of Laurel, in an effort to standardize construction of public utilities and roadways has developed these Standards and Specifications to define the materials, equipment, machinery and other components to be used in the construction, renovation, repair or replacement of streets, water systems, sanitary sewer systems and storm drainage systems.

Where a specific reference to a manufacturer and/or model, type or style is made, it is the intention to standardize and maintain uniformity throughout the Town of Laurel. Where such reference exists, no substitutes or alternates will be considered unless otherwise noted.

In addition to the requirements contained herein, all Public Works construction shall be in accordance with the most current edition of the following documents:

1. Comprehensive Plan
2. Subdivision and Land Development Project Regulations
3. Zoning Ordinance

Additionally, all construction shall be in accordance with applicable County, State and Federal requirements including, but not limited to, sediment and erosion control and stormwater management, Delaware Department of Transportation, Department of Natural Resources and Environmental Control and the US Army Corps of Engineers requirements. In the event of a conflict between the Standards and Details contained herein and applicable County, State, or Federal Requirements, the conflict shall be resolved in favor of the stricter requirement.

The Public Works Director or the Town Engineer must approve, in writing, any exceptions or alterations.

Use of these specifications by any other organization or individual will be at the user's risk.

Copies of this book may be purchased from the Public Works Department of the Town of Laurel, 201 Mechanic Street, Laurel, Delaware, 19958 or downloaded from our website at www.townoflaurel.net.

Addenda to these specifications may be issued by the Town to suit its needs.

1. **DEFINITIONS** - Wherever used in these specifications and standards, the following terms shall have the meanings indicated:

Town – The Town of Laurel, Sussex County, Delaware acting through the Director of Public Works.

Director of Public Works – The Town’s Director of Public Works.

Engineer – The authorized designee design professional that represents the Town.

Subcontractor – Any individual, firm or corporation who contracts with a contractor to perform part or all of the latter’s contract.

Contractor – The person, firm or corporation who undertakes to construct, alter, move, demolish, repair, replace, excavate or add to any public improvements or common facilities covered by these Standard Specifications.

Developer – The person or persons legally responsible to the Town for construction of improvements.

Days – Calendar days unless otherwise specified.

Inspector (also referred to as “Resident Project Representative”) – The authorized representative of the Town of Laurel assigned to make detailed inspections of construction work to assure compliance with these Standards and Specifications and the plans approved by the Town.

Plans – Profiles, cross sections, and drawings, and supplemental drawings, approved by the Town that show the locations, character, dimensions or details of the work.

Regular Working Hours – Seven (7) A.M. until five (5) P.M. of the same day, Monday through Friday.

Standards and Specification – The body of directions, provisions, and requirements contained herein, describing the method, manner of construction and the qualities and quantities of the materials and work to be furnished.

Shop Drawings – Drawings created by a contractor, subcontractor, vendor, manufacturer that illustrates construction materials, dimensions and installation for an item for incorporation into construction.

2. PERMIT, FEES AND NOTICES

- A. The Developer is responsible for all Town costs related to Engineer services, studies, reviews or other related expenses inclusive of the costs for preliminary engineering through final acceptance.
- B. The Contractor shall pay taxes, royalties, and fees, and secure licenses and permits that are required, during the time of the contract, by local, county, state and federal laws, ordinances, rules, codes and regulations for the legal performances of the contract.
- C. The Contractor shall perform the work in accordance with notices issued by public authorities having jurisdiction over the work including but not limited to Delaware Department of Transportation, Delaware Department of Health and Soil Conservation Service.
- D. If the Contractor performs work, knowingly or ignorantly, contrary to requirements of local, county, state and federal laws, ordinances, rules, codes and regulations, he shall assume full responsibility therefor and shall bear all costs of suits, actions and damages resulting from his illegal work performance.

3. INDEMNIFICATION

- A. The Contractor shall indemnify and hold harmless the Town and the Engineer and their agents and employees from and against claims, damages, losses and expenses arising out of or resulting from the performance of the work attributed to:
 - 1. Bodily injury, sickness, disease, or death, or to injury or destructions of tangible property including the loss of use resulting therefrom, and
 - 2. Negligence or willful act or omission of the Contractor or subcontractor and others directly or indirectly employed by them.

4. COOPERATION OF CONTRACTOR AND REPRESENTATIVE

- A. The Contractor shall give the work his constant attention to facilitate the progress thereof and shall cooperate with the Engineer and Owner. The Contractor shall have at all times a competent and reliable English-speaking representative on the work, authorized to receive orders and act for him.

5. COOPERATION WITH 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 Owner. 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.

6. AUTHORITY AND DUTIES OF RESIDENT PROJECT REPRESENTATIVE

- A. Resident Project Representative (RPR) employed by the Owner or Engineer shall be authorized to observe all work done and materials furnished. Such observation may extend to all or any part of the work and to the preparation or manufacture of the materials to be used. An RPR may be stationed on the work to report to the Engineer as to the progress of the work and the manner in which it is being performed; also to report whenever it appears that the materials furnished and work performed by the Contractor fail to fulfill the requirements of these specifications. No inspection, or any failure to inspect, at any time or place, however, shall relieve the Contractor from his obligation to perform all of the work strictly in accordance with the requirements of the specifications. The RPR shall perform such other duties as are assigned to him. He shall not be authorized to revoke, alter, enlarge, replace or release any requirements of these specifications, nor to approve or accept any portion of work, nor to issue instructions contrary to the drawings and specifications. The RPR shall in no case act as foreman or perform other duties for the Contractor, nor interfere with the management of the work by the latter.
- B. Contractor, if granted permission to work overtime, shall reimburse the Town for any overtime salary incurred by the RPR.

7. PUBLIC CONVENIENCE AND SAFETY

- A. The Contractor shall conduct the work in a manner that will minimize obstruction to traffic in the area. The safety and convenience of the general public and of the residents and occupants of property along and adjacent to the work shall be provided in an adequate and satisfactory manner. Footways and portions of highways and streams adjoining the work shall not be obstructed more than absolutely necessary. In no case shall any traveled thoroughfare be closed without permission of the Owner.
- B. Fire hydrants on or adjacent to the work shall be kept accessible to fire apparatus at all times and no obstructions shall be placed within 15 feet of hydrant.
- C. Gutters and storm drain inlets shall be kept unobstructed at all times.

8. WORK AFFECTING DELAWARE D.O.T. JURISDICTION

- A. All materials and construction methods for work affecting Delaware Department of Transportation jurisdiction shall be done in complete accordance with permit

and/or franchise stipulations of directives issued by the same. All costs for such work shall be the responsibilities of the Contractor.

- B. Maintenance of traffic shall be accomplished in full accordance with the Delaware Department of Transportation publication, "Traffic Controls for Street and Highway Construction and Maintenance Operations," latest edition. Work in Department of Transportation Right-of-Way shall not commence without an approved signing plan.

9. PRESERVATION AND RESTORATION OF PROPERTY

- A. Contractor shall not enter private property without permission.
- B. The Contractor shall take necessary measures to preserve public and private property, including paving and lawns outside monuments to be moved until an authorized agent has referenced their locations, and until directed to move them. The Contractor shall pay all expenses for replacing property markers disturbed. Replacement shall be a Surveyor licensed in the State.
- C. The Contractor shall be responsible for damages to property, whether caused by himself, his subcontractors, or as a result of negligent construction methods. Contractor shall provide restoration of damaged property to its original condition, or better, at no additional cost to the Owner. If Contractor fails to restore such property, the Owner may, upon 48 hours notice, have property restored at the Contractor's expense.

10. BARRICADES, DANGER, WARNING, AND DETOUR SIGNS

- A. The Contractor shall provide, erect and maintain all necessary barricades, suitable and sufficient lights, danger signals, provide a sufficient number of watchmen and take all necessary precautions for the protection of the work and safety of the public. Highways closed to traffic shall be protected by effective barricades, on which shall be placed acceptable warning signs. The Contractor shall detour traffic and shall furnish and maintain all detour signs required to direct traffic over the entire route of the detour. Costs for maintaining traffic shall be the responsibility of the Contractor.

11. LINES, GRADES AND ELEVATIONS

- A. Work done by the Contractor without having first established proper lines and grade, or work done to incorrect line and grade, may be ordered removed and replaced.
- B. The Contractor shall furnish the Town, at least five days prior to the start of construction, two record copies of the line and grade stake-out data. The furnishing of such data, shall in no way release the Contractor from the

responsibility for completeness and accuracy of stake-out work necessary for construction.

- C. All stake-out work shall be done by a Delaware licensed surveyor.
- D. All proposed sewer cleanouts and water meter pits shall be field located by the Contractor prior to the start of construction. Notice shall be given to the Town to observe the location and make any adjustments.

12. CONSTRUCTION SCHEDULE

- A. The Contractor / Developer shall prepare a construction schedule in bar chart form.

13. TEMPORARY FACILITIES

- A. The contractor shall provide and maintain approved sanitary facilities for the full term of the contract.

14. UTILITIES

- A. The Contractor shall contact "Miss Utility" at 800-441-8355 and the Town of Laurel, Department of Public Works (302-875-2277) at least forty-eight (48) hours prior to digging in the vicinity of existing underground utilities to have them located and marked.
- B. The Contractor shall install isolation valves where indicated on the drawings, or where required, to facilitate the connection, testing, and switch over of the new water main. There is no guarantee areas can be isolated. Isolation valves may have to be installed under pressure or by other means such as line stopping. All costs associated with installing isolation valves shall be borne by the Contractor.

15. TEMPORARY SUSPENSION OF WORK

- A. The Engineer and or Town shall have the authority to suspend the work, wholly or in part, for such period or periods as he may deem necessary, due to unsuitable weather, or such other conditions as are considered unfavorable for the suitable execution of the work, or for such time as is necessarily due the failure on the part of the Contractor to carry out orders given or perform any or all provisions of the contract. If it should become necessary to stop work for an indefinite period, the Contractor shall store all material in such manner that they will not obstruct or impede the traveling public unnecessarily nor become damaged in any way and he shall take every precaution to prevent destruction, damage or deterioration of the work performed, provide suitable drainage by opening ditches, shoulder drains, etc., and erect temporary structures where necessary. The Contractor shall not suspend the work without authorization. Neither the failure of the Engineer to notify

the Contractor to suspend the work on account of bad weather or other unfavorable conditions, nor permission by the Engineer to continue work during bad weather or other unfavorable conditions, shall be a cause for the acceptance of any work which does not comply in every respect with the contract and specifications.

16. SAFETY

- A. The Contractor shall comply with all safety regulations or determinations issued by an agency of the Federal Government, including OSHA and the State of Delaware.

17. ACCESS BY RESIDENTS

- A. The Contractor shall so schedule his work as to minimize the time period during which vehicular access to each dwelling along the route is prevented.
- B. The Contractor shall provide vehicular access at all time to commercial establishments.
- C. The Contractor shall provide, at all times, safe pedestrian access to all dwellings, whether residential, commercial or other.

18. REPAIR OF DAMAGED AREAS

- A. Repair of areas disturbed during construction to their pre-construction condition shall be the responsibility of the Contractor.

19. COORDINATION WITH DEPARTMENT OF PUBLIC WORKS PERSONNEL

- A. The Contractor shall fully cooperate and coordinate his activities with the Town of Laurel, Department of Public Works personnel at all times.

20. DISPOSAL OF EXCESS MATERIALS

- A. The Contractor shall be responsible for obtaining an acceptable site for all excess materials and debris not suitable for incorporation in the finished work.

21. NO TRENCH LEFT OPEN AT NIGHT

- A. All excavations shall be backfilled or suitably covered and fenced secure at the end of each working day.

22. CONTRACTOR'S RESPONSIBILITIES

- A. Should the Contractor extend his work beyond normal working hours, any and all cost of weekend, holiday and/or overtime inspection, including but not limited to direct salaries, fringe benefits, overhead profit, administration and supervision,

incurred by the Engineer, and/or, the Town, will be the sole obligation of the Contractor.

- B. There shall be no recourse by the Contractor to the Town for reimbursement of these costs.
- C. The Contractor will be allowed to work 40 hours per week, Monday through Friday, 52 weeks per year. The Contractor shall not work on Saturday, Sunday, holidays recognized by the Owner, or beyond 40 hours per week, unless prior approval is secured from the Owner.

23. FINAL ACCEPTANCE

- A. Upon completion of the work, the Town or Engineer will create a punch list of item(s) to be completed and/or repaired. Upon completion of the punch list, the Engineer will recommend final acceptance to the Town.

24. RECORD DOCUMENTS

- A. During the progress of the job, the Contractor shall keep a careful record at the job site of all changes and corrections to the information shown on the Drawings, Specifications, Addenda and Change Orders. The Contractor shall enter such changes and corrections on one (1) set of Contract Documents immediately. The record documents shall indicate, in addition to all changes and corrections, the actual location referenced from two permanently fixed surface structures utilities installed or uncovered by him. At the time of beneficial occupancy of each facility involved under the Contract, the Contractor shall submit to the Engineer one set of record documents as required herein.

25. GUARANTY

- A. The Developer hereby guarantees all of the work performed for a period of one year unless otherwise noted, after final acceptance has been certified by the Town and the Engineer. The guarantee shall be as follows:
- B. Against all faulty or imperfect materials and against all imperfect, careless and/or unskilled workmanship, as evidenced by excessive pipe settlement, cracked pavements, failure of structures, and/or equipment, etc.
- C. That the entire equipment and each and every part thereof, shall operate with proper care and attention in a satisfactory manner, and in accordance with the requirements of these standard specifications and details.
- D. That the entire structure in the vicinity if work done shall be watertight and leak proof, at every point and in every particular.

- E. The Developer agrees to replace with proper workmanship and materials, and to re-execute, correct or repair, without cost to the Town, any work which may be found to be improper or imperfect.
- F. No use or acceptance by the Town of the work or any part thereof, nor any failure to use the same, not any repairs, adjustments, replacements or corrections made by the Town due to the Developer's failure to comply with any of his obligations under these standards, shall impair in any way the guarantee obligations assumed by the Developer.

26. SHOP DRAWINGS

- A. The Developer or Contractor shall submit to the Engineer, six (6) copies, plus the number required by the Contractor, layout drawings for installation and erection of the work and shop drawings for all fabricated or manufactured articles to be used in the work.
- B. All submittal shall be made through the Developer or Contractor. No direct submittals by subcontractors will be accepted.
- C. The Developer or Contractor shall obtain and check manufacturer's shop drawings for conformance with these specifications. The Contractor shall sign or stamp each submittal stating the following:

Checked by _____
(Contractor's Name)
Signed by _____
(Checker's Name)

1.01 PROJECT DRAWINGS**A. TITLE SHEET**

1. Title of Project and Address.
2. Phase of Project (if necessary).
3. Developer's Name, Address and Phone Number.
4. Design Engineer's Name, Address and Phone Number.
5. Drawing Index.
6. Approval Block for Town Engineer's signature and date.
7. Vicinity Map showing location of Project within the Town. Typical scale shall be 1 inch equals 1000 feet.
8. Location Map of the development.
9. Design Engineer's Seal and Signature.
10. Certification by the Design Engineer to the accuracy of the drawings.
11. Certification by the Developer approving the drawings.
12. Certification by a Professional Wetlands Scientist for wetland determination if hydric soils are present.
13. Design calculations and daily flows with the total number of units, lots etc (if necessary).
14. Existing and proposed legends along with all necessary General Notes.

B. HORIZONTAL PLANS

1. The scale shall be 1 inch equals 20 feet for small projects and a maximum of 1 inch equals 50 feet for large projects.
2. North Arrow shall be shown.
3. All necessary construction notes pertaining to the sheet.
4. Location, elevation and description of all Project Bench Marks, referenced to, and using, NAVD 88 monuments.
5. Location, sizes, type and slope of all sanitary sewer lines with stations corresponding to the profiles (if necessary).
6. Locations of all manholes with grades between any elevations of flow line, top of each manhole, and all invert elevations (if necessary).

7. Location and sizes of all proposed water lines (if necessary).
8. Location of proposed valves, fittings and fire hydrants (if necessary).
9. Property lines and ownership, with details of existing and proposed easements where required.
10. Location of all existing and proposed building structures with unit and tax map numbers.
11. Beginning and end of proposed construction.
12. Location of all existing and proposed service lines.
13. Provide profiles for all utility crossings (if necessary).
14. Location of existing sanitary sewer facilities, (manholes and pipelines), shall be shown and labeled for invert and size (if necessary).

C. PROFILE SHEET

1. The scale shall be 1 inch equals 50 feet horizontally and 1 inch equals 5 feet vertically.
2. Profile of existing and proposed ground surface with elevations at the top of manholes and at the flow line shall be shown.
3. Profile of sanitary sewer showing, type and size of pipe, slope, manholes and concrete encasement (if any) and stationing of manholes.
4. Designate manhole diameters if other than 48 inches.
5. Location of all other drainage facilities and public utilities crossing sanitary sewer lines.
6. Force Mains shall also be shown with profiles as well as stationing.

D. DETAILS (WATER MAINS AND SANITARY SEWER)

1. Standard Construction Details, as shown in the Standard Detail Section of this Booklet, shall be included on the drawings where applicable.

DESIGN PARAMETERS FOR WATER DISTRIBUTION SYSTEMS

Section 110

1.01 DESIGN CAPACITY

A. WATER MAINS

1. In determining the required size and capacity of the water main, the following factors should be considered.
 - a. Estimated average and maximum water demand for the design period.
 - b. Topography of area.
 - c. Depth of excavation.
 - d. Fire fighting requirements.
 - e. Number of proposed services.
 - f. The calculations for design of the water mains, when requested, shall accompany the Project Drawings, when submitted to the Town Engineer for review.

B. WATER SERVICE LINES

1. Individual water services shall be installed to each lot of a subdivision including separate corporation stop, service line, and meter assembly. The service lines shall be one continuous piece from the main to the meter, no couplings and no curb stops shall be utilized. All office complexes and retail units shall have a separate meter for each unit. Service lines shall be designed by the developer for the use intended. Minimum standards shall include the following:

	Min. Service Size	Min. Meter Size
Single family residence, mobile home, town home, single story apartment building or condominiums	1"	5/8" x 3/4"
Two (2) unit building	1"	5/8" x 3/4"
Three (2) to eight (8) unit building	2"	2" Compound Meter

2. Larger services and commercial or industrial services shall be evaluated on a case by case basis. Fire services shall be sized by the Developer's Engineer in accordance with Fire Marshal requirements and approved by

the Town Engineer.

1.02 DESIGN SIZE

A. PRESSURE

1. All water mains shall be sized after a hydraulic analysis based on flow demands and pressure requirements. The system shall be designed to maintain a minimum pressure of 23 psi at ground level at all points in the distribution system under all conditions of flow. The normal working pressure in the distribution system should be designed for approximately 55 psi.

B. DIAMETER

1. The minimum size of water main for providing fire protection shall be 6 inch diameter. Larger mains will be required, if necessary, to allow the withdrawal of the required fire flow while maintaining the minimum residual pressure.

1.03 DEPTH OF WATER MAINS

- A. Minimum depth of water mains shall be 3'-0" as measure from the top of the pipe to finished grade. Any piping not meeting the required minimum depth shall be concrete encased

1.04 VALVES

- A. Sufficient valves shall be provided on the water mains for isolation during repairs. Valves should be located at not more than 500 foot intervals in commercial districts and at not more than one block or 800 foot intervals in other districts. Also, valves shall be placed at all main branch connections.

1.05 HYDRANTS

- A. Hydrants should be provided at each street intersection and at intermediate points between intersections as required by the State Fire Marshall. Generally, hydrant spacing may range from 400 to 600 feet depending on the area being served. Fire Hydrants shall be installed a maximum of 7 feet from curb face unless authorized in writing by the Town. Fire Hydrants shall not be installed outside of the public right-of-way or utility easement, unless authorized in writing by the Town and property owner.

1.06 SERVICE METERS

- A. Each service connection, except fire service, shall be individually metered. Fire

Services shall be installed with a detector check meter system.

1.07 DEAD ENDS

- A. Dead ends shall be minimized by looping of all water mains whenever practical. Hydrants shall be placed at the end of all dead end lines. Blow-offs shall be used, if approved by the Town.

1.08 SANITARY SEWER LOCATION WITH RELATION TO THE WATER MAINS

A. HORIZONTAL SEPARATION

- 1. Sewers shall be laid at least 10 feet horizontally from any existing or proposed water main. The distance shall be measured from outside edge to outside edge.

B. VERTICAL SEPARATION

- 1. Sewers crossing water mains shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer. This shall be the case where the water main is either above or below the sewer. The crossing shall be arranged so that the sewer joints will be equidistance and as far as possible from the water main joints. Where a water main crosses under a sewer, adequate structural support shall be provided for the sewer to prevent damage to the water main. When it is impossible to obtain proper separation, concrete encasement shall be required to be installed a minimum of 5 feet on each side of the crossing point of the lowest utility.

C. SPECIAL CONDITIONS

- 1. In cases where it is not practical to maintain a 10 foot separation, the Department of Public Health may allow deviation on a case by case basis, if supported by data from the design engineer. Such deviations may allow the water main to be closer to a sewer main, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer. In all cases a written approval from the Department of Public Health will be required.

DESIGN PARAMETERS FOR SANITARY SEWER

Section 120

1.01 DESIGN FLOW

A. PER CAPITA FLOW

1. The sanitary sewer system shall be designed based on an average daily flow of sewer of 300 gallons per day per EDU.

B. PEAK DESIGN FLOW

1. Sanitary sewer shall be designed on a peak flow basis using the ratio of peak average daily flow as determined from Figure 1, located at the end of this section.

1.02 MINIMUM SIZE

A. SANITARY SEWER MAINS

1. The required size of the sanitary sewer mains will vary with the character and size of the Development. The minimum size for sanitary sewer main is eight (8) inches.

B. LATERAL CONNECTIONS

1. Lateral cleanouts are required for use with all laterals unless a written waiver is received from the Town Engineer.
2. Each individual dwelling unit and multi-family units, with the exception of structures where each unit may not extend to the ground floor, shall have an individual lateral installed. The minimum diameter of laterals extending from the Town maintained cleanouts shall be six (6) inches at a minimum slope of 2%. Lateral cleanouts shall be placed at the property line. Additional cleanouts shall be per the State or County Plumbing Code in effect.

1.03 DEPTH OF SEWER

A. Minimum depth of sanitary sewer main shall be

1. Four (4) feet as measured from the pipe invert to finish grade if curbing and guttering is to be constructed.
2. Five (5) feet as measured from the pipe invert to finish grade if no curbing

and guttering is to be constructed

3. Any piping not having a minimum of three (3) feet of cover shall be concrete encased.

1.04 SLOPES

- A. All sewers shall be designed and constructed to give mean velocities, when flowing full, of not less than 2.0 feet per second, based on Manning's formula. If possible, pipe slopes should be increased above minimum slope in locations where pipes will carry fractional flow.

1. Using an "n" value of 0.010 for PVC, the following are the minimum slopes which are allowed.

Minimum slope per 100 Feet

8 Inch	0.28
10 inch	0.22
12 inch	0.17
15 inch	0.12
18 inch	0.10

2. Using an "n" value of 0.013 for Ductile Iron Pipe, the following are the minimum slopes which are allowed.

Minimum slope per 100 Feet

8 Inch	0.40
10 inch	0.28
12 inch	0.22
14 inch	0.17
16 inch	0.14
18 inch	0.12

3. Pipe which is to be placed in a Jack and Bore casing pipe shall use a minimum slope of 0.06 feet per 100 feet of pipe.

1.05 MANHOLES

A. LOCATION AND SPACING

1. 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

then 400 feet.

B. TERMINAL CLEANOUTS

1. Terminal cleanouts shall not be substituted for manholes. However, terminal cleanouts may be approved under special conditions by the Town Engineer on a case by case basis. Under no conditions shall terminal cleanouts be installed at the end of a main line sewer greater than 150 feet from the last manhole.

C. DROPS

1. All drop manholes shall have a minimum diameter of 5 feet. 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. Every effort should be made by the design engineer to adjust pipe slopes and inverts so that drops less than 36 inches can be avoided. No more than one drop per manhole shall be allowed. Only inside drops are permitted.

D. MINIMUM DIAMETER

1. The minimum diameter of manholes shall be 48 inches. Sewer mains above 18 inches shall require a 5 foot diameter manhole. A minimum access lid diameter of 24 inches shall be provided on all manholes.

E. FLOW CHANNELS

1. The flow pipe channel through manholes shall be pre-cast conforming in shape to that of the sewer. The channel shall drop a minimum of 0.10 feet from influent pipe to effluent pipe. The flow channel shall be smooth and shall be free of any shoulders or gaps that may prevent solids from flowing through.

1.06 SANITARY SEWER LOCATION WITH RELATION TO THE WATER MAINS

A. HORIZONTAL SEPARATION

1. Sewers shall be laid at least 10 feet horizontally from any existing or proposed water main. The distance shall be measured from outside edge to outside edge.

B. VERTICAL SEPARATION

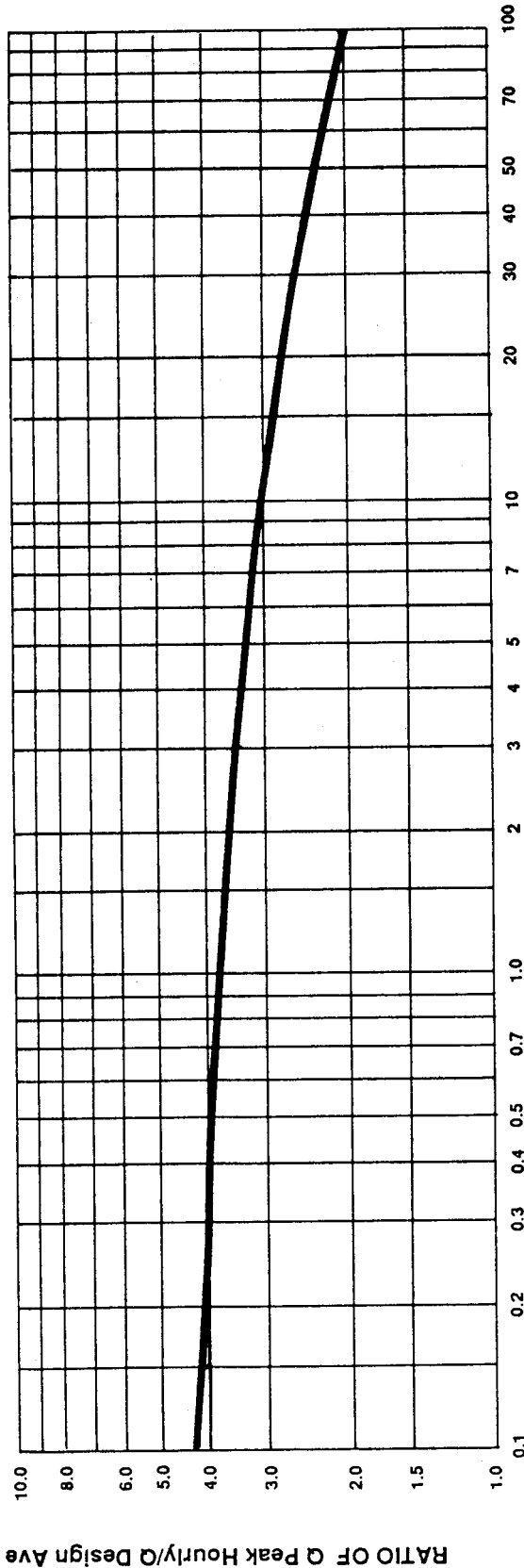
1. Sewers crossing water mains shall be laid to provide a minimum vertical

distance of 18 inches between the outside of the water main and the outside of the sewer. This shall be the case where the water main is either above or below the sewer. The crossing shall be arranged so that the sewer joints will be equidistance and as far as possible from the water main joints. Where a water main crosses under a sewer, adequate structural support shall be provided for the sewer to prevent damage to the water main. When it is impossible to obtain proper separation, concrete encasement shall be required to be installed a minimum of 5 feet on each side of the crossing point of the lowest utility.

C. SPECIAL CONDITIONS

1. In cases where it is not practical to maintain a 10 foot separation, the Department of Public Health may allow deviation on a case by case basis, if supported by data from the design engineer. Such deviations may allow the water main to be closer to a sewer main, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer. In all cases a written approval from the Department of Public Health will be required.

FIGURE 1.
RATIO OF PEAK HOURLY FLOW TO DESIGN AVERAGE FLOW



10-5

POPULATION IN THOUSANDS

Q peak hourly: Maximum Rate of Wastewater Flow (Peak Hourly Flow)

Q design ave: Design Average Daily Wastewater Flow

Source: $Q \text{ Peak Hourly} / Q \text{ Design Ave} = \frac{18 + \sqrt{P}}{4 + \sqrt{P}} \quad \text{--- (P = population in thousands)}$

Fair, G.M. and Geyer, J.C. "Water Supply and Waste-water Disposal" 1st Ed., John Wiley & Sons, Inc., New York (1954), p. 136

EXCAVATION AND BACKFILL FOR UTILITY CONSTRUCTION

Section 210

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This work shall consist of all excavation necessary to open the pipe or conduit trench, lay the pipe or conduit, and backfill and compact to the existing or proposed grade as required by the Contract Drawings.
- B. DEFINITIONS
 - 1. Excavation: Removal of materials of any kind in the excavation.
 - 2. Excavation Below Subgrade: Same as excavation except such excavation is performed below elevations given as subgrade.
 - 3. Subgrade: Trench bottom prepared as specified to receive gravel bedding, concrete cradle or concrete encasement or the bottom of excavations prepared to receive pipe line structures.

1.02 QUALITY ASSURANCE

- A. TESTS AND INSPECTIONS
 - 1. The Engineer may, at his discretion, direct that Proctor and field density testing be done to determine the degree of compaction.
 - 2. Tests and inspections will be performed by an independent testing agency selected and paid by the Contractor. Work of the testing agency includes but is not limited to:
 - a. Prior approval of material used as fill and backfill.
 - b. Verification of compaction by in-place density tests.
 - 3. Contractor shall provide access for and shall assist testing agency in acquisition of samples and performance of tests.
 - 4. Whenever test results indicate compaction densities less than specified, the Contractor shall correct the installation and retest until satisfactory results are achieved. All costs thereof shall be borne by the Contractor.
- B. REFERENCE STANDARDS
 - 1. American Association of State Highway and Transportation Officials (AASHTO):

- a. T 180, Method A: Moisture-Density Relationship; Modified Proctor Test.
- b. T 191: Density By Sand Cone.
- c. T 224: Coarse Particle Correction.
- d. T 238: Density By Nuclear Methods.
- e. T 239: Moisture Content By Nuclear Methods.
- f. T 272: Method C: Moisture-Density Family of Curves.

1.04 JOB CONDITIONS

A. ENVIRONMENTAL REQUIREMENTS

- 1. Do not perform trenching, backfilling or compacting when weather conditions or the condition of materials are such, in the opinion of the Engineer, that work cannot be performed satisfactorily.
- 2. Do not use frozen materials as backfill nor wet materials containing moisture in excess of the amount necessary for satisfactory compaction.
- 3. Prior to use, moisten dry backfill material not having sufficient moisture to obtain satisfactory placement or compaction.
- 4. Prior to use, dry wet backfill material to a sufficient moisture to obtain satisfactory placement or compaction.
- 5. Plan work so as to provide adequate protection during storms with provisions available at all time for preventing flood damage. Protect installed piping and other work at all times against damage from uplift due to high ground water levels.
- 6. Accommodation of Drainage: Keep gutters, sewers, drains and ditches open at all times for surface drainage. No damming or ponding or water in gutters or other waterways will be permitted. Do not direct water flows across or over pavements except through approved pipes or properly constructed troughs. When so required, provide pipes or troughs of such sizes and lengths as may be required, and place the same as required at no expense to the Owner. Perform grading in the vicinity of trenches so that the ground surface is properly pitched to prevent water running into the trenches.

B. PROTECTION

- 1. Responsibility for Condition of Excavation
 - a. The Contractor shall be responsible for the condition of all excavations made by him. All slides and caves shall be removed.

2. Protection of Property and Structures

- a. The Contractor shall sustain in their places and protect from direct or indirect injury all pipes, wires, conduits, poles, tracks, walls, signs, wells, septic tanks, buildings, and other structures or property in the vicinity of his work whether above or below ground, or that may appear in the excavation. He shall at all times have a sufficient quantity of timber and plank, chains, ropes, and other material and equipment, on the site and shall use them as necessary for sheeting his excavations and for sustaining or supporting any structures that are uncovered, undermined, endangered, threatened, or weakened.
- b. The Contractor shall take all risks attending the presence or proximity of pipes, wires, conduits, poles, tracks, walls, buildings, and other structures and property of every kind and description in or over his trenches or in the vicinity of his work whether above or below the ground surface, and he shall be responsible for all damage and assume all expense for direct or indirect injury caused by his work to any of them or to any person or property by reason of injury to them.
- c. Any wells or structures removed or damaged, as a result of the Contractor's work, shall be replaced to meet the latest applicable standards.
- d. The Contractor shall not enter upon private property for any purpose without obtaining the property owner's written permission, and he shall be responsible for the preservation of all public and private property, trees, monuments, and any and all natural or manmade objects, along and adjacent to the work and shall use every precaution necessary to prevent damage or injury to any and all property or persons. He shall use necessary precautions to prevent damage to pipe, conduits, and all other structures, and shall protect markers until a registered land surveyor in the State of Delaware paid for and retained by the Contractor has witnessed or otherwise referenced the location, and shall not remove them until directed. All such land monuments and property markers, whether damaged and/or removed shall be properly replaced prior to the completion of the work by a registered land surveyor licensed in the state. The Contractor shall not willfully or maliciously injure or destroy trees or shrubs and shall not remove or cut them without proper written authority of the property owner. The Contractor shall be strictly responsible for any and all damage or injury of every kind and description which directly or indirectly may be done to any property or sustained by any persons during the procession of the work resulting from any wrongdoing, misconduct, want of care or skill, or any negligence of himself or his agents and/or employees in

his manner or method of executing said Work or due to his non-execution of said Work, even though such manner or method of said Work be concurred in, permitted, or allowed by the Engineer or the Town, its agents, and/or employees, or at any time due to defective Work or materials. When or where any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the Work, or in consequence of 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.

3. Utilities

- a. The Contractor shall contact "Miss Utility" at (800) 282-8555 at least 48 hours prior to digging in the vicinity of existing underground utilities to have them located and marked.
- b. Where the outside limits of an underground utility service have been located and staked on the ground the Contractor shall be required to use excavation methods acceptable to the Engineer within 3 feet of such outside limits at such points as may be required to insure protection from damage due to the Contractor's operations.
- c. Should the Contractor damage or interrupt the operation of a utility service or facility by accident or otherwise, he shall immediately notify the proper authority and the Engineer, and shall take all reasonable measures to prevent further damage or interruption of service. The Contractor, in such events, shall cooperate with the utility service or facility owner and the Engineer continuously until such damage has been repaired and service restored to the satisfaction of the utility or facility owner.
- d. The Contractor shall bear all costs of damage and restoration of service to any utility service or facility due to his operation whether or not due to negligence or accident.
- e. The Contractor shall pay all charges levied by utility companies from work performed by their forces to locate, inspect, protect, relocate, replace or repair overhead or underground utilities shown on the drawings as necessary for the construction of this project.

4. Pipe Supports

- a. Adequately support underground pipes or conduits exposed as a result of excavations. Provide adequate support along their entire exposed length by salt treated timber or planking. Install such

supports in such manner that backfilling may be performed without dislodging such pipes or conduits. Place and carefully compact material from excavation or Special Backfill, as required, around the supports, and leave such supports in place as a guard against breakage due to backfill settlement.

E. EXCAVATION CONDITION

1. Condition and results of excavation are solely the responsibility of the Contractor. Remove slides and cave-ins at whatever time and under whatever circumstance they occur.
- G. Perform soil erosion and sediment control work in accordance with applicable requirements of the Soil Conservation District.
- H. If stability of adjoining structures or walls is endangered by excavations, shoring and bracing or underpinning shall be provided as necessary to insure their stability.
- I. If it is necessary to place or operate power shovels, trucks or other heavy objects on a level above and near an excavation, the sides of the excavation shall be sheet-piled, shored and braced as necessary to resist the extra pressure due to such superimposed loads.

PART 2 - PRODUCTS

2.01 MATERIALS

A. PIPE BEDDING

1. Pipe bedding shall consist of coarse stone aggregate meeting requirements for No. 57, with gradation in accordance with the following:

<u>Square Mesh Sieve</u> <u>Size (inches)</u>	<u>Minimum and Maximum Percent</u> <u>Passing by Weight</u>
1-1/2"	100
1"	95-100
1/2"	5-60
No. 4	0-10
No. 8	0-5

B. TRENCH BACKFILL

1. On site excavated soil or soil-rock mixed materials free of topsoil, plant life, lumber, metal, refuse and rock or similar hard objects larger than two inches

in any dimension. For bedding under and backfill around the pipe, the Contractor shall use material from excavation meeting AASHTO Classification A-1, A-2-4, A-2-5, or A-3.

2. Backfill material shall contain sufficient moisture for proper compaction and shall be compacted to not less than 95% of the maximum density for any specific soil classification, as determined by the Modified Proctor Test AASHTO T-180, Method "A".

PART 3 - EXECUTION

3.01 PREPARATION

- A. Pipe Lines and Grades: Prior to excavation for any run of piping, set control points for line and grade.
 1. Control Point: Sufficiently offset control points from trench centerline to prevent loss of points during excavation and pipe laying operations. Make the offset on the trench side opposite the excavated material stockpile. Set the control points 25 feet apart maximum for lines less than 100 feet in length. Set control points at maximum of 100 feet apart or less if required by the Contractor, for lines greater than 100 feet in length, with a minimum of 4 control points.
 - a. In unpaved or unsurfaced areas, place control points on top of hubs driven firmly into the earth. Place a reference stake next to each hub.
 - b. In paved areas, drive spikes or cut crosses into paving; in either case, enclose in a painted circle.
 2. Elevations: Taken using a surveyor's level and recorded. Depths of cut to pipeline invert shall be computed and both the stationing and computed depth of cut shall be marked on the stakes and the road surface.
 3. Horizontal and Vertical Control: Use either properly calibrated laser or grade stakes and batter boards to maintain vertical and horizontal alignment. Laser operation personnel shall be competent, trained for use with the instrument.
 4. Methods used to lay out and maintain lines and grades of pipelines, other than those specified previously, will be permitted; however, such methods will be subject to the approval of the Engineer.

3.02 PERFORMANCE

A. GENERAL

1. Excavations shall be on open cut except where and to such extent as the

Engineer or permit requirements may authorize or direct that the same be done by other methods. Trenches may in general be excavated and backfilled either by machinery or by hand as the Contractor may elect provided; however, the Engineer shall be empowered, wherever he shall decide that such necessity exists, to direct that hand excavation shall be employed, and provided further that backfilling by hand shall be done to the extent hereinafter specified. Hand excavation may be required where necessary to protect existing structures or buried utilities.

2. In all areas which the Delaware Department of Transportation exercises jurisdiction, all excavation and backfill shall be accomplished in full conformance with their requirements.
3. Excess excavated material that cannot be used at the project site shall be removed and disposed of off the site in a legal manner.

B. REMOVAL AND STORAGE OF SURFACE AND SUBGRADE MATERIALS

1. The Contractor shall grub and clear the surface and remove all surface and subgrade materials of whatever nature over the line of the trench and the site of other structures and areas to be graded; and he shall properly store, guard, and preserve such of said materials as may be required for use in backfilling, resurfacing, repaving, or for any other purposes.
2. Stockpiled materials shall in no case be placed in such a manner as to endanger the trench, existing structures, private property, or the environmental quality of the area. Measures shall be taken to insure no blockage of existing surface drainage and to minimize the possibility of erosion and siltation of these materials.

C. EXCAVATING

1. Perform excavation and backfilling using machinery, except as follows:
 - a. Hand excavation and backfilling may be required where necessary to protect existing structures or utilities.
 - b. Backfilling shall be done by hand to the extent hereinafter specified.
2. Excavate trenches to necessary width and depth as required elsewhere herein.
3. Begin excavation in trenches at the control point having the lower invert and proceed upgrade.

- D. Bedding Placement: Bedding shall be placed uniformly on the prepared base, in a satisfactory manner, to the lines and grades indicated on the Drawings. Placing of bedding by dumping from top of slope or by other methods that will tend to segregate particle sizes within the bedding will not be permitted. Any damage to

the surface of the bedding base during placing of the bedding shall be repaired before proceeding with the work.

E. TRENCH WIDTH AND DEPTH

1. Trench width shall provide suitable room for proper laying and joining of pipes, considering any sheeting or dewatering requirements.
2. From subgrade elevation to an elevation at least twelve inches above the top of the outside barrel of the pipe, excavate trench banks to vertical lines.
3. From a point twelve inches above the top of the outside barrel of the pipe, keep trench banks as nearly vertical as possible with due regard for safety.

F. LENGTH OF OPEN TRENCH

1. No greater length of trench in any location shall be left open in advance of the completed structure placed therein than shall be authorized or directed. The Engineer shall be empowered at any time to require the backfilling of open trenches over completed pipeline if in his judgment such action is necessary.
2. If work is stopped on any trench for any reason and the excavation is left open for an unreasonable length of time in advance of construction, the Contractor shall if so directed backfill such trench and shall not again open said trench until he is ready to complete the structure therein.

H. BACKFILLING

1. Backfill excavations as rapidly as practical after completion of construction work therein or after excavations have served their purpose. Accomplish backfilling as specified herein and as indicated on drawings.
2. Use material from excavation for backfill unless, in the opinion of the Engineer, such material is not suitable for use as backfill.
3. Backfill materials shall be carefully placed and compacted along the haunch of the pipe. Unless otherwise indicated or directed, hand place backfill materials in six (6) inch layers to a point at least two (2) feet above pipe crown. Thoroughly compact each layer for the full trench width and under, around and over pipe, using mechanical tampers exerting a pressure of not less than 250 foot pounds per square foot of tamping face. For bedding under and backfill around the pipe, the Contractor shall use material from excavation meeting AASHTO Classification A-1, A-2-4, A-2-5, or A-3. It is the Contractor's responsibility to use material from excavation meeting the above requirements where it is available.
4. Remainder of trench, more than two feet above pipe crown, may be backfilled by machinery in eight (8) inch layers. Thoroughly compact each

layer for the full trench width using mechanical tampers. Heavy duty equipment shall not be run over the trench unless the pipe cover exceeds four (4) feet, unless otherwise approved by pipe manufacturer and Owner

5. Upon completion of backfilling, the Engineer may require tests to determine the degree of compaction of the backfill material. If the results of tests indicate densities less than specified, the Contractor shall remedy the condition as directed, in such portions of the trenches as may be required.
 6. Flooding of trenches will not be permitted.
 7. Do not use frozen backfill materials or place backfill materials on frozen subgrade or trench surfaces.
- I. Cleanup: After trenches and other excavations are refilled and the work completed, remove surplus excavated materials, stone or such other materials from the work in such manner as the Contractor may elect or provide, but subject to the Engineer's approval. Dispose of such materials off the site in a legal manner at no additional expense to the Owner.
- J. MAINTENANCE OF BACKFILLED EXCAVATIONS
1. The Contractor shall maintain all back-filled, repaved, topsoiled or otherwise restored areas, including temporary pavement, in proper condition until the end of the guarantee period for the project. All defects shall be promptly corrected.
 2. The Contractor shall be responsible for any injury or damage that may result from improper maintenance of trenches or pavement at any time prior to the end of the aforementioned guarantee period.
- K. TEMPORARY PAVING
1. A 3" layer of cold patch or Type B bituminous concrete over a base of 8" of graded aggregate, Type B crusher run, shall be placed on all lateral and main line utility trenches crossing commercial entrances or parking lots for temporary paving at the end of every workday.

PART 1 – GENERAL**1.01 DESCRIPTION**

- A. The Contractor shall furnish and lay all water mains, valves, hydrants, fittings and appurtenances in accordance with these specifications, as indicated on the Drawings, and as required to complete the work.

PART 2 – PRODUCTS**2.01 POLYVINYL CHLORIDE (PVC) WATER MAIN PIPE**

- A. Polyvinyl chloride (PVC) plastic pipe used for water main construction shall meet or exceed the requirements of AWWA C 900 or C909 latest edition. It shall have outside diameters equal to cast iron pipe with a standard dimension ratio (SDR) of 18. The pipe shall be rated for a working pressure of at least 150 psi plus a surge allowance of at least 35 psi and shall have a minimum ultimate hydrostatic strength of 600 psi.
- B. Polyvinyl chloride pipe and fittings shall be manufactured with integral wall bell and spigot joints which shall utilize a flexible O-ring rubber gasketed joint conforming to ASTM D 3139, "Joints for Plastic Pressure Pipe Using Flexible Elastomeric Seals". Pipe ends shall be beveled to accept gasketed fittings.
- C. Pipe shall be manufactured in lengths not to exceed 20 feet.
- D. Each pipe section including bell or coupling shall be subjected to a hydrostatic test of not less than 500 psi for at least 10 seconds. Pipe shall be tested in accordance with conditions specified in ASTM D 618. Any pipe that leaks or is unable to withstand the test pressure shall be rejected. The test shall be conducted at the factory and certification stating that the test has been conducted as specified and the pipe meets all conditions of this specification shall be submitted to the Engineer.
- E. Polyvinyl chloride pipe specified herein is manufactured to cast iron pipe size. However, if adapters for connecting polyvinyl chloride pipe to cast iron fittings and valves are necessary, they shall be of the type recommended by the pipe manufacturer. Adapters must be manufactured of material specified herein or approved by the Engineer. Furnishing and installing adapters shall be included in the unit prices bid for the pipe.

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

2.02 DUCTILE IRON (D.I.) WATER MAIN PIPE

- A. All ductile iron pipe shall be manufactured in accordance with the standards of ANSI/AWWA C151/A21.51 and ANSI/AWWA C150/A21.50. Ductile iron pipe shall be not more than 20 feet in length.
- B. All underground ductile iron pipe shall be furnished with mechanical joint end design conforming to ANSI/AWWA C111/A21.11 or push-on joint ends.
- C. The nominal thickness of all ductile iron pipe shall not be less than ANSI/AWWA C151/A21.51 Class 50 for mechanical joints and Class 53 for grooved and flanged joints.
- D. Ductile iron pipe/pipe system shall be furnished by Griffin Pipe, American Cast Iron Pipe Company, U.S. Pipe and Foundry, or approved equal.

2.03 FITTINGS

- A. Cast iron fittings shall be in accordance with ANSI/AWWA A21.10/C110 and shall be class 250 and provided with mechanical joint ends furnished in accordance with ANSI/AWWA A21.11/C111.
- B. Ductile iron fittings shall be mechanical joint with a 350 psi rating conforming to ANSI/AWWA A21.53/C153. Mechanical joint ends shall be furnished in accordance with ANSI/AWWA A21.11/C111.
- C. Fittings and specials for exposed ductile iron pipe shall be flanged in accordance with ANSI/AWWA C110/A21.10 and ANSI B16.1 faced and drilled 125# standard, or grooved in accordance with AWWA C606.
- D. Restrained Joints: Mechanical joint restraints shall be wedge type. Furnish Megalug as manufactured by EBAA Iron, Gripper Gland as manufactured by U.S. Pipe, or approved equal. Set screw retainer glands will not be permitted.
- E. Grooved End Joints: Grooved end joints shall be Victaulic Style 31 Couplings, Style 241 Vic-flange adapters, or approved equal.

- F. Flange Adapters: Flanges shall be drilled to meet ANSI B16.1 125# standard. Flange material shall be ductile iron meeting ASTM A536 Grade 65-45-12. The Gasket shall be EPDM suitable for wastewater. Set screws shall be AIAI 4140 Steel- tensile 190,000 psi minimum, heat traced to Rockwell C42-50 and zinc plated for corrosion resistance. Flange adapter shall be Uni-Flange Series 400 or approved equal.

2.04 PIPE COATINGS

- A. The interior of ductile iron pipe and fittings shall be double cement lined with a bituminous seal coat in accordance with ANSI/AWWA C104/A21.4. The outside of fittings shall be bituminous seal coated.

2.05 GATE VALVES

- A. Gate valves shall be iron body, bronze mounted, resilient seated, non-rising stems, mechanical joint ends, square nut operated, and shall open by turning to the left. Iron wedge shall be fully encapsulated in synthetic rubber. A sworn certificate of inspection and testing shall be furnished by the manufacturer. All gates valves shall be by the same manufacturer.
- B. Gate valves in sizes from 4"-12" shall be in conformance with AWWA C-509, latest edition, and be rated for 250 psi working pressure. Gate valves in sizes 14" and larger shall be in conformance with AWWA C-515, latest edition, and be rated for 250 psi working pressure. All interior and exterior exposed iron surfaces shall be fusion epoxy coated in compliance with AWWA C-550 and certified to NSF 61.
- C. Furnish one (1) valve wrench for every two (2) valves supplied.
- D. Gate valves shall be as manufactured by Kennedy Valve Model Kenseal II or Mueller Co. Model A-2360/A-2361.

2.06 VALVE BOXES

- A. Valve boxes shall be cast iron, two piece slip with 5-1/4 inch shafts. Valve boxes shall be adjustable between the limits of 2'-4" and 3'-4". If necessary, the water main shall be lowered to provide adequate depth of installation of the valve box.
- B. Lids shall be extra deep with two holes and the word "WATER" cast in the upper surface.
- C. Valve box assemblies shall be as manufactured by Tyler, Model 564A, or approved equal.
- D. Furnished and installed with Valve Box Adaptor II.

2.07 FIRE HYDRANTS

- A. Fire hydrants shall be a traffic model compression type with 5-1/4" main valve opening, on 4-1/2" pumper nozzle and two 2-1/2" hose nozzles. Hydrants shall have a 6" side inlet mechanical joint shoe connection to accommodate the class of pipe hereinbefore specified.
- B. Hydrants shall conform with AWWA Specification C-502, latest edition. Hydrant seat shall be provided with bronze to bronze threaded connection.
- C. Threading of pumper and hose nozzles shall be Town of Laurel standard. Hydrants shall open by turning counter-clockwise (open left) and shall comply with AWWA specifications for the hydrant type specified. A certificate of inspection and test shall be furnished including submission of a flow and friction loss curve.
- D. The operating nut shall be pentagon shape measuring 1-1/2" National Standard point to flat.
- E. Non-kinking hose nozzle chains are required.
- F. Hydrants shall receive prime and shop coats of paint at the factory. Submit coating specifications for approval. The Contractor shall be responsible for field touch up or repainting of hydrants as required. Color shall be Rust-Oleum Fire Hydrant Red.
- G. 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.
- H. The design shall be such that lubrication of the operating threads is possible without disassembly.
- I. Drain mechanisms shall be bronze to bronze to preclude galvanic corrosion of dissimilar metals and shall operate automatically with the opening and closing of the main valve.
- J. Fire hydrants shall be Model B-62-B as manufactured by American-Darling Valve and Manufacturing Company or Guardian K81D as manufactured by Kennedy Valve.
- K. Hydrants shall be equipped with Town of Laurel's standard hydrant adapter and bushings as manufactured by Kocheck Co, Inc. Hydrant retrofit Conversion Model No. SZM 5045-1-Y low profile, one set screw and cap Model No. CC 507-003-7 cap with Pentagon Lug., red in color.
- L. Each hydrant installed shall be flow tested by certified personnel. Flow data shall be turned over to the Town prior to final acceptance.

M. Provide hydrant operating wrench and repair kits as follows:

1. For 1 to 5 hydrants – 1 wrench
2. For 6 to 12 hydrants – 2 wrenches
3. For greater than 12 hydrants – 3 wrenches
4. One kit for every 3 hydrants – minimum of one kit

2.08 BLOW-OFF HYDRANT

- A. Hydrants shall be self-draining, non-freezing, compression type with 2-3/16" main valve opening.
- B. Hydrants shall have a 3" ductile iron pipe riser with a cast iron top stock, and non-turning operation rod. Principle interior operation parts shall be brass and removable from the hydrant for servicing without excavating the hydrant.
- C. Hydrant shall be set in 4 cubic feet of crushed stone to allow for proper drainage of the hydrant.
- D. Post hydrants shall be Eclipse No. 2 post hydrants as manufactured by John C. Kupferle Foundry Company, St. Louis, Missouri.

2.09 TAPPING SLEEVE & VALVE

- A. Tapping sleeves shall be of all stainless steel construction including sleeve, bolts and nuts. Sleeves shall wrap 360 degrees around the pipe with gridded full circumference gasket. Units shall be FAST Model by Ford Meter Box Co., Powerseal Model 3490.
- B. Tapping valves shall be cast iron, Mueller or Kenseal II R/W SMJ.
- C. Install tapping sleeve and valve per manufacturer's recommendations.

2.10 LAYING WATER MAIN AND FITTINGS

- A. PVC pipe shall be installed in accordance with AWWA C 605, latest revision. Pipe and fittings shall be carefully handled and lowered into the trench. The ends of pipe shall abut against each other in such manner that there shall be no shoulder or unevenness on the inside of the main.
- B. Use lubricants specified and supplied by pipe manufacturer and approved for water service for proper pipe joint installation.
- C. 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 at his own expense. Bell holes shall be dug sufficiently large to insure the making of proper joints.

- D. Proper and suitable tools and appliances for the safe and convenient handling and laying of pipes and fittings shall be used. Care shall be taken to prevent the pipe wall from being damaged, and any wall damage shall be repaired to the satisfaction of the Engineer by the Contractor.
- E. Pipe and fittings shall be thoroughly cleaned before they are laid and shall be kept clean until the acceptance of the completed work. At the close of each work day, 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 laying is again resumed.
- F. 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 so as to leave a smooth end, and without extra compensation. Polyvinyl chloride pipe shall be beveled in accordance with manufacturer's recommendation before making pipe joint.
- G. In jointing pipe and fittings, the Contractor shall exercise particular care to insure that the outside of the spigot and inside of the bell are entirely free of oil, tar and greasy substances to insure a tight fit.
- H. All concrete required to construct buttresses behind plugs, tees, bends and other fittings and anchorages above or beneath vertical bends shall be placed as directed and/or as shown on the Drawings. Concrete shall be 3,000 psi, with Type II Portland cement.

2.11 INSTALLING FITTINGS, HYDRANTS, GATE VALVES AND VALVE BOXES

- A. Fittings, hydrants, gate valves and valve boxes shall be placed along the water mains at the locations indicated on the drawings or where otherwise designated by the Owner or Engineer.
- B. A valve box shall be carefully placed over the bonnet of the gate valve with the top at the finished grade elevation of the ground elevation or at such other elevation as the Owner or Engineer 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 so as 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, at the Contractor's expense.
- C. Hydrant assemblies include connecting pipes, fittings, valve and valve box and hydrants. Ductile iron pipe with cast iron fittings shall be used exclusively throughout the assembly. The use of other pipe materials will not be permitted in

construction of any portion of the hydrant assemblies.

2.12 JACKED INSTALLATIONS

- A. Where possible, an approach trench shall be excavated enough to provide a jacking face of at least three (3) feet from a pavement surface. This open face shall be shored securely to prevent slipping or raveling of the face.
- B. A complete detailed design procedure and method shall be submitted for each such installation and, as a minimum shall contain layout sketches indicating pit dimensions and location with respect to adjacent structures, complete details of the approach pit including design and details of the backstop, face and side bracings, material and equipment specifications and a sequence of operations. The backstop shall be so designed as to withstand a reaction in excess of the maximum jack capacity.
- C. It is suggested that the Contractor retain the services of a jacking installation specialist in an effort to preclude the necessity for a restart at a second location due to inadequacies that could be foreseen through the use of such a specialist.
- D. The direction of the jacking operation shall generally proceed upstream to allow for groundwater drainage to the approach pit. The approach pit shall be maintained in a dry condition through the use of crushed stone, or quarry waste, and an adequately sized sump pump. Such materials shall be included in the lump sum price bid for jacking.
- E. The installation of the casing pipe shall proceed simultaneously with the boring excavation and material removal. The jacked casing shall lead the boring removal operation by a sufficient distance at all times to minimize differential settlement caused by the creation of voids between the jacking sleeve and the surrounding soil. All such voids shall be filled by pressure grouting.
- F. If an obstruction is encountered that prohibits the forward action of the pipe, and it becomes evident that it will be impossible to advance the pipe, operations shall cease and the pipe will be abandoned in place and filled completely with grout.
- G. Support carrier pipe inside casing pipe with casing spacers as shown on plans. Ends of casing pipe shall be sealed.
- H. Steel casing pipes shall be Schedule 40 and shall conform to ASTM A-53 Grade B. The casing shall be constructed to such line and grade as to ensure installation of the carrier pipe to design grade and elevation as shown on the plans.
- I. The jacking operation, once commenced, shall be continuous until such time as the jacked crossing is completed.

2.13 HORIZONTAL DIRECTIONAL DRILLING

- A. A complete detailed design procedure and method shall be submitted for each such installation and shall contain as a minimum: layout sketches indicating pit dimensions and locations, proposed line and grade of the drilling, complete details and specifications of the materials and equipment to be used to complete the drilled installation, size and type of drill pipe, drilling fluid information, drilling fluid disposal plan, frac-out plan, and a sequence of operations.
- B. It is suggested that the Contractor retain the services of a horizontal directional drilling specialist in an effort to preclude the necessity for a restart at a second location due to inadequacies that could be foreseen through the use of such specialist.
- C. If an obstruction is encountered that prohibits the forward action of the drilling operation or pipe installation, and it becomes evident that it will be impossible to advance the drill head or the pipe, operations shall cease and the pipe will be abandoned in place and filled completely with grout. Drilling shall restart at a second location.
- D. The horizontal directional drilling (HDD) operation, once commenced, shall be continuous until such time as the HDD is completed.
- E. The rig shall be capable of the push/pull capacity, rotational speed, torque, and horsepower requirements, including size and capacity of the drilling fluid pump, to successfully complete the HDD.
- F. The mud motor shall be capable of delivering sufficient amount of drilling fluid to maintain the borehole integrity. The Contractor shall be responsible for providing the right mixture of drilling fluid to fit the characteristics of the soil conditions. The Contractor shall be responsible for the disposal of the drilling fluid.
- G. The Contractor shall keep drilling logs. These logs shall include specific dates, times and locations (x,y,z positioning), soil conditions, drilling data such as depth, angle, rate of penetration, and utility crossings. Drilling logs shall be accurate to facilitate the production of as-built drawings, with "x,y,z" locations no further than 30' apart. Six (6) copies of the drilling logs shall be provided to the Engineer.
- H. The minimum radius of curvature of any drilling operation shall be limited to 100 times the diameter of the drill pipe, or the diameter of the product line, whichever is larger.
- I. All drilling operations shall include reaming of the pilot hole prior to installation of the product line. The pilot hole shall be reamed to a minimum size of 1.5 times the outside diameter of the product line. Reamers shall be chosen to match the soil conditions encountered.

- J. A wire-line steering tool system shall be used for all drilling over 500', or drilling beneath a water course. Short, shallow drilling operations may be guided via a walkover system subject to the approval of the Engineer.
- K. The driller shall use two-way radio or cellular phone communication between the drill rig operator and the pipe pull-back crew to assure that the pipe begins moving immediately upon the operator's commencement of the pull-back operation.
- L. The drill pipe shall be connected to the product line using a pull head or a pulling eye and swivel. A reamer shall be placed between the drill pipe and pull head to insure that the hole stays open during the pull-back.
- M. The Contractor shall employ the services of a certified fuser.
- N. The entire length of the pipe, for the bore, shall be fused prior to installation.
- O. Contractor shall provide all necessary rollers to accommodate movement of the pipe aboveground during the pull-back operation. Contractor shall provide necessary means (i.e. scaffold mounted rollers with a minimum vertical clearance of 14') to maintain access to roads and driveways during the pull-back operation.
- P. The drilling contractor shall carry comprehensive general liability insurance covering underground collapse or explosion.

2.14 STERILIZATION OF WATER MAINS

- A. The Contractor shall disinfect all water mains in accordance with AWWA Standard C 651, latest edition.
- B. The Contractor shall place in each length of pipe, and other appurtenances, a sufficient amount of HTH tablets to insure adequate disinfection treatment of the main after its completion. Tablets shall be fastened to the inside top of every length of pipe as laid, using "Permatex No. 2" gasket cement.
- C. The Contractor will be responsible for securing a minimum residual chlorine content of 5 parts per million (ppm) at the extremities of the water mains after a minimum of twenty-four (24) hour contact with the water under full pressure on the main.
- D. Water for filling the mains shall be introduced at a velocity of less than 1 foot per second in order to permit the HTH to completely dissolve and have a reasonably uniform distribution throughout the mains.
- E. After the chlorine has been in contact with the mains for a minimum of twenty-four (24) hours, samples collected from the extremities of the mains shall indicate a residual chlorine content of 5 ppm or more.

- F. If less than 5 ppm residual chlorine is indicated, the system shall be drained and the disinfection treatment repeated.
- G. If samples collected at the extremities indicate a residual chlorine of 5 ppm or more, the system shall be drained and flushed until there is only a normal chlorine residual (1.0 ppm or less) present, as determined by the DPD Method Test. Samples of water shall be collected from various points along the lines, by the State Board of Health for bacteriological analysis. If satisfactory bacteriological results are obtained, the lines may then be allowed to be placed in service upon receipt of an "Approval to Operate" from DHSS. A copy of all test results shall be submitted to the Inspection Agency and Owner and Engineer.
- H. The Contractor shall be responsible for dechlorization of the blow-off water.

2.15 TESTING

- A. The Contractor shall furnish all labor, tools, materials, including water, and equipment, including pumps, compressors, stopwatch, gauges, and meters subject to the approval of the Engineer and Inspection Agency for testing and/or replacement/repair of pipe in accordance with these specifications.
- B. The Contractor shall perform all testing and/or replacement/repair of the pipe in the presence of the Owner, Engineer or designated representative.
- C. The Owner, Engineer or Inspection Agency shall be notified in advance of all tests, and all tests shall be conducted to their entire satisfaction. All tests shall be conducted in the presence of the Inspection Agency.

D. PRESSURE TEST

- 1. After backfilling has been completed, all newly laid pipe and any valved section thereof shall be subject to a hydrostatic pressure test of 120 psi for a duration of three hours with the pressure measured at the highest elevation on the line. The procedure for the pressure test shall be as follows:
 - a. Each valved section of pipe shall be slowly filled with water and the specified test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer and Inspection Agency.
 - b. Before applying the specified test pressure, all air shall be expelled from the pipe. If permanent air vents are not located at all high points, the Contractor shall install corporation stops at such points so the air can be expelled.
 - c. Maintain test pressure to within 3 psi of initial test pressure, without

introduction of additional pressure.

2. The test procedure for HDPE shall be as follows:
 - a. Initial expansion of the test phase: Apply a hydrostatic pressure test of 120 psi. During this three hour initial test phase, expansion of the pipe may occur. Sufficient make-up water must be added to the system at hourly intervals for three hours to maintain the test pressure. After about four hours, the initial expansion should be complete and the actual test can start.
 - b. Testing phase. Maintain the test pressure of 120 psi for a period of two hours.
 - c. Maintain test pressure to within 3 psi of initial test pressure.
- E. Should either test show the main to be defective, the Contractor shall remedy such defects and retest the main as specified above. This procedure shall be repeated until the test requirements are met. Contractor is to bear full responsibility and cost for testing, repair, replacement, and retesting, at no additional cost to the Owner.

2.16 LAYING PIPE IN FREEZING WEATHER

- A. No pipe shall be laid upon a foundation into which frost has penetrated, nor at any time when the Engineer shall deem 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 refilling are observed.

2.17 ARTIFICIAL FOUNDATION

- A. Whenever directed, the Contractor shall lay pipe upon an artificial foundation which he shall construct. Such foundation may consist of gravel or concrete, all to be of the form and dimensions, and placed in the manner required by the Engineer. All necessary excavation for the construction of artificial foundations shall be made by the Contractor.

2.18 PIPELINE DETECTION SYSTEM

- A. Pipeline detection tape shall be installed continuously along all water mains. The tape shall be installed directly above the water mains and twelve inches from the ground surface.
- B. The tape shall be Lineguard Type III Detectable Tape as manufactured by Lineguard, Inc., of Wheaton, Illinois, or equal. The tape shall be a minimum of six inches wide, blue in color, imprinted with the words, "CAUTION--WATER LINE BELOW", and be capable of being detected with inductive methods.

- C. A 12 gage copper wire, type THHN/THWN shall be attached along the top of the pipe.

2.19 DEFECTS TO BE MADE GOOD

- A. 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 with proper material and workmanship, without extra compensation for the labor and material required, even though such injury or damage may not have been due to any act, default or negligence on the part of the Contractor. 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.

PART 1 – GENERAL**1.01 DESCRIPTION**

- A. The Contractor shall furnish and install all corporation stops, house service pipe, meter assembly, covers, valves and appurtenances as indicated on the drawings, and specified herein. All underground service lines, valves and fittings shall conform to ANSI/AWWA C800-84.

PART 2 – PRODUCTS**2.01 SERVICE PIPE AND CONNECTIONS**

- A. Service piping shall be ultra-high molecular weight poly-ethylene plastic pipe manufactured in accordance with ASTM D-2737, with a minimum standard dimension ratio (SDR) of 9. Pipe shall meet the requirements of Type III Class C Category 5-P34 polyethylene as defined in ASTM D-1248 and shall be rated for a 160 psi working pressure at 73.4° F and designed to withstand a hydrostatic stress of 630 psi at the same temperature. The pipe shall be approved by the National Sanitation Foundation for use as a carrier of potable water. Pipe shall have name of manufacturer, pipe size, ASTM specification number and pressure rating permanently imprinted on exterior of pipe wall at minimum intervals of 5 feet. Pipe delivered and stockpiled shall be packaged for protection against dirt and damage and suitably covered to protect the pipe from sunlight.
- B. Polyethylene pipe connections shall be made with compressive-type couplings.
- C. Corporation stops shall be AWWA Standard inlet threads, suitable for connection to polyethylene water service piping as specified. Stops shall be Town of Laurel standard, Model FB1000, with stainless steel liner, as manufactured by Ford. A saddle is required for each corporation stop, Model 3412AS, as manufactured by Power Seal Pipeline Products Corp or Ford Model FS303.
- D. Meter box frames shall be Ford A32. Meter pit covers shall be DFW-12ADFW. For meters set in traffic areas Contractor shall furnish and install extra heavy lids A32H. Lids shall have the word "Water" cast into the cover and include lifter worm locks. Contractor shall verify fit and compatibility of assembly components prior to ordering. Contractor shall supply meter box lid wrenches as required by the Owner.
- E. Meter box assemblies shall be installed in locations shown on the drawings. The meter box shall be Carson MS 182230 HDPE. Meter support shall be by a lateral PVC brace. Meter setter shall be Ford PSIB-28L-22-18/PSO HH-28L-22-18 with

check valve on the outlet, or equal. No meter installation shall be placed in a traffic area or driveway unless otherwise approved by Engineer or Owner.

2.02 WATER METERS

- A. To be purchased from the Town and installed by the Contractor.

2.03 SERVICE LINE DETECTION SYSTEM

- A. A 12 gage copper wire, type THHN/THWN shall be attached along the top of the pipe.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Cutting tools shall be of the hollow, shell bit type for removal of pipe plug. For tapping PVC mains use only Mueller Plastic Cutting Tool. Auger-type drills will not be allowed.
- B. Corporation stops shall be spaced no closer than 12 inches along the barrel of the main.
- C. Requirements for disinfection and pressure testing of service connections shall be the same as specified for mains.
- D. Pipeline detection tape shall be installed continuously along all water services. The tape shall be as specified for mains.

PART 1 – GENERAL**1.01 DESCRIPTION**

- A. The Contractor shall furnish all material for and shall construct the pipelines and all required appurtenances at the locations and to the lines, slopes and elevation shown on the drawings or designated by the Engineer.
- B. All sewer pipe shall be polyvinyl chloride (PVC) pipe.

PART 2 - PRODUCTS**2.01 PRECAST REINFORCED CONCRETE MANHOLE SECTIONS**

- A. Precast reinforced concrete risers, eccentric cones, bases and slabs shall be as detailed and in conformance with ASTM Designation C478. Joints between riser sections shall be fitted with an "O" ring rubber gasket, meeting the requirements of ASTM Designation C 443. Installation of risers shall be in accordance with manufacturer's recommendations under the supervision of the Engineer.
- B. Precast reinforced concrete base and riser sections shall be as manufactured by Atlantic Precast Corporation, or equal.
- C. Interior and exterior joint spaces of all manhole risers shall be mortared.
- D. Lifting holes in the walls of precast reinforced concrete risers will be allowed but shall be plugged with rubber stoppers and grouted flush with face of 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.
- E. All pipe-to-manhole connections shall be made by means of an integrally cast flexible connector meeting the requirements of ASTM C-923. The connector shall be A-Lok or Z-Lok manhole gasket as manufactured by A-Lok Products Inc., Tullytown, PA or equal.
- F. The exterior surface of all precast manholes shall receive two (2) coats of Koppers Super Service Black waterproof bitumastic coating or approved equal, applied in the field.

2.02 FLOW CHANNELS

- A. All manhole flow channels and benches shall be precast.

2.03 MANHOLE STEPS

- A. 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.
- B. Manhole steps shall be cast in place during manufacture of precast reinforced concrete sections. Embedment length shall be suitable for minimum 5 inch thick, precast reinforced concrete riser walls.
- C. Manhole steps shall be OSHA approved and as manufactured by M.A. Industries, Inc., Peachtree City, Georgia, or equal.
- D. Manhole steps shall be at twelve (12) inches apart with the first step not exceeding sixteen (16) inches.

2.04 MANHOLE FRAMES AND COVERS

- A. Frames and covers for manholes shall be set by the Contractor as the work progresses. The frame shall be well bedded in mortar.
- B. Material for frames and covers shall be in accordance with the standard specifications for gray iron castings ASTM Designation A 48 for Class No. 30.
- C. Frames and covers shall be PAMREX as manufactured by CertainTeed. Part No. 55048 with the words SANITARY SEWER stamped on the cover.

2.05 POLYVINYL CHLORIDE PIPE AND FITTINGS

- A. Polyvinyl chloride (PVC) pipe, used for sewer and lateral construction, shall equal or exceed the requirements of ASTM D 3034 and shall have a minimum standard dimension (SDR) ratio of 35 and the minimum pipe stiffness, as tested in accordance with ASTM D 2412, shall be 45 when measured under 5 percent deflection at 73 degrees Fahrenheit. Pipe shall be manufactured with integral wall bell and spigot joints in standard lengths not exceeding 20.0 feet.
- B. All polyvinyl chloride (PVC) pipe and fittings shall utilize an elastomeric O-ring gasketed joint assembled in accordance with the manufacturer's recommendations. Provide all necessary adapters.
- C. Polyvinyl chloride wye 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 pipe. Wye branches shall be complete pipe sections. Saddles will not be permitted for use.

- D. Polyvinyl chloride 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 in the trench, 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.
- E. 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 on this project.

2.06 CLEANOUT FRAMES & COVERS

- A. Cleanout frames and covers shall be cast iron as detailed on the Drawings.

2.07 PIPE INSTALLATION

- A. Pipe and fittings shall be carefully handled and lowered into the trench. Special care shall be taken to insure that each length shall abut against the next in such manner that there shall be no shoulder or unevenness of any kind along the inside of the pipe.
- B. Before pipe is placed, the bottom of the trench shall be carefully shaped to fit the lower part of the pipe exterior with reasonable closeness for a width of at least 60% of the pipe width as indicated on the plans. Bell holes shall be dug sufficiently large to insure the making of proper joints and so that after placement, only the barrel of the pipe receives bearing pressure from the trench bottom. No pipe shall be brought into position until the preceding length has been thoroughly bedded and secured in place. Any defects due to settlement shall be made good by the Contractor without additional compensation therefor.
- C. Proper and suitable tools and appliances for the safe and convenient handling and laying of pipe shall be used.
- D. 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.
- 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 pipeline at all times when laying is not in actual progress.

- F. All concrete required to support and reinforce wye branches, bends and other fittings shall be placed as directed, and the cost thereof shall be included and covered by the various items for furnishing and laying wye branches, bends and other fittings.
- G. Backfill materials shall be hand placed and mechanically tamped in six inch layers, placed uniformly on both sides of the pipe, to a point at least one foot above the pipe crown. Each layer shall be thoroughly compacted for the full trench width and under, around and over the pipe. Mechanical tampers shall exert a pressure of not less than 250 foot pounds per square foot of area of tamping face.
- H. A minimum vertical separation of 18 inches between water mains and sewer lines shall be maintained throughout the project. Where water mains and sewer lines cross, sewer pipe joints shall be equidistant from the intersection and as far from water main joints as possible.

2.08 LAYING PIPE IN FREEZING WEATHER

- A. No pipe shall be laid upon a foundation into which frost has penetrated, nor at any time when the Engineer shall deem 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.

2.09 ARTIFICIAL FOUNDATION

- A. Whenever directed, the Contractor shall lay pipe upon an artificial foundation which he shall construct. Such foundation may consist of gravel or concrete; all to be of the form and dimension and placed in the manner required by the Engineer. All artificial foundations shall be of a character equal to that as hereinbefore specified.

2.10 TESTING

- A. General: The Contractor shall furnish all labor, tools, materials, water, and equipment, including mirrors, flashlights, or other artificial lighting, weirs, pump, compressors, stopwatch, gauges, and meters, subject to the approval of the Engineer for testing in accordance with these specifications.
- B. Leak Testing: Infiltration/Exfiltration tests shall be performed on all sanitary sewers in the presence of the Engineer and shall generally conform as follows:
 - 1. All sewers above the groundwater line will be tested by the exfiltration method.
 - 2. This method will involve plugging the upstream pipe ends of the lower and upper manhole and filling the intermediate pipe section with water. Water

shall be introduced into the upper manhole to a level two (2) feet above the top of pipe elevation in the manhole and this level maintained for a period of time sufficient to allow complete pipe and manhole water absorption. Measurements of time vs. the quantity of water required to maintain this level shall then be taken for the period of time required to provide substantial and meaningful results converted to gallons per day. Water for exfiltration tests shall be supplied by the Contractor.

3. All sewers below the groundwater line shall be tested by the infiltration method. This method will involve measuring the amount of infiltration in to the pipe section at the lower end of the pipe section by means of a weir installed in the pipe or by other means, as approved by the Engineer.
 4. Sewers shall be tested in sections of not more than 1,000 foot lengths unless otherwise approved immediately upon completion thereof. Each section shall meet the infiltration or exfiltration requirements specified herein.
 5. All sheeting shall be removed, except as may be indicated otherwise, backfill placed to finished grade, and dewatering operations ceased at least 48 hours prior to infiltration tests.
 6. The maximum allowable leakage, as determined by the infiltration or exfiltration method shall be 50 gallons per inch of pipe diameter, per mile, per day (24 hours).
 7. Exfiltration tests incorporating the use of low pressure air and in accordance with the requirements of ASTM C 828 and pipe manufacture's recommendations may be used in lieu of the water test subject to approval of the Engineer. Procedural and equipment details shall be submitted to the Engineer prior to acceptance of this use for testing.
- C. Mirror Test of Sanitary Sewers: Upon completion of pipe laying and backfilling to a point at least two (2) feet above the crown of the pipe, the Engineer will conduct a mirror test to check for defects, or leakage, and for horizontal or vertical misalignment. Mirror testing shall consist of reflecting sunlight or artificial light via mirrors through the completed section of pipeline, which, in order to be accepted, shall be true and straight in horizontal and vertical alignment to allow for the full passage of the reflected light.
- D. Deflection testing of Sanitary Sewers: Sanitary sewers shall be tested in the presence of the Owner's and the Contractor's representatives to determine the amount of vertical deflection in the completed pipeline as follows:
1. Deflection testing as specified hereinafter shall be accomplished by the Contractor on all sanitary sewers installed.
 2. Installation of sanitary sewers shall be complete prior to the start of deflection testing. All sheeting shall be removed except where written approval by the Engineer has been obtained. All backfill shall be placed,

consolidated and dewatering operations ceased 14 days prior to the start of deflection testing.

3. One of the following methods of testing shall be utilized:
 - a. A steel ball or mandrel with a diameter equivalent to 95 percent of the inside diameter of the pipe to be tested shall be pulled through the pipeline, from manhole to manhole, by hand. If the steel ball is unable to pass through the pipe without applying excessive force (as judged by the Engineer), it will be construed as evidence that the pipe has deflected more than 5 percent of the inside pipe diameter. A permanent record of all testing with locations where excessive pipeline deflections occur shall be kept by the Contractor and forwarded to the Engineer after completion of testing on each line. If a mandrel is utilized, it shall be approved by the Engineer prior to use. Mandrels shall have an odd number of gauging plates. The minimum number of plates shall be nine with a contact surface length equal to the inside pipe diameter plus two inches for pipelines 10 inches in diameter and smaller. On larger diameters, the contact surface length shall equal the inside pipe diameter.
 - b. A deflectometer or a similar instrument, either of which must be approved for use by the Engineer shall be pulled through the pipeline from manhole to manhole. The instrument shall measure the vertical deflection in the pipeline to the nearest tenth of one percent. A permanent record of all testing with locations where excessive pipeline deflections (greater than 5% of inside diameter of pipe) occur shall be kept by the Contractor and forwarded to the Engineer after completion of testing on each line.
4. The Contractor shall immediately replace all sections of pipe which deflect more than 5 percent as measured by one of the foregoing methods.
5. All material and labor required for testing and replacement of pipelines shall be furnished by the Contractor.

- E. Lateral lines shall be tested by the method defined in subparagraph (b). Mirror and deflection testing are not required for laterals.

2.11 PIPELINE DETECTION SYSTEM

- A. Pipeline detectable tape shall be installed continuously along all gravity sewers and laterals. The tape shall be installed directly above the pipeline and six inches from the ground surface.
- B. The tape shall be Lineguard Type III Detectable Tape as manufactured by Lineguard, Inc., of Wheaton, Illinois, or equal. The tape shall be a minimum of six

inches wide, green in color, imprinted with the words, "CAUTION--SEWER LINE BELOW", and be capable of being detected with inductive methods.

PART 1 - GENERAL**1.01 DESCRIPTION**

- A. The Contractor shall construct manholes and catch basins of precast reinforced concrete when possible.
- B. All openings for pipe connections shall be integrally cast. The Contractor will not be allowed to field cut, break or core pipe openings through precast manhole walls.

PART 2 – PRODUCTS**2.01 REINFORCED CONCRETE PIPE**

- A. All concrete pipe and fittings shall be reinforced concrete pipe, furnished in accordance with requirements of ASTM Standard Specification C-755, latest revision thereof.
- B. Reinforced concrete pipe diameter shall be Class IV in accordance with ASTM Designation C-76, latest revision thereof.
- C. All reinforced concrete pipe furnished under this contract shall have joints composed of concrete fitted with rubber gaskets as specified in Section 18 of ASTM Designation C-361 or other elastomeric gasketing approved by the Engineer.
- D. The rubber gasket shall be the sole element depended upon to make the joint watertight under all conditions, including movement due to expansion, contraction and normal settlement. Joints shall be made up according to the manufacturer's recommendations.

2.02 DUCTILE IRON PIPE

- A. Storm drain leads, where designated, shall be Class 52 ductile iron pipe meeting the requirements of ANSI A21.51. All ductile iron pipe shall be coated inside and outside with a bituminous material.
- B. Joints for ductile iron pipe shall be push-on utilizing a one piece rubber gasket in accordance with ANSI A21.11.

2.03 CORRUGATED METAL PIPE

- A. Corrugated metal pipe shall conform to the requirements of Division 614 of the DelDOT Specifications for Road And Bridge Construction, 2001.

2.04 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

- A. All high density polyethylene pipe and fittings shall be in accordance with AASHTO Designations M-252 and M-294, and shall be ADS N-12, smooth interior pipe, as manufactured by ADS Inc., Columbus, Ohio, or equal.
- B. Joints shall be soil tight, and shall be by pipe manufacturer. Joints shall be Pro-Link WT type, as manufactured by ADS Inc., or equal. Manufacturer shall certify that joints are water tight.

2.05 INLETS, JUNCTION BOXES AND JUNCTION VAULTS

- A. Precast reinforced concrete inlets and junction boxes shall be as manufactured by Atlantic Concrete Products Company, Virginia Precast Corporation or approved equal. Brick inlets and junction boxes will be allowed on a case by case basis when approved by the Engineer.
- B. Mortar cement shall be in accordance with the "Standard Specification for Portland Cement" ASTM Designation C150 for Type II.
- C. Junction Vault and inlet steps shall be made of 3/8 inch diameter (No. 3) steel reinforcing bars, ASTM Designation A 615, Grade 60, encased in polypropylene plastic. Steps shall have notched tread ridge with retainer lug on each side. Inlet steps shall be cast in place during manufacture of precast reinforced concrete risers.
- D. Frame and cover for junction vaults shall meet specifications of manhole frame and cover, unless otherwise indicated, but should be printed "STORM DRAIN".

2.06 PRECAST REINFORCED CONCRETE MANHOLE SECTIONS

- A. Precast reinforced concrete risers, eccentric cones, bases and slabs shall be as detailed and in conformance with ASTM Designation C478. Joints between riser sections shall be fitted with an "O" ring rubber gasket, meeting the requirements of ASTM Designation C 443. Installation of risers shall be in accordance with manufacturer's recommendations under the supervision of the Engineer.
- B. Precast reinforced concrete base and riser sections shall be as manufactured by Atlantic Precast Corporation, or equal.
- C. Interior and exterior joint spaces of all manhole risers shall be mortared.

- D. Lifting holes in the walls of precast reinforced concrete risers will be allowed but shall be plugged with rubber stoppers and grouted flush with face of 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.
- E. All pipe-to-manhole connections shall be made by means of an integrally cast flexible connector meeting the requirements of ASTM C-923. The connector shall be A-Lok or Z-Lok manhole gasket as manufactured by A-Lok Products Inc., Tullytown, PA or equal.

2.07 POURED-IN-PLACE CONCRETE

- A. All poured-in-place concrete for manhole base and top slabs shall have a minimum compressive strength of 3,000 psi at 28 days.

2.08 MORTAR

- A. Cement shall be in accordance with the "Standard Specifications for Portland Cement", ASTM Designation C 150 for Type II.
- B. Sand shall be composed of sharp, angular, silicious 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. Sand containing more than 5 percent by weight of foreign material shall not be used. This limit may be changed for special classes or work if hereinafter specified. Sand exhibiting more than an acceptable amount of fine matter or impurities may be required to be washed after delivery on the work or shall be rejected altogether. The Contractor shall submit samples of the sand he proposes using. These shall be retained in the office of the Engineer as a standard for comparison during the progress of the work, and all sand used shall be equal in quality to the accepted samples. 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 of a very fine material.
- 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. 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.
- D. Sand obtained from the excavation shall not be used.

2.09 LAYING BRICK

- A. All brickwork shall be laid by competent mechanics, and any workmen not deemed to be such by the Engineer shall be removed from the work at once.
- B. All brick shall be laid in a full bed of mortar with all vertical and horizontal joints filled solid with mortar.
- C. Joints shall be not less than 3/8-inch or more than 1/2-inch wide except as otherwise specified in (e) below.
- D. No brickwork shall be laid when the temperature is below 40 degrees or when the indications are for lower temperatures within 24 hours. The Contractor shall take such measures as may be approved to prevent brickwork from being exposed to freezing temperatures for a period of not less than five days after laying.
- E. Special care shall be taken in laying brick in inverts of manholes to insure a uniform flow of water through the sections. In such locations, joints shall not exceed 1/16-inch in thickness and each brick shall be laid in full mortar bed with joints on bottom side and end made in one operation. No grouting or working in of mortar after laying the brick will be permitted.

2.10 WATERPROOFING

- A. All brick structures shall be parged with cement mortar on all exterior surfaces. The parge coat shall be kept in a moist condition for at least 48 hours after placing. Cement mortar shall receive two (2) coats of Koppers Super Service black waterproof bitumastic compound or approved equal.
- B. The exterior surface of all precast manholes shall receive two (2) coats of Koppers Super Service Black waterproof bitumastic coating or approved equal, applied in the field.

2.11 MANHOLE STEPS

- A. 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.
- B. Manhole steps shall be cast in place during manufacture of precast reinforced concrete sections. Embedment length shall be suitable for minimum 5 inch thick, precast reinforced concrete riser walls.
- C. Manhole steps shall be OSHA approved and as manufactured by M.A. Industries, Inc., Peachtree City, Georgia, or equal.

- D. Manhole steps shall be at twelve (12) inches apart with the first step not exceeding sixteen (16) inches.

2.12 MANHOLE FRAMES AND COVERS

- A. Frames and covers for manholes shall be set by the Contractor as the work progresses. The frame shall be well bedded in mortar.
- B. Material for frames and covers shall be in accordance with the standard specifications for gray iron castings ASTM Designation A 48 for Class No. 30.
- C. Frames and covers shall be PAMREX as manufactured by CertainTeed. Part No. 55059 with the words STORM DRAIN stamped on the cover.

2.13 CATCH BASIN FRAMES AND GRATES

- A. Frames and grates for catch basins shall be set by the Contractor as work progresses.
- B. Material for frames and grates shall be in accordance with the standard specifications for gray iron castings ASTM A 48 for Class No. 30.
- C. Frames and grates shall conform to the Delaware Department of Highways and Transportation Standard Specification Section 708 and Standard Detail Sheet D5-2. Frames and grates shall be of the size and type detailed on the drawings.

2.14 TESTS

- A. If inspection reveals any visible leakage or seepage in any manhole, the Contractor will be required to accomplish such remedial measures as may be directed by the Engineer. Caulking or patching or interior manhole surfaces will not be acceptable.

2.15 CONNECTIONS TO EXISTING STRUCTURES

- A. The size of opening through the wall of existing structures for connection of new pipe shall not exceed the outside diameter of pipe plus six (6) inches. All connections shall be fully grouted.
- B. All existing curb, gutter, pavement and sidewalk removed or damaged in order to facilitate connection to existing catch basins shall be replaced. Concrete curb and gutter shall be removed and replaced in standard length sections. Concrete sidewalks shall be removed and replaced in whole blocks.
- C. Existing catch basins noted for connection by new leads shall be modified and restored as needed. All damaged or deteriorated walls shall be reconstructed. Missing bricks shall be replaced and cracks or holes 1/6" or larger shall be bridged.

by the use of non-shrink grout.

PART 1 - GENERAL

1.01 DESCRIPTION

- A. All Portland Cement concrete work for gutters, sidewalks and driveways shall meet these STANDARDS AND SPECIFICATIONS.

1.02 SUBMITTALS

- A. Contractor Mix Design: Submit a mix design for concrete, including a complete list of materials including admixtures and the applicable reference specifications and copies of test reports showing that the mix has been successfully used to produce concrete with the properties specified.
- B. Certification: Submit one copy of the delivery ticket for each load of ready-mixed concrete, showing all information required by ASTM C 94.

1.03 QUALITY ASSURANCE AND CONTROL

- A. All sidewalks including wheel chair ramps and depressed driveway sections must meet the latest ADA requirements.
- B. The contractor shall retain the service of an independent testing agency to perform concrete testing. The testing agency shall be responsible for sample preparation, transportation, testing and submission of testing reports. Testing shall include slump test, air content, ambient temperature, concrete temperature and 7-day and 28-day compression tests. Testing results shall be submitted direct from the testing agency to the Town Engineer.
- C. The Contractor shall furnish and install 1' x 1' concrete block in sidewalk areas designated by the Town for street signs.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. CONCRETE:
 - 1. Contractor Furnished Mix Design: Design concrete mix in accordance with ACI 211.1. Slump shall be between 2 inches and 3 inches. The

concrete shall have a 28-day compressive strength of 3000 pounds per square inch unless noted otherwise. The concrete shall contain no less than 6-1/2 bags of Portland Cement per cubic yard of concrete.

2. Air-Entrained Concrete: Provide for all concrete exposed to the weather. Compressive strength 3000 pounds per square inch at 28 days. Accomplish air-entrainment by using an air-entraining admixture, not air-entraining cement. If the entrained air content falls below the specified limit, add a sufficient quantity of admixture to bring the entrained air content within the specified limits. Dissolve the admixture in a portion of the mixing water and add to the mix in the drum in a manner that will ensure uniform distribution of the agent throughout the batch. The air content of freshly mixed air-entrained concrete shall be as follows:

<u>Maximum aggregate size</u>	<u>Amount of air (percent volume of concrete)</u>
1 inch	between 4 and 6

- B. Cement: ASTM C 150, Type I.
- C. Water: Water, including free moisture and water in the aggregates, shall be fresh, clean and potable.
- D. Aggregates: ASTM C 33, size no. 57 except as modified herein. Aggregates shall be free from any substance which may be deleteriously reactive with the alkalis in the cement. One-inch maximum aggregate size unless indicated otherwise.
- E. ADMIXTURES:
1. Air-entraining: ASTM C 260, for all air-entrained concrete.
2. Accelerating: ASTM D 98, Type I or Type II. Use only when approved.
- F. Materials for Forms: Forms shall be constructed of steel. Surfaces of forms shall be free from irregularities, dents and sags. Other forms may be used in special circumstances with written authorization by the Engineer.
- G. Welded Wire Fabric: ASTM A 185, 6" by 6" - #10 gauge unless otherwise indicated.
- H. Materials for Curing Concrete:
1. Impervious Sheeting: Waterproof paper, polyethylene sheeting, or polyethylene coated burlap conforming to ASTM C 171.

2. Liquid Membrane-Forming Compound: ASTM C 309, white-pigmented, Type 2, free of paraffin or petroleum.
 3. Liquid Chemical Compound: A suitable sealer-hardener designed for sealing and hardening in addition to curing of the concrete, applied by the method and at the rate recommended by the manufacturer. It shall not reduce the adhesion of paint or other material to be applied to the concrete. The chemical compound shall be free of petroleum resins or waxes.
- I. Preformed Joint Filler: ASTM D 1751.
- J. Vapor Retarder Material: Polyethylene sheeting, 6-mil nominal thickness.

PART 3 - EXECUTION

3.01 FORMS

- A. General: Provide forms for all concrete. Set forms true to line and grade and maintain so as to ensure completed work within the allowable tolerances specified, and make mortar-tight. Place forms so that they can be removed without damaging the concrete.
- B. Coating: Before placing the concrete, coat the contact surfaces of forms with a non-staining mineral oil, non-staining form coating compound, or two coats of nitro-cellulose lacquer.
- C. Tolerances and Variations: Set and maintain concrete forms to ensure that after removal of the forms no portion of the concrete work will exceed any of the tolerances specified in ACI 347.

3.02 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

- A. Provide all wire fabric as indicated or specified, together with all necessary wire ties, supports and other devices necessary to install and secure the reinforcement properly. All reinforcement, when placed, shall be free from rust, scale, oil, grease, clay and other coating and foreign substances that could reduce or destroy the bond. Rusting of reinforcement shall not be a basis of rejection, provided that the rusting has not reduced the effective cross sectional area of the reinforcement, and provided that loose rust shall be removed prior to placing.
- B. Placing: Place reinforcement accurately and secure in place. On the ground, use concrete or other non-corrodible material for supporting reinforcement.

- C. Splicing: Conform to ACI 318, except as otherwise indicated or specified. Where splices in addition to those indicated are necessary, they shall be approved prior to their use. Do not make splices at points of maximum stress. Make splices in welded wire fabric so that the overlap is not less than the spacing of the cross wires.
- D. Setting Miscellaneous Material: Place and secure anchors and bolts, pipe sleeves, conduits and other such items in position before the concrete is placed. Plumb anchor bolts, check for location and elevation and secure rigidly in position. Fill voids in sleeves temporarily with rapidly removable material to prevent the entry of concrete into the voids.
- E. Expansion Joints: Make joints 1/2-inch wide except as indicated otherwise. Fill expansion joints flush with surface, with preformed joint material. Do not extend reinforcement or other embedded metal items bonded to the concrete through any expansion joint.

3.03 FIBEROUS REINFORCING

- A. When approved by the Engineer, fibrous reinforcing may be utilized. Fibrous concrete reinforcement shall be one hundred percent (100%) virgin polypropylene fibrillated fibers specifically manufactured for use as concrete reinforcement, containing no reprocessed olefin materials. The fibers shall have the following physical characteristics:
 - 1. Specific gravity – 0.91
 - 2. Tensile Strength – 70,000 to 110,000 psi
 - 3. Fiber Length – per manufacturer's recommendation for specific use (three quarters inch [3/4"] for sidewalks)
- B. Add fibrous concrete reinforcement to concrete materials at the time the concrete is batched in the amounts recommended by the manufacturer (1.5 lb./cubic yard for sidewalks) or as indicated on the accepted plans.
- C. Concrete shall be mixed in strict accord with the fibrous concrete reinforcement manufacturer's instructions and recommendations to assure uniform and complete dispersion.

3.04 MEASURING, MIXING, TRANSPORTING AND PLACING CONCRETE: IN ACCORDANCE WITH ACI 301, CHAPTERS 7 & 8, EXCEPT AS MODIFIED HEREIN.

- A. Measuring: Make moisture, volumetric and air determinations at intervals specified herein under testing requirements. Allowable tolerances for measuring cement and water shall be 1 percent; for aggregates, 2 percent; and for

admixtures, 3 percent.

- B. Mixing: Machine mix all concrete. Begin mixing within 30 minutes after cement has been added to the aggregates. Introduce all mixing water in the drum before one-fourth of the mixing time has elapsed. The time elapsing between the introduction of the mixing water to the cement and aggregates or the cement to the aggregates and the start of placing of the concrete in final position in the forms shall not exceed 60 minutes if the air temperature is less than 85 degrees Fahrenheit, and 45 minutes if the air temperature is equal or greater than 85 degrees F. On arrival at the job site, no addition of water will be allowed other than that required initially to adjust to the specified slump. Such an addition must not exceed the limits of the specified maximum water-cement ratio.
- C. Conveying: Convey concrete from the mixer to the forms as rapidly as practicable and so as not to cause segregation or loss of ingredients. Deposit concrete as close as practicable to its final position in the forms. As any point in the conveying, the free vertical drop of the concrete shall not exceed 3 feet. Clean conveying equipment thoroughly before each run. Do not use aluminum pipe or chutes. Place concrete as soon as practicable after the forms and the reinforcement has been inspected and approved. Remove any concrete which has segregated in conveying and dispose of as directed.
- D. Placing: Do not place concrete when weather conditions prevent proper placement and consolidation. Do not place concrete in uncovered areas during periods of precipitation. Do not place concrete in water. Prepare subgrades of earth or other material properly and, if necessary, cover with heavy building paper or other suitable material to prevent the concrete from becoming contaminated. Dampen porous subgrades as required to prevent water of hydration from being absorbed into the subgrade. Clean forms of dirt, construction debris, water, snow and ice. Place concrete in one continuous operation except where construction joints are provided. Place concrete in areas bounded by construction joints in one continuous operation. Remove water which accumulates on the surface of the concrete during placing by absorption with porous materials in a manner that prevents removal of cement.
- E. Vibration: Consolidate concrete by wood tampers, spading and settling with a heavy leveling straight edge.
- F. Cold Weather: Except with authorization, do not place concrete when the ambient temperature is below 40 degrees Fahrenheit or when the concrete is likely to be subjected to freezing temperatures within 24 hours. Remove lumps of frozen material and ice from the aggregates before placing aggregates in the mixer. Refer to ACI 306.
- G. Hot Weather: Cool ingredients before mixing so as to prevent rapid drying of newly placed concrete. When the ambient temperature is more than 90 degrees

F, the temperature of the concrete as placed shall not exceed 90 degrees F; shade the fresh concrete as soon as possible after placing; and start curing as soon as the surface of the fresh concrete is sufficiently hard to permit curing without damage to the concrete.

3.05 SURFACE FINISHES

- A. Finishing: The surfaces of the concrete shall be screeded by means of a template advanced with a combined longitudinal and crosswise motion, a slight surplus of concrete being maintained ahead of the template. After screeding, the concrete shall be floated longitudinally with a plank float, after which the surface shall be checked with a straight edge and corrected and refloated as necessary. The sidewalk surface shall be scored and broom finished. Edges and joints shall be rounded with an edger having a radius of 1/4-inch with picture frame edging.

3.06 CURING AND PROTECTION

- A. General Requirements: Protect concrete adequately from injurious action by sun, rain, frost, mechanical injury and oil stains and do not allow it to dry out from the time it is placed until the expiration of the minimum curing periods specified herein. Use impervious-sheeting curing, liquid chemical or liquid membrane-forming compound, except as specified otherwise herein. Do not use membrane-forming compound on surfaces where its appearance would be objectionable, or where coverings are to be bonded to the concrete. Begin curing immediately following the removal of forms. Maintain the temperature of the air next to the concrete at no less than 40 degrees F for the full curing periods.
- B. Impervious-Sheeting Curing: Wet the entire exposed surface thoroughly with a fine spray of water and then cover with impervious sheeting. Lay sheets directly on the concrete surface and overlap 12 inches. Make sheeting not less than 18 inches wider than the concrete surface to be cured, and weight down on the edges and over the transverse laps to form closed joints. Repair or replace sheets if torn or otherwise damaged during curing. The sheeting shall remain on the concrete surface to be cured for not less than 7 days.
- C. Liquid Membrane-Forming Compound Curing: Seal or cover all joint openings prior to application of the curing compound to prevent the curing compound from entering the joint. Compound shall remain on the concrete for 7 days before sealer or covering is removed and joint sealing material is placed in the joint.
- D. Application: Apply the compound immediately after the surface loses its water sheen and has a dull appearance. Agitate curing compound thoroughly by mechanical means during use and apply uniformly in a two-coat continuous operation by suitable power-spraying equipment. The total coverage for the two

coats shall be between 150 and 200 square feet per gallon of undiluted compound. The compound shall form a uniform, continuous, coherent film that will not check, crack or peel and shall be free from pinholes or other imperfections. Apply an additional coat of the compound immediately to areas where the film is defective. Respray concrete surfaces that are subject to heavy rainfall within 3 hours after the curing compound has been applied in the same manner.

- E. Protection of Treated Surfaces: Keep concrete surfaces to which liquid membrane-forming compounds have been applied free from foot and vehicular traffic and other sources of abrasion for not less than 72 hours. Maintain continuity of the coating for the entire curing period and repair damage to the coating during this period immediately.
- F. Liquid Chemical Compound Curing: Provide for surfaces for which a sealer-hardener finish is specified, and, at the Contractor's option, provide in lieu of liquid membrane-forming compound curing for other surfaces. The application of the compound shall conform to the requirements for liquid membrane-forming compound curing except as specified otherwise herein. The coverage and number of applications shall be in accordance with the recommendations of the manufacturer of the compound.
- G. Curing Periods: Cure not less than 10 days for concrete exposed to the weather and not less than 7 days for all other concrete.
- H. Removal of Forms: Remove forms in a manner which will prevent damage to the concrete. Do not remove forms without approval, nor sooner than 24 hours after placement of concrete.

3.07 SAMPLE SECTION

- A. A 10 foot sample section of 4 foot wide, 4 inch thick sidewalk, with curb and gutter shall be placed and approved by the Engineer prior to placement of any permanent curb, gutter or sidewalk. The sample section, if approved, may be part of the permanent work.
- B. The sample section shall include expansion joint material, finishes and all other features as specified hereinbefore.
- C. The sample section shall include depressed curb and ramp, and radius curb as detailed on the Contract Drawings.

PART 1 - GENERAL**1.01 DESCRIPTION**

- A. The Contractor shall restore all surfaces damaged during construction. The type of material, thickness, and typical sections shall be as detailed in these STANDARDS AND SPECIFICATIONS.

1.02 GENERAL

- A. Pavement shall not be constructed until all underground utilities have been installed, tested and approved by the Town.
- B. The Contractor shall run compaction tests on the subbase prior to paving.
- C. The Contractor shall raise sewer and drainage manholes and water valves, etc to grade prior to paving.
- D. When matching existing pavement, a neat work line shall be saw cut.
- E. All saw cut edges of existing pavement shall be clean and coated with tack coat prior to placing new pavement adjacent to existing pavement.
- F. Patches must have a minimum length of six (6) feet plus the outside dimension of the pipe as measured along the roadway centerline and the width of the lane or lanes disturbed.
- G. Patches shall be boxed square. No irregular patches will be accepted.
- H. Trenches shall be cut back one (1) foot.
- I. The Contractor shall be responsible for maintaining the trench and any temporary pavement prior to final pavement. If the Contractor fails to make repairs within 48 hours after receipt of a written notice, the Town may refill said depressions at the cost of the Contractor.

1.03 SUBMITTALS

- A. Mix designs for bituminous concrete.

1.04 QUALITY ASSURANCE

- A. Specifications: Delaware Department of Highways and Transportation Standard Specifications (DOH) 1985 Edition as currently amended.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General: Use locally available materials and graduations which exhibit a satisfactory record of previous installations.
- B. Coarse Aggregate, Binder Course Aggregate and Surface Course Aggregates: Crushed stone, crushed slag or crushed gravel and siliceous sand as specified in DOH Sections 302, 401, 805, 813 and 821.
- C. Base course shall be graded aggregate type "B", furnished and placed in conformance with Delaware Department of Transportation Standard Specification Sections 302 and 821 as shown on the contract drawings.
- D. Asphalt Cement: Comply with DOH Section 810, AASHTO M226, Grade: AC-20.
- E. Tack Coat: DOH Section 401.34, Type RS-1 per AASHTO M140.
- F. Asphalt Paving: Construct Type C Surface Course in accordance with the pavement restoration details, pavement details, and cross sections, shown on the sketches, and in accordance with DOH Section 401 as appropriate, or unless otherwise noted.
- G. Bituminous Surface Treatment materials: in accordance with Delaware Department of Transportation Standard Specification Section 404.

2.02 PAVEMENT MIXES

- A. Composition of Mixtures: Wearing course mixture composition shall conform to the requirements of the above referenced specifications and the following:
 - 1. Establish a job-mix formula prior to beginning work which shall not be changed during the progress of work without the Engineer's approval. Job-mixing tolerances shall not be presumed to permit acceptance of materials whose graduations fall outside the master ranges set forth in the above referenced specifications.
 - 2. The approved job-mix formula shall lie within the specification limits and

be suitable for the layer thickness and other conditions prevailing. It shall not be changed after work has started without the approval of the Engineer.

PART 3 - EXECUTION

3.01 GENERAL

- A. The Contractor shall not install final permanent bituminous concrete pavement surface until the roadway permanent patch has been satisfactorily completed, and authorization is issued by the Owner. The Contractor shall maintain the existing roadway surface in good condition during the construction of the project, in order to limit inconvenience to the residents. The Contractor shall endeavor to complete all final paving as quickly as feasible, and must complete final paving as a condition of Substantial Completion. When authorized to install pavement, the Contractor shall make all repairs to the existing pavement, or prepared subbase, as required by the Engineer to allow proper placement of bituminous concrete.

3.02 INSPECTION

- A. Examine areas and conditions under which asphalt concrete paving is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.03 PAVEMENT BASE

- A. Grade Control: During construction, follow lines and grades of the existing surface, including cross-slope. Vary only to avoid "bird baths" or areas of poor drainage.
- B. Placing: Place base course material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting subbase material during placement operations.
 - 1. When a compacted base course is shown to be 6" thick or less, place material in a single layer. When shown to be more than 6" thick, place material in equal layers, except no single layer shall be more than 6" or less than 3" in thickness when compacted.
- C. Base shall be thoroughly compacted to a minimum of 95 percent of maximum dry density as determined by AASHTO T-180 Method A. In-place density tests shall be conducted in accordance with AASHTO T-191 Method A to verify degree of compaction. Number and locations of Proctor and density tests shall be as

determined by the Engineer.

- D. All testing shall be arranged by the Contractor and performed by an independent testing agency approved by the Engineer. The testing agency, so employed by the Contractor, shall submit a copy of all testing reports directly to the Engineer. Each report shall contain the project identification name and number, name of Contractor, name of testing agency, and location of sample tested, as a minimum.

3.04 SURFACE PREPARATION

- A. For paving installed over existing pavements, the full width of surface to be paved shall be swept with a power broom or cleaned by blowing of compressed air, or both, to remove all loose dirt and other objectionable material.
- B. For paving installed over existing pavements, all potholes and areas with broken pavement shall be filled to grade with hot mix patching and/or graded aggregate base, compacted in place to provide a stable base. All loose debris or impediments shall be removed prior to this action.
- C. For paving installed over an aggregate base course, proof roll or tamp prepare base to check for unstable areas and areas requiring additional compaction per Paragraph 3.03.
- D. Apply tack coat in accordance with Section 401.34 DOH Specifications.

3.05 PLACING MIX

- A. General: Place bituminous concrete mixes as specified in Section 401.35 DOH Specifications.
- B. Compaction: Use 6 to 8 ton Steel Wheel Rollers or smooth tread pneumatic tired rollers. Conform with procedure outlined in Section 401.36 DOH Specifications.

3.06 FIELD QUALITY CONTROL

- A. General: Test in-place bituminous concrete courses for compliance with requirements for thickness and surface smoothness. Repair or remove and replace unacceptable paving as directed.
- B. Thickness: In-place compacted thickness will not be acceptable if exceeding following allowable variation from required thickness:
 - 1. Binder Course: 1/2", plus or minus.
 - 2. Surface Course: 1/4", plus or minus.

- C. Surface Smoothness: Test finished surface of each asphaltic concrete surface for smoothness, using 10 foot straightedge applied parallel with, and at right angles to centerline of paved area. Surfaces will not be acceptable in exceeding following tolerances for smoothness:
1. Base Course Surfaces: 1/4".
 2. Wearing Course Surface: 3/16".

3.07 PROTECTION

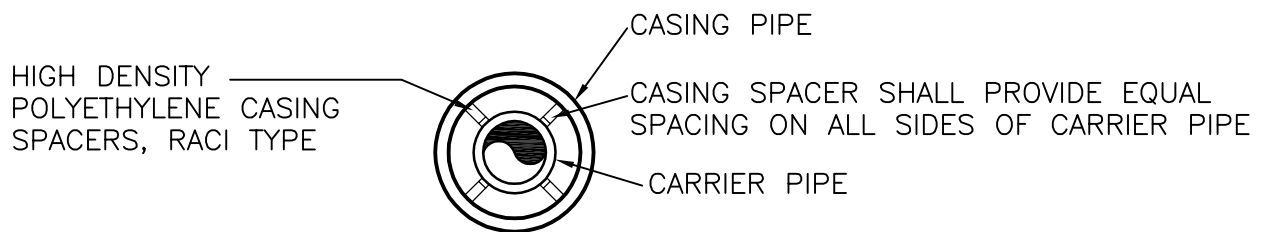
- A. Protect from damage and vehicular traffic until paving has cooled and attained its maximum degree of hardness.
- B. Apply paving striping, if required, in accordance with manufacturer's specifications, but do not damage paving with application equipment.

3.08 TOPSOIL AND SEEDING

- A. Topsoil shall be placed in areas where grass has been disturbed by the Contractor's operations. Depth of topsoil shall be four inches (4") minimum. Topsoil salvaged and stockpiled during trench and structure excavation may be used for this purpose. When topsoiling, all materials and methods of construction shall meet the provisions of DelDOT Standards, Section 732 and 733. If directed, the Contractor shall have the topsoil tested by a State certified laboratory and shall submit certification that topsoil meets the specified standard. Topsoil shall be clean, free of roots, stones and other debris.
- B. Seeding shall consist of furnishing and placing seed and soil supplements on topsoiled areas and at any other location, as directed by the Engineer. When seeding, all materials and methods of construction shall meet the provisions of DelDOT Standards, Section 734.
- C. Fertilizer shall be a recognized commercial fertilizer containing a minimum of five percent (5%) nitrogen, ten percent (10%) available phosphoric acid and ten percent (10%) soluble potash by weight. It shall be applied in sufficient amounts to provide sixty (60) pounds of nitrogen per acre.
- D. Fertilizing and seeding application dates shall be in conformance with DelDOT Standards, Section 734 (Seeding) as specified for "Standard Roadside Mix". Seed shall be applied at a rate of four (4) to five (5) pounds per 1,000 square feet.
- E. No mulch shall be required unless the area to be seeded rests upon a slope greater than 3 to 1. Mulch for these areas shall consist of straw mulch as

specified in DeIDOT Standards, Section 735 "Mulching".

CARRIER PIPE SIZE	CASING PIPE SIZE
1	3
4	12
6	16
8	16
10	18
12	20
14	24
16	30
18	36
20	36
24	42
30	42
36	48
42	54
48	60



NOTE:

- 1 ENDS OF CASING PIPE SHALL BE CLOSED USING AN END SEAL EQUAL TO MODEL AC PULL-ON END SEAL AS MANUFACTURED BY ADVANCE PRODUCTS AND SYSTEMS, INC.
- 2 CASING PIPE DIAMETERS NOTED ABOVE ARE MINIMUM ALLOWABLE BASED ON THE CARRIER PIPE DIAMETER. CASING SHALL BE THE SIZE AND MATERIAL REQUIRED BY THE APPLICABLE PERMITTING AGENCY.

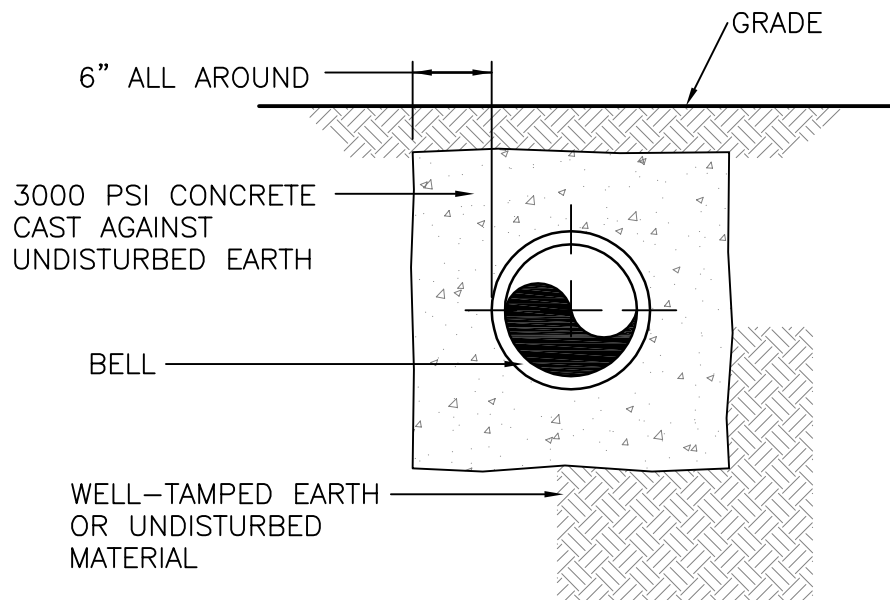
TOWN OF
LAUREL
PUBLIC WORKS
DEPARTMENT



GENERAL STANDARD DETAILS

DRAWING TITLE: CASING PIPE
DRAWING NO: G-100
APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE
DATE: OCT 2007



NOTES:

- 1 ENCASEMENT SHALL BE A MINIMUM OF 10 FEET IN LENGTH IN EACH DIRECTION, OR AS DIRECTED BY THE TOWN ENGINEER.
- 2 THE CROSSINGS SHALL BE ARRANGED SUCH THAT THE SEWER JOINTS WILL BE EQUAL DISTANCE AND AS FAR AS POSSIBLE FROM WATER MAIN JOINTS.

TOWN OF
LAUREL
PUBLIC WORKS
DEPARTMENT



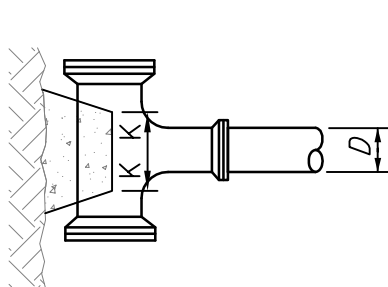
GENERAL STANDARD DETAILS

DRAWING TITLE: CONCRETE ENCASEMENT
DRAWING NO: G-101
APPROVED BY: E. VICKERS

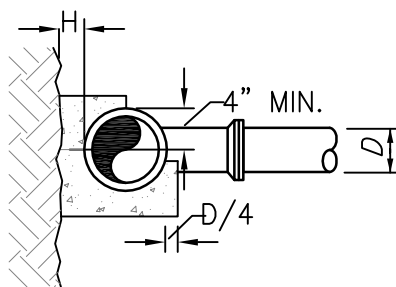
SCALE: NOT TO SCALE
DATE: OCT 2007

BUTTRESS DIMENSIONS										
	D	6"	8"	10"	12"	16"	20"	24"	30"	36"
BUTTRESS FOR TEES	H	8"	9"	10"	1'-0"	1'-2"	1'-4"	1'-6"	1'-9"	2'-0"
	I	8"	10"	1'-0"	1'-3"	1'-8"	2'-1"	2'-6"	3'-1"	3'-9"
	J	7"	9"	1'-0"	1'-2"	1'-6"	1'-11"	2'-4"	2'-10"	3'-5"
	K	6"	8"	8"	8"	10"	1'-2"	1'-4"	1'-6"	1'-10"
	K*	5"	5"	5"	5"					
BUTTRESS FOR PLUGS	E	6"	8"	8"	10"	1'-0"	1'-4"	1'-8"	2'-0"	2'-0"
	F	1'-0"	1'-4"	1'-8"	2'-0"	2'-8"	3'-3"	4'-0"	4'-9"	5'-9"
	G	1'-5"	1'-11"	2'-5"	2'-10"	3'-9"	4'-9"	5'-8"	7'-6"	8'-10"

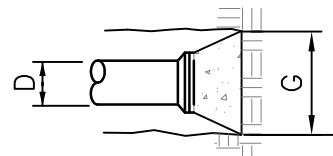
K* FOR COMPACT FITTINGS



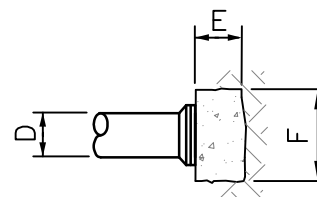
PLAN-TEE



SECTION-TEE



PLAN-PLUG



SECTION-PLUG

NOTES:

1. ALL CONCRETE TO HAVE MINIMUM COMPRESSIVE STRENGTH OF 3000 PSI.
2. BUTTRESS DIMENSIONS GIVEN ARE MINIMUM DIMENSIONS BASED UPON 3000 PSI SOIL BEARING CAPACITY AND 150 PSI INTERNAL PIPE PRESSURE.
3. ALL CONCRETE SHALL BE CARRIED TO UNDISTURBED EARTH.
4. WRAP PIPE JOINTS WITH KRAFT PAPER PRIOR TO POURING CONCRETE.

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GENERAL STANDARD DETAILS

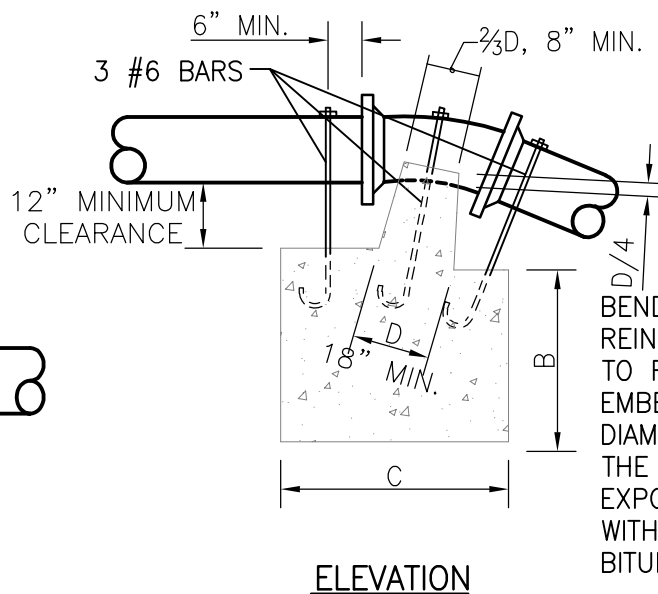
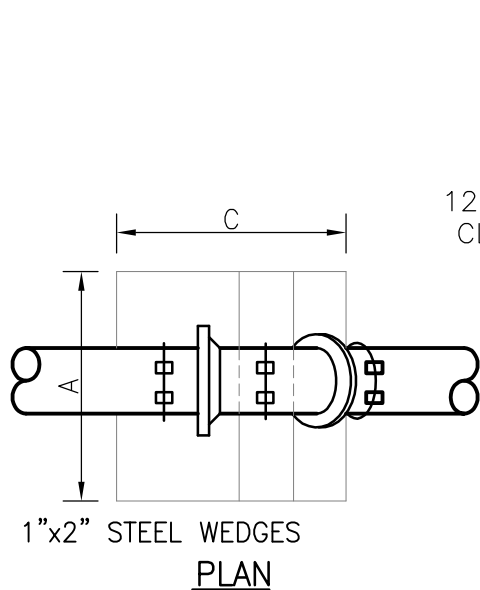
DRAWING TITLE: BUTTRESS FOR TEES AND PLUGS

DRAWING NO: G-102

APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE

DATE: OCT 2007



BEND 6" MINIMUM OF REINFORCING BAR END TO FORM HOOK. EMBED BARS 36 DIAMETERS INCLUDING THE HOOK. PAINT EXPOSED REINF. BARS WITH 2 COATS OF BITUMINOUS PAINT.

BUTTRESS DIMENSIONS							
BEND		3"	4"	6"	8"	10"	12"
ANCHORAGE 11 1/4° BEND	A	1'-6"	1'-6"	1'-6"	1'-6"	1'-5"	3'-0"
	B	1'-3"	1'-3"	1'-3"	1'-9"	1'-3"	2'-0"
	C	2'-0"	2'-0"	2'-0"	2'-6"	2'-9"	3'-0"
ANCHORAGE 22 1/2° BEND	A	2'-0"	2'-0"	2'-0"	3'-4"	3'-8"	4'-0"
	B	1'-9"	1'-9"	1'-9"	2'-3"	2'-6"	2'-6"
	C	2'-6"	2'-6"	2'-6"	2'-8"	3'-10"	4'-0"
ANCHORAGE 45° BEND	A	2'-6"	2'-6"	2'-6"	3'-0"	4'-0"	4'-6"
	B	2'-6"	2'-6"	2'-6"	2'-9"	3'-0"	3'-6"
	C	3'-0"	3'-0"	3'-0"	4'-0"	4'-6"	4'-9"

NOTES:

- 1 ALL CONCRETE TO HAVE MINIMUM COMPRESSIVE STRENGTH OF 3000 PSI.
- 2 BUTTRESS DIMENSIONS GIVEN ARE MINIMUM DIMENSIONS BASED UPON 3000 PSI SOIL BEARING CAPACITY AND 150 PSI INTERNAL PIPE PRESSURE.
- 3 ALL CONCRETE SHALL BE CARRIED TO UNDISTURBED EARTH.
- 4 WRAP PIPE JOINTS WITH KRAFT PAPER PRIOR TO POURING OF CONCRETE.

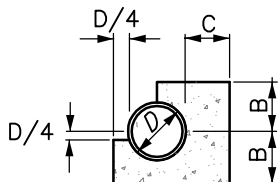
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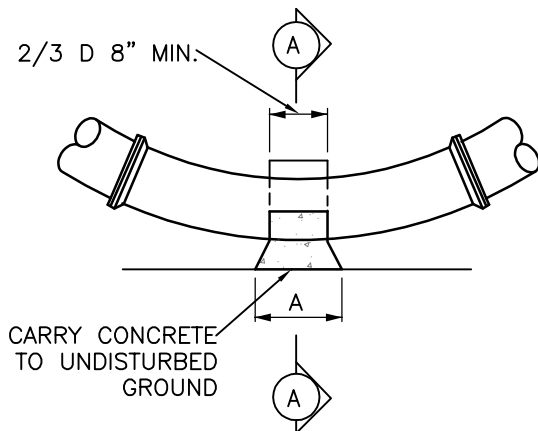
GENERAL STANDARD DETAILS

DRAWING TITLE: VERTICAL BENDS
DRAWING NO: G-103
APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE
DATE: OCT 2007



SECTION A-A



PLAN

BUTTRESS DIMENSIONS FOR HORIZONTAL BENDS

BEND	D	6"	8"	10"	12"	16"	20"	24"	30"	36"
5%	A						1'-8"	2'-0"	2'-6"	3'-0"
	B						10"	1'-0"	1'-3"	1'-6"
	C						10"	1'-0"	1'-1"	1'-2"
11¼°	A	6"	8"	10"	1'-0"	1'-4"	1'-8"	2'-0"	2'-6"	3'-0"
	B	7"	8"	9"	10"	1'-0"	1'-2"	1'-4"	1'-7"	1'-11"
	C	7"	7"	8"	8"	9"	10"	1'-0"	1'-1"	1'-2"
22½°	A	9"	1'-0"	1'-6"	1'-9"	2'-3"	3'-0"	3'-6"	4'-2"	5'-4"
	B	7"	8"	9"	10"	1'-0"	1'-2"	1'-4"	1'-7"	2'-0"
	C	8"	9"	10"	11"	1'-2"	1'-4"	1'-6"	1'-9"	2'-0"
45°	A	1'-3"	1'-8"	2'-1"	2'-6"	3'-4"	4'-2"	5'-0"	6'-3"	7'-6"
	B	7"	8"	9"	11"	1'-3"	1'-6"	1'-8"	2'-0"	2'-6"
	C	8"	9"	10"	11"	1'-2"	1'-4"	1'-9"	2'-3"	2'-8"
90°	A	2'-0"	2'-6"	3'-0"	3'-6"	5'-0"	SPECIAL DESIGN			
	B	6"	9"	1'-0"	1'-3"	1'-6"				
	C	1'-10"	1'-9"	1'-8"	1'-7"	1'-5"				

NOTES:

1. ALL CONCRETE TO HAVE A MINIMUM COMPRESSION STRENGTH OF 3000 PSI.
2. BUTTRESS DIMENSIONS GIVEN ARE MINIMUM DIMENSIONS BASED UPON 3000 PSI SOIL BEARING CAPACITY AND 150 PSI INTERNAL PIPE PRESSURE.
3. ALL CONCRETE SHALL BE CARRIED TO UNDISTURBED EARTH.
4. NO DRY MIX TO BE USED.

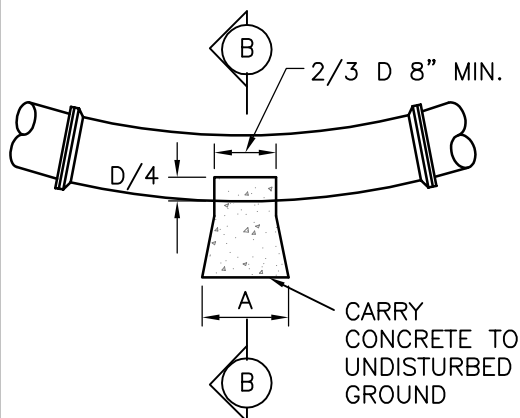
GENERAL STANDARD DETAILS

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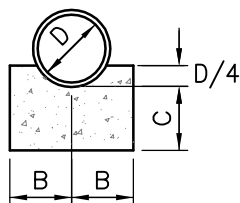


DRAWING TITLE: HORIZONTAL BENDS
DRAWING NO: G-104
APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE
DATE: OCT 2007



ELEVATION



SECTION B-B

BUTTRESS DIMENSIONS FOR VERTICAL BENDS										
BEND	D	6"	8"	10"	12"	16"	20"	24"	30"	36"
11¼°	A						1'-8"	2'-0"	2'-6"	3'-0"
	B						10"	1'-0"	1'-3"	1'-6"
	C						10"	1'-0"	1'-1"	1'-2"
22½°	A	6"	8"	10"	1'-0"	1'-4"	1'-8"	2'-0"	2'-6"	3'-0"
	B	7"	8"	9"	10"	1'-0"	1'-2"	1'-4"	1'-7"	1'-10"
	C	7"	7"	8"	8"	9"	10"	1'-0"	1'-1"	1'-2"
45°	A	9"	1'-0"	1'-6"	1'-9"	2'-3"	3'-0"	3'-6"	4'-2"	5'-4"
	B	7"	7"	8"	10"	1'-0"	1'-2"	1'-4"	1'-7"	2'-0"
	C	7"	7"	8"	8"	9"	10"	1'-0"	1'-1"	1'-2"
90°	A	1'-3"	1'-8"	2'-1"	2'-6"	3'-4"	4'-2"	5'-0"	6'-3"	7'-6"
	B	7"	8"	9"	11"	1'-3"	1'-6"	1'-9"	2'-3"	2'-6"
	C	7"	8"	10"	11"	1'-3"	1'-6"	1'-9"	2'-3"	2'-8"

NOTES:

1. ALL CONCRETE TO HAVE A MINIMUM COMPRESSION STRENGTH OF 3000 PSI.
2. BUTTRESS DIMENSIONS GIVEN ARE MINIMUM DIMENSIONS BASED UPON 3000 PSI SOIL BEARING CAPACITY AND 150 PSI INTERNAL PIPE PRESSURE.
3. ALL CONCRETE SHALL BE CARRIED TO UNDISTURBED EARTH.
4. NO DRY MIX TO BE USED.

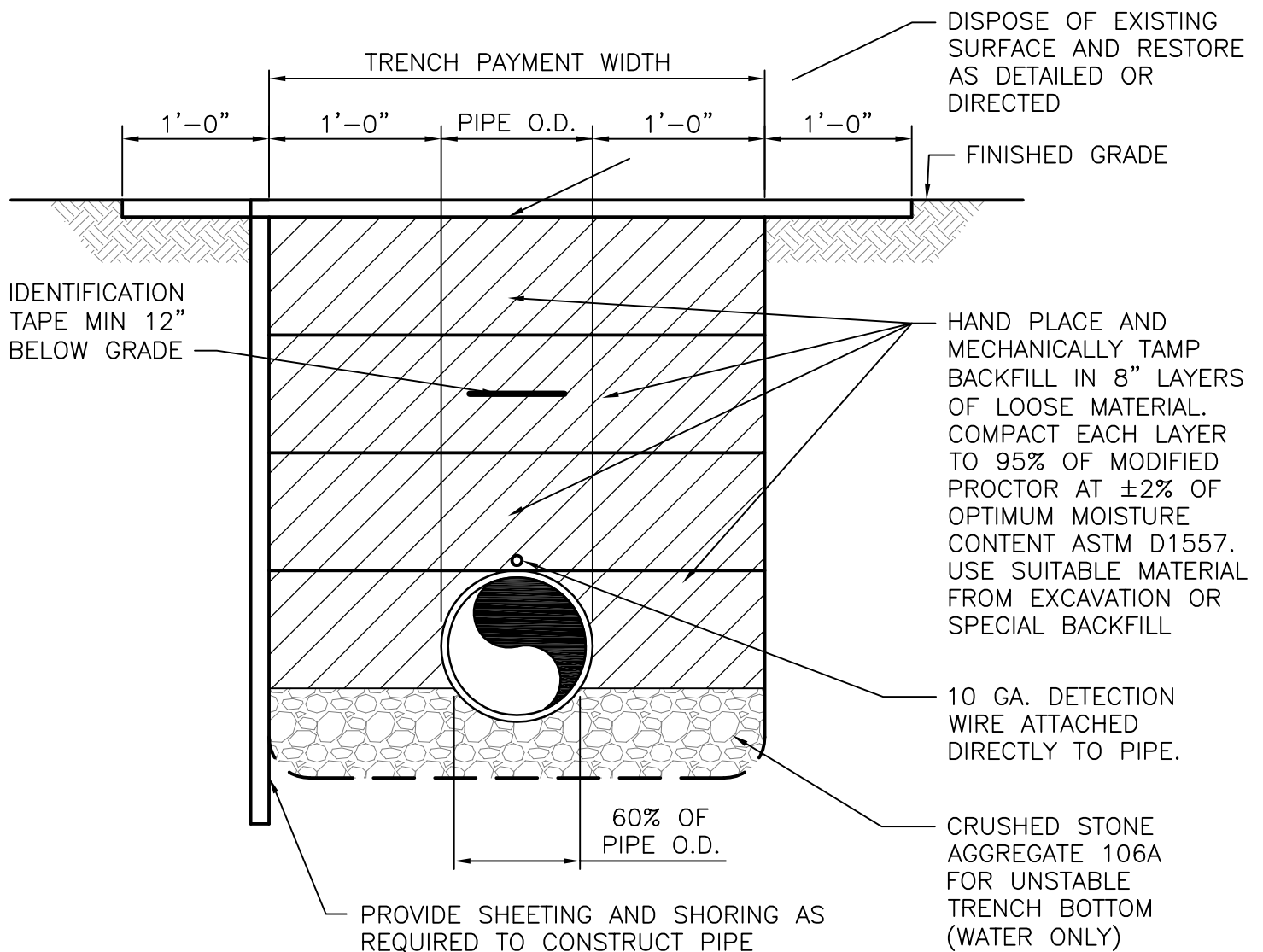
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GENERAL STANDARD DETAILS

DRAWING TITLE: VERTICAL BENDS
DRAWING NO: G-105
APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE
DATE: OCT 2007



NOTE: INSTALL 2" HOTMIX OR COLD PATCH ON ALL OPEN UTILITY TRENCHES AT THE END OF EVERY WORKDAY.

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GENERAL STANDARD DETAILS

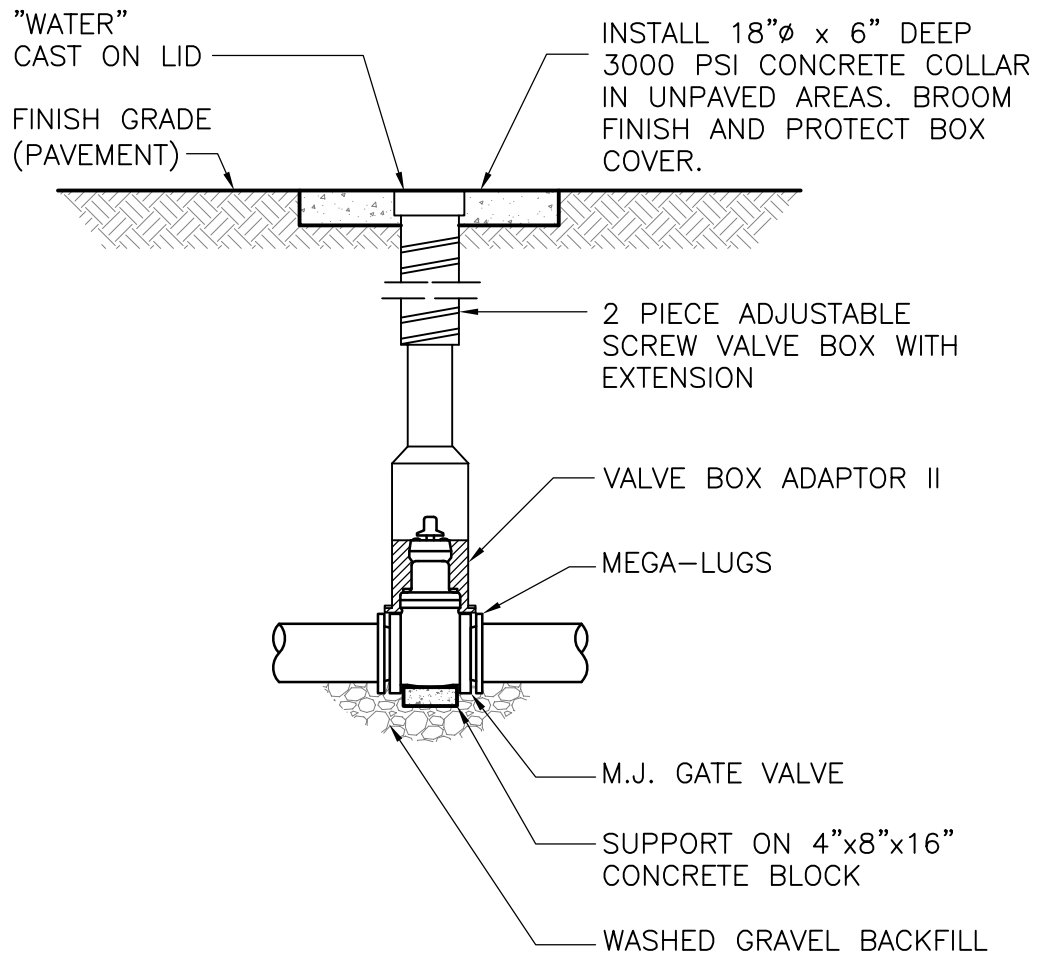
DRAWING TITLE: PIPE BEDDING AND BACKFILL

DRAWING NO: G-106

APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE

DATE: OCT 2007



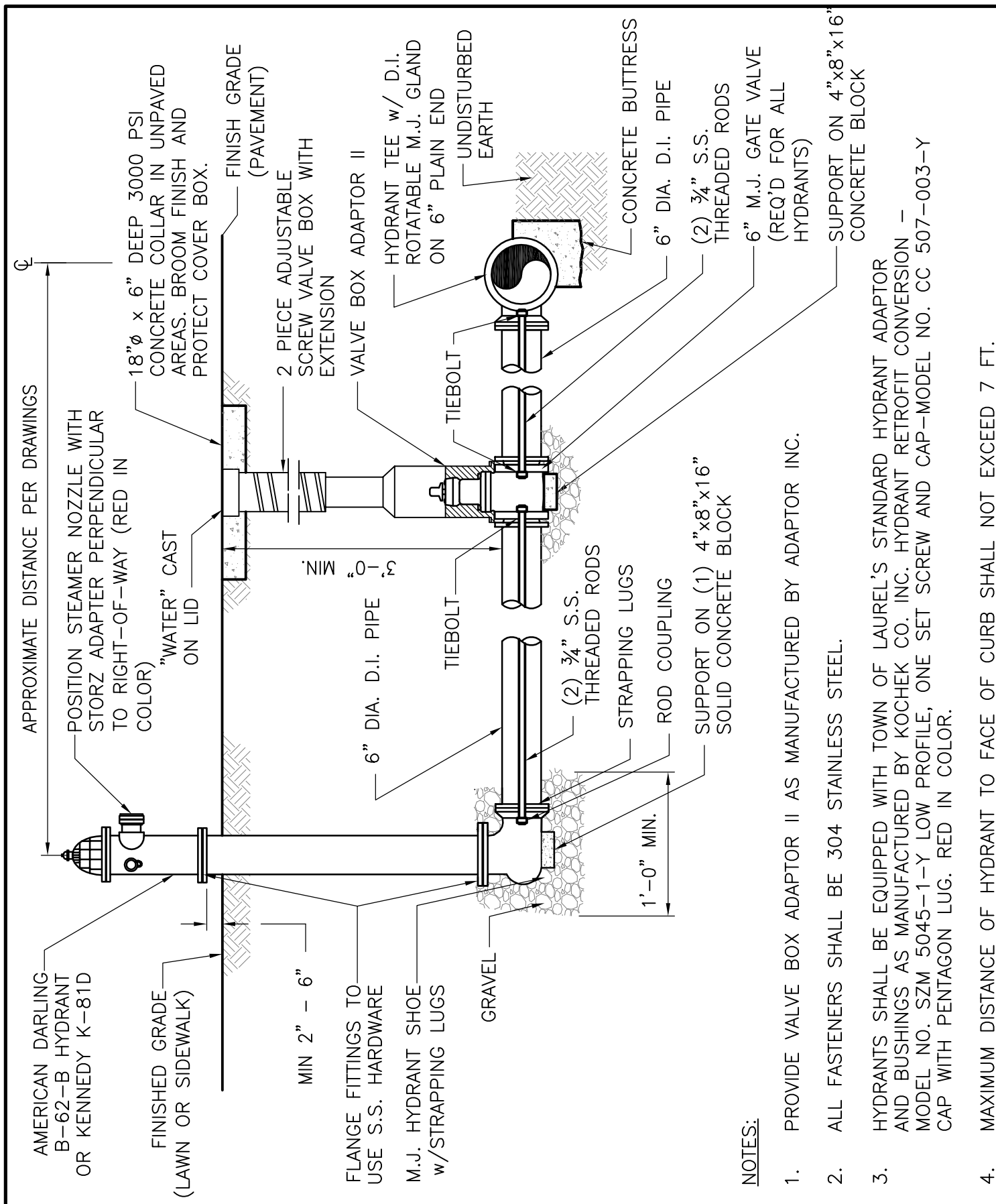
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DRAWING TITLE: GATE VALVE
DRAWING NO: W-200
APPROVED BY: E. VICKERS

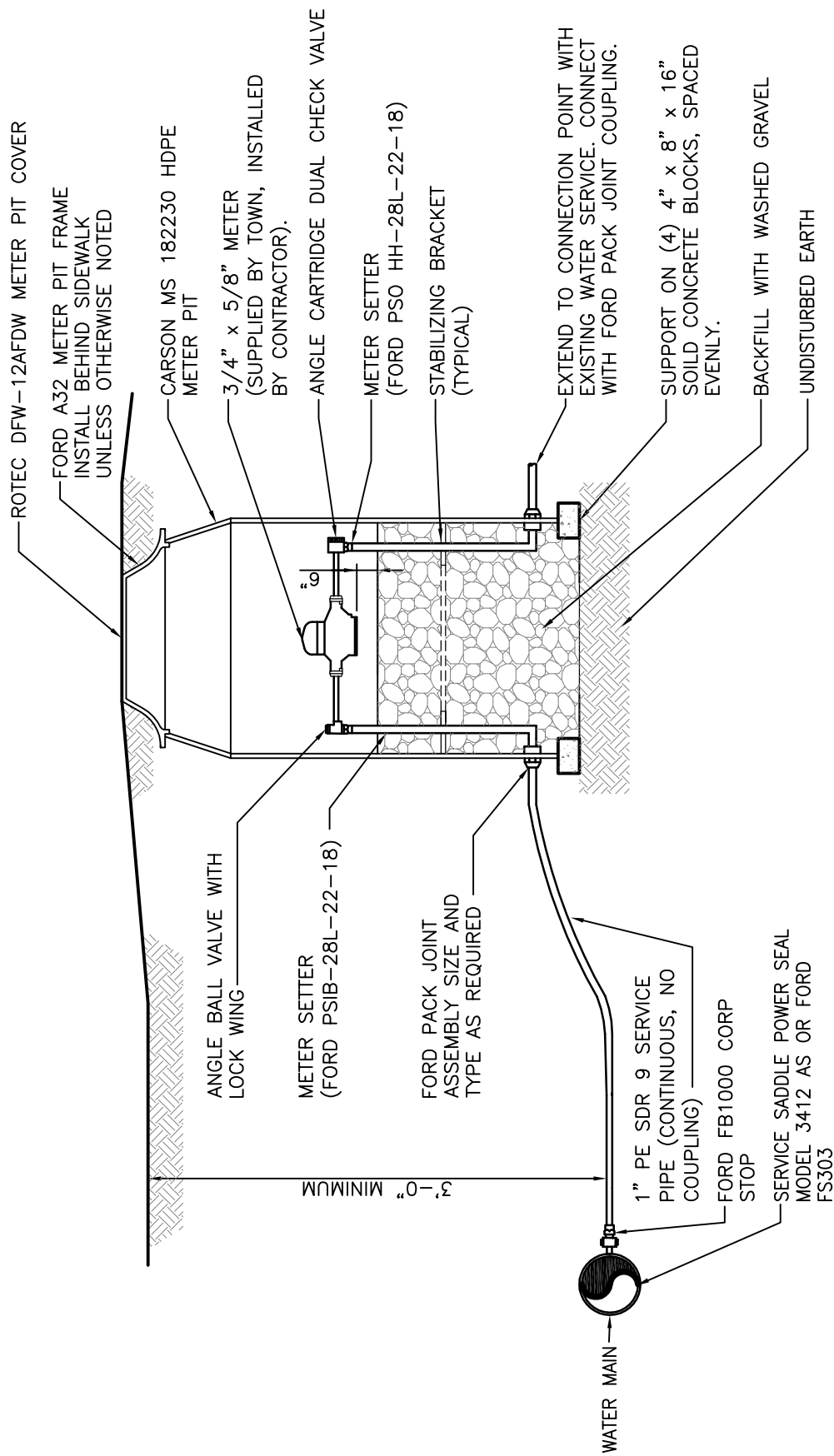
GENERAL STANDARD DETAILS

SCALE: NOT TO SCALE
DATE: OCT 2007



NOTES:

1. PROVIDE VALVE BOX ADAPTOR II AS MANUFACTURED BY ADAPTOR INC.
2. ALL FASTENERS SHALL BE 304 STAINLESS STEEL.
3. HYDRANTS SHALL BE EQUIPPED WITH TOWN OF LAUREL'S STANDARD HYDRANT ADAPTOR AND BUSHINGS AS MANUFACTURED BY KOCHER CO. INC. HYDRANT RETROFIT CONVERSION - MODEL NO. SZM 5045-1-Y LOW PROFILE, ONE SET SCREW AND CAP-MODEL NO. CC 507-003-Y CAP WITH PENTAGON LUG. RED IN COLOR.
4. MAXIMUM DISTANCE OF HYDRANT TO FACE OF CURB SHALL NOT EXCEED 7 FT.



NOTES:

1. CONTRACTOR SHALL FURNISH AND INSTALL SERVICE SADDLES AND CORPORATION STOPS ON NEW PVC WATER MAIN.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONNECTION OF NEW WATER SERVICE TO EXISTING WATER SERVICE.
3. ALL P.E. PIPE CONNECTIONS SHALL HAVE S.S. INSERT STIFFENERS.
4. DO NOT INSTALL METERS IN DRIVEWAY AREAS.
5. PROVIDE BRASS CAP OVER 1" OULIET AT LOCATIONS INDICATED FOR FUTURE CONNECTION.

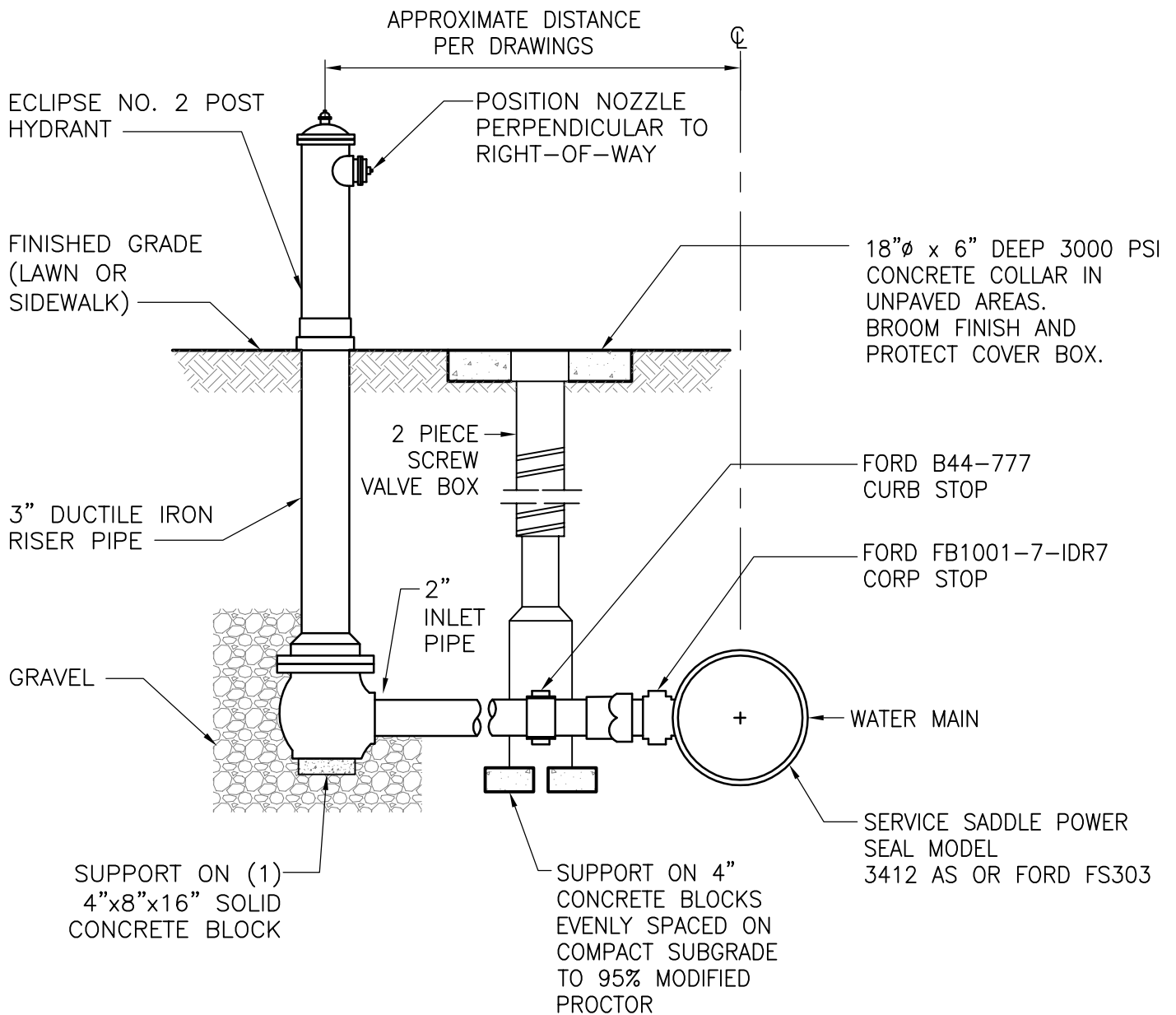
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GENERAL STANDARD DETAILS

DRAWING TITLE: HOUSE CONNECTION
DRAWING NO: W-202
APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE
DATE: OCT 2007



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GENERAL STANDARD DETAILS

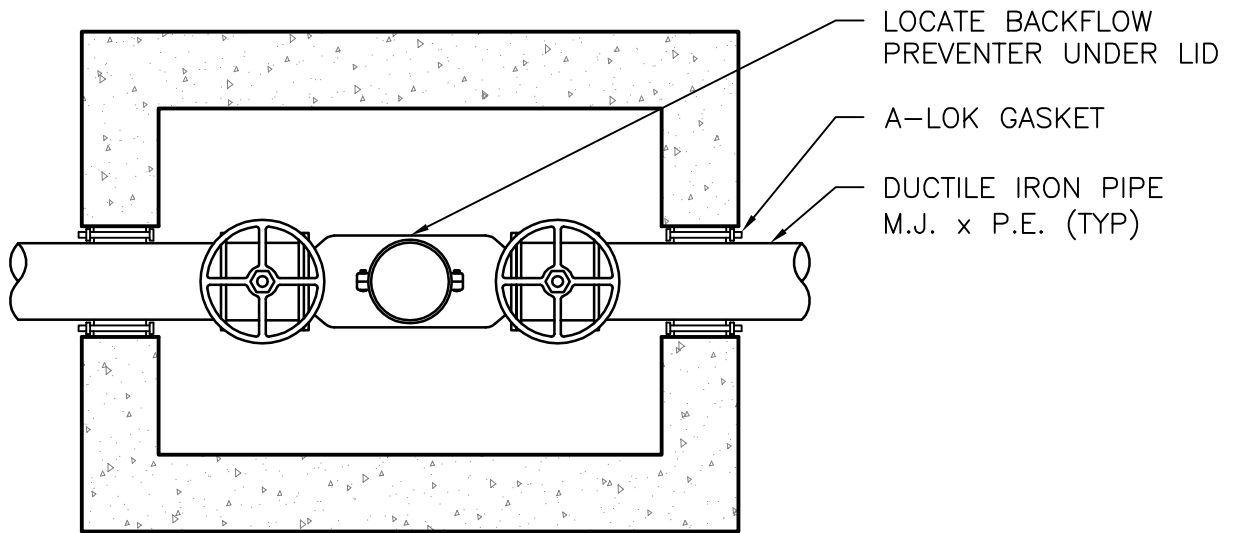
DRAWING TITLE: BLOW OFF HYDRANT

DRAWING NO: W-203

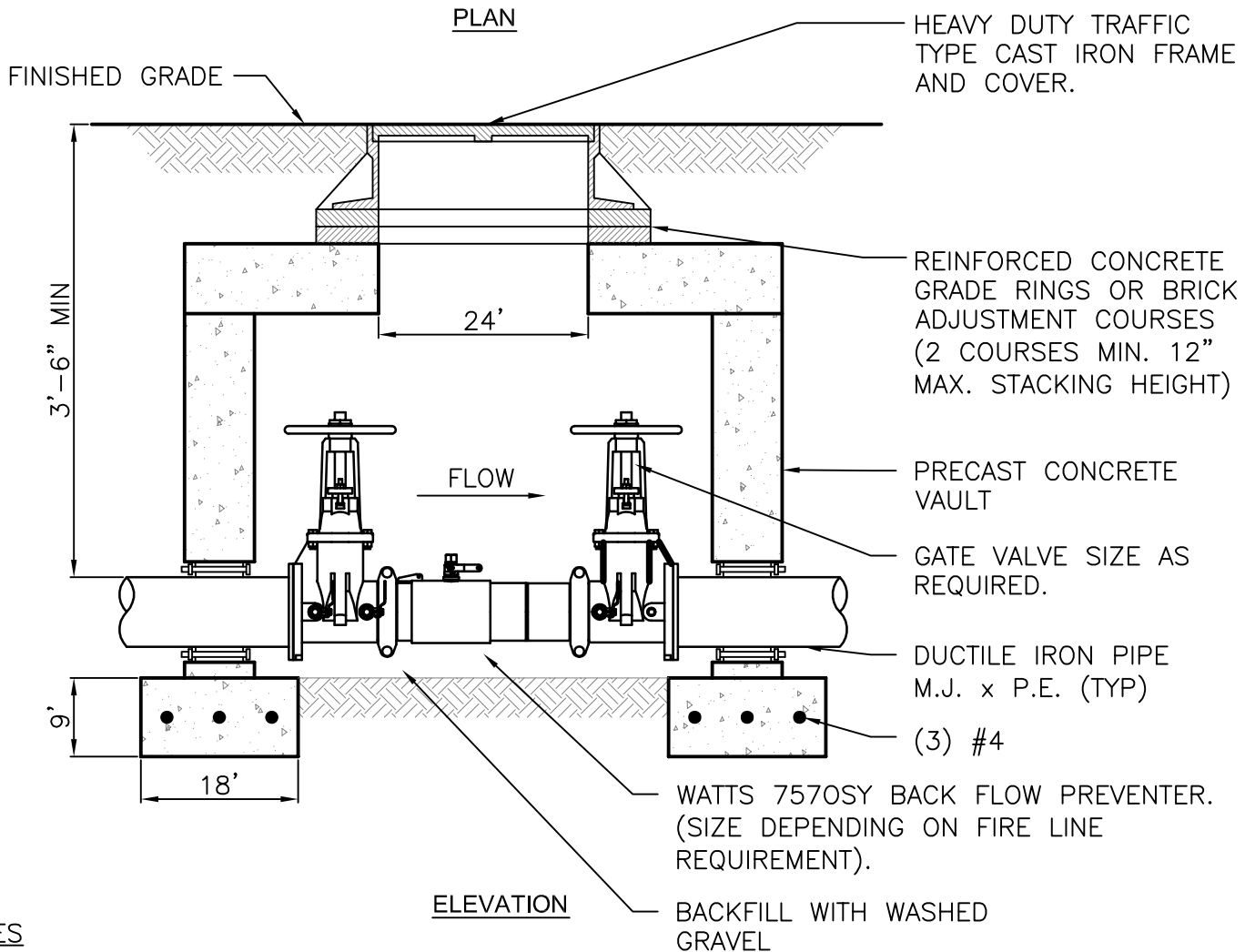
APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE

DATE: OCT 2007



PLAN



NOTES

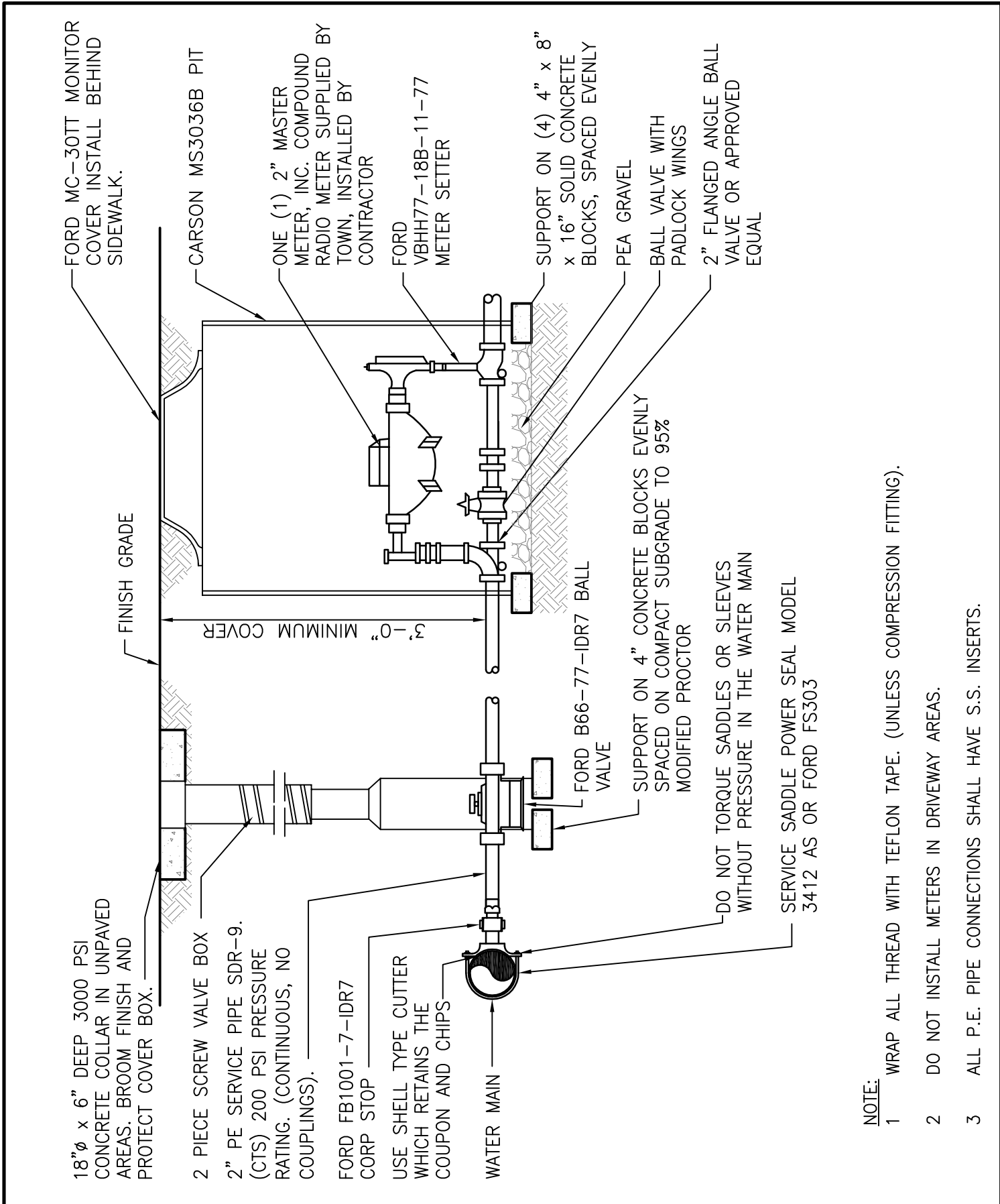
1. EQUIPMENT SHALL BE INSTALLED INSIDE THE BUILDING TO THE EXTENT POSSIBLE. A PRECAST VAULT MAY BE USED ONLY IF SPACE INSIDE THE BUILDING IS NOT AVAILABLE.

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GENERAL STANDARD DETAILS
DRAWING TITLE: FIRE LINE BACKFLOW PREVENTER
DRAWING NO: W-204
APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE
DATE: OCT 2007



NOTE:

- 1 WRAP ALL THREAD WITH TEFLON TAPE. (UNLESS COMPRESSION FITTING).
- 2 DO NOT INSTALL METERS IN DRIVEWAY AREAS.
- 3 ALL P.E. PIPE CONNECTIONS SHALL HAVE S.S. INSERTS.

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GENERAL STANDARD DETAILS

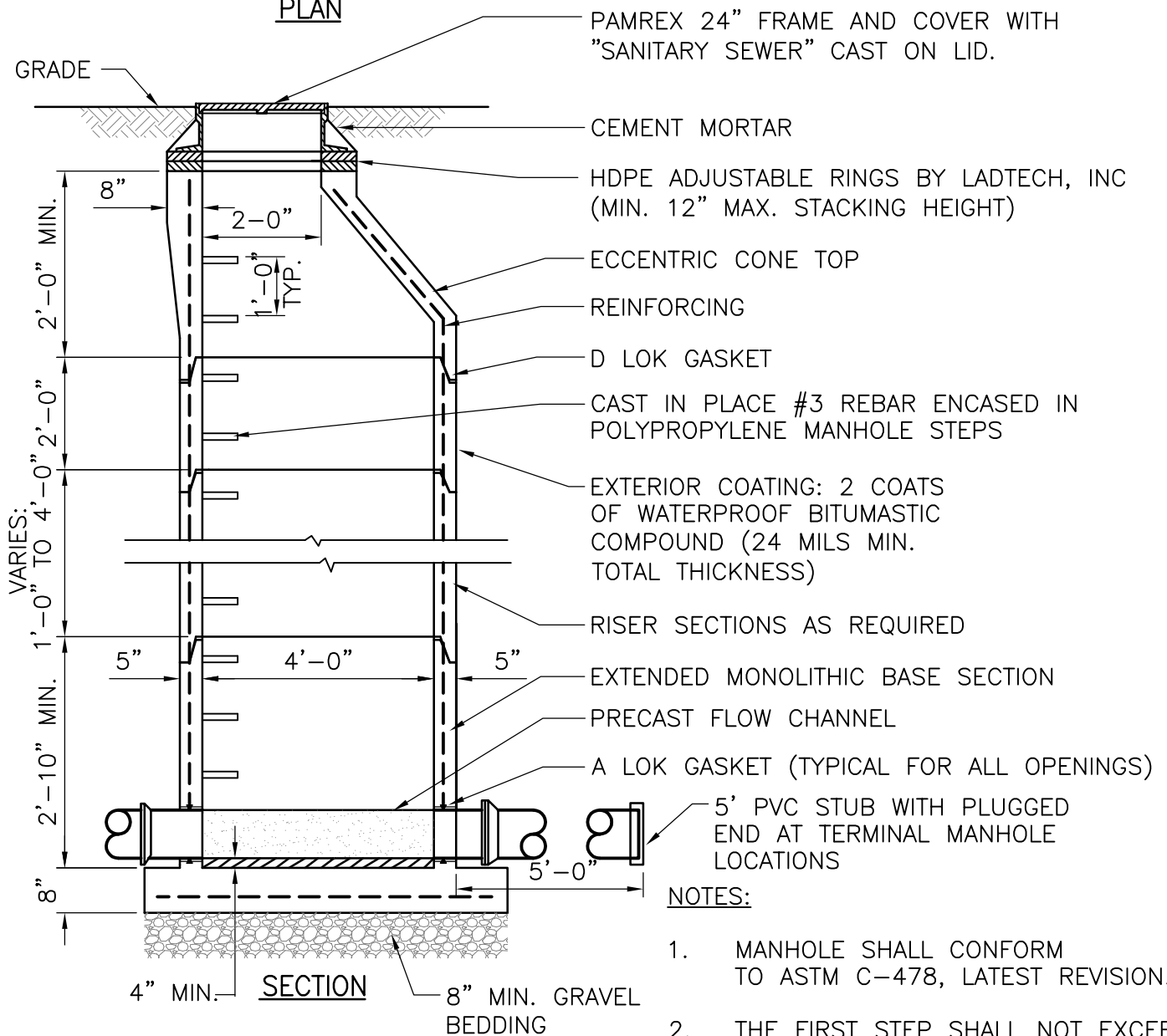
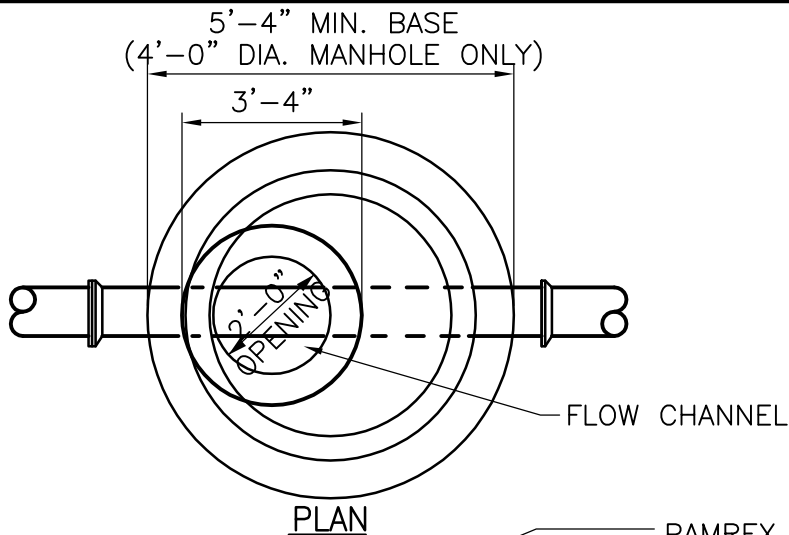
DRAWING TITLE: 2" WATER SERVICE CONNECTION

DRAWING NO: W-205

APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE

DATE: OCT 2007



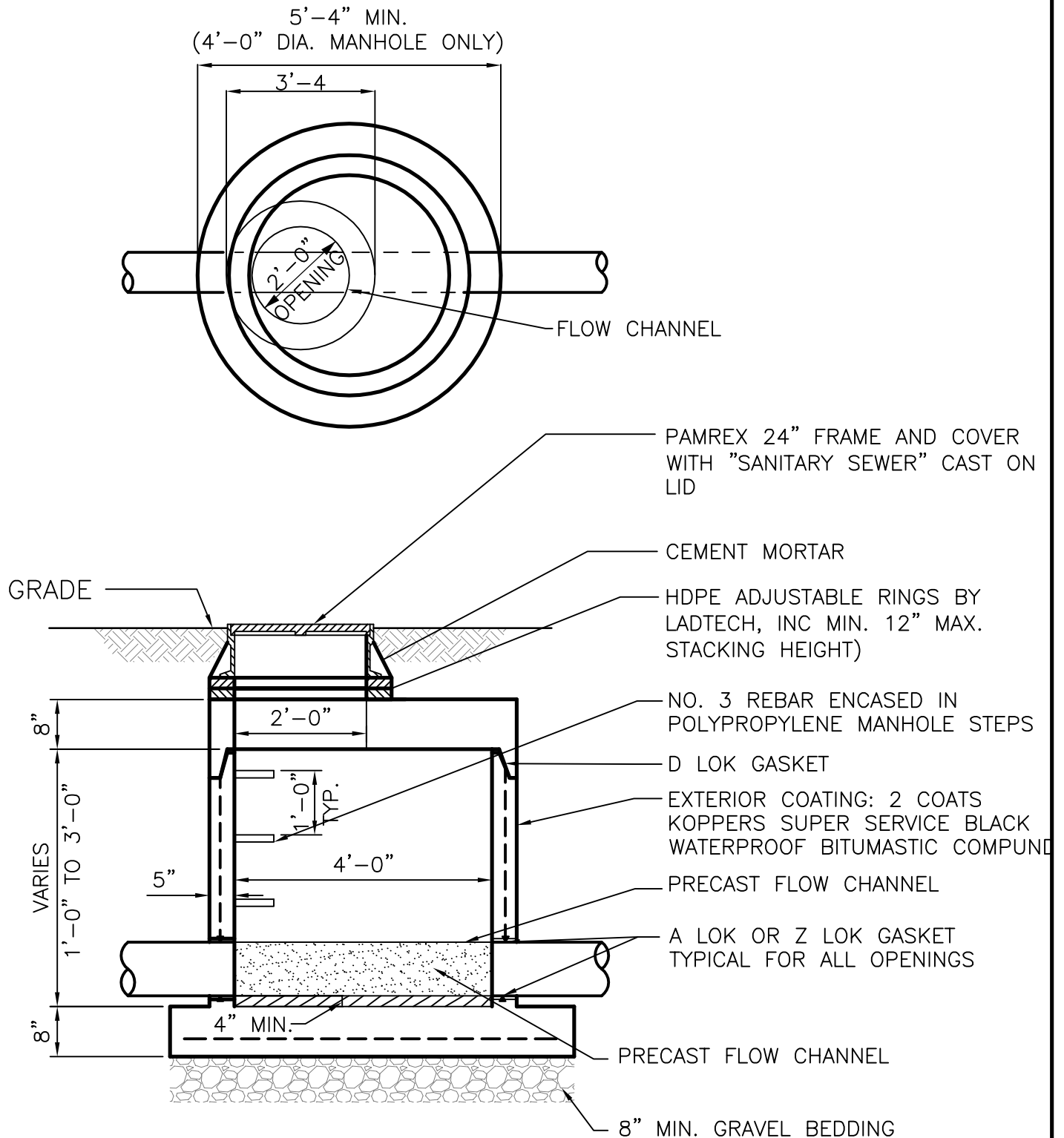
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DRAWING TITLE: PRECAST CONCRETE MANHOLE
DRAWING NO: S-300
APPROVED BY: E. VICKERS

GENERAL STANDARD DETAILS

SCALE: NOT TO SCALE
DATE: OCT 2007



NOTE:

1. MANHOLE SHALL CONFORM TO ASTM C-478
2. DETAIL APPLIES TO SANITARY SEWER AND STORM WATER MANHOLES

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GENERAL STANDARD DETAILS

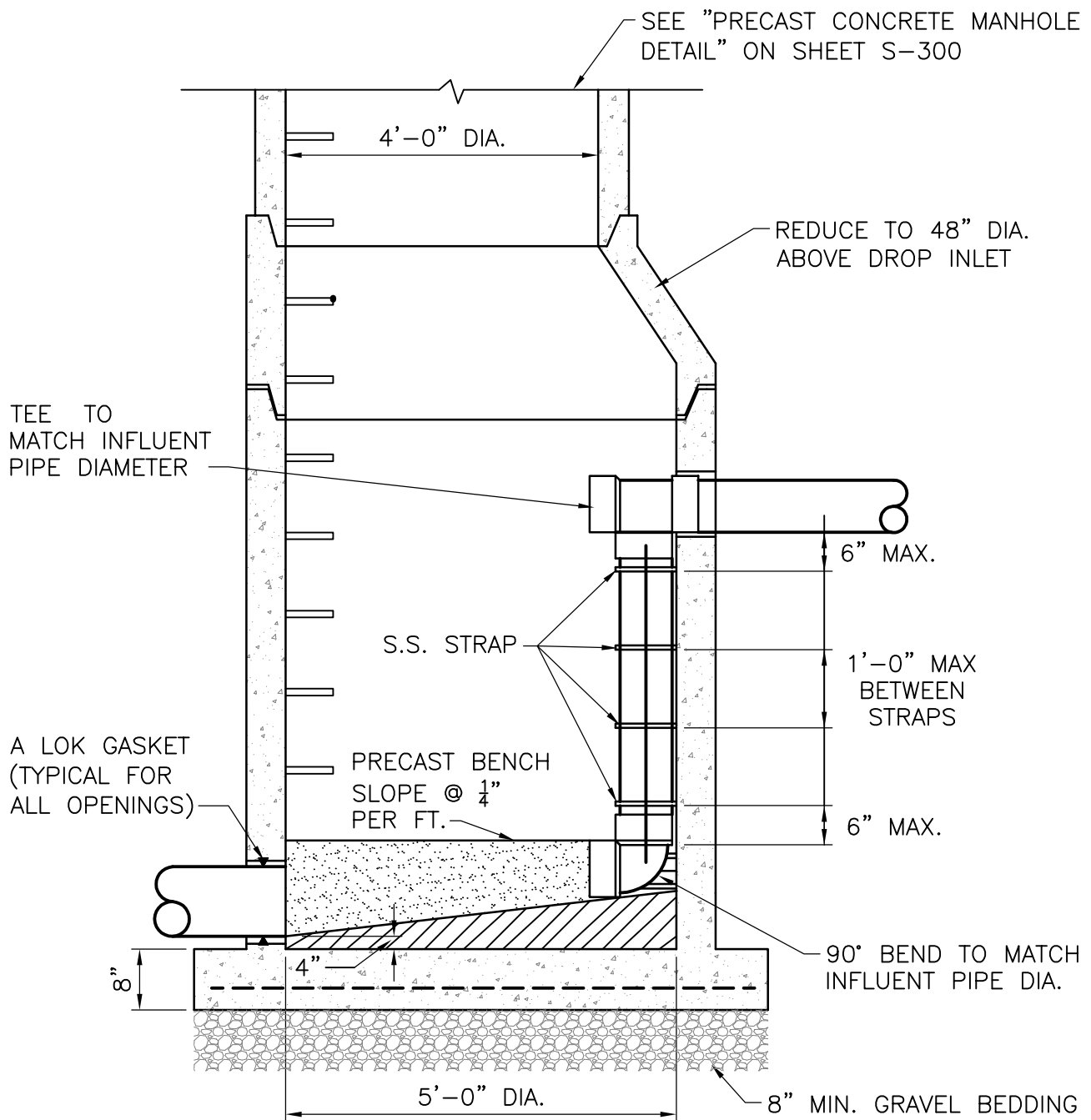
DRAWING TITLE: SHALLOW PRECAST MANHOLE

DRAWING NO: S-301

APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE

DATE: OCT 2007



NOTES:

1. STAINLESS STEEL STRAPS SHALL BE $\frac{1}{8}$ "x1" MINIMUM.
2. S.S. STRAP CONNECTORS SHALL BE EXPANSION BOLTS OR APPROVED EQUAL.

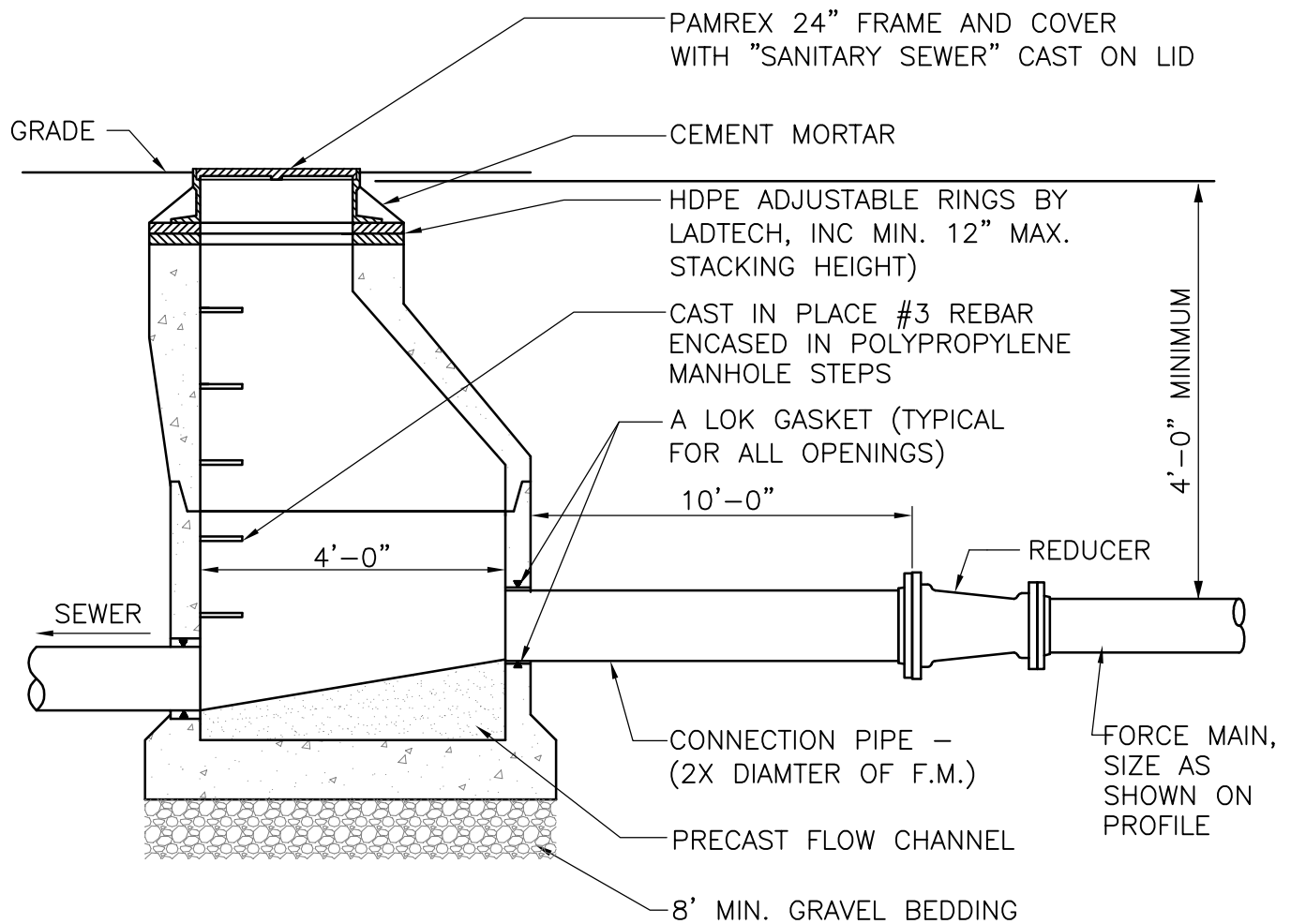
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GENERAL STANDARD DETAILS

DRAWING TITLE: INSIDE DROP MANHOLE
DRAWING NO: S-302
APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE
DATE: OCT 2007



SECTION

NOTE: MANHOLE SHALL CONFORM TO ASTM C-478, LATEST REVISION

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GENERAL STANDARD DETAILS

DRAWING TITLE: FORCEMAIN DISCHARGE MANHOLE

DRAWING NO: S-303

APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE

DATE: OCT 2007

WALL AREA BETWEEN EXISTING
PIPE AND DOGHOUSE OPENINGS
SHALL BE FILLED WITH BRICK
AND NON-SHRINK MORTAR.

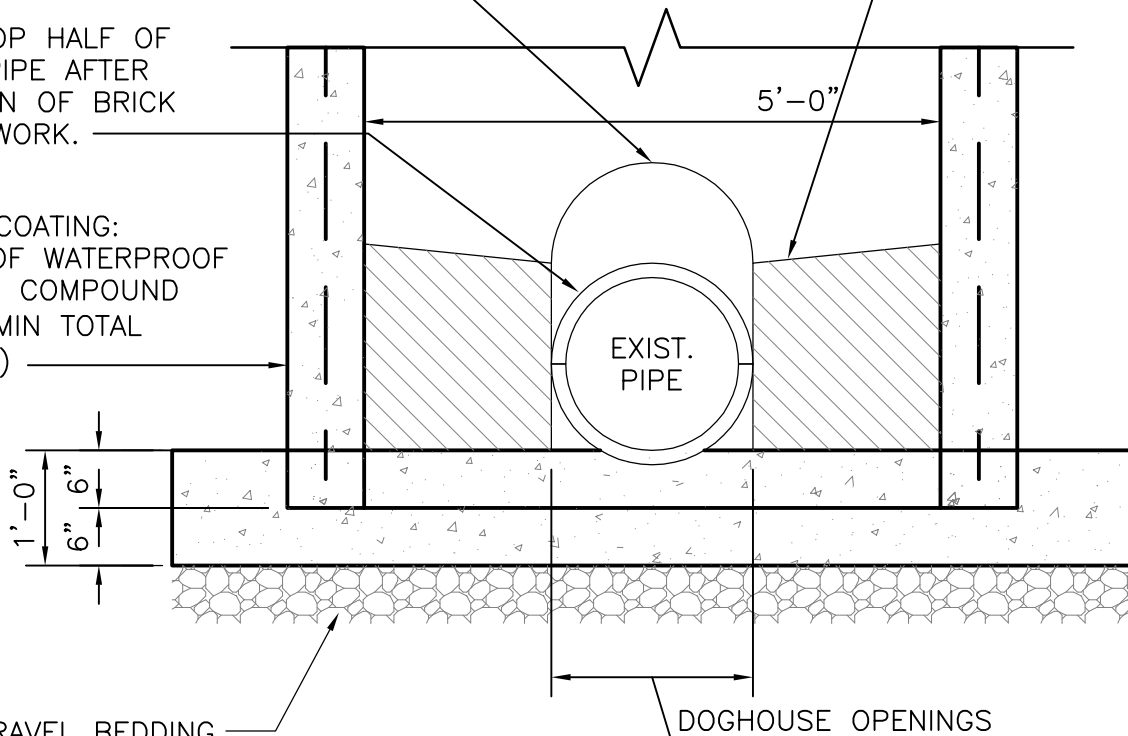
REMOVE TOP HALF OF
EXISTING PIPE AFTER
COMPLETION OF BRICK
CHANNEL WORK.

EXTERIOR COATING:
2 COATS OF WATERPROOF
BITUMASTIC COMPOUND
(24 MILS MIN TOTAL
THICKNESS)

BRICK FLOW CHANNELS
SLOPE 1/4" PER 1FT

8" MIN. GRAVEL BEDDING

DOGHOUSE OPENINGS



NOTE: MANHOLE SHALL CONFORM TO ASTM C-478, LATEST REVISION

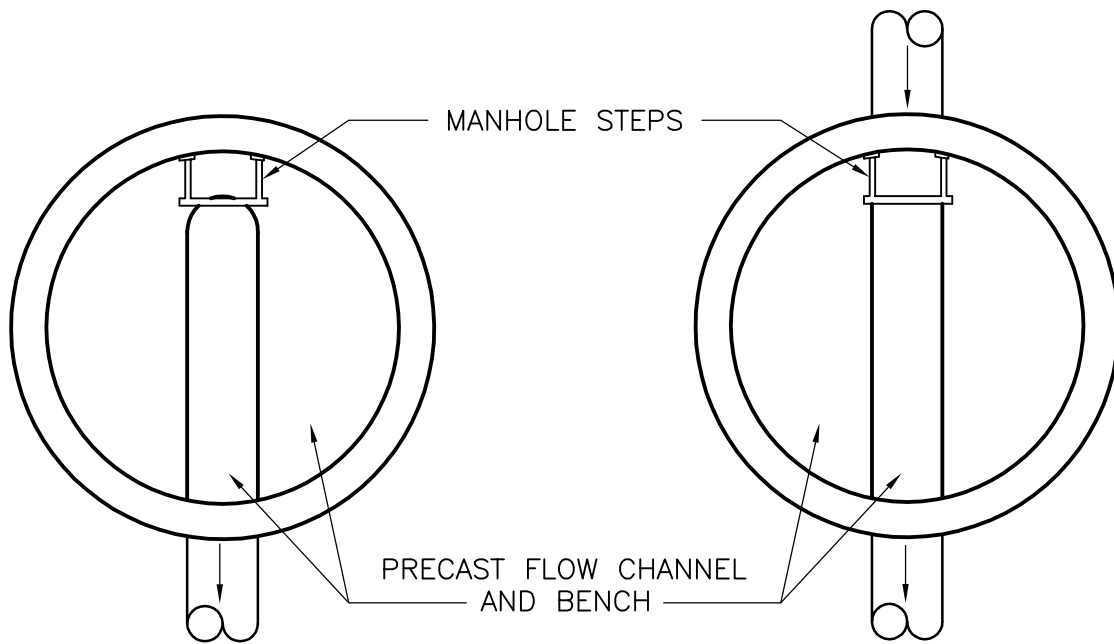
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GENERAL STANDARD DETAILS

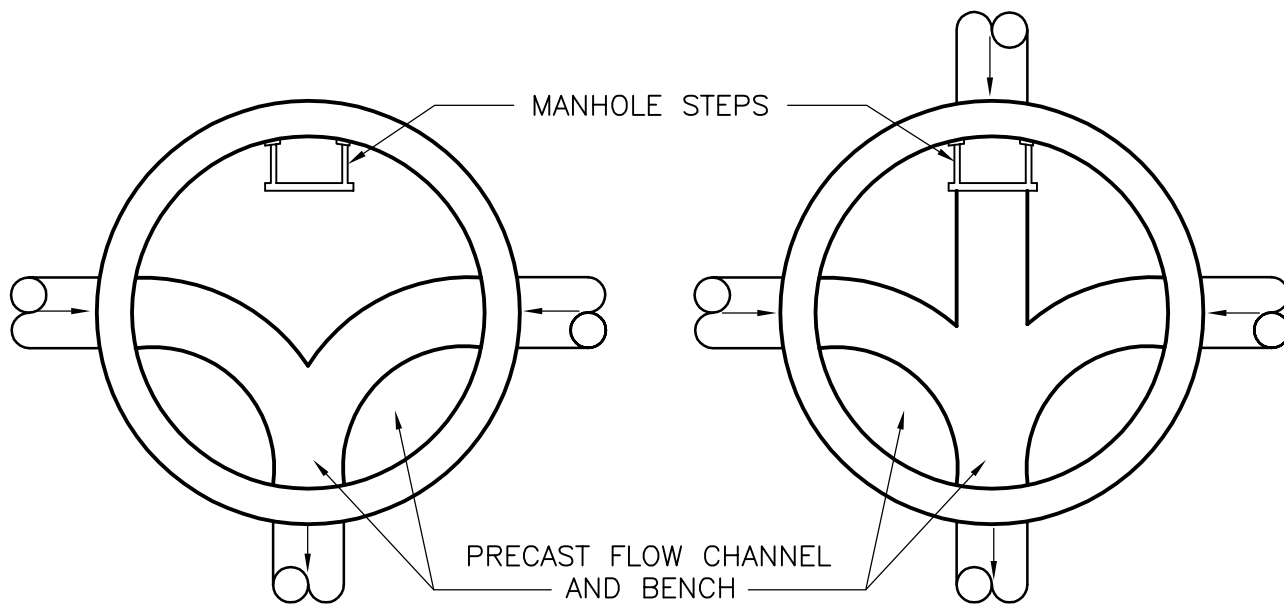
DRAWING TITLE: DOGHOUSE MANHOLE
DRAWING NO: S-304
APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE
DATE: OCT 2007



TERMINAL

1-WAY



2-WAY

3-WAY

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GENERAL STANDARD DETAILS

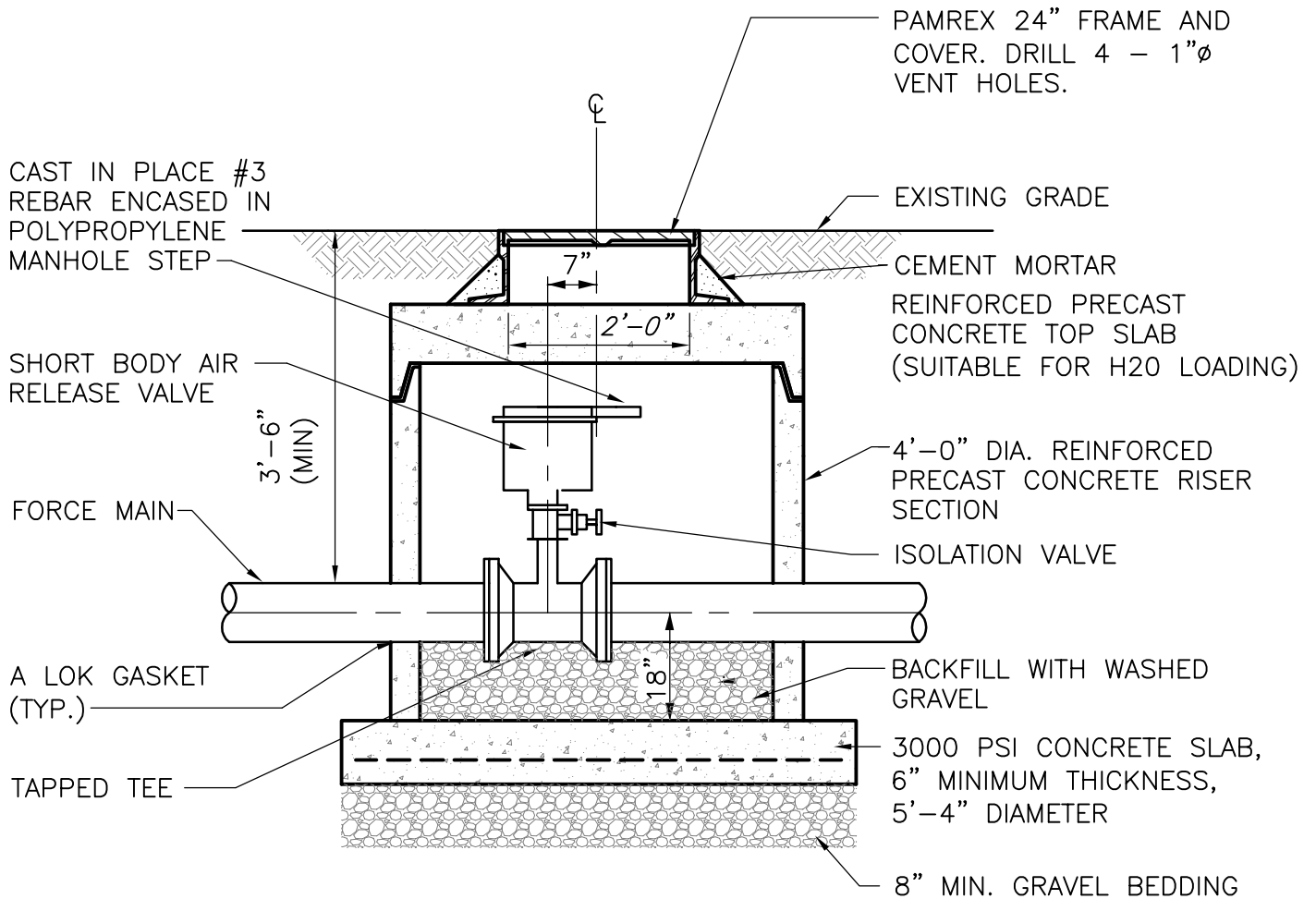
DRAWING TITLE: MANHOLE FLOW CHANNEL

DRAWING NO: S-305

APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE

DATE: OCT 2007



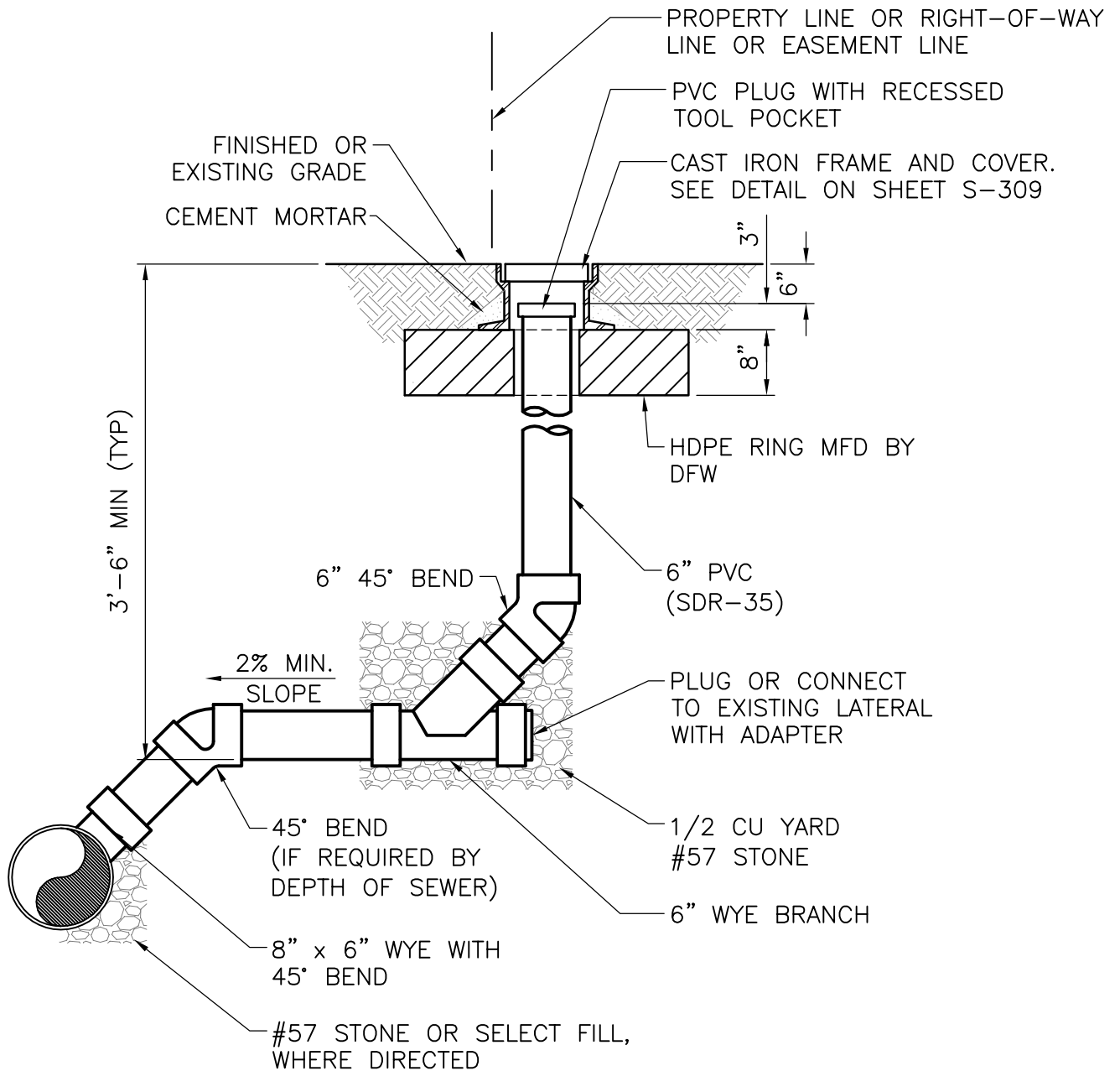
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GENERAL STANDARD DETAILS

DRAWING TITLE: AIR RELEASE VALVE
DRAWING NO: S-306
APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE
DATE: OCT 2007



NOTES:

1. COORDINATE LATERAL LOCATIONS IN FIELD WITH TOWN OF LAUREL AND PROPERTY OWNER. DO NOT LOCATE IN DITCH, SWALE, ETC. PIPE AND FITTINGS TO BE SDR 35 PVC, ASTM D-3034 AND D-2412. ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH TOWN STANDARDS.

2. MAINTAIN 10' MINIMUM HORIZONTAL SEPARATION BETWEEN WATER AND SEWER LINES.

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GENERAL STANDARD DETAILS

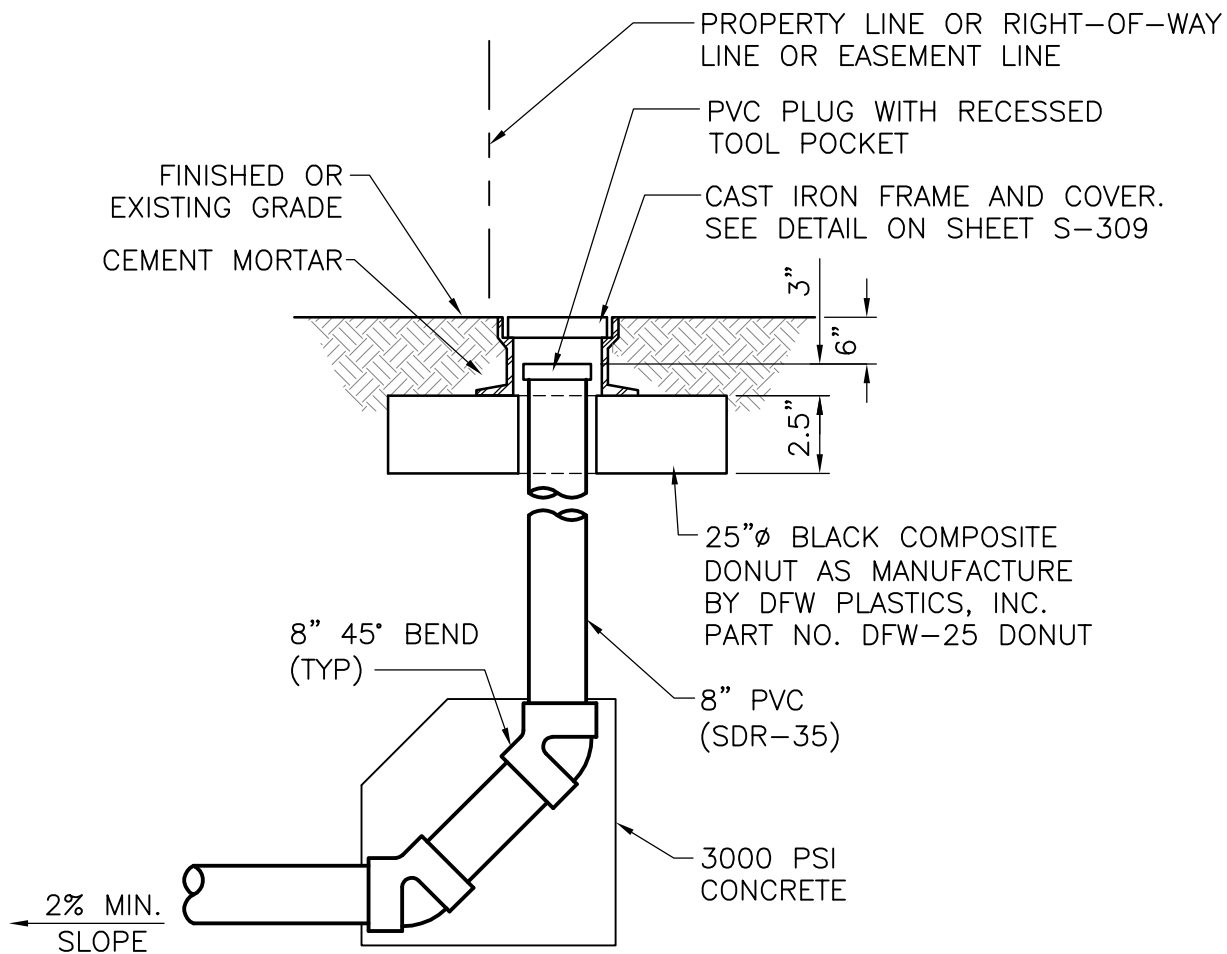
DRAWING TITLE: STANDARD LATERAL CLEANOUT

DRAWING NO: S-307

APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE

DATE: OCT 2007



TOWN OF
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GENERAL STANDARD DETAILS

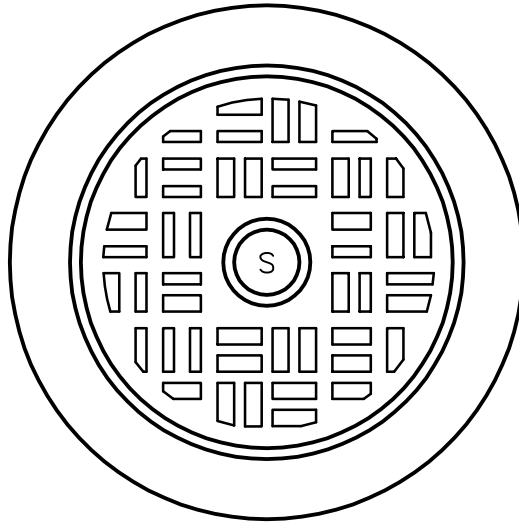
DRAWING TITLE: TERMINAL LATERAL CLEANOUT

DRAWING NO: S-308

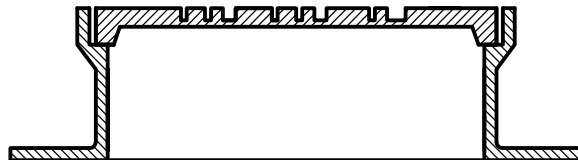
APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE

DATE: OCT 2007



FOR 6": EAST JORDAN IRON WORKS MODEL 1566
FOR 8": EAST JORDAN IRON WORKS MODEL 1564



GENERAL STANDARD DETAILS

TOWN OF
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DEPARTMENT



DRAWING TITLE: CLEANOUT FRAME AND COVER

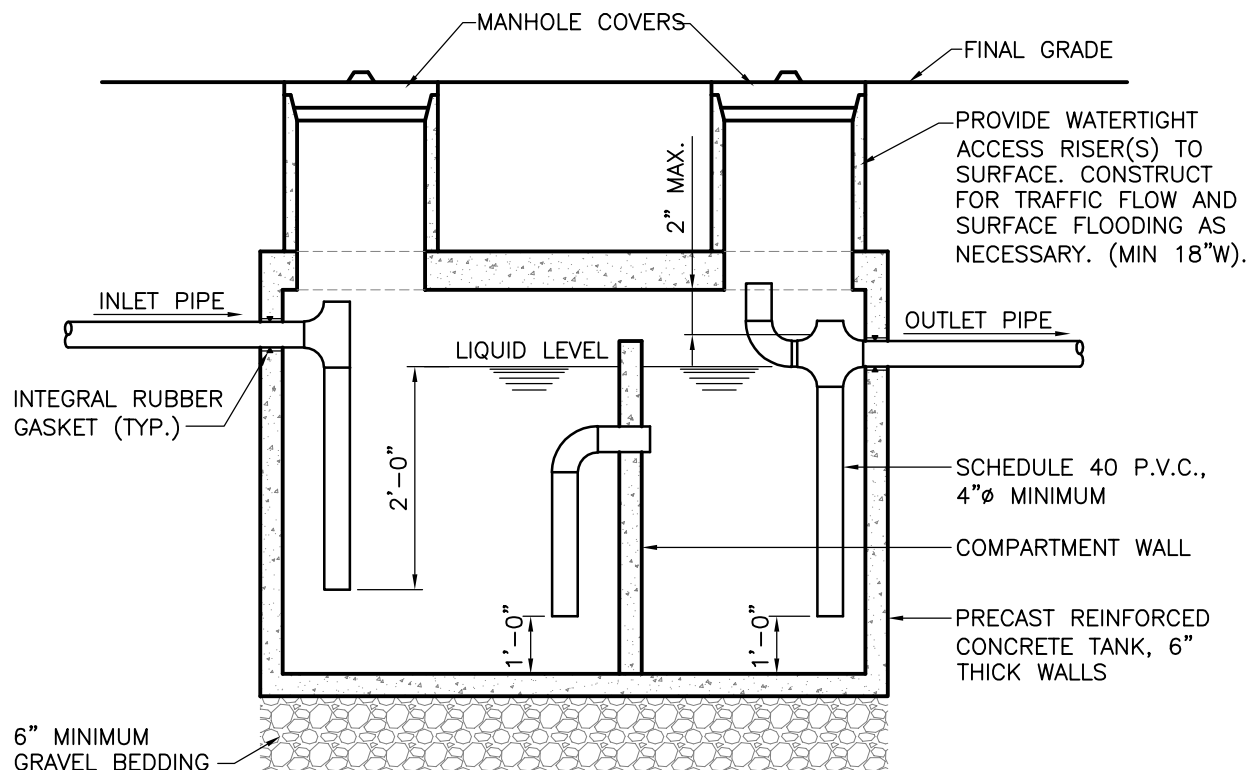
DRAWING NO: S-309

APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE

DATE: OCT 2007

PLAN



SECTION

NOTES:

1. GREASE TRAP SHALL BE SIZED SUCH THAT GREASE RETENTION CAPACITY IS EQUAL TO AT LEAST TWICE THE PEAK FLOW CAPACITY IN GPM.
2. SEAL ALL SEAMS WITH NON-SHRINK GROUT.
3. TANK SHALL HAVE TOP SEAM.
4. WHENEVER PRACTICAL ALL OPENINGS MUST BE ABOVE THE SEASONAL HIGH WATER TABLE.
5. EXCAVATION LIMITS SHALL EXTEND AT LEAST TWO FEET BEYOND TANK PERIMETER.

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GENERAL STANDARD DETAILS

DRAWING TITLE: GREASE TRAP
DRAWING NO: S-310
APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE
DATE: OCT 2007

GREASE TRAPS

GREASE TRAPS ARE REQUIRED FOR ALL COMMERCIAL OPERATIONS, RESTAURANTS, CONVENIENCE STORES, ETC. WHICH HAVE COOKING OPERATIONS. TRAPS SHALL BE DESIGNED TO PREVENT ACCUMULATION OF GREASE IN SANITARY SEWERS. MAINTENANCE IS THE RESPONSIBILITY OF THE PROPERTY OWNER. THE PROPERTY OWNER SHALL SUBMIT TO THE TOWN A MAINTENANCE CONTRACT WITH A LOCAL HAULER DEFINING THESE RESPONSIBILITIES FOR INSPECTION AND PUMP OUT AS REQUIRED. MAINTENANCE RECORDS SHALL BE MADE AVAILABLE TO THE TOWN UPON REQUEST.

CAPACITY OF GREASE TRAPS SHALL BE DETERMINED BASED ON THE SPECIFIC APPLICATION. THE FOLLOWING FORMULAS SHALL APPLY:

1 RESTAURANTS

WHERE:

- D = NUMBER OF SEATS IN DINING AREA
- GL = GALLONS OF WASTEWATER PER MEAL, NORMALLY 4 GAL
- ST = STORAGE CAPACITY FACTOR – MINIMUM OF 1.0
- HR = NUMBER OF HOURS OPEN
- LF = LOADING FACTOR
 - 1.0 MAJOR HIGHWAY
 - 1.0 RECREATIONAL AREAS
 - 0.8 MAIN HIGHWAYS
 - 0.5 TOWN CENTER

$$(D) \times (GL) \times (ST) \times (HR/4) \times (LF) = \text{SIZE OF GREASE TRAP INTERCEPTOR, GALLONS*}$$

2 NURSING HOMES, OTHER TYPE COMMERCIAL KITCHENS WITH VARIED SEATING CAPACITY

WHERE:

- M = MEALS PER DAY
- GL = GALLONS OF WASTEWATER PER MEAL, NORMALLY 1.0
- ST = STORAGE CAPACITY FACTOR – MINIMUM OF 1.2
- LF = LOADING FACTOR
 - 1.25 GARBAGE DISPOSAL AND DISHWASHING
 - 1.00 WITHOUT GARBAGE DISPOSAL
 - 0.75 WITHOUT DISHWASHING
 - 0.50 WITH DISHWASHING AND GARBAGE DISPOSAL

$$(M) \times (GL) \times (ST) \times (2.5) \times (LF) = \text{SIZE OF GREASE INTERCEPTOR, GALLONS*}$$

THUS FOR A RESTAURANT WITH A 75 SEAT DINING AREA, AN 8 HOUR PER DAY OPERATION, A TYPICAL DISCHARGE OF 4 GALLONS PER MEAL, A STORAGE CAPACITY FACTOR OF 1.2 AND A LOADING FACTOR OF 0.8, THE SIZE OF THE GREASE TRAP INTERCEPTOR IS CALCULATED AS FOLLOWS:

$$(75) \times (4) \times (12) \times (8/4) \times (0.8) = 960 \text{ GALLONS}$$

OTHER DESIGN CONSIDERATIONS INCLUDE: FACILITIES FOR INSURING THAT BOTH THE INLET AND OUTLET ARE PROPERLY BAFFLED; EASY MANHOLE ACCESS FOR CLEANING; AND INACCESSIBILITY OF THE TRAP TO INSECTS AND VERMIN,

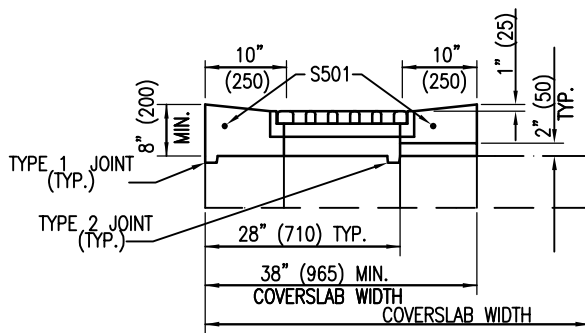
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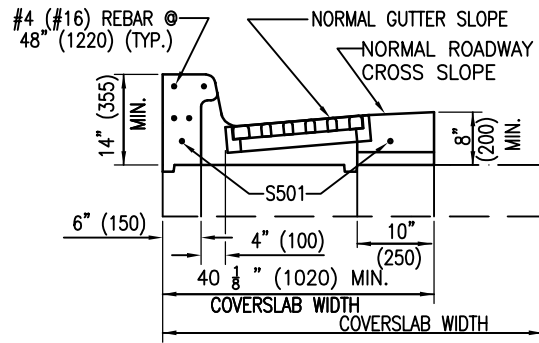
GENERAL STANDARD DETAILS

DRAWING TITLE: GREASE TRAP
DRAWING NO: S-310a
APPROVED BY: E. VICKERS

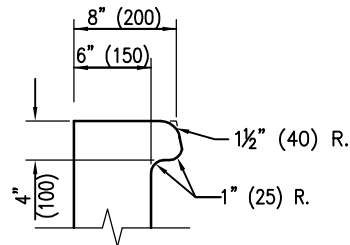
SCALE: NOT TO SCALE
DATE: OCT 2007



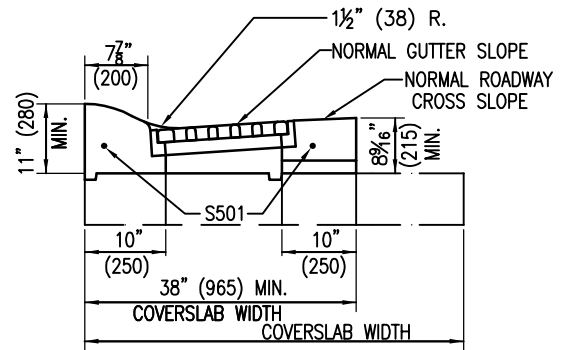
TYPE A



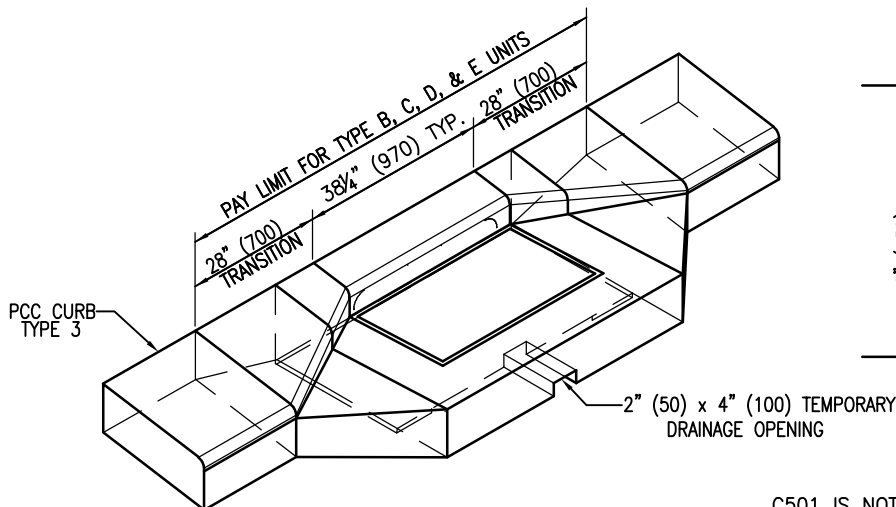
TYPE B



CURB OPENING DETAIL

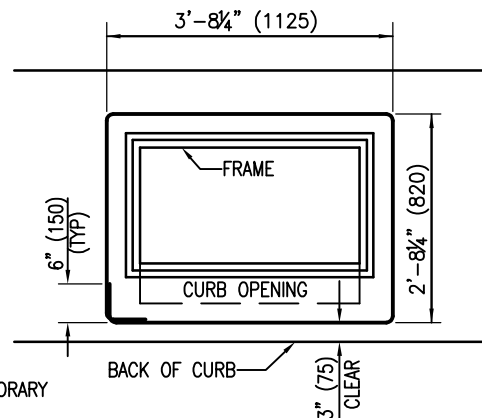


TYPE D



ISOMETRIC VIEW

TYPE E UNIT SHOWN



C501 BENDING DIAGRAM

C501 IS NOT REQUIRED TO BE ONE CONTINUOUS BAR. IF MORE THAN ONE BAR IS USED, THERE MUST BE A 12" (300) OVERLAP BETWEEN BARS.

DRAINAGE INLET TOP UNITS

NOTE: TOP UNIT IS TO BE CAST IN PLACE TO GRADE AS SPECIFIED ON PLAN SHEETS OR AS DIRECTED BY ENGINEER.

INLET TOP UNIT APPLICATIONS	
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

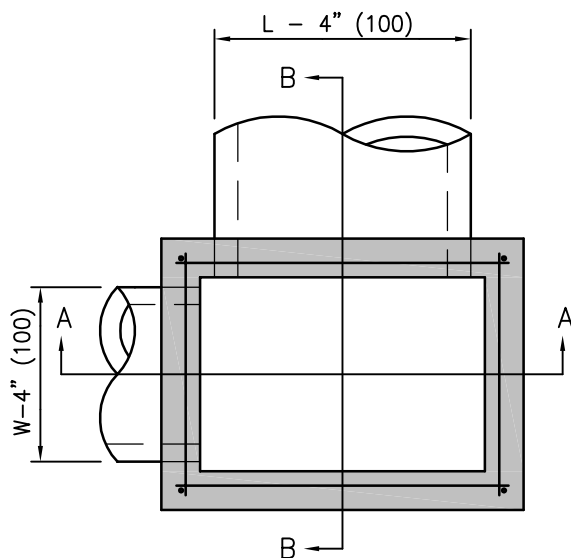
GENERAL STANDARD DETAILS

DRAWING TITLE: CATCH BASIN
 DRAWING NO: S-311
 APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE
 DATE: OCT 2007

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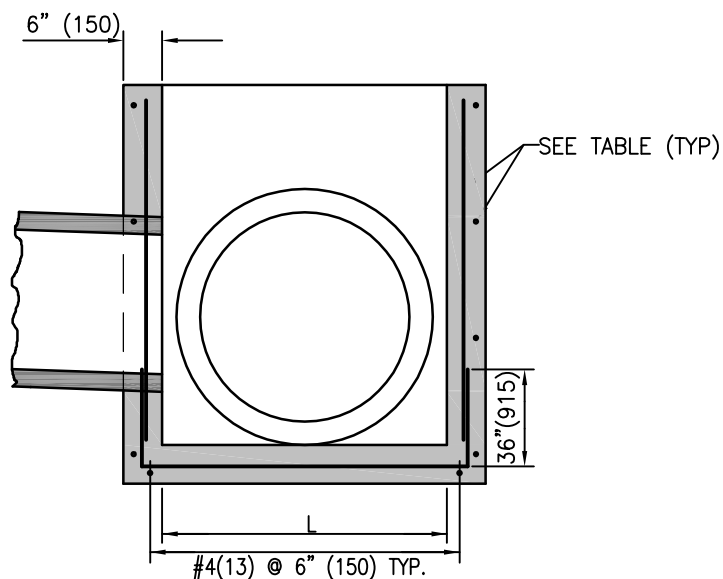




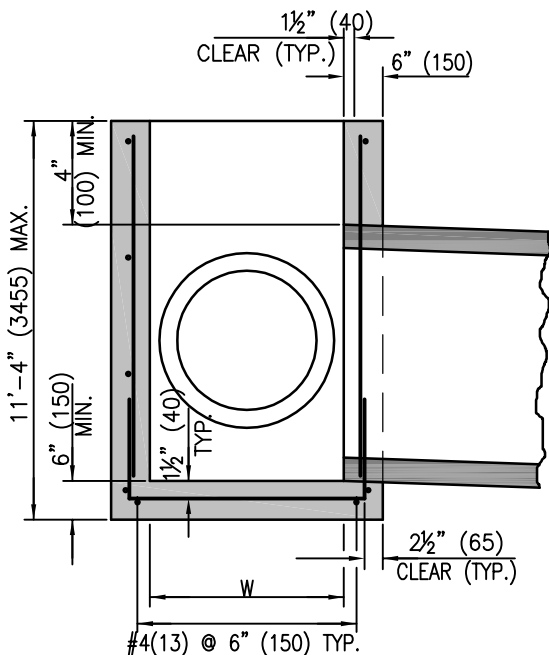
TOP VIEW

INLET BOX SCHEDULE			
L	W	L MAX	W MAX
34" (865)	18" (455)	34" (865)	18" (455)
34" (865)	24" (610)	34" (865)	24" (610)
48" (1220)	30" (760)	54" (1370)	36" (915)
48" (1220)	48" (1220)	54" (1370)	54" (1370)
66" (1675)	30" (760)	72" (1830)	36" (915)
66" (1675)	48" (1220)	72" (1830)	54" (1370)
66" (1675)	66" (1675)	72" (1830)	72" (1830)
72" (1830)	24" (610)	72" (1830)	30" (760)
72" (1830)	48" (1220)	72" (1830)	54" (1370)
72" (1830)	72" (1830)	72" (1830)	72" (1830)

WALL REINFORCEMENT SCHEDULE		
INTERIOR WALL	AREA OF HORIZONTAL REINFORCEMENT PER FOOT (mm ²)	AREA OF VERTICAL REINFORCEMENT PER FOOT (mm ²)
	IN ² (mm ²)	IN ² (mm ²)
LESS THAN 4' (1220)	0.132 (85)	0.132 (85)
4' (1220) TO 4.5' (1370)	0.163 (105)	0.132 (85)
4.5' (1370) TO 5' (1525)	0.198 (128)	0.132 (85)
5' (1525) TO 5.5' (1675)	0.239 (154)	0.132 (85)
5.5' (1675) TO 6' (1830)	0.284 (183)	0.132 (85)



SECTION A-A



SECTION B-B

- NOTES: 1. INLET BOXES ARE TO BE PRE-CAST OR CAST-IN-PLACE.
2. OUTSIDE OF PIPE MUST FIT INTO THE INTERIOR OF THE BOX.

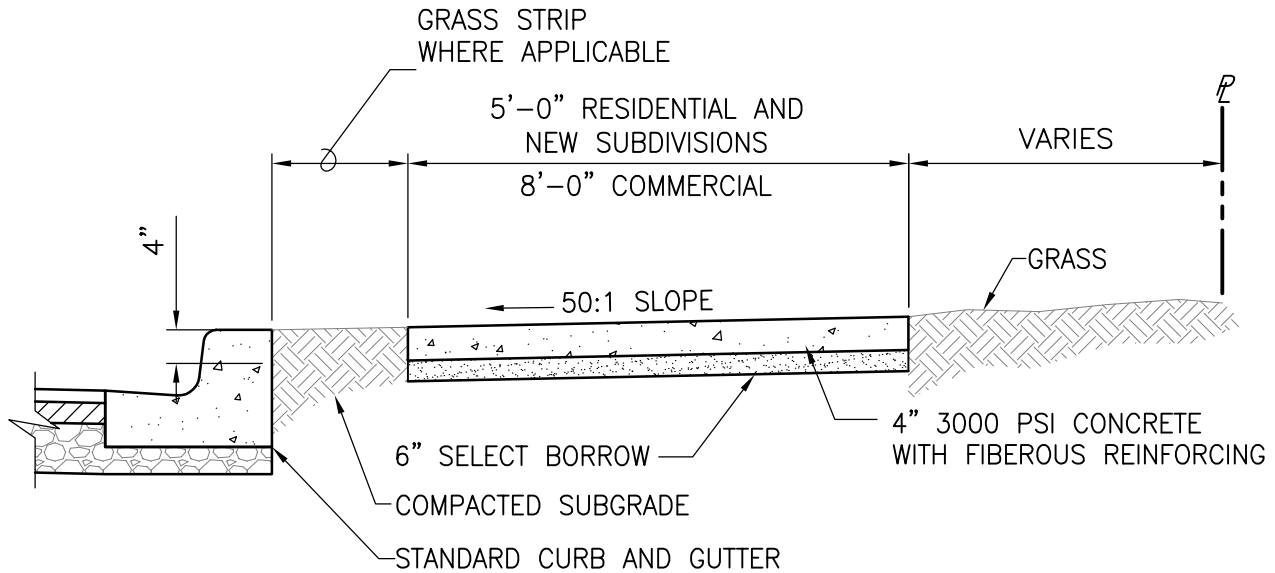
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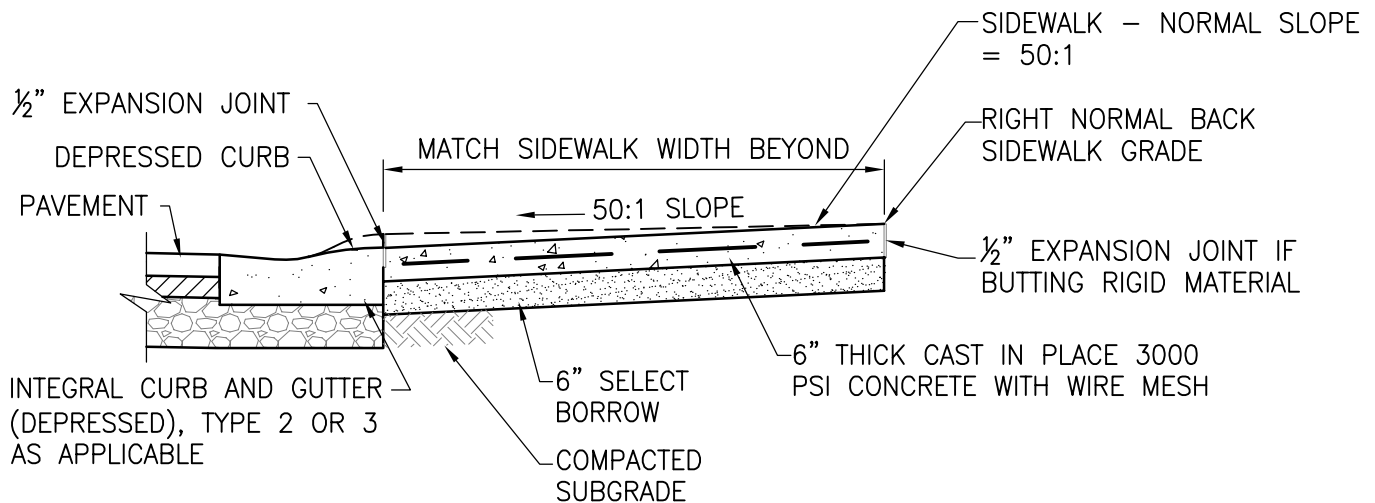
DRAWING TITLE: INLET BOX
DRAWING NO: S-312
APPROVED BY: E. VICKERS

GENERAL STANDARD DETAILS

SCALE: NOT TO SCALE
DATE: OCT 2007



TYPICAL SIDEWALK INSTALLATION



TYPICAL SIDEWALK AT DRIVEWAY ENTRANCE

NOTES:

1. CONSTRUCT 1/2" EXPANSION JOINT WHERE CONCRETE ABUTS RIGID PAVEMENT, CURB AND/OR WALL.
2. TOPSOIL, SEED AND MULCH ALL DISTURBED AREAS. REGRADE AS REQUIRED TO MEET BACK OF CURB ELEVATION.
3. ALL SIDEWALKS AND RAMPS SHALL MEET THE LATEST ADA REQUIREMENTS.

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GENERAL STANDARD DETAILS

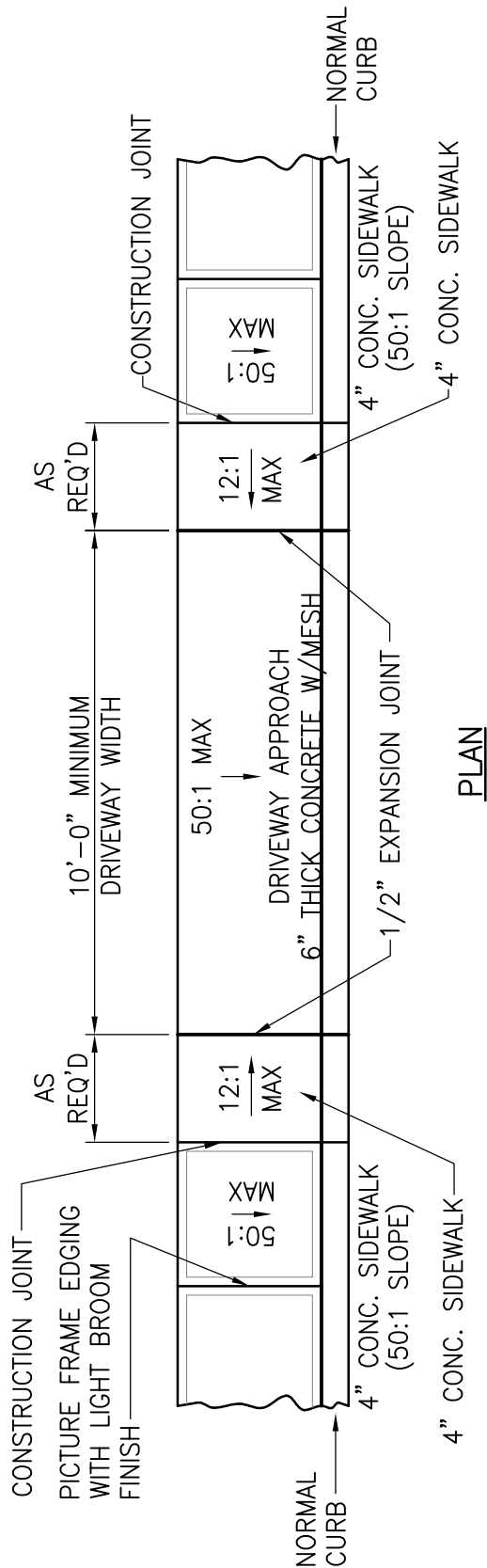
DRAWING TITLE: TYPICAL SIDEWALK

DRAWING NO: SW-400

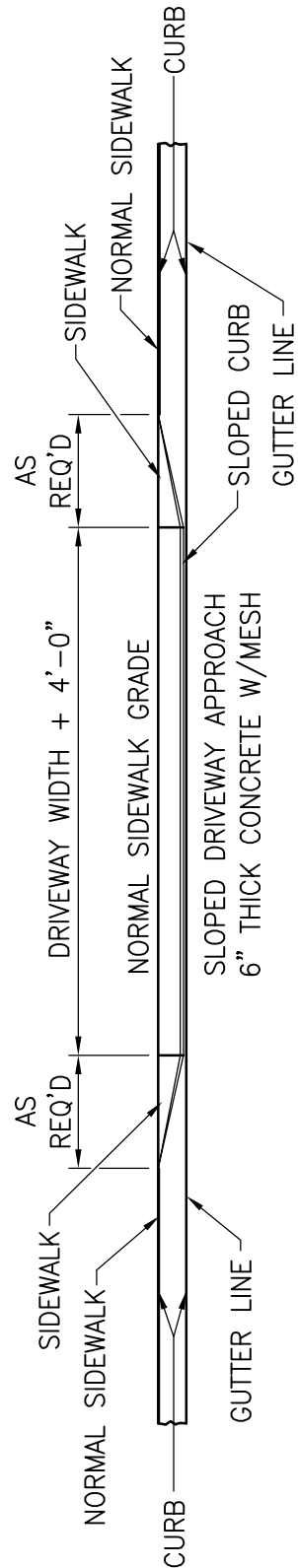
APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE

DATE: OCT 2007



PLAN



FRONT VIEW

NOTE:
ALL SIDEWALK AND DRIVEWAY ENTRANCES SHALL MEET A.D.A. REQUIREMENTS.

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GENERAL STANDARD DETAILS

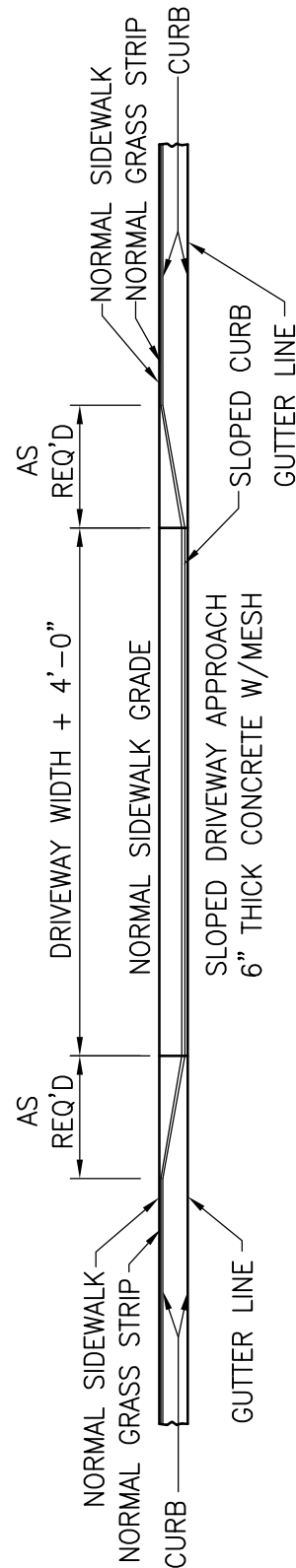
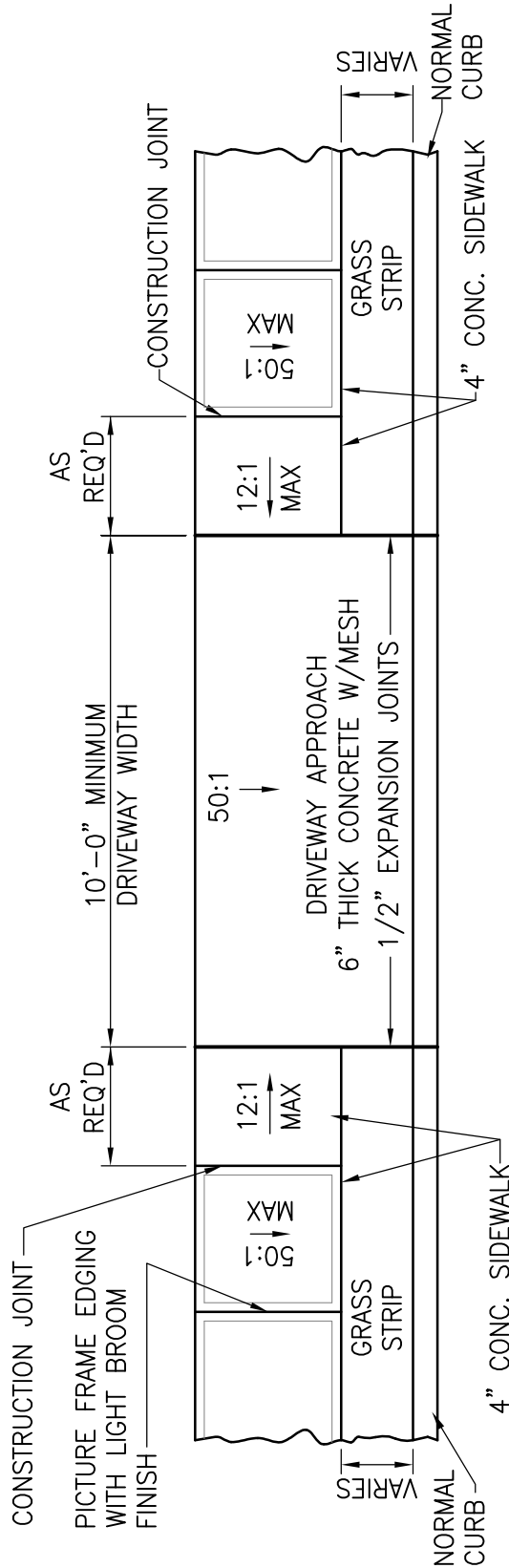
DRAWING TITLE: TYPICAL DRIVEWAY ENTRANCES

DRAWING NO: SW-401

APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE

DATE: OCT 2007



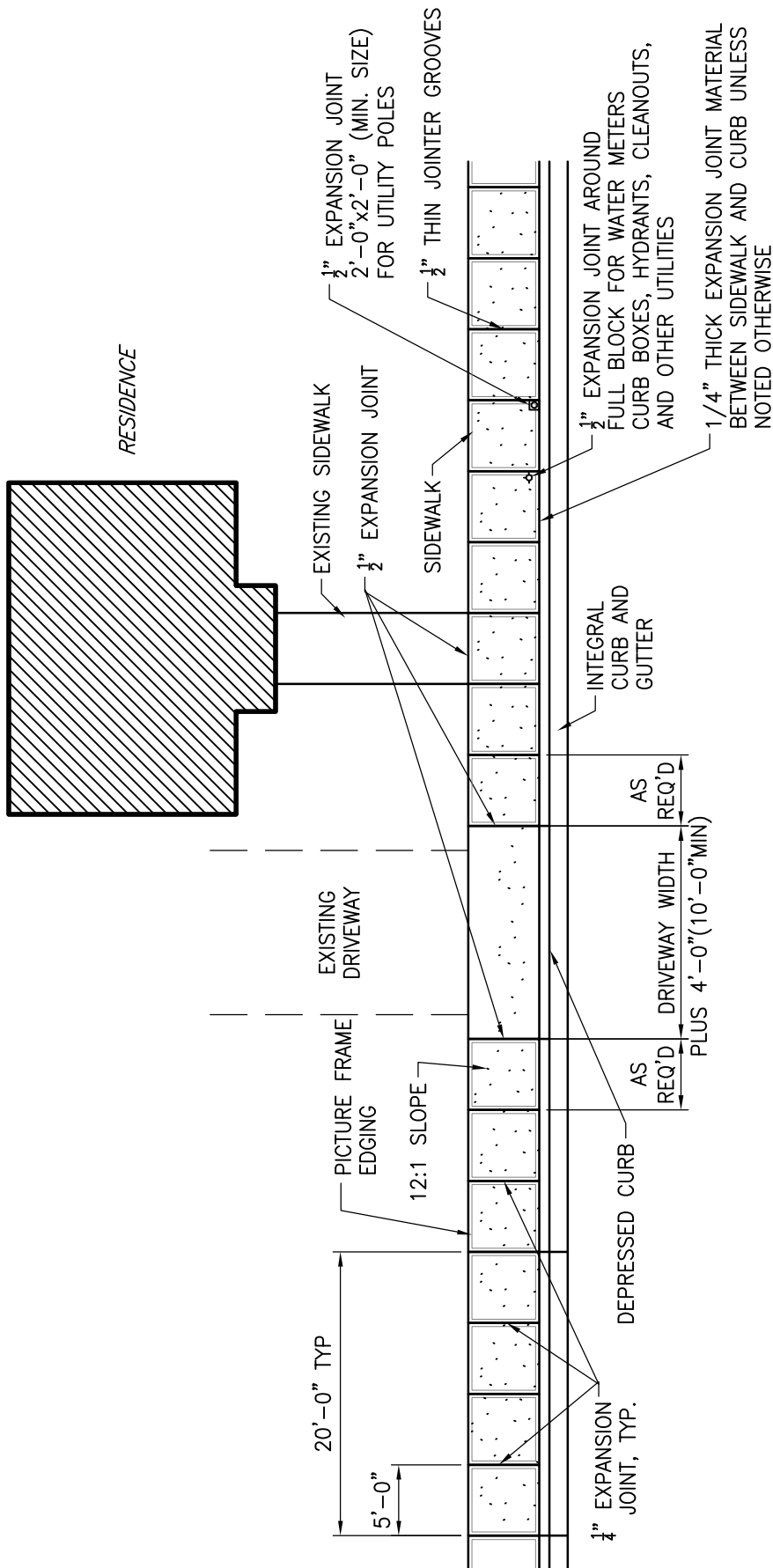
NOTE:
ALL SIDEWALK AND DRIVEWAY ENTRANCES SHALL MEET A.D.A. REQUIREMENTS.

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GENERAL STANDARD DETAILS

DRAWING TITLE: TYPICAL DRIVEWAY ENTRANCES WITH GRASS STRIP
DRAWING NO: SW-402
APPROVED BY: E. VICKERS
SCALE: NOT TO SCALE
DATE: OCT 2007



NOTE:

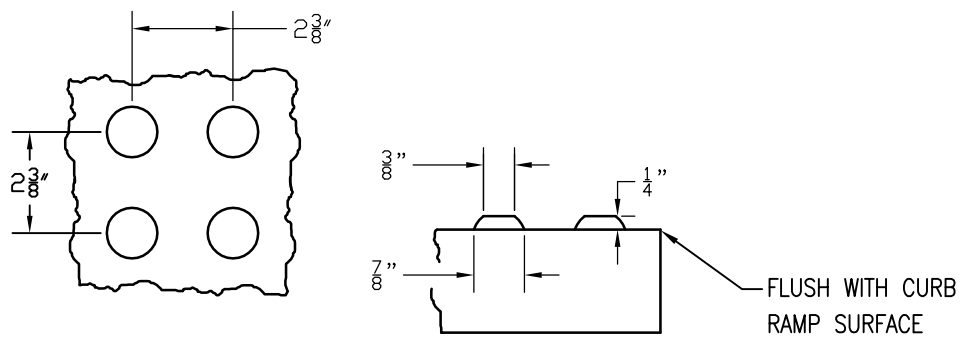
1. PLACE 1/4" THICK EXPANSION JOINT MATERIAL WHERE ALL NEW CONCRETE MEETS A RIGID SURFACE.

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GENERAL STANDARD DETAILS

DRAWING TITLE: TYPICAL CURB, GUTTER AND SIDEWALK EXPANSION JOINT
DRAWING NO: SW-403
APPROVED BY: E. VICKERS
SCALE: NOT TO SCALE
DATE: OCT 2007



NOTES:

- 1) THE AREA OF DETECTABLE WARNING TRUNCATED DOMES SHALL BE 24" LONG AND THE FULL WIDTH OF THE RAMP. REFER TO ADA REQUIREMENTS.

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GENERAL STANDARD DETAILS

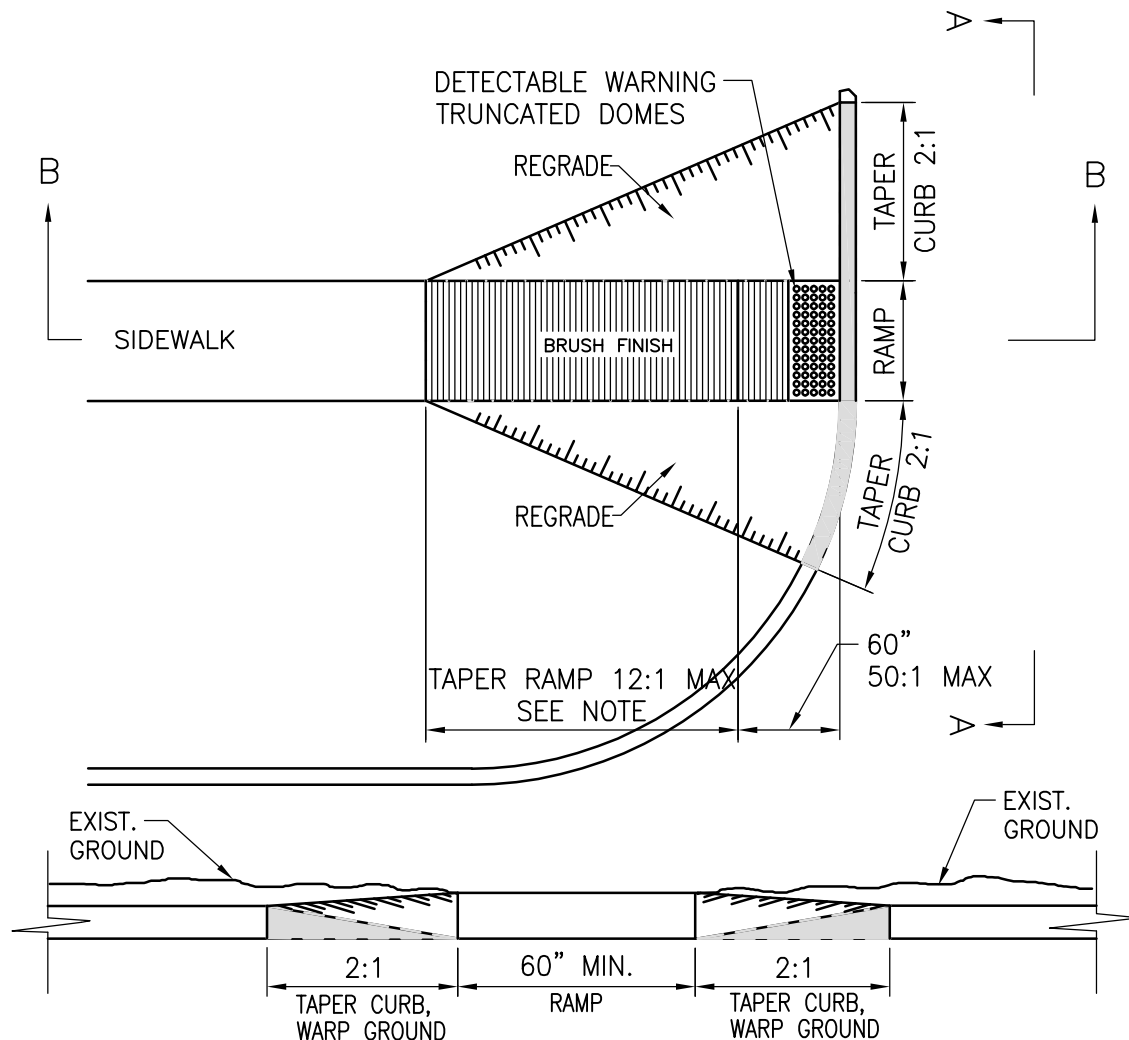
DRAWING TITLE: DETECTABLE WARNING TRUNCATED DOMES

DRAWING NO: SW-404

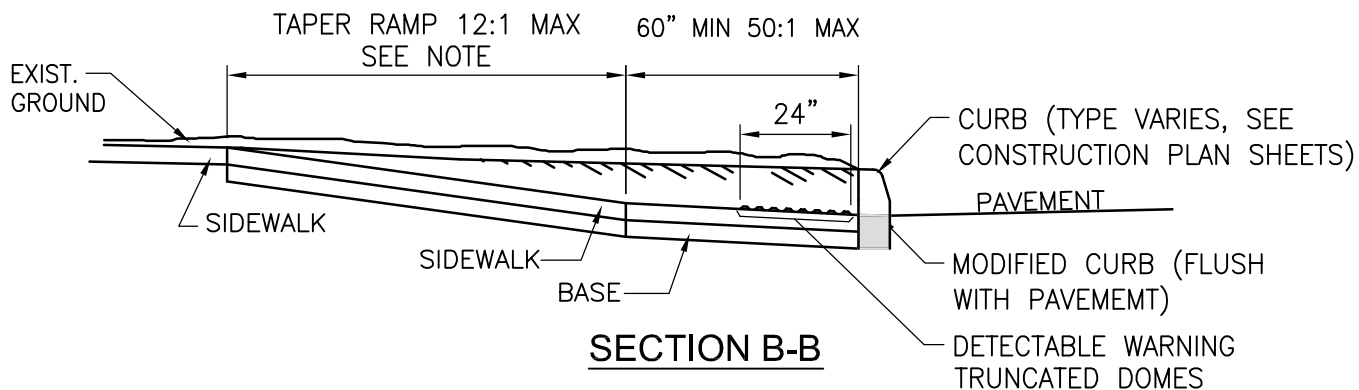
APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE

DATE: OCT 2007



ELEVATION A-A



SECTION B-B

NOTE : 1 WHERE A 12:1 MAXIMUM SLOPE RAMP WILL NOT MEET THE SIDEWALK GRADE WITHIN A LENGTH OF 15' DUE TO STEEP ADJACENT ROADWAY, THE RAMP LENGTH MAY BE LIMITED TO 15', AND THE RAMP SLOPE ALLOWED TO EXCEED 12:1.

2 MEET ADA REQUIREMENTS.

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GENERAL STANDARD DETAILS

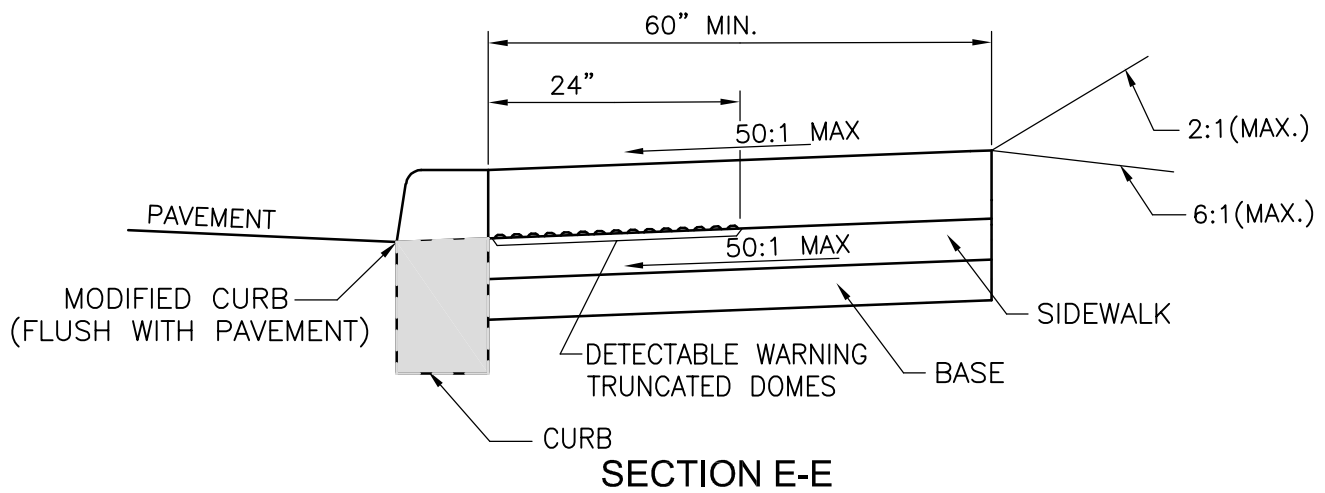
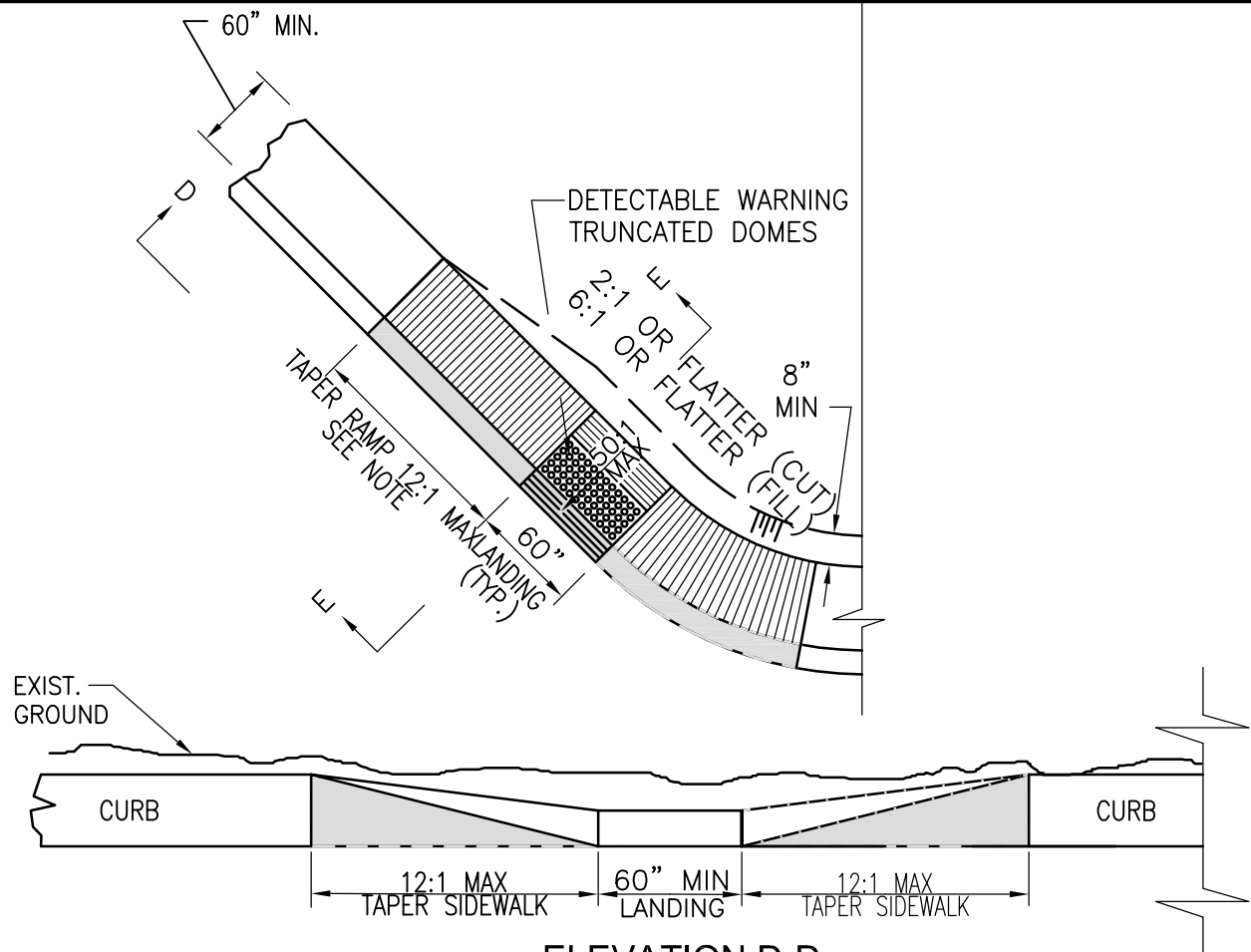
DRAWING TITLE: TYPE 1 CURB RAMP

DRAWING NO: SW-405

APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE

DATE: OCT 2007



- NOTE : 1 WHERE A 12:1 MAXIMUM SLOPE RAMP WILL NOT MEET THE SIDEWALK GRADE WITHIN A LENGTH OF 15' DUE TO STEEP ADJACENT ROADWAY, THE RAMP LENGTH MAY BE LIMITED TO 15', AND THE RAMP SLOPE ALLOWED TO EXCEED 12:1.
- 2 MEET ADA REQUIREMENTS.

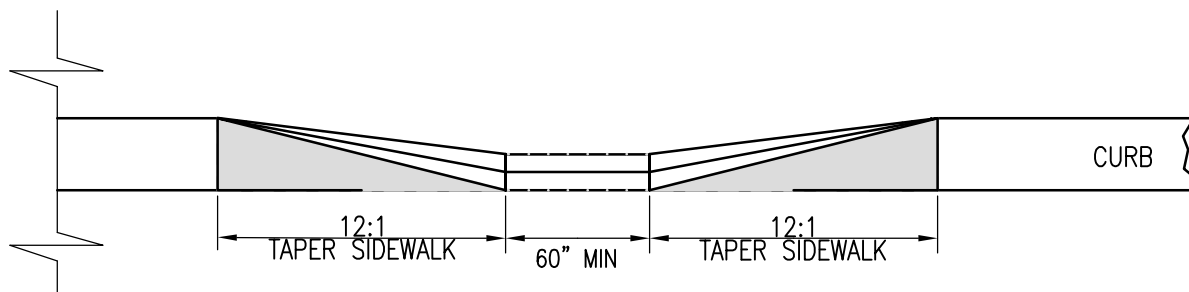
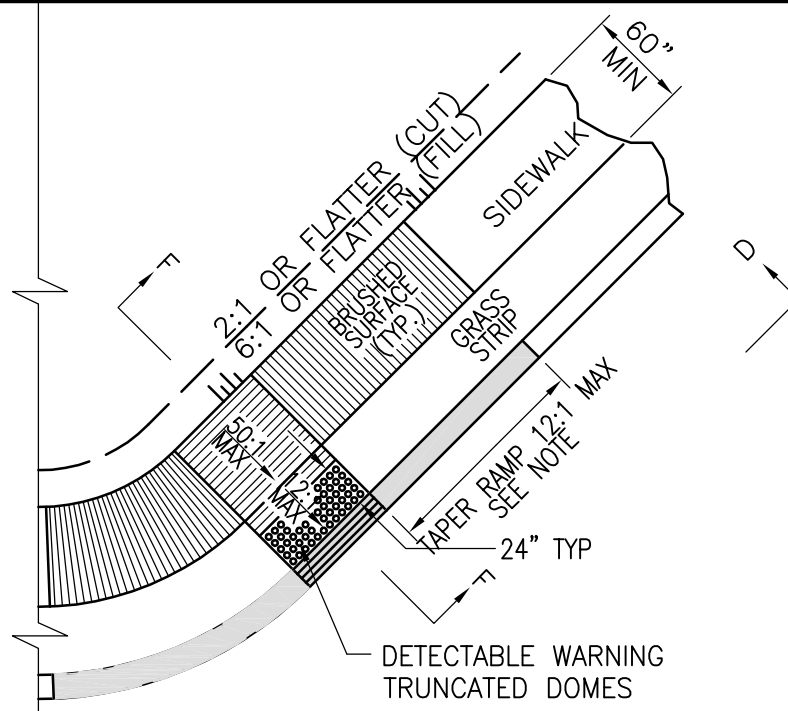
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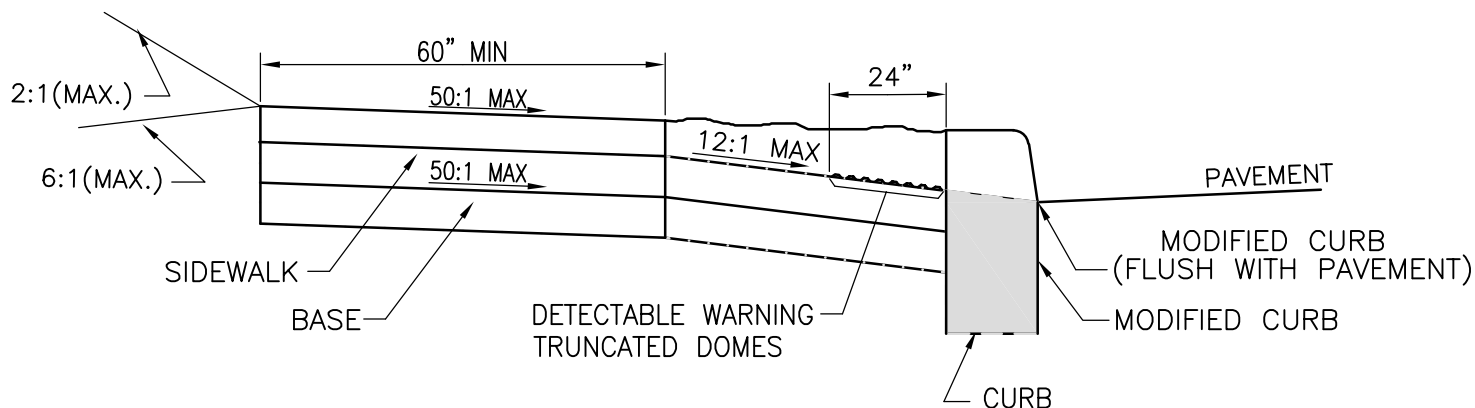
GENERAL STANDARD DETAILS

DRAWING TITLE: TYPE 2 CURB RAMP
DRAWING NO: SW-406
APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE
DATE: OCT 2007



ELEVATION D-D



SECTION F-F

NOTE : 1 WHERE A 12:1 MAXIMUM SLOPE RAMP WILL NOT MEET THE SIDEWALK GRADE WITHIN A LENGTH OF 15' DUE TO STEEP ADJACENT ROADWAY, THE RAMP LENGTH MAY BE LIMITED TO 15', AND THE RAMP SLOPE ALLOWED TO EXCEED 12:1.

2 MEET ADA REQUIREMENTS.

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GENERAL STANDARD DETAILS

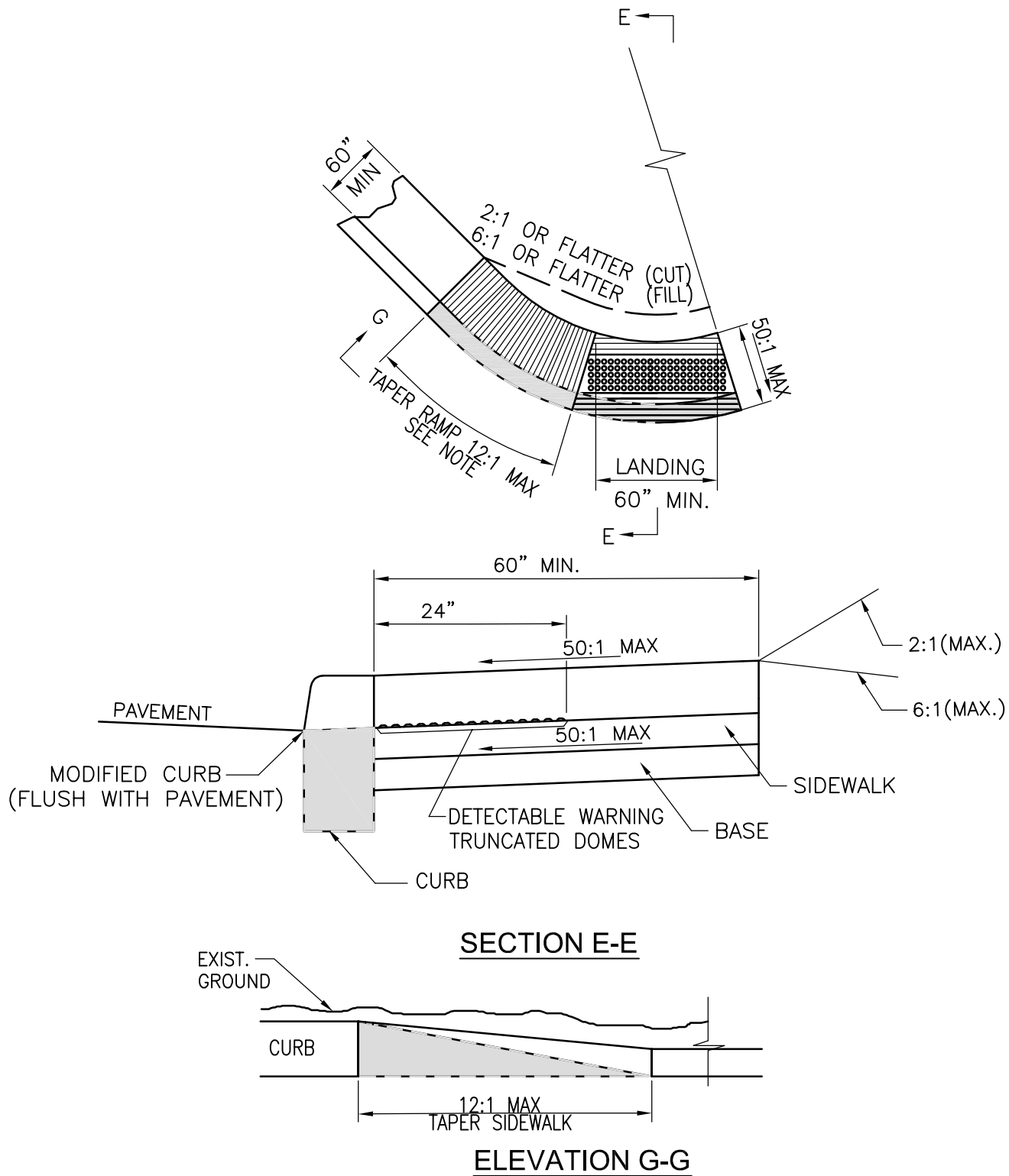
DRAWING TITLE: TYPE 2 CURB RAMP WITH GRASS STRIP

DRAWING NO: SW-407

APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE

DATE: OCT 2007



NOTE : 1 WHERE A 12:1 MAXIMUM SLOPE RAMP WILL NOT MEET THE SIDEWALK GRADE WITHIN A LENGTH OF 15' DUE TO STEEP ADJACENT ROADWAY, THE RAMP LENGTH MAY BE LIMITED TO 15', AND THE RAMP SLOPE ALLOWED TO EXCEED 12:1.

2 MEET ADA REQUIREMENTS.

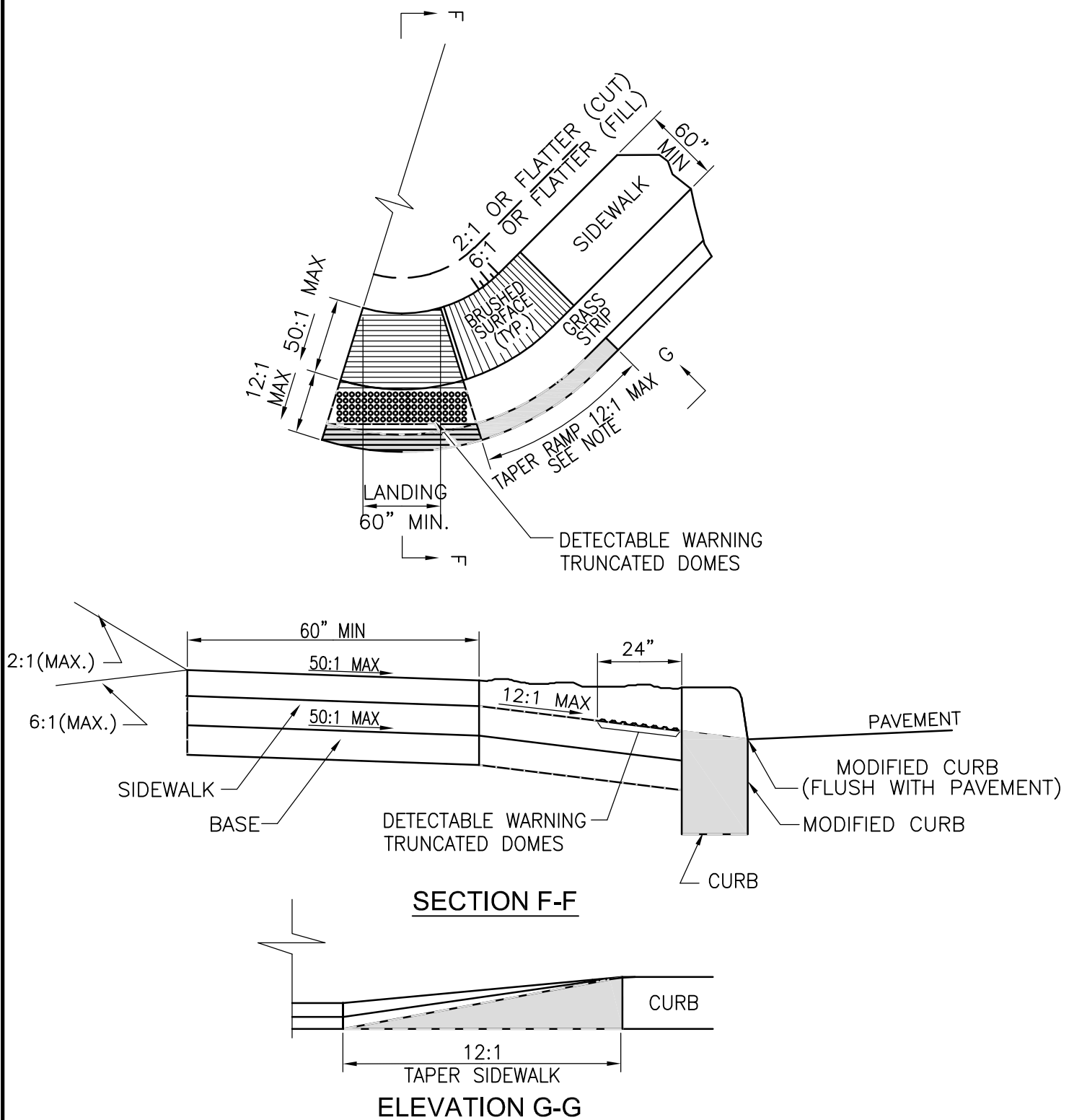
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GENERAL STANDARD DETAILS

DRAWING TITLE: TYPE 3 CURB RAMP
DRAWING NO: SW-408
APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE
DATE: OCT 2007



NOTE : 1 WHERE A 12:1 MAXIMUM SLOPE RAMP WILL NOT MEET THE SIDEWALK GRADE WITHIN A LENGTH OF 15' DUE TO STEEP ADJACENT ROADWAY, THE RAMP LENGTH MAY BE LIMITED TO 15', AND THE RAMP SLOPE ALLOWED TO EXCEED 12:1.

2 MEET ADA REQUIREMENTS.

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GENERAL STANDARD DETAILS

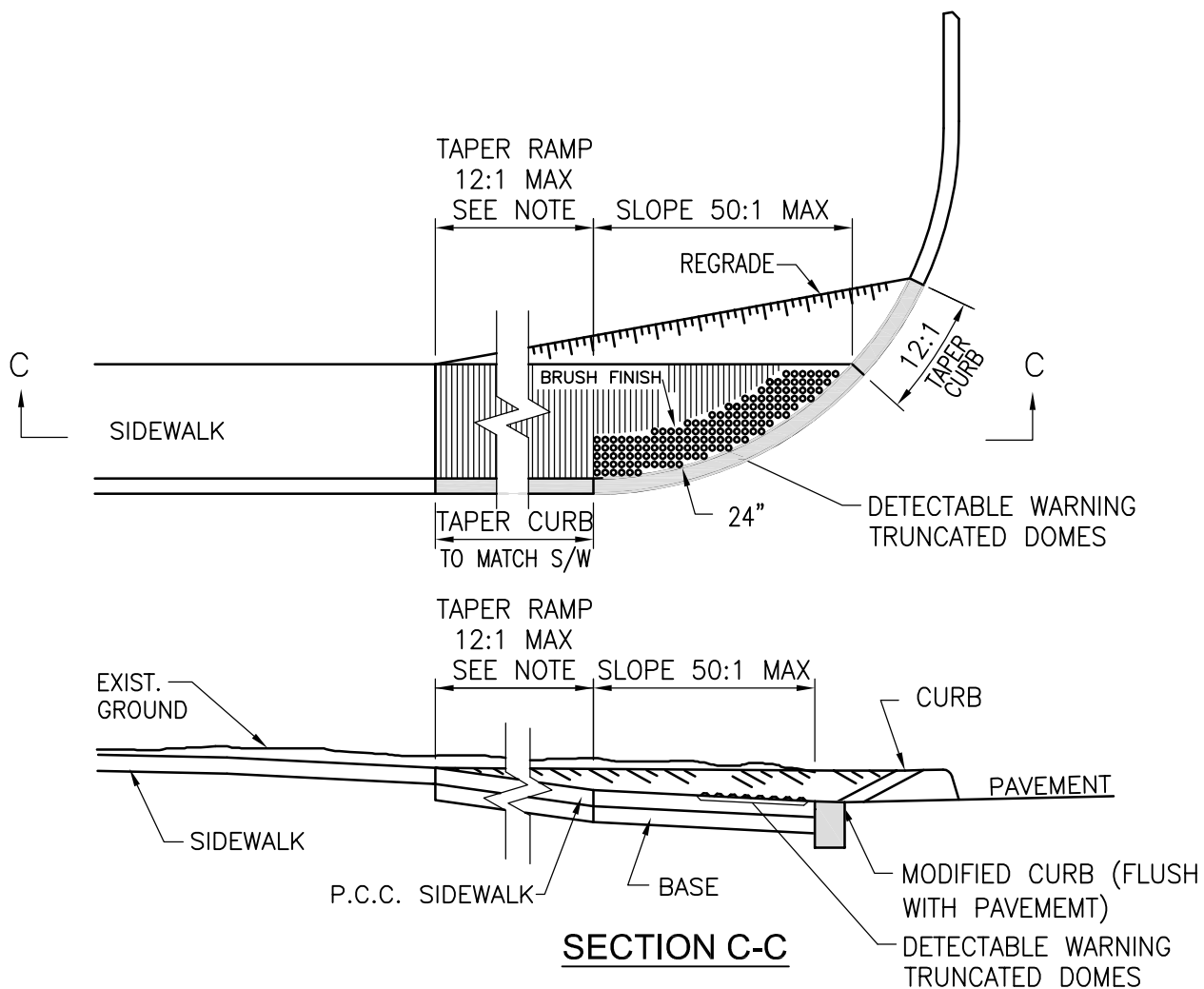
DRAWING TITLE: TYPE 3 CURB RAMP WITH GRASS STRIP

DRAWING NO: SW-409

APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE

DATE: OCT 2007



NOTE : 1 WHERE A 12:1 MAXIMUM SLOPE RAMP WILL NOT MEET THE SIDEWALK GRADE WITHIN A LENGTH OF 15' DUE TO STEEP ADJACENT ROADWAY, THE RAMP LENGTH MAY BE LIMITED TO 15', AND THE RAMP SLOPE ALLOWED TO EXCEED 12:1.

2 MEET ADA REQUIREMENTS.

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GENERAL STANDARD DETAILS

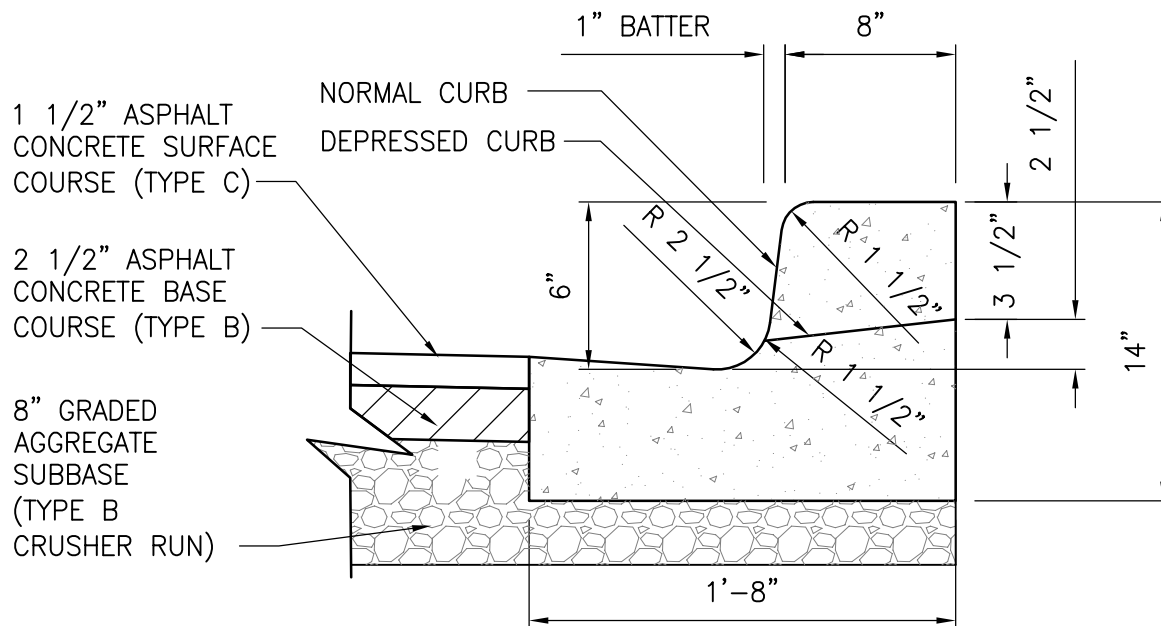
DRAWING TITLE: TYPE 1 CURB RAMP AT CORNER

DRAWING NO: SW-410

APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE

DATE: OCT 2007

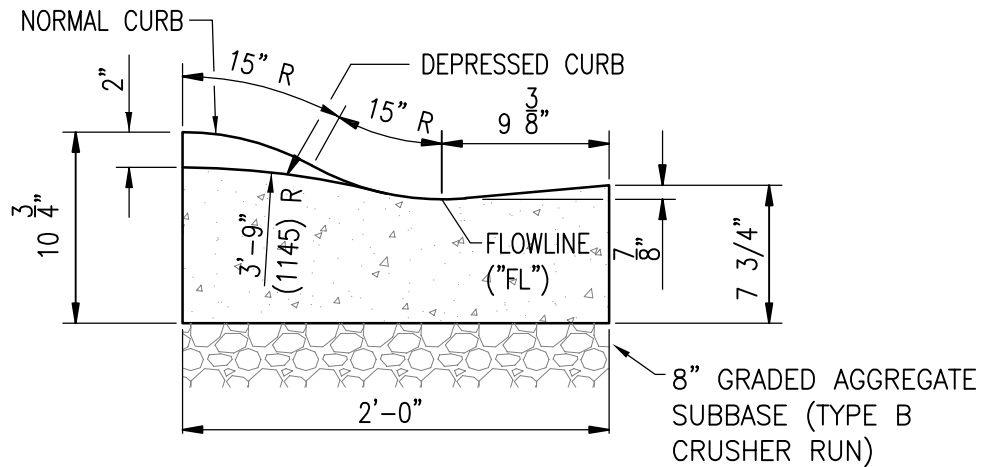


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GENERAL STANDARD DETAILS

DRAWING TITLE: TYPE 3 MODIFIED INTEGRAL P.C.C CURB AND GUTTER
 DRAWING NO: SW-411
 APPROVED BY: E. VICKERS
 SCALE: NOT TO SCALE
 DATE: OCT 2007



- NOTES: 1 WHEN P.C.C. CURB OR INTEGRAL P.C.C. CURB AND GUTTER IS PLACED ADJACENT TO PORTLAND CEMENT CONCRETE PAVEMENT, USE APPROVED EXPANSION JOINT. TO BE PAID UNDER RESPECTIVE CURB AND GUTTER ITEM.
- 2 DEPRESS CURB AT DRIVEWAYS AS DETAILED.
- 3 DEPRESS CURB AT HANDICAP RAMPS.

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GENERAL STANDARD DETAILS

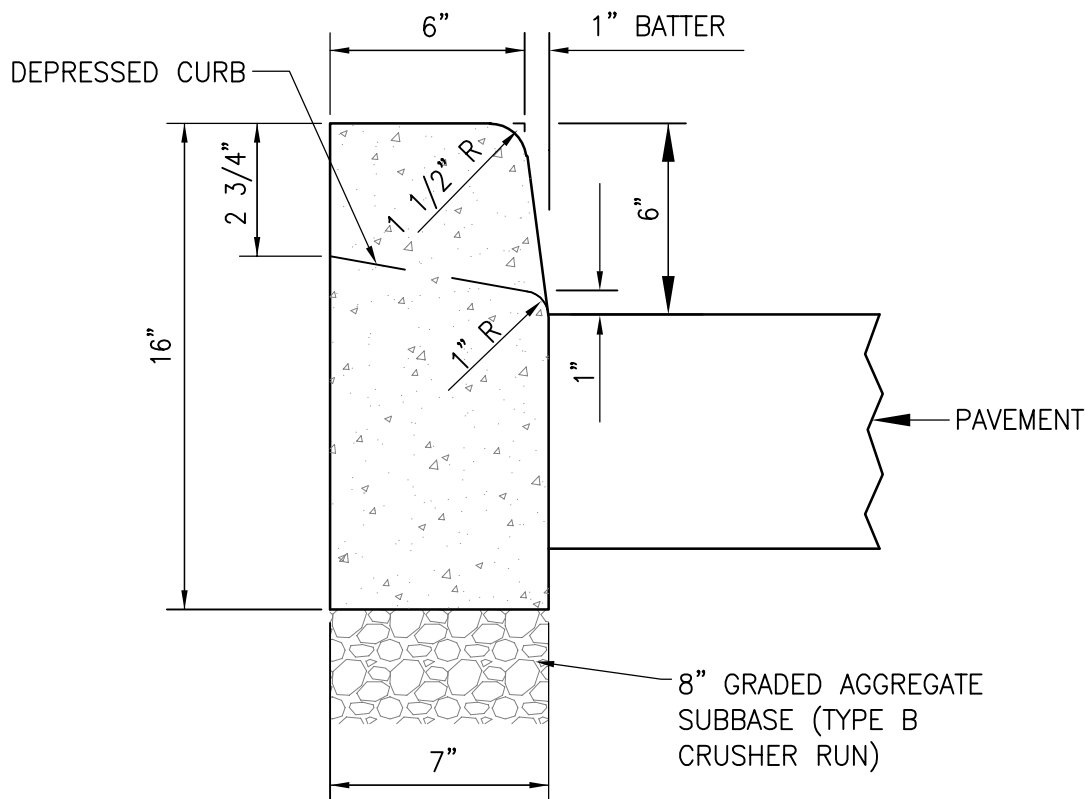
DRAWING TITLE: TYPE 2 INTEGRAL P.C.C. CURB AND GUTTER

DRAWING NO: SW-412

APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE

DATE: OCT 2007



- NOTES: 1 DEPRESS CURB AT DRIVEWAYS AS DETAILED.
- 2 DEPRESS CURB AT HANDICAP RAMPS.
- 3 FOR USE WITH PRE-EXISTING CONDITIONS ONLY.

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GENERAL STANDARD DETAILS

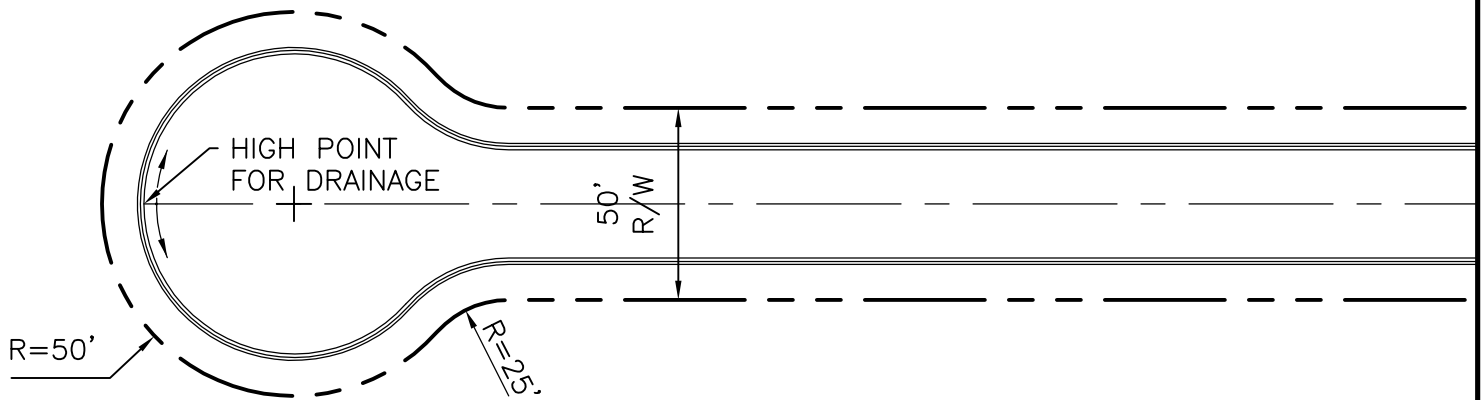
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DRAWING NO: SW-413

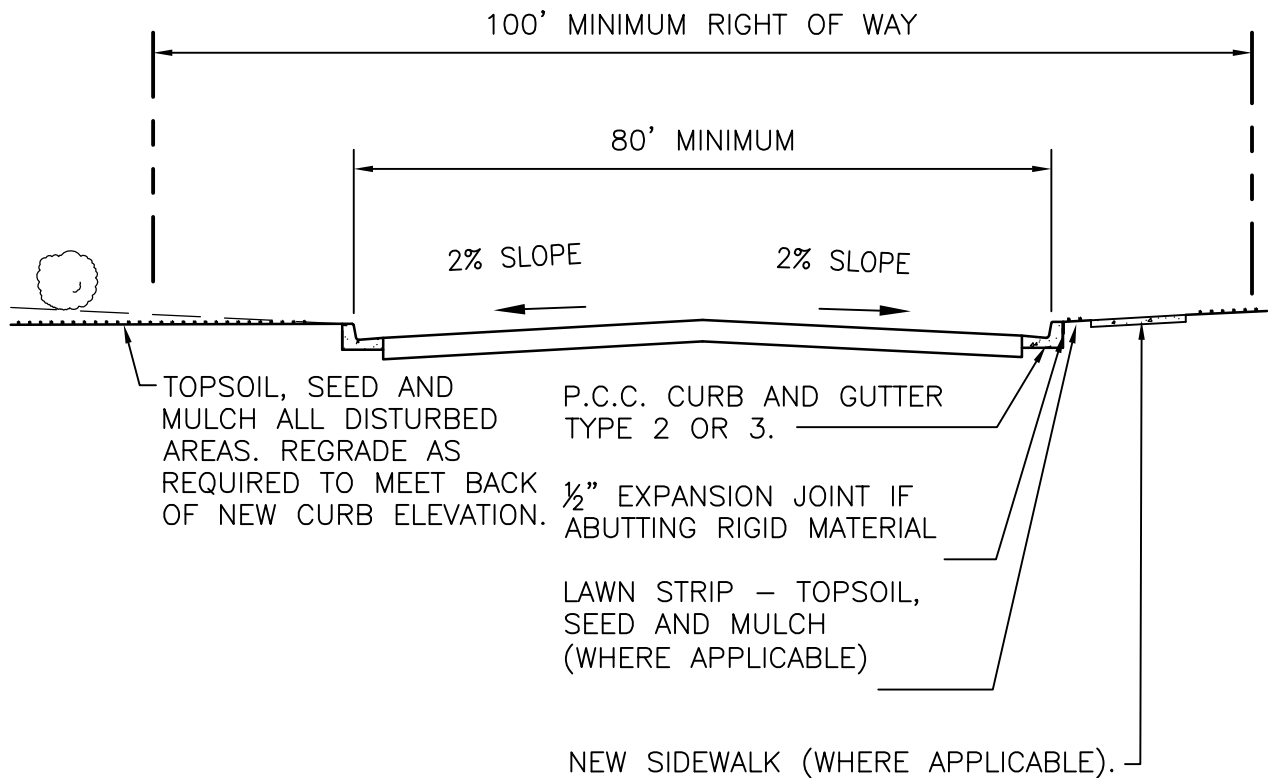
APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE

DATE: OCT 2007



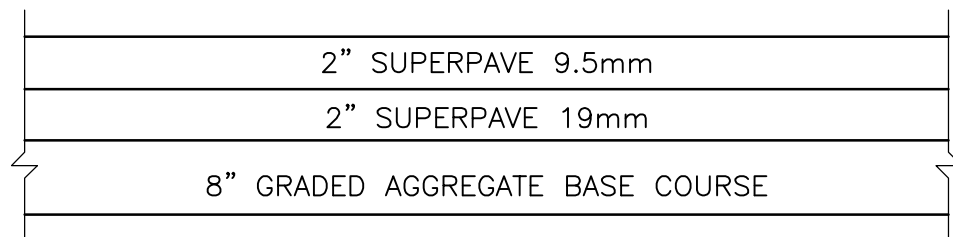
PLAN



NOTE:

MAXIMUM LENGTH: 600 FEET.

RIGHT OF WAY SECTION



PAVING SECTION

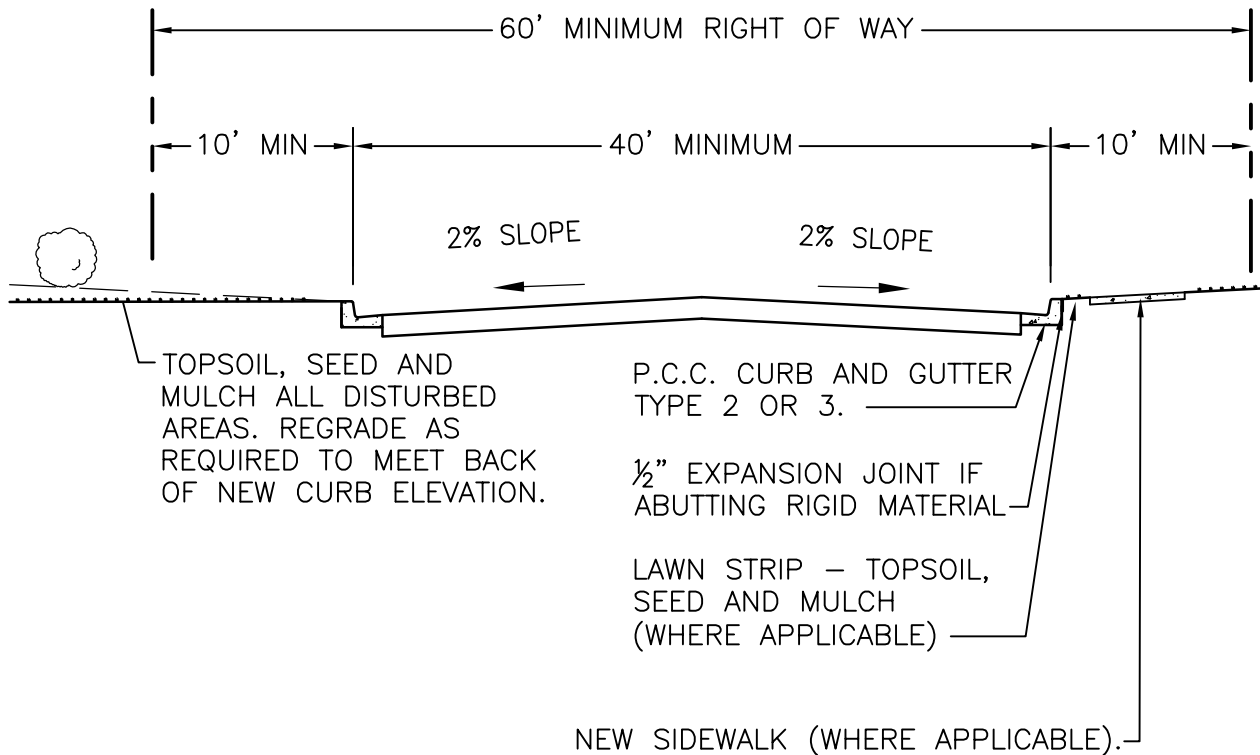
GENERAL STANDARD DETAILS

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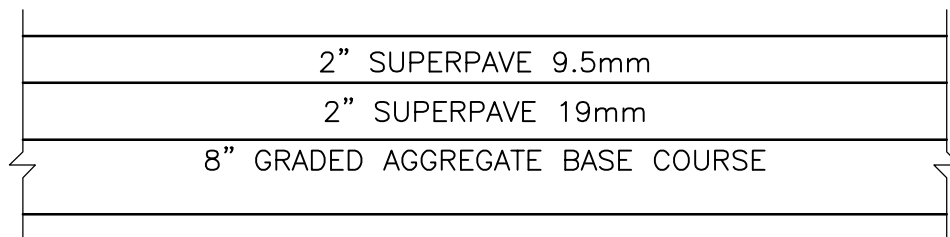


DRAWING TITLE: CUL-DE-SAC
DRAWING NO: R-500
APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE
DATE: OCT 2007



RIGHT OF WAY SECTION



PAVING SECTION

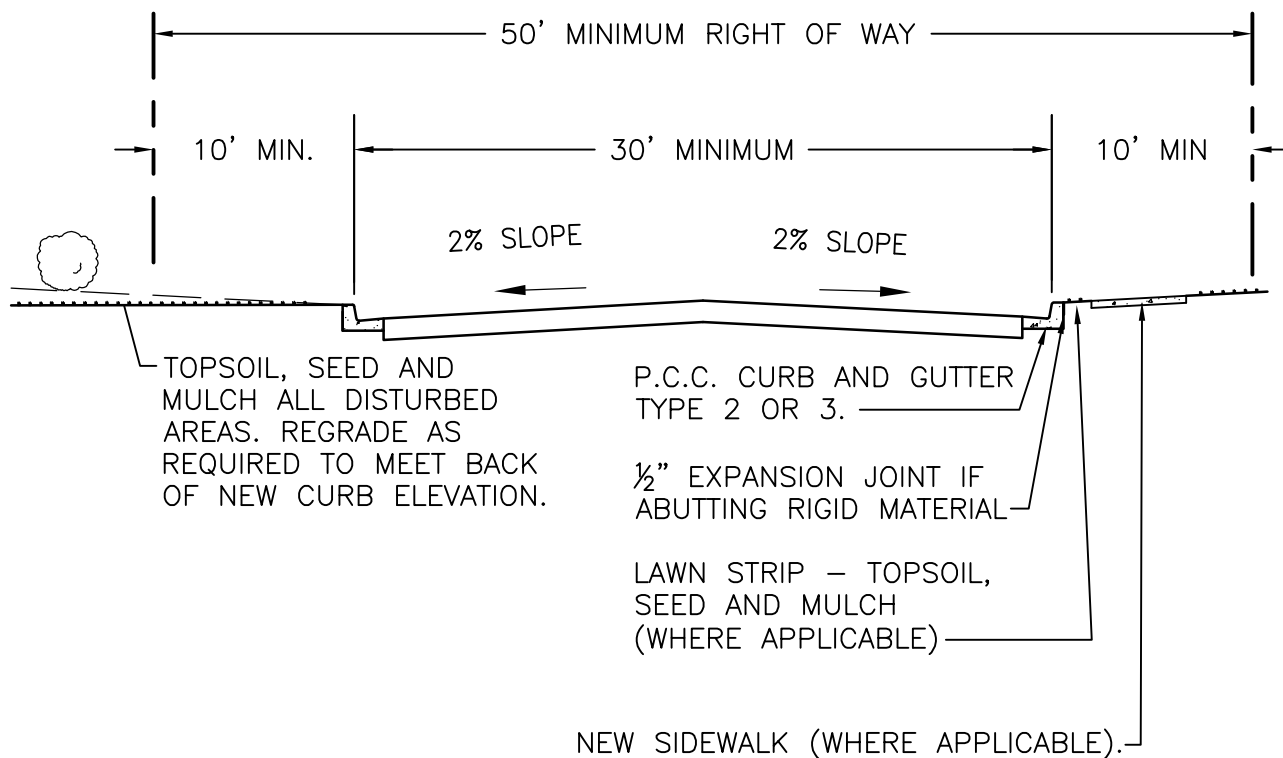
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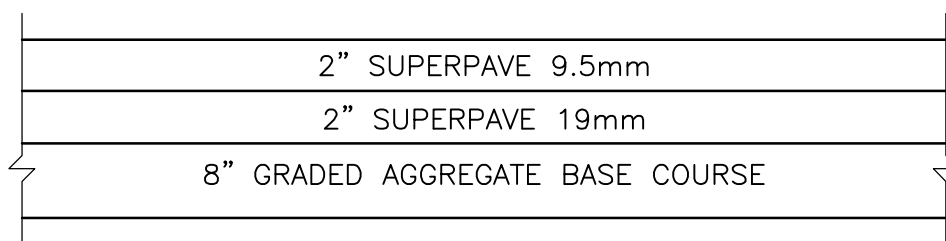
GENERAL STANDARD DETAILS

DRAWING TITLE: COLLECTOR STREET - COMMERCIAL AND RESIDENTIAL AREAS
DRAWING NO: R-501
APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE
DATE: OCT 2007



RIGHT OF WAY SECTION



PAVING SECTION

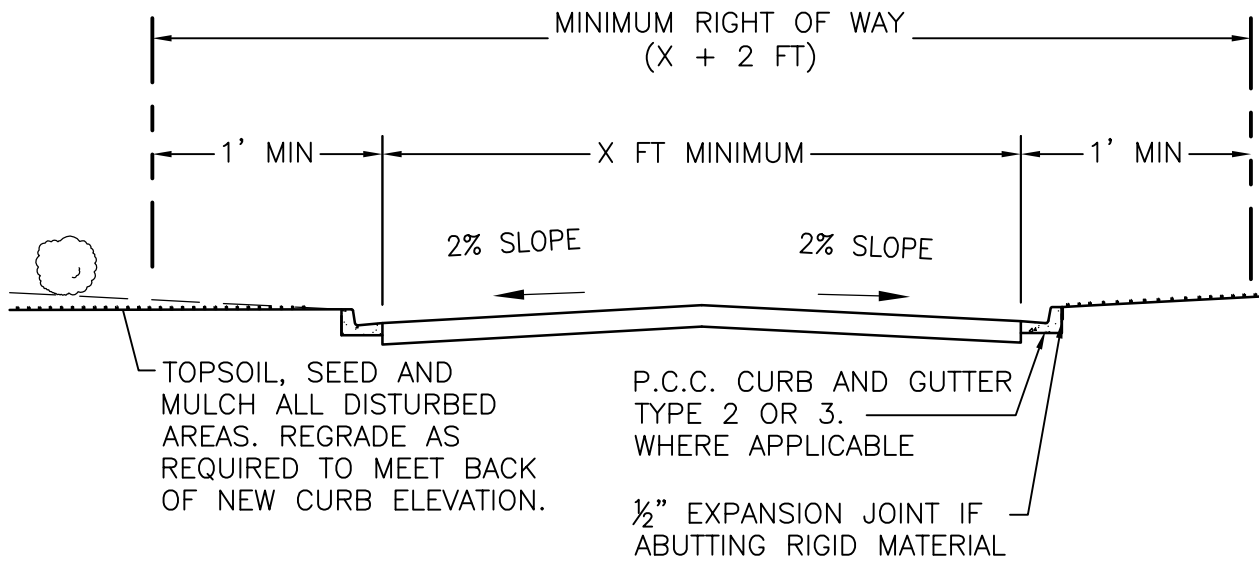
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GENERAL STANDARD DETAILS

DRAWING TITLE: MINOR STREETS - SINGLE FAMILY RESIDENTIAL AREAS
DRAWING NO: R-502
APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE
DATE: OCT 2007

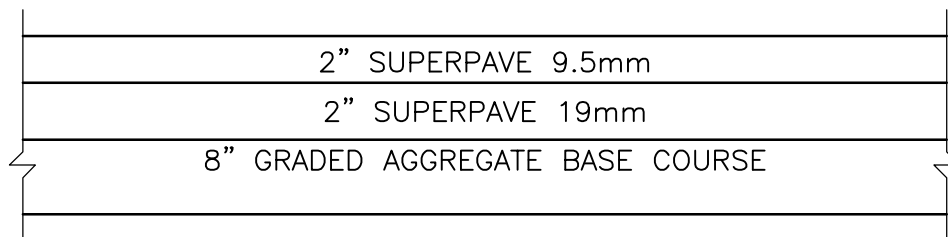


ALLEY STREET SECTION

X = 12' MINIMUM WITHOUT SECONDARY FIRE LANE
OR
X = 16' MINIMUM WITH SECONDARY FIRE LANE

NOTES:

1. PAVEMENT SECTION MAY BE SLOPED TO THE CENTER FOR DRAINAGE.
2. RIGHT OF WAY SHALL EXTEND 1 FT BEYOND EDGE OF PAVEMENT OR BACK OF CURB IF PRESENT.



PAVING SECTION

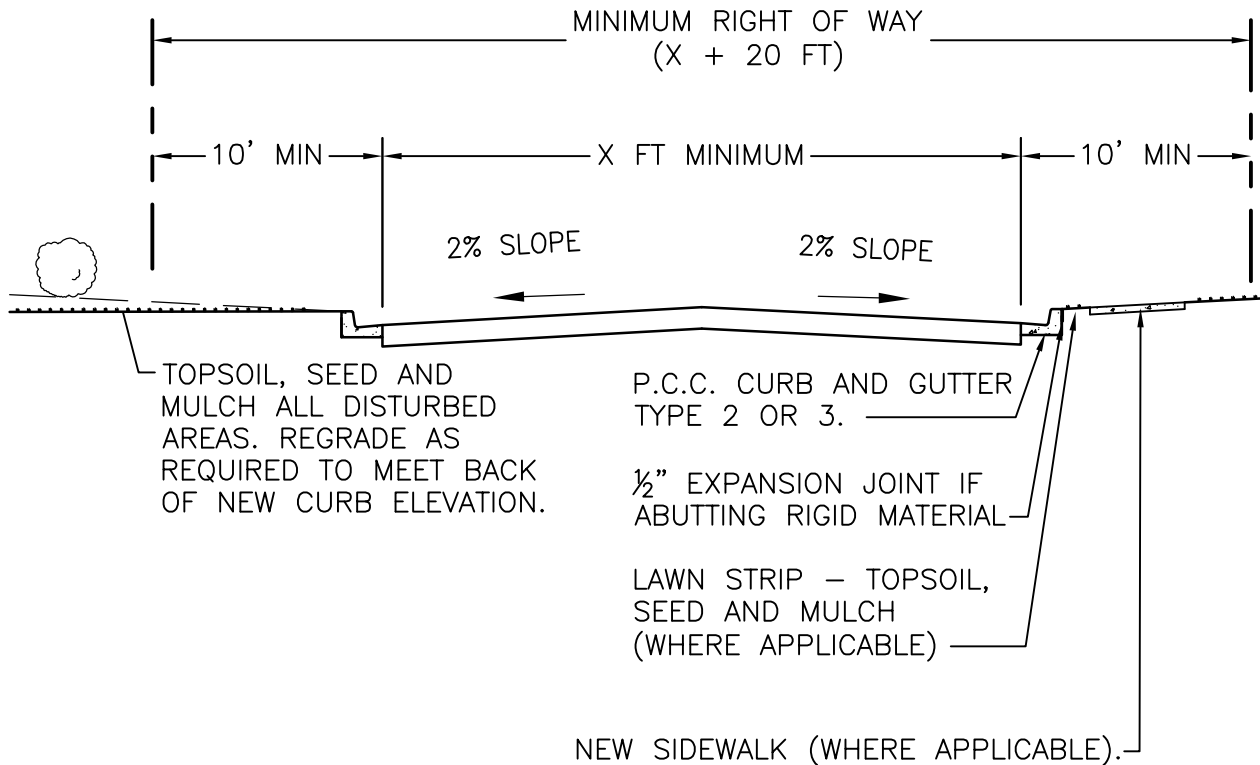
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GENERAL STANDARD DETAILS

DRAWING TITLE: ALLEY STREET
DRAWING NO: R-503
APPROVED BY: E. VICKERS

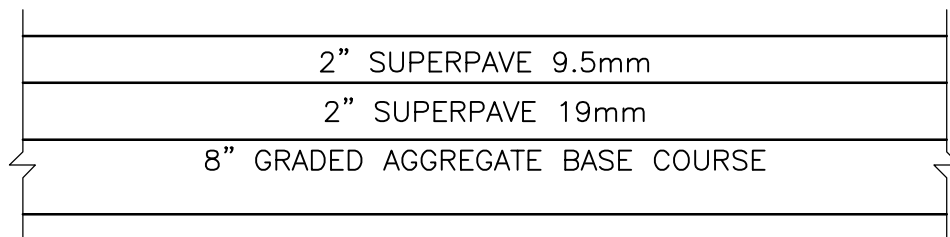
SCALE: NOT TO SCALE
DATE: OCT 2007



RIGHT OF WAY SECTION

X = 16' MINIMUM WITH NO ONSTREET PARKING
OR

X = 24' MINIMUM WITH ONE SIDE ONSTREET PARKING



PAVING SECTION

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GENERAL STANDARD DETAILS

DRAWING TITLE: ONE WAY STREET

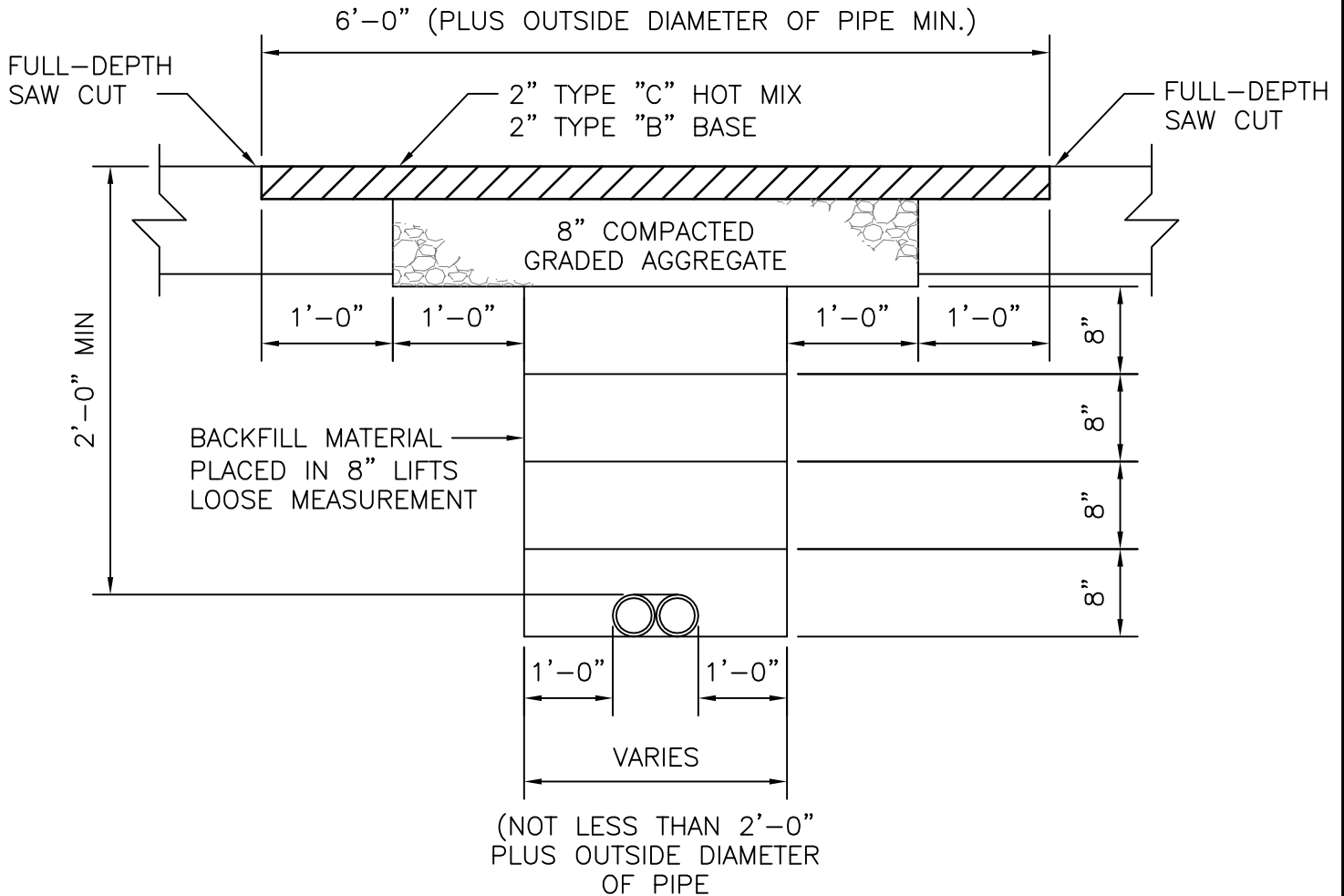
DRAWING NO: R-504

APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE

DATE: OCT 2007

PATCHES MUST HAVE A MINIMUM LENGTH OF 6 FEET PLUS OUTSIDE DIAMETER OF PIPE (AS MEASURED ALONG THE ROADWAY CENTERLINE) AND THE WIDTH OF THE LANE OR LANES DISTURBED.



NOTE:

- 1 THIS IS A MINIMUM PATCH. IF THE EXISTING ROADWAY HAS A HEAVIER CROSS SECTION THAN SHOWN HERE, IT SHALL BE REPLACED WITH THAT CROSS SECTION, OR AS DIRECTED BY THE TOWN ENGINEER.
- 2 ALL MATERIALS AND METHODS OF CONSTRUCTION SHALL MEET THE REQUIREMENTS SET FORTH IN THE CURRENT DELAWARE DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION.
3. PATCHES LOCATED WITHIN 300 FT OF EACH OTHER SHALL REQUIRE A MINIMUM. OF 1.5 INCHES OF MILLING AND HOT-MIX OVERLAY OF THE LANE OR LANES DISTURBED

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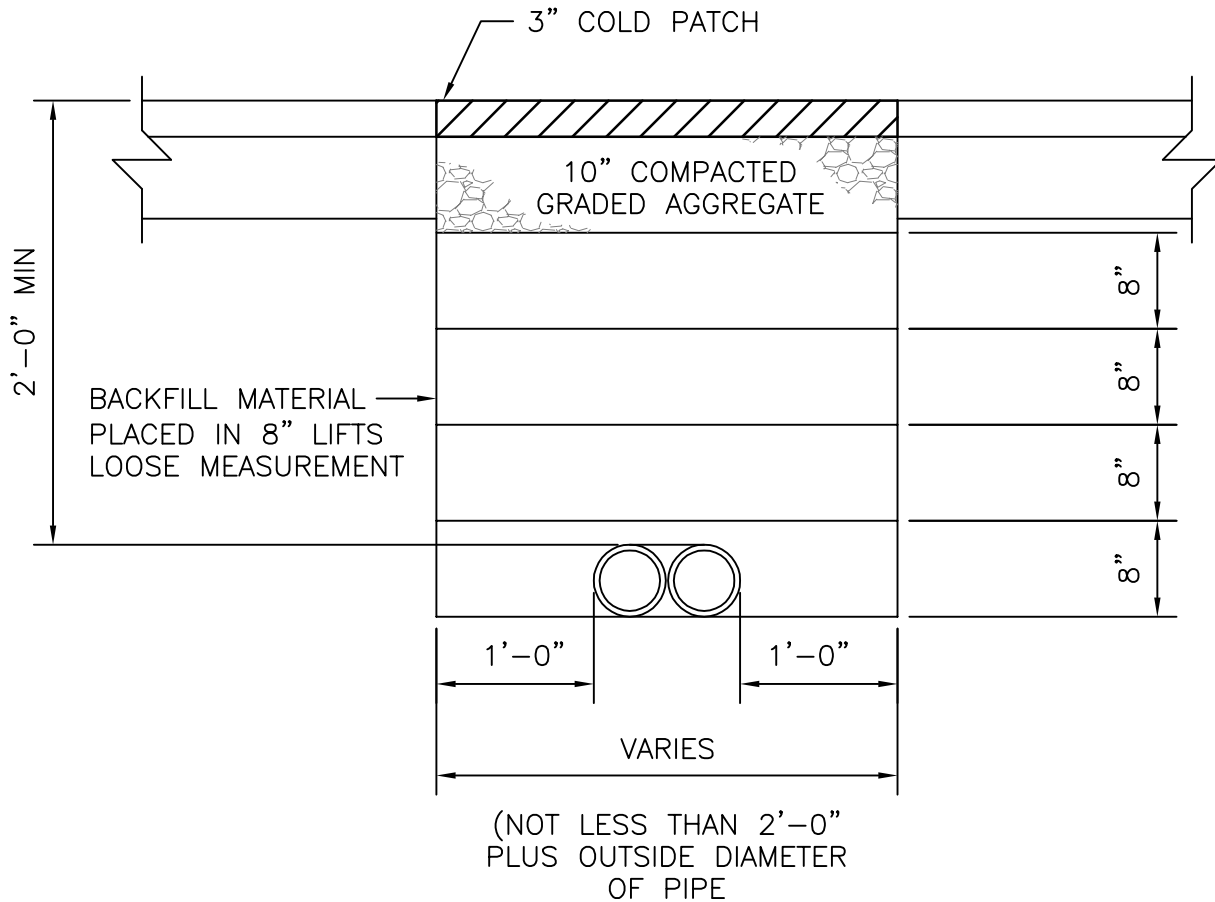


GENERAL STANDARD DETAILS

DRAWING TITLE: ROAD PATCH
DRAWING NO: R-505
APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE
DATE: OCT 2007

MINIMUM DESIGN REQUIREMENTS
(TOWN ENGINEER MAY CHANGE REQUIREMENTS IN SPECIAL CASES)



NOTE:

1 ALL MATERIALS AND METHODS OF CONSTRUCTION SHALL MEET THE REQUIREMENTS SET FORTH IN THE CURRENT DELAWARE DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION.

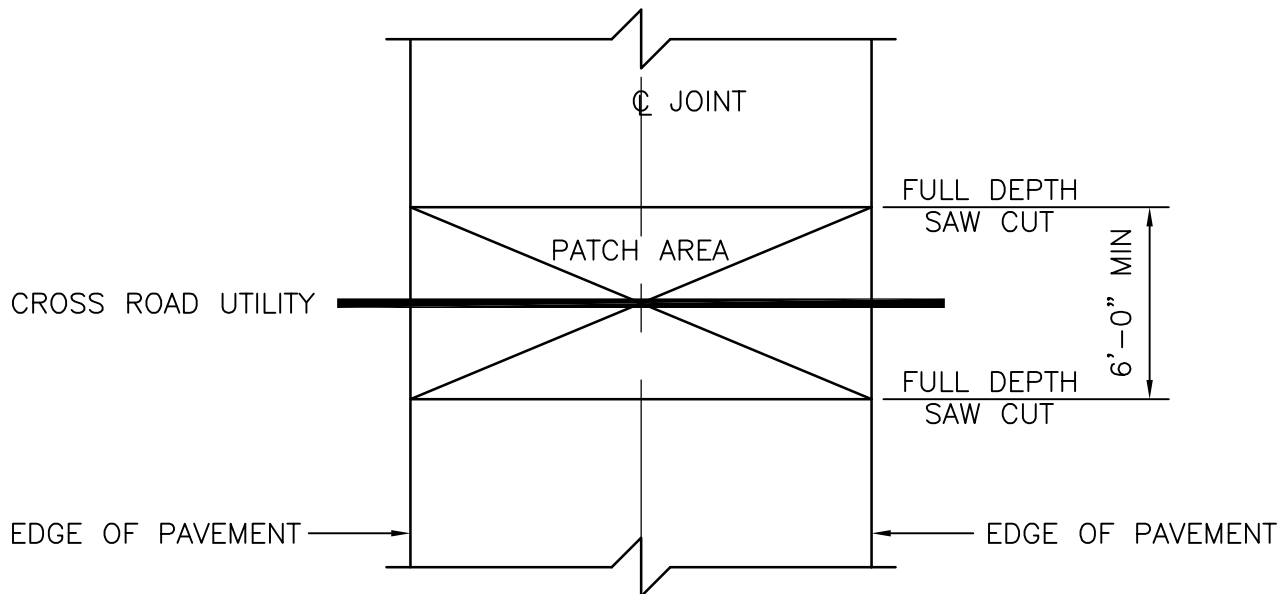
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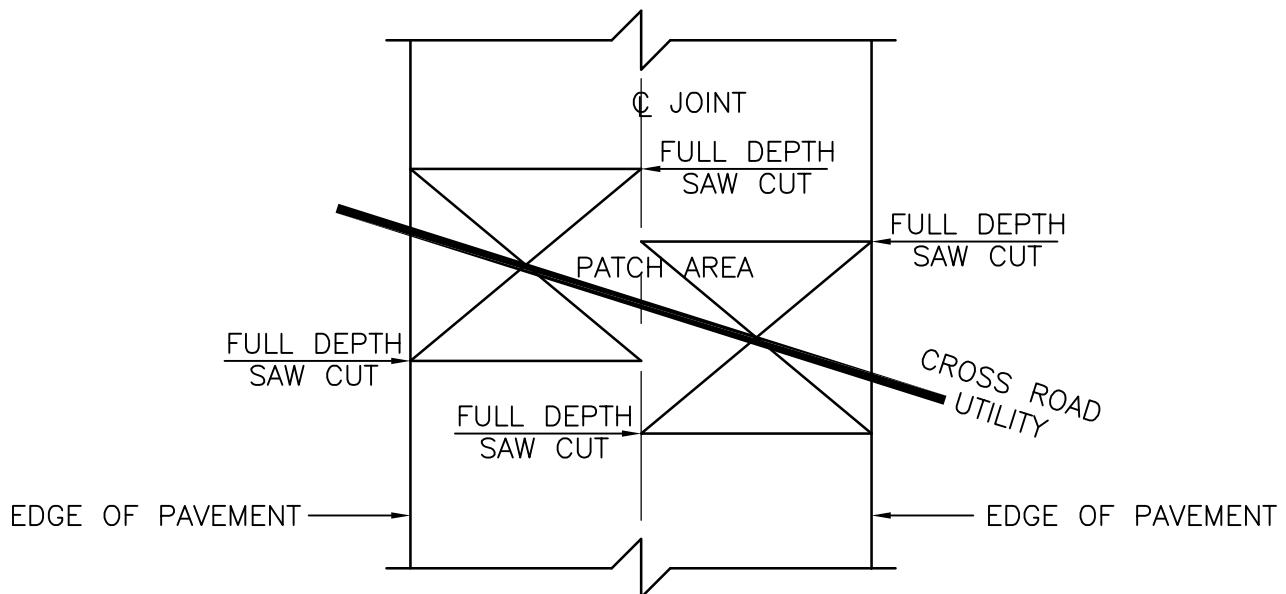
GENERAL STANDARD DETAILS

DRAWING TITLE: TEMPORARY PATCH
DRAWING NO: R-506
APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE
DATE: OCT 2007



NORMAL CROSSING



SKewed CROSSING

NOTE:

- 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 6 FEET LONG AS MEASURED ALONG THE ROADWAY CENTERLINE.
- 3 SKEWED CROSSING PERMITTED ONLY BY EXCEPTION.

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GENERAL STANDARD DETAILS

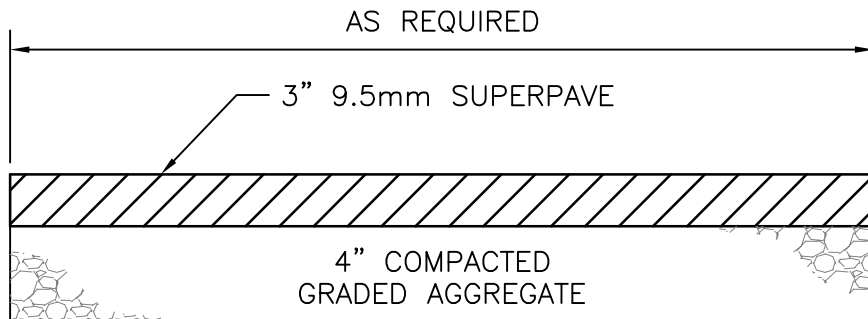
DRAWING TITLE: CROSS ROAD CUTS FOR UTILITIES

DRAWING NO: R-507

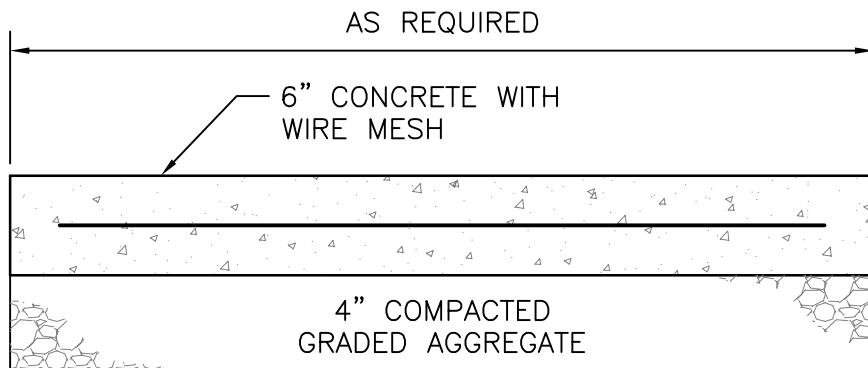
APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE

DATE: OCT 2007



PAVED DRIVEWAY



CONCRETE DRIVEWAY

NOTE: DRIVEWAY SHALL HAVE A MINIMUM AREA OF 400 SQFT

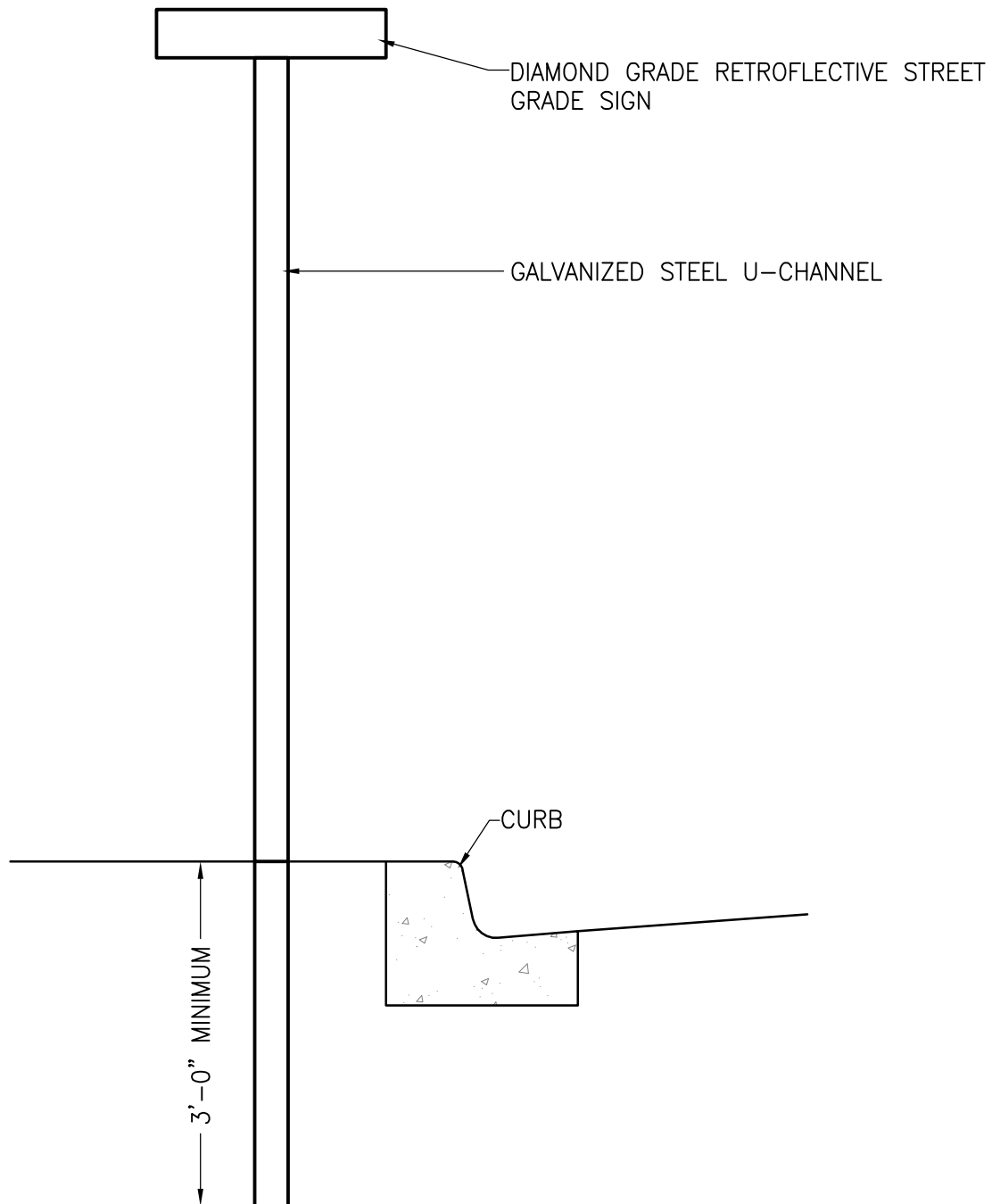
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GENERAL STANDARD DETAILS

DRAWING TITLE: DRIVEWAY
DRAWING NO: R-508
APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE
DATE: OCT 2007



NOTES:

1. SIGN POST SHALL BE MARION STEEL COMPANY "LAP SPLICE BREAKAWAY SYSTEM" MODEL OR AN APPROVED EQUAL.
2. SIGN HEIGHT AND PLACEMENT SHALL BE IN ACCORDANCE WITH THE CURRENT "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES" (MUTCD).

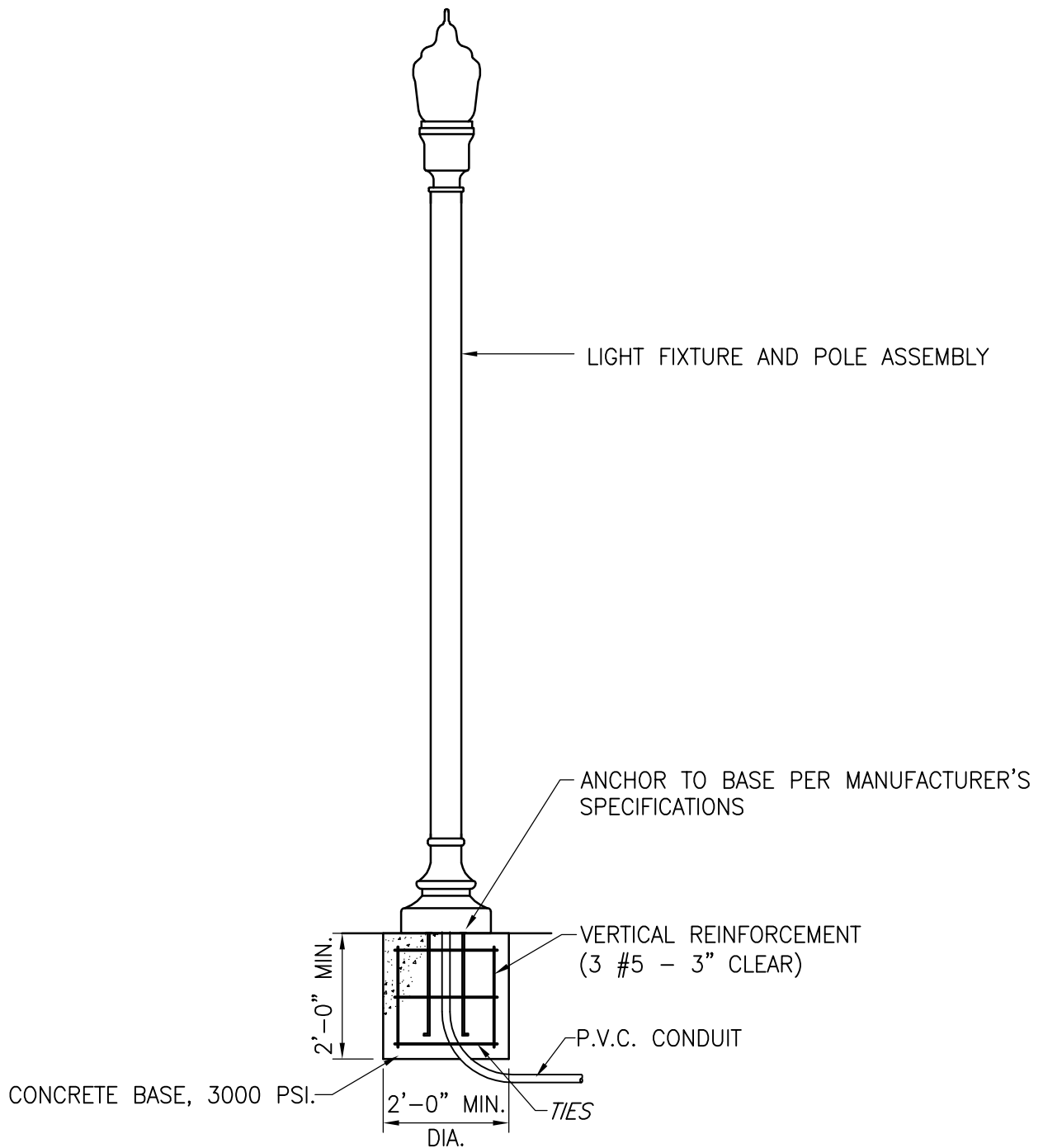
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GENERAL STANDARD DETAILS

DRAWING TITLE: STREET SIGN
DRAWING NO: R-509
APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE
DATE: OCT 2007



NOTES:

1. DECORATIVE LIGHTING SHALL BE CONECTIV "GRANVILLE", "GRANVILLE WITH RIBS", OR "ARLINGTON" MODELS OR AN APPROVED EQUAL.
2. HEIGHT NOT TO EXCEED 12 FOOT FROM GRADE.

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GENERAL STANDARD DETAILS

DRAWING TITLE: STREET LIGHT
DRAWING NO: R-510
APPROVED BY: E. VICKERS

SCALE: NOT TO SCALE
DATE: OCT 2007