



Town of Framingham
Department of Public Works
Construction Standards

March 2009

Revised
March 2016



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Appendices

Appendix A Plan Content and As Built Plan Requirements

Appendix B Construction Details

Glossary



AAB	Architectural Access Board
AASHTO	American Association of State Highway and Transportation Officials
AC	Asbestos Cement
ADA	Americans with Disabilities Act
ADAAG	Americans with Disabilities Act Accessibility Guidelines
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials. Note: ASTM International is originally known as the American Society for Testing and Materials, is an international standards organization that develops and publishes voluntary technical standards for a wide range of materials, products, systems, and services
AWWA	American Water Works Association
ATSSA	American Traffic Safety Services Association
BMP	Best Management Practice
CDF	Controlled Density Fill
CLOMR	Conditional Letter of Map Revisions
CMR	Code of Massachusetts Regulations
DBH	Diameter at Breast Height (the diameter of a tree trunk at 4.5 feet above ground)
DEP	Massachusetts Department of Environmental Protection
DI	Ductile Iron
DPW	Town of Framingham Department of Public Works
Engineer	A member of the Framingham Department of Public Works Engineering & Transportation Division or an authorized representative thereof
FEMA	Federal Emergency Management Agency
HDPE	High Density Polyethylene
HMA	Hot Mix Asphalt
ID	Inner Diameter
LOMR	Letter of Map Revisions



Mandrel Test	The roundness of a pipeline is tested by moving a slightly smaller steel shank, called a mandrel, through the inside of the pipeline. If the pipeline is out of round, the mandrel will be held and kept from moving forward.
MGL30 §39M	Massachusetts General Law “General Provisions Relative to State Departments, Commissions, Officers and Employees: Contracts for Construction and Materials; Manner of Awarding”
mg/l	milligrams per liter
MassDEP	Massachusetts Department of Environmental Protection
Mass DLS	Massachusetts Department Labor and Standards
MassDOT	Massachusetts Department of Transportation (formerly Massachusetts Highway Department)
MUTCD	Manual on Uniform Traffic Control Devices
NPDES	National Pollutant Discharge Elimination System
OD	Outer Diameter
OSHA	Occupational Safety and Health Administration
PE	Polyethylene
PP	Polypropylene
PVC	Polyvinyl Chloride
ppm	Parts per million
psi, psig	Pounds per square inch, pounds per square inch (gauge)
RCP	Reinforced Concrete Pipe
SOP	Street Opening Permit
SDR	Standard Diameter Ratio
US DOT	U.S. Department of Transportation
US EPA	U.S. Environmental Protection Agency



1 General

1.1 Preamble

- A. These Construction Standards are hereby established by the Town of Framingham Department of Public Works (DPW). Their purpose is to provide a consistent policy under which the controlling requirements for construction of physical aspects of infrastructure system improvements within the Town limits will be implemented. These aspects include streets, sidewalks, storm drains, water supply and sewer lines.
- B. These Design and Construction Standards and Construction Details are herein after referred to as the Standards. The Design and Construction Standards are provided as specifications in the materials and methods for performing work relative to the Town of Framingham's infrastructure systems. The Construction Details are provided to graphically depict and to help illustrate key elements outlined within the written portion of these Standards.
- C. Most of the elements contained in this document are related to public improvements and Town of Framingham contract projects; however, it is intended that they apply to both public and private work designated herein. For private work that does not fall within the regulatory jurisdiction of Town Bylaws or regulations, DPW strongly recommends that these standards be used as a basis for construction. These Standards address the more typical infrastructure components. Accordingly, these Standards are intended to assist but not to substitute for competent work by design professionals by providing basic information. It is expected that engineers will bring to each project the best of skills from their respective disciplines, and design professionals shall contact the DPW for clarification and direction regarding designs not covered by these Standards.
- D. These Standards are also not intended to unreasonably limit any innovative or creative effort which could result in better quality, cost savings, or both. However, any proposed departure from the Standards will be judged on the likelihood that such variance will produce a long-term compensating or comparable result, in every way adequate for the user and Town resident. Any variances from these Standards must be approved by the DPW. Further, these Standards are not intended to restrict the DPW in its effort to obtain the maximum benefits for the Town in any construction project.
- E. These Standards are supplemented by regulations and fee structures. Reference to the pertinent regulations and fee structures is provided within each section of this document. In some cases, the regulations, fee structures, and forms are provided as Appendices to these Standards.

1.2 Regulatory Framework

- A. These Standards are provided to outline the DPW minimum criteria for construction of infrastructure within Town limits. It is the responsibility of the property owner to verify and obtain all applicable permits.
- B. These standards are supplemental to the standards in the *Town of Framingham Zoning By-Law* regulations for erosion and sediment control during and after construction and the *Rules and Regulations Governing Subdivision of Land in the Town of Framingham*, which provides general design standards. Please refer to these documents for design requirements. All work shall conform to the current versions of the Town of Framingham Water and Sewer regulations.
- C. All construction materials and methods shall conform to the requirements contained in the latest version of the Massachusetts Department of Transportation (MassDOT) Standard Specifications for Highways and Bridges as amended, unless otherwise specified herein or approved by the Town of Framingham Department of Public Works.



1.2.1 Application/Plan Review

- A. Proposed construction must be approved by the DPW. The approval must be by the Town Engineer, or designee. Proposed work shall be submitted as an Engineering Plan stamped by a Professional Engineer registered in the Commonwealth of Massachusetts. The DPW will provide the Applicant with written correspondence indicating approval of the plan, or required changes. See Appendix A for Plan content requirements.
- B. In addition to plan review approval, it is the responsibility of the property owner to verify and obtain all written permits from appropriate agencies and pay all permit fees before construction begins.

1.2.2 Construction

- A. DPW Inspector of Construction and Utilities may approve field changes, or allowances, that differ from submitted plans or Town standards. No changes are allowed without prior approval by the Inspector.

1.2.3 As-Built/Record Documents

- A. The Contractor shall be responsible for the preparation and submittal of record drawings to the DPW when construction is complete. Record drawings shall be a full set of drawings showing all details of the construction, along with any specifications or design reports. This plan shall include all drain lines and structures with rim and invert elevations; all water lines, gates and dwelling service shut offs; all sewer lines and structures with rim and invert elevations; all service wyes with distances to the nearest structures and all relevant easements. Record drawings and reports shall be certified (signed and stamped) true and correct by a Professional Engineer registered in the Commonwealth of Massachusetts and/or Professional Land Surveyor registered in the Commonwealth of Massachusetts, as applicable. Drawings shall be submitted in both electronic and hard copy formats. Contact the DPW to determine the current acceptable electronic format. See Appendix A for As-built Plan content requirements
- B. Certificates of Occupancy will not be signed until payments of the required fees are confirmed and a final site inspection is concluded to validate completeness and accuracy of the submitted as-built plan documents. The DPW requires a minimum of five business days following the delivery of as-built documents package (turnaround time subject to document package completeness) to provide Occupancy Certificate Sign-off.

1.3 General Requirements

1.3.1 Brand Name or Equal

- A. If an item in these Standards is identified as "brand name or an approved equal," the product will reflect the characteristics and level of quality that will satisfy the Town's needs. The Town will evaluate "equal" products on the basis of information furnished by the Applicant or Contractor. All "or Equal" submissions must be approved during the Plan review process and will be judged consistent with MGL 30 §39M. All technical information submitted must be as provided by the manufacturer. The Town is not responsible for locating or obtaining any information not identified.

1.3.2 FEMA Regulations

- A. The developer or owner is required to meet all Federal Emergency Management Agency (FEMA) regulations and the Town's Zoning By-Law, Section III (H) "Floodplain Districts." When a



submittal to FEMA is required to adjust the FEMA Flood Boundary and Floodway Maps, the submittal must be submitted to and approved by the Town Engineer prior to submitting to FEMA. Conditional Letter of Map Revisions (CLOMRs) and Letter of Map Revisions (LOMRs) are required for any modifications to a floodplain or floodway.

1.3.3 Easements

- A. Easements for Water, Sewer, or Drainage on or across lots or centered on rear lot lines or side lines shall be provided where necessary and shall be at least thirty feet (30 feet) wide. Major easements (i.e., over three hundred feet (300 feet) long) for sewer, water and drainage must be at least forty feet (40 feet) wide. Signed copies of easements and agreements affecting land not within a subdivision, but necessary for provision of utilities shall be submitted to the Department of Public Works before a plan can be approved. Where a subdivision is traversed by a water course, drainage way, channel, or stream, the Department of Public Works may require a storm water easement or drainage right of way be provided of adequate width to conform substantially to the lines of such water course, drainage way, channel, or stream and the necessary width for access. The Department of Public Works may further require the sub-divider to provide construction of such improvements as they consider essential for public safety and for the adequate control of a one hundred (100) year storm.

1.3.4 Roadway Bounds and Monumentation

- A. All existing roadway monumentation shall be inventoried and protected. Any and all proposed impacts shall be brought to the attention of the Engineering Division immediately.
- B. The Engineering Division shall be notified immediately if any survey monuments are uncovered, exposed or damaged.
- C. Any damage to roadway or other survey monuments prior to acceptance by the Town shall be repaired in a manner satisfactory to the Department of Public Works and the full cost of such repair shall be paid by the Contractor. Any material used which does not meet the standards of the Department of Public Works shall be replaced by the Contractor at no cost to the Town.

1.3.5 Traffic Management Plans

- A. All traffic management plans shall be approved by the Engineering Division before construction may begin.
- B. Traffic management plans shall meet the requirements and guidance set forth in the MassDOT Work Zone Safety Guidelines, the ATSSA Guide to Temporary Traffic Control, and the MUTCD guidelines.
- B. Specific requirements are provided in Section 6 of these Construction Standards.

1.3.6 Construction Site Maintenance

- A. At the completion of each working day, all areas affected by work shall be brought to a reasonably clean, safe, and usable condition as determined by the Town or its designee.



1.4 Erosion Control

1.4.1 Stormwater Management During Construction

- A. All construction shall comply with the Town's Zoning By-Laws and Subdivision Regulations for land disturbance including clearing, erosion control, and stormwater management. In addition, construction shall comply with any applicable federal and state requirements, including but not limited to National Pollutant Discharge Elimination System (NPDES) stormwater discharge requirements.
- B. Every person seeking to construct, repair, or modify a property's infrastructure that is either in the right of way or is subject to applicable Town requirements (e.g., Planning Board or Conservation Commission) shall be required by the Town to prepare and implement an Erosion and Sedimentation Control Plan to prevent the introduction of sediments into the Town's drainage system. The person initiating such modification will be held accountable as the "Responsible Party" with the obligation to:
1. Secure the design of any facilities required pursuant to this section;
 2. Submit the design to DPW for review and approval;
 3. Be responsible for the full expense of installation and maintenance of such facilities; and
 4. Notify the DPW prior to the start of any work to arrange and coordinate Town Inspection of the installation.
- C. Silt fencing shall be used as one of the primary erosion control measures. Silt fence shall consist of a sheet of synthetic fabric such as polypropylene, nylon, polyester, or polyethylene yarn. Silt fence shall be erected in a continuous fashion from a single roll of fabric. The bottom of the fabric fence shall be buried sufficiently below the ground surface to prevent gaps from forming, usually 4 to 6 inches below ground surface. The fabric shall be installed on the upstream side of the stakes. Stakes shall be strong enough and tall enough to securely anchor the fabric to the ground. Stake spacing shall be no more than 10 feet apart for extra-strength fabric and 6 feet apart for standard strength fabric. Maintenance of the fence is required during construction. Material shall be based on the synthetic fabric requirements as follows:
1. Filtering efficiency: 75% (minimum)
 2. Tensile strength: Standard strength: 30 lb./linear inch (minimum), Extra strength: 50 lb./linear inch (minimum)
 3. Elongation: 20% (maximum)
 4. Ultraviolet radiation: 90% (minimum)
 5. Slurry flow rate: 0.3 gal/ft²/min (minimum)
- D. Fiber rolls or an approved equal shall be used as another primary erosion control measures. Fiber rolls shall be used in conjunction with silt fences except when used for hillside erosion control, where they may be used alone.
1. Fiber rolls shall be trenched between 3 and 5 inches into the ground, depending on the size of the fiber roll.
 2. Fiber rolls shall be staked securely into the ground using wood stakes. A minimum of 3 inches of the stake shall stick out above the roll.
 3. Stakes shall be spaced 3 to 4 feet apart unless otherwise approved by the DPW.



4. Fiber rolls placed around drain inlets shall be placed a minimum of one (1) foot back from the inlet.
 5. For slope stabilization, fiber rolls shall be placed perpendicular to the expected flow of stormwater runoff, with the following separation:
 - 1:1 slopes = 10 feet apart
 - 2:1 slopes = 20 feet apart
 - 3:1 slopes = 30 feet apart
 - 4:1 slopes = 40 feet apart
- E. Gravel aprons shall be installed at the entrance of construction sites where disturbance is over 4,000 square feet to prevent sediment from the construction site entering the roadway. Aprons shall be a minimum of 15 feet in length, and extend the width of the entrance.
- F. Silt sacks (or equivalent) shall be placed in down gradient catch basins to prevent sediment from entering the drainage system. Silt sacks shall be periodically cleaned while in use and must be cleaned prior to and after precipitation events. Applicants are advised they may be required to respond immediately for repair and maintenance at the request of the Town within two hours of notification.
- G. All erosion and sediment controls shall remain in effective operating condition during construction activities. Inspect all erosion and sediment controls regularly and make the necessary repairs or modifications to ensure effectiveness or as directed by the Town Inspector.
- H. Initiate soil stabilization measures immediately whenever earth-disturbing activities have permanently or temporarily ceased on any portion of the site. Complete soil stabilization measures as soon as practicable, but no later than 14 calendar days after the initiation of soil stabilization measures.

1.4.2 Stormwater Management Post Construction

- A. Every person shall be required to prepare and implement a stormwater management operations and maintenance plan as required by Town review requirements (e.g., Planning Board or Conservation Commission).
- B. Such a plan shall include non-structural and structural measures to manage stormwater during and after construction of the new or expanded facility. The design of such facilities shall be subject to the approval of the DPW. The costs for the design, installation and maintenance of the aforementioned stormwater management systems shall be the responsibility of the facility owner. The DPW shall receive advance notice prior to the start of said work to coordinate Inspectional coverage of the installation.
- C. For subdivisions regulated by the Town's Subdivision By-Laws, the DPW may require that major components of stormwater management systems be placed on the property rather than within the Town right-of-way limits. In such cases, the owner or homeowners' association shall be responsible for the ongoing maintenance of said components, and the approved stormwater management plan shall include management of these components. This management plan shall be recorded with the deed at the Massachusetts Registry of Deeds.



1.5 Tree Planting and Protection

- A. All tree work shall be completed in accordance with the requirements of the Tree Warden and/or planning board as appropriate.
- B. When specifying trees to be planted on or near the roadways in Town, specifications shall identify species and cultivar. The more disease resistant cultivars shall be recommended.
- C. Trees shall be tagged with identification as to location of origin, species, and cultivar. Notification shall be provided to the Tree Warden to provide time for inspection and verification of tree species and cultivar.
- D. When planted, an area around the trees shall be mulched for a minimum of 3 feet from the tree or twice the size of the root ball, whichever is greater. The area immediately around the tree trunk (within 2 inches of the trunk) shall remain un-mulched.
 - 1. The planting hole shall be at least 2 times the width of the rootball, up to 5 times the rootball.
 - 2. Burlap, twine, and wire baskets shall be entirely removed after planting.
 - 3. Place the tree in the hole at both the appropriate upright angle and depth.
 - 4. Replace the soil so that there is no excessive coverage to roots or contact above the root flare at the stem.
 - 5. Add a two- to three-inch layer of mulch, not contacting the bark of the tree.
 - 6. Immediately water the tree, with a plan for regular follow-up watering.
 - 7. Provide a final quality-control check, where depth of the structural roots is verified, with the use of a chaining pin or other measuring implement.
- E. Tree protection shall include the following.
 - 1. Notification shall be provided to Tree Warden during the planning and specification development of projects where tree protection may be required. The Tree Warden may require that a Town-approved certified arborist oversee construction activities related to tree protection.
 - 2. A pre-construction meeting with the Tree Warden shall be conducted at least two weeks prior to construction to review tree protection procedures.
 - 3. Tree protection shall be provided for each tree within the work area.
 - 4. The tree protection zone shall extend out from the center of the trunk to a radius of 1.5 feet per inch of DBH (DBH = diameter of trunk at 4.5 feet above ground).
 - 5. Primary tree protection shall include 2" x 4" boards in 8-foot lengths vertically strapped around the trunk, at a maximum of 8 inches apart, on center. No penetration of the tree trunk shall be allowed except as approved by a certified arborist or the Tree Warden.
 - 6. Secondary tree protection shall include fencing around the tree protection zone.
 - 7. No storage of any materials or equipment shall be allowed within the tree protection zone.
 - 8. No parking shall be allowed within the tree protection zone.
 - 9. No roots greater than 2 inches shall be cut during construction activities.



10. Any pruning of tree limbs shall be done under the direction of a certified arborist.
 11. During excavation, major roots as determined by the Tree Warden shall be exposed using an air spade and flagged for protection.
 12. Vertical mulching shall be required if soil compaction levels exceeds 75% or more than 3 passes by heavy equipment are expected.
 13. If travel is required within the tree protection area, a layer of at least 6 inches of wood chips, mulch, or other matting as approved by the Tree Warden shall be laid down to protect the roots. The matting shall be removed and the area restored to pre-construction conditions upon completion of the work.
 14. For construction where trees roots may be damaged, only root pruning methods may be used for removal. The Tree Warden shall be notified and a plan submitted to the Tree Warden for approval.
 15. Curb cuts should not be closer than five (5) feet from the trunk of any adjacent tree.
- F. Trees that, in the judgment of the Engineer or the Tree Warden, have been irreparably damaged by the Contractor shall be replaced in kind and in size, or with a quantity of 2-inch caliper replacement trees (the quantity of which shall be determined by the Engineer) such that the cumulative caliper of the replacement trees will be up to the equivalent diameter of the lost tree at breast height. Cost of removal of a destroyed tree, including roots and stumps, as well as the cost of replacement trees, shall be paid for by the Contractor.
- G. A written guarantee shall be provided to the Town that trees planted in Town as per the contract will thrive for a minimum of two (2) years. The guarantee shall include replacement of trees that the Tree Warden has determined are not thriving. Replacements shall be required to have the same guarantees as the original trees.

1.6 Asbestos Cement Pipe Encountered during Construction

- A. If either asbestos cement (AC) pipe or asbestos cement material in soil is encountered, notification shall be immediately provided to the DPW Engineering and Transportation Division.
- B. Handling of any AC Pipe or AC material shall be according to federal and state regulations, specifically but not limited to EPA's *National Emission Standards for Hazardous Air Pollutants* (NESHAP) Title 40, Part 61; EPA's *Guide to Respiratory Protection for the Asbestos Abatement Industry* OSHA 29 CFR part 1926.1101; OSHA 29 CFR 1010.1001; USDOT 49 CFR 100-185; Massachusetts Division of Labor Standards 453 CMR 6; MassDEP 310 CMR 7.00, 7.09, 7.15; and MassDEP *Asbestos Cement Pipe Guidance Document* (June 2011).

1.7 Conditions for Street Acceptance

- A. The following shall be required as applicable as conditions for acceptance of streets. Any listed reports shall be signed and stamped by a registered professional engineer or land surveyor with applicable qualifications.
 1. Conditions & confirmation conditions achieved
 2. Order letter of conditions
 3. Identified condition exceptions
 4. Homeowner association document
 5. As-built subdivision or plot plan
 6. Roadway layout plan
 7. Copies of deeded easements



8. Inspection reports of plantings and other items in the right of way
9. Street light inspection report
10. Fire pull box inspection report
11. Highway sign and/or striping inspection report
12. Layout /bound/ easement inspection report
13. Roadway/sidewalk/curbing base & finish inspection report
14. Utilities inspection (water, sewer, drainage) reports, including water quality testing for all water systems
15. CCTV drain/ sewer systems reports
16. Hydrant inspection reports including test data
17. Drainage/retention pond inspection report

1.8 Items Not Covered in This Document

- A. Items not covered in this document include the following:
1. Complex and specialty items such as bridges, culverts, siphons, pump stations, and backflow prevention. Plans for these items are to be provided for individual review by the DPW.
 2. Drainage that is completely operating within the boundaries of private property, with no discharge to waterways or the Town's drainage system.
 3. Street Opening Permit (SOP) requirements for any facility installation that may occur within the Town Right of Way limits. For SOP policy details please refer to Town of Framingham Web site link as follows: http://www.framinghamma.gov/public_works/sop/default.htm.
 4. Trench Opening Permit requirements for any excavation that meets the definition of a trench as per MGL Chapter 82A Unattended Open Trenches Safety Hazards Rules, Regulations and Fines, and regulated under 520 CMR 14.00 Excavation and Trench Safety Regulations.

1.9 References

Standards	Title/Subject
ATSSA	Guide to Temporary Traffic Control in Work Zones
Mass DLS	453 CMR 6. Current Asbestos Regulations
MassDEP	310 CMR 7.00. Air Pollution Control Regulations. Includes Section 7.09 <i>Dust Odor, Construction and Demolitions</i> and 7.15: <i>Asbestos</i>
MassDEP	Asbestos Cement Pipe Guidance Document (June 2011).
MassDOT	Work Zone Safety Guidelines for Massachusetts Municipalities and Contractors
US DOT	Manual on Uniform Traffic Control Devices
OSHA	29 CFR part 1926.1101. Safety and Health Regulations for Construction, SubPart Z, Toxic and Hazardous Substances: Asbestos
OSHA	29 CFR 1010.1001. Occupational Safety and Health Standards, Subpart Z, Toxic and Hazardous Substances: Asbestos



US DOT	49 CFR 100-185. Hazardous Materials Transportation
US EPA	National Emission Standards for Hazardous Air Pollutants (NESHAPS) Title 40, Part 61
US EPA	Guide to Respiratory Protection for the Asbestos Abatement Industry



2 Water Construction Standards

2.1 General

2.1.1 Description

- A. The work includes furnishing and installing all pipe, fittings, valves, structures and appurtenances required for the proposed system to supply water to users of the Town's Water System.
- B. Work and materials shall be performed in accordance with the State Plumbing Code when work is within ten (10) feet of buildings.
- C. Only one domestic water service shall be installed per parcel.
- D. All water connections shall be to Town owned distribution mains.

2.1.2 Submittals

- A. Materials List and Shop Drawings
 - 1. Materials list of materials proposed shall be submitted to the Town.
 - 2. Approved shop drawings for all materials and structures shall be submitted to the Town.
 - 3. Plans for chlorination, dechlorination, pressure test, bypass construction shall be submitted to the Town. All pressure testing shall be performed by a qualified third party approved by the Town. All pressure testing must be in conformance to a written plan submitted to, and approved by, the Town.
- B. As-Built Drawings
 - 1. Submit one (1) copies of As-Built Drawings to the DPW upon completion and acceptance of work as wells as an electronic version of the drawings in both AutoCAD and Acrobat (PDF) format.
 - 2. As-Built Drawings shall be complete and shall indicate the true measurement and location, horizontal and vertical, of all new construction. As-Built Drawings shall include a minimum of three (3) ties to each valve cover and curb stop from fixed permanent objects. Three (3) ties shall also be provided for each bend or other unanticipated field change. As-Built drawings shall also contain any additional information required by the municipality and shall be stamped with the seal of a Professional Land Surveyor or Licensed Professional Engineer. The Town may, at its discretion, require that as-built plans be submitted on electronic form (e.g., AutoCAD release 2008 or higher).
 - 3. As-Built Drawings shall be filed or stored on property and available for use by DPW for all commercial, industrial, and institutional properties and large residential properties, such as apartment or condominium complexes and assisted or congregate living facilities.
- C. Temporary Bypass Plans shall be prepared by a registered professional engineer and submitted to DPW for review and approval prior to installation. Bypass plans shall include and consider the following:
 - 1. Proposed schedule for installing, testing, disinfecting, operating, and removing the temporary bypass.



2. All components of the bypass shall be for potable water transmission and distribution with a minimum service pressure of 150 psi. Piping and hose shall be galvanized steel, high density polyethylene (HDPE) or polyvinylchloride (PVC) pipe. All plastic pipe or hose shall bear the imprint of the National Sanitary Foundation (NSF) approval for potable water NSF-PW or shall be capable of meeting the standards established by the NSF for this use.
3. Details of the materials, size, and location of temporary facilities including bypass mains, valves, connections, laterals, services, and fire hydrants.
4. Bypass mains shall be supplied by at least two connections to the existing system either via an existing hydrant or a direct connection to an underground main.
5. Bypass mains shall be a minimum of 6-inches in diameter when supplying water for fire protection to temporary hydrants. Temporary hydrants shall be located in the same approximate location as existing hydrants that have been placed out of service and bagged. The number of hydrants on the temporary bypass shall be greater than or equal to the number of existing hydrants that are placed out of service.
6. Minimum size of bypass mains that do not supply water for fire protection is 2-inches. All temporary services shall be greater than or equal to the diameter of the existing service.
7. Bypass mains shall be laid outside of the traveled and access ways whenever possible and trenched when crossing roadways. All services shall be ramped or trenched.
8. All services shall be connected to the user's sill cock using a wye fitting with valves to accommodate connections of garden hoses by the user.
9. All plans shall include provision of twenty-four/seven contact information for operation and maintenance of the bypass system.
10. Pressure testing shall comply with the requirements of Section 2.3.1.1 and disinfection testing shall comply with the requirements Section 2.3.1.2.
11. All work shall be coordinated with DPW and the Fire Department and no construction activity shall commence without a minimum of 48 hours advance notice to each department.

2.1.3 Inspection

- A. The Applicant is responsible for the provisions and all test requirements specified herein. In addition, all pipe and appurtenances shall be inspected at the plant for compliance with these specifications by an independent testing laboratory.
- B. Inspection of the pipe and appurtenances shall also be made after delivery. The pipe and appurtenances shall be subject to rejection at any time on account of failure to meet any of the specification requirements, even though samples may have been accepted as satisfactory at the place of manufacture. Pipe and appurtenances rejected after delivery shall be marked for identification and shall be removed from the site at once.
- C. All bypass plans must be submitted to DPW for review and approval prior to installation.
- D. All work shall be inspected by the Town's Inspector of Construction and Utilities prior to backfill.

2.1.4 Delivery, Storage and Handling

- A. All materials shall be adequately protected from damage during transit. Pipes shall not be dropped.



- B. All pipe and other appurtenances shall be inspected before placement in the work and any found to be defective from any cause, including damage caused by handling, and determined by the Town to be unrepairable.
- C. Storage and handling of pipes and other appurtenances shall be in accordance with the manufacturer's recommendations, subject to the approval of the Town.

2.2 Materials

- A. The Materials section summarizes the Town's standards to be used in public or private components that affect the Town's water system. All materials should conform to the applicable AWWA standards unless otherwise noted.

2.2.1 Lead Free

- A. All materials used in public or private water systems within the Town of Framingham's water system must be certified "lead free."

2.2.2 Pipe

- A. All water mains shall be minimum Ductile Iron Class 52, single gasket, double sealing pipe with cement mortar lining. All ductile iron water main pipe shall be rated for a minimum operating pressure of 350 psi. All water mains shall be encased in polyethylene film when the trench is backfilled with control density fill.
- B. All water mains shall be minimum 8-inch diameter. All hydrant branches shall be minimum 6-inch diameter.
- C. Push-on type joints are recommended on straight runs of pipe. Gaskets must be standard for pipe used and be acceptable to the DPW.
- D. Mechanical joint restraints shall consist of individually actuated wedges that increase their resistance to pull out as pressure or external forces increase. The device shall be capable of full mechanical joint deflection during assembly and the flexibility of the joint shall be maintained after burial. They shall have a rated work pressure of 350 psi in sizes 16-inch and smaller and 250 psi on in sizes greater than 16 inches.
- E. The Town has standardized on the Series 1100 MEGA-LUG restraint as produced by EBAA Iron, Inc. or approved equal.
- F. Where petroleum contamination is known or suspected to be in the soil and/or groundwater, nitrile gaskets shall be required.

2.2.2.1 Fittings

- A. Ductile iron fittings shall be used and shall be cement lined. Fittings shall be equipped with a mechanical joint restraint, unless otherwise specified by the DPW. Mechanical joint fittings in sizes 4 inch through 12 inch shall be ductile iron compact fittings and rated for 350 psi working pressure. All nuts and bolts shall be of a type equal to ductile iron or KOR-10 steel T-bolts and nuts or an approved equal.

2.2.2.2 Couplings

- A. Couplings shall be provided with AWWA approved plain, Grade 27, rubber gaskets and track-head bolts with nuts. Couplings shall be Smith Blair, Style 441 or Dress, Style 153; 360 or an approved equal. If the outer diameter of the pipe permits, a Dresser coupling is preferred.



- B. Where petroleum contamination is known or suspected to be in the soil and/or groundwater, nitrile gaskets shall be required.

2.2.2.3 Resilient Seat Gate Valves

- A. Resilient seat gate valve bodies shall be manufactured of ductile iron. Gate valves shall be open left (counter clockwise). All valves shall be designed for minimum 250 psi working water pressure.
- B. The Town has standardized on American Flow Control and Kennedy.

2.2.2.4 Valve Boxes

- A. Valve boxes shall be heavy duty, adjustable style with the lower part manufactured of cast iron and the upper part of steel or cast iron. All valve boxes shall be designed and constructed to prevent direct transmission of traffic loads to the pipe or valve, and shall have the lower part manufactured of cast iron and the upper part of steel or cast iron. The top of the cover shall be flush with the finish grade. Boxes shall be as manufactured by Bibby Ste-Croix or approved equal.
- B. Box covers shall be round frame and cover manufactured by the Bibby Ste-Croix or approved equal. The boxes shall be labeled to differentiate between division valves ("DIV"), Blow-Off ("B.O.") and generic valves as indicated in the Construction Details. Box covers shall have a minimum height of four (4) inches.

2.2.2.5 Tapping Sleeves and Valves

- A. Tapping sleeves shall be of the mechanical joint type. The valves shall be flanged by mechanical joint outlet with non-rising stem and designed for vertical burial. Tapping valves shall be rated at 200 psi working pressure and shop tested at 300 psi. Bolts on bonnet and stuffing box shall be stainless steel (316 stainless steel), stuffing boxes shall be "O" ring type. The operating nut shall be 2 inches square. Gaskets shall cover the entire flange surface. Valves shall open left, (counter clockwise).
- B. The Town has standardized on American Darling 1004 or an approved equal.
- C. Tapping sleeves shall be no greater than one-half of the diameter of the main being tapped.

2.2.3 Piping Connections

2.2.3.1 Service Connections

- A. All service pipe shall be type "K" copper tubing. All services shall have the valve box installed at the corporation on the main.
- B. Plastic services are allowed on a case-by-case basis. In such circumstances, the Town will require that the applicant verify that no petroleum constituents are present in subsurface soil in the vicinity of the service. Plastic water services shall be NSW-PW, listed, High Density Polyethylene (HDPE) blue plastic and shall conform to the following:
 1. Copper Tube Size (CTS) – ASTM 2737, 200 psi, PE 3608 or PE 3710, SDR9
 2. Iron Pipe Size (IPS) – ASTM 2239, 200 psi, PE 3608 or PE 3710, SDR7



Plastic pipe shall be as manufactured by Silver Line Plastics or approved equal. Dimensional and performance characteristics shall conform to the requirements of AWWA C901. The use of HDPE pipe and tubing may be allowed for water service - two (2) inches or under in diameter (4-inch and larger diameter water services shall use cement lined ductile iron water pipe). HDPE pipe shall be installed with enough slack to compensate for settlement and compaction and shall be laid on a bed of fine grained material.

- C. Curb valves shall not include a drain.
- D. The Town has standardized on lead-free service connections manufactured by McDonald, Mueller, Ford or an approved equal. Copper tubing shall be of the type commercially known as type "K" soft and conforms to ASTM Specifications B-88-49.
- E. Curb boxes shall be Erie box style for 1-inch services and Buffalo box style (no rod) for 1-1/2-inch and larger services.

2.2.3.2 Corporations

- A. Corporations for 1 inch installations shall be heavy pattern, solid plug, easy turning. The inlet shall be an AWWA (CC) thread. The 1-1/2 inch and 2 inch corporations shall be of a tee head ball valve type which incorporates Teflon seats to assure self-centering of Teflon coated bronze ball. The corporation shall be easy turning and non-binding. The inlet shall be an AWWA (CC) thread. Corporations shall be subject to a sustained hydraulic pressure of 200 psi. All 1½ and 2-inch saddles shall have stainless steel straps.

2.2.4 Hydrants

- A. Hydrants shall have a 5-1/4-inch valve opened by turning the operating unit in the counter clockwise direction. The hydrant shall have one 4-1/2- inch steamer and two 2-1/2- inch hose connections. The hose and steamer connections shall have National Standard Thread. The operating nuts shall be pentagonal in shape, 1-1/2- inch from point to opposite flat and shall open left (counter clockwise). The hydrant shall be the hub or mechanical-joint type having a 6-inch pipe connection to an 8-inch or larger diameter main.
- B. The hydrant valve shall consist of a cast iron valve and valve bottom and hydrant valve rubber. The rod threads shall be permanently sealed from contact with water. The hydrant valve shall seal against the bronze hydrant seat. The upper barrel shall be ductile iron with markings identifying size, model and year of manufacture. The lower barrel shall be ductile iron.
- C. The upper barrel shall connect to the lower barrel with a breakable traffic flange and 8 bolts and nuts. This connection shall allow 360 degree rotation of the upper nozzle section.
- D. The hydrant shall have a bronze drain ring securely held between the barrel and base flange. It shall provide bronze to bronze threaded connection for hydrant seal. The bronze drain ring shall serve as a non-corrosive multi-port drain channel.
- E. The hydrant shall have a minimum working pressure of 200 psi. Hydrant design shall be of positive automatic drain type to prevent freezing.
- F. All hydrants that will not be Town owned shall be painted red. Hydrants that are Town owned, or will be Town owned, shall be factory painted with Sherman-Williams brand paint to the Town's paint scheme:

Hydrant body: hydrant blue b54tz104
Caps: Pure white-b54w2101



- G. The Town has standardized on American Darling Model No. B-62B as manufactured by American Flow Control Inc.

2.3 Execution

- A. This section summarizes the Town's standardized methods for the installation and maintenance of certain aspects of the water system. All procedures shall be performed consistent with AWWA standards.

2.3.1 Piping

- A. The sizing of water mains shall be based on sound engineering principals. All water mains shall be minimum 8-inch nominal diameter. All hydrant connections shall be minimum 6-inch diameter.
- B. All piping shall be installed with a minimum 5-foot cover. In such cases where 5-foot cover is not possible, the piping shall be appropriately insulated. Water pipe shall be installed with minimum distance from sewer and septic pipe as summarized in Section 3.3.1.2 H.
- C. Pipe shall be laid accurately to line and grade in sand bedding conforming to MassDOT Standard Spec. M1.04.0 Sand Borrow and AWWA guidelines. The depth of the sand bedding shall be one half (1/2) the diameter of the pipe under the main and one half (1/2) the diameter of the pipe over the main or 6 inches both under and over the pipe, whichever is greater. Bedding shall be placed in layers not over six inches thick, and each layer shall be thoroughly compacted by tamping and chinking on each side of pipe to provide uniform support.
- D. Backfill material placed above the bedding material and below the roadway foundation shall conform to 6.3.1. Roadway foundation and surface restoration shall conform to Section 5, Roadway Construction Standards, and Section 6, Existing Road Openings, as applicable.
- E. Push-on pipe gaskets shall be clean and thoroughly coated with lubricant specified by the manufacturer during installation.

2.3.1.1 Pressure Tests

- A. The pipelines shall be tested (in sections if required by the Town) for strength and for leakage at a pressure of 200 pounds per square inch. In certain circumstances, the Town may require higher pressure tests. The tests for leakage shall last for two hours although the Town may allow a one hour test subject to advanced approval. No more than 1,000 feet of water main shall be tested in a single test.
- B. The additional water needed to maintain the required pressure shall be accurately measured in a manner approved by the Town. The container shall be clearly labeled with its capacity in gallons. Allowable leakage amounts will be determined by the AWWA standards for pressure testing Ductile Iron pipe (AWWA C600 latest revision).
- C. Tests shall be made for all newly installed pipe and when required by the Town. A 24-hour notice shall be given to the Town prior to all tests. The Contractor shall pay for and make all necessary arrangements for securing the water for test purposes. For private funded projects where water is collected straight from an un-metered source, the Contractor shall notify the Town of the quantity of water to be used. The Town will subsequently bill the contractor for that water usage.
- D. During this test all hydrant laterals shall be in the open position. Methods of testing and plans showing sections to be tested shall be submitted to the Town for approval as requested. The Contractor will not perform a pressure test against existing valves unless authorized by the Town.



- E. The Contractor shall submit a written report to the DPW summarizing the results. The Contractor shall repair all leaks discovered under any of the required tests and retest the pipe. The Town will not accept any installation where a final test has not been passed.

2.3.1.2 Chlorination of the Pipeline

- A. Prior to disinfection, the Contractor shall submit a detailed disinfection plan to the DPW. The plan shall be prepared consistent with AWWA standards and federal and state regulations, and it shall outline and describe the disinfection procedures. At minimum, the plan shall include the following components:
- General: All water mains, water services, attached appurtenances and connections shall be disinfected in accordance with AWWA Standard C651.
 - Disinfection of new mains, including all chlorination, chlorine residual measurements, collection of samples, and certification shall be conducted by a third party testing agency approved by the DPW.
 - All pipe, fittings, and appurtenances shall be kept free from dirt and foreign matter at all times. During construction all open pipe ends and fittings shall be fitted with a water tight plug. At the end of the work day the open pipe in the trench shall be plugged in an equally suitable manner.
 - The interior surfaces of new valves, pipe and appurtenances shall be swabbed, as well as the interior surfaces of existing main, both upstream and downstream of the new pipe section, with a minimum five percent concentration of hypochlorite disinfection solution before installation. During the chlorination or chlorinating process, all valves shall be operated, and the chlorine solution shall be drawn through all laterals and appurtenances. Disinfection of mains and appurtenances, hydrostatic testing, and chlorine retention may run concurrently for the required minimum 24- hour period only if prior approval is obtained from DPW.
 - In the event of leakage or where repairs are necessary, added disinfection shall be made only by injecting chlorine into the line whereby adequate mixing is assured. If the test results are not satisfactory, additional disinfection shall be required.
 - Chlorine Dosage and Injection shall be performed in accordance with the continuous feed method as described in AWWA C651. The Disinfection Plan shall summarize the intended chlorine dosage and the method for establishing that dosage. The disinfection may be accomplished by introducing into all the various parts of the new water mains a liquid solution containing one percent available chlorine in such volume that the rate of dosage to the water mains shall be at least 25 parts per million of available chlorine. The Disinfection Plan shall document the locations and methods for applying the chlorine into the pipeline. Disinfection Period and Flushing – The contact period for this disinfection shall be at least twenty-four hours, and a longer period will be required if tests of residual chlorine show it to be less than the required minimum of 10 mg/l. The pipeline shall be adequately flushed with potable water and the Disinfection Plan shall document the method for de-chlorinating and discharging the residual water. All discharges must comply with local, state and federal requirements
 - Water shall be flushed from the line at its extremities and at all outlets until the chlorine residual of the water system being flushed is equal or less than the distribution system level.
 - Sampling – Sampling shall be performed by an independent certified laboratory according to AWWA C651 – Disinfecting Water Mains. After flushing the chlorine, the water shall sit in the pipe for 24 hours and then be sampled. After this sample is taken, the same water shall remain for another 24 hours' retention time and shall be sampled again (i.e., samples will be taken at 24 and 48 hours after flushing). Should the chlorine residual in any part of the



disinfected system be higher than the distribution system level, the flushing procedure shall be repeated. If bacterial test results fail to pass the requirements, corrective actions shall be taken, and daily bacteriological sampling shall be continued until two (2) consecutive negative samples are demonstrated.

- B. The Contractor shall not proceed with the disinfection procedures until the Disinfection Plan has been approved by the DPW. All sampling results shall be submitted to the DPW prior to activation of the water main.
- C. Connections at cuttings shall be swabbed with a 5% solution of chlorine at locations when other methods are not applicable.
- D. All water used to disinfect pipe shall be discharged and managed consistent with the appropriate state and local regulations. These shall include the Town of Framingham Conservation Commission permitting and the *Illicit Discharges to Municipal Separate Storm Sewer System* bylaw.
- E. Water mains and appurtenances must be completely installed, flushed, disinfected, and satisfactory bacteriological sample results received prior to connections being made to the active distribution system.

2.3.2 Valves

- A. All material shall be inspected for defects prior to installation. Defective materials shall be immediately removed from the site. All foreign matter shall be removed from valve openings and seat faces. All nuts and bolts shall be checked for tightness.
- B. For any T-connections that may be considered a lateral connection, the valve for the lateral line shall be attached with an anchor-T or tapping sleeve if approved by DPW (See Detail W-2.4.1). The valves on the main line shall be installed in line with the curb (see Detail W-2.4.3).

2.3.3 Tapping

- A. Where there is more than one public water main in a street, the Town shall determine which main the owner may tap for water service pipe connection. Water mains designated as transmission mains shall not be tapped for water service, except when approved by the Town.
- B. Service taps to the distribution main shall be separated by a minimum of 18-inches in all directions.
- C. Temporary taps installed for filling and testing a pipe shall be abandoned prior to Town acceptance. Abandonment shall include cut pipe no more than 3" from the corporation stop and corporation stop shall be in the closed position.

2.3.4 Thrust Restraint

2.3.4.1 Thrust Blocks

- A. Thrust blocks may only be used against undisturbed soil. They shall be designed in accordance with the Design Standards using the appropriate concrete and pressures as specified in the Construction Details and the AWWA standards and guidelines.

2.3.4.2 Tie Rods

- A. Tie rod systems may be used where approved by the Town. All materials shall be steel and coated with an approved bituminous coating or other approved corrosion resistant coatings. Unless otherwise



required or approved by the Engineer, the Contractor shall install tie rods in accordance with the following schedule for all fittings:

Minimum Tie Rod Design		
Pipe Size (inches)	Number of Rods	Tie Rod Diameter (inches)
4"-12"	2	3/4"
16"	4	3/4"
20" – 24"	4	1 1/2"

2.3.4.3 Wedge Action Retaining Joints

- A. Wedge Action Retaining Joints may be used wherever approved by the Town and shall be manufactured of ductile iron conforming to ASTM A536. The mechanical joint restraint shall be Megalug Series 1100 or equal approved by DPW.

2.3.5 Electrical Grounding

- A. No electrical grounds shall be made on water service pipes where a driven ground rod can provide the needed grounding service. Electrical grounding shall be provided in accordance with the Massachusetts Electric Code.

2.3.6 Fire Suppression

- A. All new fire suppression (i.e. sprinkler) connections shall be coordinated with and approved by the Town's fire department.
- B. Fire suppression connections shall be coordinated with the property owner. Sprinkler valves shall only be operated by a certified sprinkler operator. The certified sprinkler operator shall bleed air from the sprinkler system upon completion of installation.
- C. Single-family detached dwellings (i.e. single-family homes) may tap a single fire suppression service connection from their domestic water line if all of the following conditions are met:
1. The connection is made after the water meter
 2. A testable backflow preventer is installed on the fire service line next to the connection
 3. All pipes used in the fire suppression system be approved to carry potable water
 4. Fire suppression system does not contain anti-freeze or any substance other than potable water
- D. No fire service connection may be tapped off a domestic service (and vice-versa) for all commercial and multi-family properties. Separate domestic and fire services shall be installed from the building serviced to the public water main.

2.3.7 Pipe, Valve and Structure Abandonment / Removal

- A. Pipes left in place that are greater than 6 inches in diameter shall be filled with CDF regardless of material (e.g., DI, PVC).



- B Pipes left in place that are equal to or less than 6 inches in diameter may be left unfilled.
- C Structures left in place shall be demolished down to five feet below ground surface, the bottom shall be cracked and compacted, and the remaining structure filled with CDF. Demolition debris shall be removed, and the area regraded and compacted over the filled structure.
- D. When abandoning asbestos cement pipe, care shall be used to prevent pipe material from becoming friable, thereby rendering it as regulated asbestos containing material (US EPA).

2.4 References

- A. All materials and execution shall conform to the highest applicable standards. If there is a conflict between other standards, or between other standards and these Design standards, then the most stringent criteria shall be used.
- B. The Town commonly references AWWA standards as guidance for the materials and execution of work performed on the Town's water infrastructure. The following summarizes select AWWA standards applicable to the sections in these Design Standards. This list is not exclusive as other standards may apply. The latest revision of each standard shall be referenced.

Standards	Title/Subject
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM D3350.	Standard Specification for Polyethylene Plastic Pipe and Fittings Materials
AWWA C104/ANSI 21.4.	American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105/ANSI A21.5.	American Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110/ANSI A21.10.	American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 Inch Through 48 Inch for Water
AWWA C111/ANSI A21.11.	American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C150/ANSI A21.50.	American National Standard for the Thickness Design of Ductile-Iron Pipe
AWWA C151/ANSI A21.51.	American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C153/ANSI A21.53.	American National Standard for Ductile-Iron Compact Fittings, 3 In. Through 64 In.
AWWA C502.	AWWA Standards for Dry-Barrel Fire Hydrants
AWWA C504	AWWA Standard for Rubber-Seated Butterfly Valves
AWWA C509.	AWWA Standard for Resilient-Seated Gate Valves for Water Supply Service
AWWA C515.	AWWA Standard for Reduced-Wall Resilient-Seated Gate Valves for Water Supply Service



AWWA C600.	AWWA Standard for the Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C651.	AWWA Standard for Disinfecting Water Mains
AWWA C901.	Polyethylene (PE) Pressure Pipe and Tubing, ½ Inch – 3 Inch, for Water Service
MassDEP	Guidelines for Public Water Systems (April 2014)
US EPA	In a Guidance Letter dated July 17, 1991, identified as Control # C99 within the Agency Applicability Determination Index, the U.S. EPA determined that “the pumping of grout into buried lines is not a process which, in and of itself, would cause asbestos cement pipe to become regulated asbestos containing material.”





3 Sewer Construction Standards

3.1 General

3.1.1 Description

- A. This Section specifies requirements for a gravity flow sewerage system and pressure sewer system.
- B. The work includes furnishing and installing all pipe, fittings, manholes, structures and appurtenances required for the proposed system to convey sewage by gravity flow conditions. Work when applicable will include furnishing and installing all pipe, fittings, valves and structures for a pressure sewer system.
- C. Work and materials shall be performed in accordance with the State Plumbing Code when work is within ten (10) feet of buildings.

3.1.2 Submittals

- A. Materials List and Shop Drawings
 - 1. The list of materials proposed shall be submitted to the Town.
 - 2. Approved shop drawings for all materials (including bricks and mortar) and structures shall be submitted to the Town.
- B. As-Built Drawings
 - 1. Submit one (1) copy of As-Built Drawings to the DPW upon completion and acceptance of work.
 - 2. As-Built Drawings shall be complete and shall indicate the true measurement and location, horizontal and vertical, of all new construction. As-Built Drawings shall include a minimum of three (3) ties to each manhole from fixed permanent objects. As-Built drawings shall also contain any additional information required by the municipality and shall be stamped with the seal of a Professional Land Surveyor or Licensed Professional Engineer. The Town may, at its discretion, require that as-built plans be submitted on electronic form (e.g., AutoCAD release 2008 or higher).
 - 3. As-Built Drawings shall be filed or stored on property and available for use by DPW for all commercial, industrial, and institutional properties and large residential properties, such as apartment or condominium complexes and assisted or congregate living facilities.
- C. Abandonment Plan
 - 1. Pipes abandoned using control density fill shall be subject to prior DPW approval of an abandonment plan.
- D. Temporary wastewater bypass plans shall be prepared by a registered professional engineer and submitted to DPW for review and approval prior to installation. Bypass plans shall include and consider the following:
 - 1. Proposed schedule for installing, testing, operating, restoring flows to normal conditions, and removing the temporary bypass.



2. Details of the materials, size, number, and location of temporary facilities including upstream suction manhole and downstream discharge manhole locations, piping layout, bypass pumps, mains, valves, connections, laterals, services, and primary and standby power.
 3. Sewer plugging location(s) and method, type, and quantity of plugs. Spare plugs of the proper size and material shall be stored on site and available at all times of bypass operation.
 4. Primary and backup bypass pump sizes, capacity, and number to be on site, power requirements, and power supply. Pumps shall be either submersible or self-priming type.
 5. All bypass piping and system components shall be watertight and pressure rated for the proposed bypass system operating conditions.
 6. Calculations of flow rate, static head, friction losses, total dynamic head, flow velocity, and pump curves indicating operating range.
 7. Method of noise control for pumps and generators.
 8. Surcharging of upstream flows during bypass shall be minimized at all times. The pumping system may not surcharge the upstream sewer more than 18-inches in the vertical direction as measured from the invert of the existing suction manhole from which bypass pumps are withdrawing wastewater. The suction and discharge manholes shall be frequently monitored by the Contractor to observe flow rate and flow depth conditions in the existing system during bypass operations.
 9. Flow turbulence in the downstream discharge manhole shall be minimized at all times.
 10. All work shall be coordinated with DPW and no construction activity shall commence without a minimum of 48 hours advance notice.
- E. Temporary stone sump systems are not allowed as a temporary wastewater disposal method for service connection flows

3.1.3 Inspection

- A. The Applicant is responsible for the provisions and all test requirements specified in ASTM D3034 for SDR 35 gravity pipe and ASTM D2241 for polyvinyl chloride (PVC) pressure rated sewer pipe. In addition, all PVC pipe may be inspected at the plant for compliance with these specifications by an independent testing laboratory.
- B. Inspection of the pipe may also be made after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the specification requirements, even though pipe samples may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the site at once.

3.1.4 Delivery, Storage and Handling

- A. All materials shall be adequately protected from damage during transit. Pipes shall not be dropped.
- B. All pipe and other appurtenances shall be inspected before placement in the work and any found to be defective from any cause, including damage caused by handling, and determined by the Town to be unreparable, shall be replaced at no cost to the Town.
- C. Storage and handling of pipes, manholes and other sewer system appurtenances shall be in accordance with the manufacturer's recommendations, subject to the approval of the Town.



3.2 Materials – Gravity Sewer Systems

- A. The Materials section summarizes the Town's standardized components to be used in public and private components that affect the Town's sewer system. All materials should conform to the applicable ASTM standards.

3.2.1 Polyvinyl Chloride Pipe (PVC) (Gravity)

- A. Pipe and Fittings: Polyvinyl chloride pipe and fittings (PVC) shall be minimum SDR 35 with full diameter dimensions conforming to the specifications for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings, ASTM Designation D-3034, latest revision, for sizes 3 inches to 15 inches. For sizes 18 inches to 48 inches, the pipe shall comply with ASTM F679, latest record.
- B. Pipe color shall be in accordance with Uniform Color Code as established by the American Public Works Association Utility Location and Coordination Council (adopted September 2000).

3.2.2 Couplings

- A. Fittings, couplings, and adaptors for use with the gravity sewer system shall be Romac Industries, Inc. or an approved equal. Saddles for low-pressure sewers shall be bolt-on premier units. They shall have polypropylene bodies, stainless steel fasteners, stainless steel reinforced outlets.
- B. Joints: PVC pipe shall have an integral wall bell and spigot push-on joint with elastomeric gaskets secured in place in the bell of the pipe. The bell shall consist of an integral wall section with a solid cross section elastomeric gasket, factory assembled, securely locked in place to prevent displacement during assembly. Elastomeric gaskets shall conform to ASTM D3212.
- C. Spigot pipe ends shall be supplied with bevels from the manufacturer to ensure proper insertion. Each spigot end shall have an "assembly stripe" imprinted thereon to which the bell end of the mated pipe will extend upon proper joining of the two pipes.
- D. Where petroleum contamination is known or suspected to be in the soil and/or groundwater, nitrile gaskets shall be required.

3.2.3 Ductile Iron Pipe (Gravity) – where required by Town

- A. Ductile Iron Pipe: ASTM A746, Extra Heavy type, bell and spigot end, with Inderon Protecto 401 ceramic epoxy lining or equivalent applied per manufacturer's recommendation.
- B. Ductile Iron Pipe Joint: ANSI A21.11, rubber gasket joint.
- C. Where petroleum contamination is known or suspected to be in the soil and/or groundwater, nitrile gaskets shall be required.

3.2.4 Cast Iron Pipe (Gravity) (For Plumbing Code Areas Only)

- A. Cast Iron Soil Pipe: ANSI/ASTM A74, Extra Heavy type, bell and spigot end, inside to be asphalt coated per manufacturer standard.
- B. Cast Iron Pipe Joint: ASTM C564, rubber gasket joint devices.
- C. Transitions between different gravity pipe sizes shall be accomplished by using Femco or approved equal flexible eccentric reducing couplings with stainless steel bands. Completed pipelines shall be free of deviations from grade. Visible leaks, broken pipes, etc., shall be repaired or replaced.



- D. Fittings for pressure sewer pipe shall be of similar calls and style and material to match the force main material (PVC or DI). Bells shall be gasketed joint conforming to ASTM D3139 with gaskets conforming to ASTM F477. Gasket material shall be equal to that specified for pipe.

3.2.5 Cleanouts

- A. The sewer cleanouts shall be minimum 6-inch diameter or sized to match the service pipe, whichever is greater. The cleanouts shall be either stubbed 6 inches above surface grade, or completed at finish grade if contained within a hand hole clearly marked "SEWER" per Standard Detail S-3.2.0. Cleanouts shall include a water-tight cap.

3.2.6 Manholes

- A. All precast concrete manholes shall conform to the ASTM "Specifications for Precast Reinforced Concrete Manhole Sections," Designation D478. The barrel shall be 4-foot or 5-foot diameter at the Town's discretion. The precast structures shall be manufactured with 4,000 psi minimum compressive strength concrete, with eccentric cone section tapering to 30-inch diameter, or flat top, and one pour monolithic base section conforming to ASTM C478. All units to be designed for HS-20 loading.
- B. Precast Unit Joint: Butyl rubber section joint conforming to ASTM C443.
- C. The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on the inside of each precast section.
- D. Manhole frames and covers shall be minimum Class 25 conforming to ASTM "Standard Specification for Gray Iron Castings," Designation: A48. Manhole frame shall have a clear opening of 24 inches and be a minimum of 6 inches in height. The surface of the covers for manholes that will not become the property of the Town of Framingham shall have a diamond pattern with the word "SEWER" cast thereon for sanitary sewers. For sewer systems that will become the property of the Town, the sewer manholes shall include the words "FRAMINGHAM SEWER." Watertight manhole covers shall be secured with six (6) stainless steel bolts and have a watertight gasket. The frame and cover shall be watertight up to 15 psig external pressure.
- E. All manholes frames and covers shall be manufactured by East Jordan Iron Works (formerly LeBaron Foundry Co.) or an approved equal.
- F. The top of cone shall be constructed of red brick or reinforced concrete grading rings for adjusting frame to match finished surface. Manhole frame shall be flush with grade using a minimum of two (2) and a maximum of five (5) brick courses. Elevations greater than 6 inches vertical may include riser rings designed for that purpose. Brick shall conform to sewer bricks (made from clay) ASTM designation C32, Grade MS.
- G. Curve side inverts and layout main inverts (where direction changes) shall be constructed with smooth curves of longest possible radius tangent to adjoining pipelines centerline. All inverts shall be constructed with 4,000 psi concrete in void areas and with sewer brick. Brick shall conform to sewer bricks (made from clay) ASTM designation C32, Grade SS.
- H. Mortar shall be in conformance with ASTM C270, Type M. The mortar shall be composed of Portland cement hydrated lime, and sand, in the proportions of 1 part cement to ¼ part hydrated lime to 3 ½ parts sand, by volume.
- I. Cement shall be Type I or II Portland cement conforming to ASTM C150, Standard Specification for Portland Cement. Where masonry is exposed to salt water, Type II shall be used.
- J. Hydrated lime shall be Type S conforming to ASTM D207.
- K. Sand for masonry mortar shall conform to the gradation requirements of ASTM C144.



- L. All drop manholes will be of the external type. The drop pipe shall be constructed of minimum SDR 35 PVC. The drop piping and horizontal cleanout sections will be sized the same as the sewer main piping and shall enter the manhole at invert elevation. The drop portion of the piping shall be secured with anchor straps. The drop piping shall be encased with control density fill.
- M. Manhole Pipe Connections: Flexible sleeve or rubber gaskets shall be Lock Joint, Kor-n-Seal, A-Lok, or approved equivalent.
- N. Manhole covers shall be watertight when placed in the 100-year flood plain areas or as determined by DPW, and as specified in federal, state and local regulations.

3.2.7 Manholes & Sewer Structures – Bitumastic Coatings

- A. The entire exterior surface of all masonry and concrete (whether precast or cast-in-place) structures associated with sewerage systems, such as: manholes, grease traps, holding tanks, tight tanks, septic tanks, aeration tanks, pump stations, valve pits, etc., shall receive two coats of waterproofing such as Carboline Bitumastic 300M as manufactured by SOMAY Products, Inc., Miami, FL; Sonnoshield HLM 5000 as manufactured by Sonneborn, Shakopee, MN or approved equal at a minimum thickness of 7 mils per coat and a total thickness of 14 mils; however, in no case shall the thickness per coat be less than that recommended by the manufacturer.

3.2.8 Sewer Piping Connections

3.2.8.1 Service Connections

- A. Gravity service connections shall be minimum 6 inch PVC. All connections into sewers shall be by wyes, T-wyes, or a Romac saddle, and couplings manufactured for use with the same type of pipe. Service connections made using saddles and tapping sleeves shall be allowed only when authorized by the DPW. All service connections shall have a slope between 2 and 6 percent. Service connections that have a vertical drop of 4 feet to 12 feet between the house sewer invert at the street and the main sewer invert shall be by sloped line using 22-degree or 45-degree angle connectors to allow snakes and rods to clean the line between the house and the main sewer.
- B. For grinder pump to gravity sewer connections, the service connections shall be minimum 2-inch DI or SDR 21 PVC. Check valves shall be Y-pattern commercial bronze valves.
- C. Portions of existing service piping to remain shall be video inspected prior to verify pipe condition, ensure integrity, and limit infiltration. Service piping video shall be provided to DPW for review prior to approval of existing piping reuse.
- D. Use of Inserta Tee service connectors may be allowed upon specific approval by DPW.

3.3 Execution – Gravity Sewer Systems

- A. This section summarizes the DPW's standardized methods for the installation and maintenance of certain aspects of the sewer system. All procedures should be performed consistent with ASTM standards.

3.3.1 Piping

- A. The minimum pipe diameters for gravity building sewers and public sewers shall be six and eight inches, respectively. All pipes shall be designed based on the standards established in the Water Environment Federation/American Society of Civil Engineers *Manual of Practice No. FD-5, Gravity Sanitary Sewer Design and Construction*, latest edition, and New England Interstate



Water Pollution Control Commission, *Guides for the Design of Wastewater Treatment Works, Technical Report # 16*, latest edition, and sound engineering principals.

- B. Pipe shall be handled in an approved manner, using slings or other approved devices. No pipe shall be dropped from trucks or into trenches.
- C. Pipe shall be laid accurately to line and grade in three-quarter (3/4") crushed stone. The depth of the crushed stone shall be one half (1/2) the diameter of the pipe under the main and one half (1/2) the diameter of the pipe over the main or 6 inches both under and over the pipe, whichever is greater. Stone shall be placed in layers not over six inches thick, and each layer shall be thoroughly compacted by tamping and chinking on each side of pipe to provide uniform support.
- D. Backfill material placed above the bedding material and below the roadway foundation shall conform to 6.3.1. Roadway foundation and surface restoration shall conform to Section 5, Roadway Construction Standards, and Section 6, Existing Road Openings, as applicable.
- E. Impervious material may be required on service connections for a distance 10 feet from the inside wall of the foundation to where crushed stone can start. Pipe shall be laid with the spigot end pointing in the direction of the flow.
- F. Sewer pipe shall be laid at a minimum of ten feet from the water main. Should local conditions prevent a lateral separation of ten feet, a sewer may be laid closer than ten feet from a water main if:
 - Approved by DPW
 - It is laid in a separate trench.
 - The sewer is encased in concrete, unless otherwise approved by DPW.
 - The elevation of the top (crown) of the sewer is at least 18 inches below the bottom (invert) of the water main. The sewer pipe shall be laid such that the pipe joints are equidistant and located as far as possible from the water main crossing. See Section 3.3.1.2.H for additional requirements.
- G. Sewer pipe shall be laid at a minimum of 5 feet horizontally from a drainage main and 18 inches vertically from a drainage main (see 4.3.7)
- H. Sewer pipe shall have a minimum cover of 3 feet unless otherwise approved by DPW.

3.3.1.1 Gravity Main

- A. The connection of the building sewer to the public sewer shall be made at the "Y" branch, if such branch is available at a suitable location. Lateral stubs or stubs for future sewer extensions shall be capped watertight until permanent connections are completed. All lateral stubs shall be approved by the Town prior to installation. If no branch is available, a connection may be made by tapping the public sewer by an approved method, then inserting an approved cast iron, ductile iron, stainless steel or PVC "Y" or "T" saddle with stainless steel mounting bands or other approved connection device. Cutting a hole in the public sewer by hand is prohibited.
- B. All sewer mains shall be laid with a straight alignment between manholes. When tying into an existing manhole, the manhole wall shall be cored and an insert installed for water-tightness.

3.3.1.2 Pipe Installation

- A. All sewer pipes shall be laid accurately to the lines and grades shown in the Drawings and in conformance with pipe manufacturer's recommended procedures.
- B. Notch under pipe bells and joints, where applicable, to provide for uniform bearing under entire length of pipe.



- C. **Laying Pipe:** Each length of pipe shall be laid with firm, full and even bearing throughout its entire length, in a prepared trench. Pipe shall be laid with bells upgrade unless otherwise approved by the Engineer. Do not permanently support pipes on bells.
- Every length of pipe shall be inspected and cleaned of all dirt and debris before being laid. The interior of the pipe and the jointing seal shall be free from sand, dirt and trash. Extreme care shall be taken to keep the bells of the pipe free from dirt and rocks so that joints may be properly lubricated and assembled. No pipe shall be trimmed or chipped to fit.
- No length of pipe shall be laid until the proceeding lengths of pipe have been thoroughly embedded in place, to prevent movement or disturbance of the pipe alignment.
- All piping shall be laid in the dry with the spigot ends pointing in the direction of flow. Installation shall proceed from the downstream to upstream in all cases.
- D. **Pipe Extension:** Where an existing pipe is to be extended, the same type of pipe shall be used, unless otherwise approved by the Engineer.
- E. **Full Lengths of Pipe:** Only full lengths of pipe shall be used in the installation except that partial lengths of pipe may be used at the entrance to structures, and to accommodate the required locations of service connection fittings.
- F. **Pipe Entrances to Structures:** All pipe entering structures shall be cut flush with the inside face of the structure, and cut ends of the pipe surface within the structure shall be properly rounded and finished so that there will be no protrusion, ragged edges or imperfections that will impede or affect the hydraulic characteristics of the sewage flow. The method of cutting and finishing shall be subject to the approval of the Engineer.
- G. **Protection During Construction:** The Applicant shall protect the installation at all times during construction, and movement of construction equipment, vehicles and loads over and adjacent to any pipe shall be performed at the Applicant's risk.
- At all times when pipe laying is not in progress, all open ends of pipes shall be closed by approved temporary water-tight plugs. If water is in the trench when work is resumed, the plug shall not be removed until the trench has been dewatered and all danger of water entering the pipe eliminated.
- H. **Water Pipe – Sewer Pipe Separation:** When a sewer pipe crosses above or below a water pipe, the following procedures shall be utilized. The Applicant shall comply with the following procedures:
1. **Relation to Water Mains:**
 - a. *Horizontal Separation:* Whenever possible, sewers shall be laid at a minimum at least 10 feet horizontally from any existing or proposed water main. Should local conditions prevent a lateral separation of 10 feet, a sewer may be laid closer than 10 feet to a water main, if:
 - i. It is laid in a separate trench, or if
 - ii. It is laid in the same trench with the water mains located at one side on a bench of undistributed earth, and if
 - iii. In either case, the elevation of the top (crown) of the sewer is at least 18 inches below the bottom (invert) of the water main.
 - b. *Vertical Separation:* Whenever sewers must cross under water mains, the sewer shall be laid at such an elevation that the top of the sewer is at least 18 inches below the bottom of the water main. When the elevation of the sewer cannot be varied to meet the above requirements, the water main shall be relocated to provide this separation or reconstructed with mechanical-joint pipe for a distance of 10 feet on each side of the



sewer. One full length of the water main should be centered over the sewer so that both joints will be as far from the sewer as possible.

When it is impossible to obtain horizontal and/or vertical separation as stipulated above, the sewer shall be provided with ceramic epoxy lining for sewer applications or other equivalent based on, corrosion protection, watertightness, and structural soundness. Both pipes shall be pressure tested by an approved method as described in Section 3.3.2 to assure watertightness or both pipes shall be encased in control density fill (CDF).

- I. Sewer Pipes-Laser Installation: Sewer pipes shall be laid to required grades by use of a laser and target system, unless otherwise specifically approved in writing by engineer.

3.3.1.3 Pipe Joints

- A. All joints shall be made water-tight.
- B. Pipe shall be jointed in strict accordance with the Pipe manufacturer's instruction. Jointing of all pipe shall be done entirely in the trench.
- C.
 - 1. Lubricant for jointing of PVC pipe shall be applied as specified by the pipe manufacturer. Use only lubricant supplied by the pipe manufacturer.
 - 2. PVC Pipe shall be pushed home by hand or with the use of bar and block. The use of power equipment, such as a backhoe bucket, shall only be used at the direction of the manufacturer.
 - 3. Field-cut pipe ends shall be cut square and the pipe surface beveled to the size and shape of a factory-finished beveled end. All sharp edges shall be rounded off.
- D. Jointing of Ductile Iron and Cast Iron Pipe shall be in accordance with Section 2, Water Construction Standards.
- E. Bentonite collars shall be placed every 500 feet on sewer lines placed in the groundwater table that are more than 1200 feet in length. Collars shall extend to the width and height of the stone bed.

3.3.1.4 Manholes

- A. General Requirements: All manholes shall be built in accordance with the Details and in the locations shown on the Town of Framingham Details.
- B. Structures shall be constructed of precast concrete.
- C. All masonry shall be installed by personnel experienced and skilled in this work, and any person not deemed to be such by the Engineer shall be removed and replaced by a person so qualified.
- D. Manholes shall be constructed as soon as the pipe laying reaches the location of the manhole. Should the Applicant continue pipe laying without making provision for completion of the manhole, the Engineer shall have the authority to stop the pipe laying operations until the manhole is completed.
- E. The Applicant shall accurately locate each manhole and set accurate templates to conform to the required line and grade. Any manhole which is mislocated or oriented improperly shall be removed and rebuilt in its proper location, alignment and orientation at no additional cost to the Owner.
- F. Foundations: All manholes shall be constructed on a 12-inch layer of compacted bedding material. The excavation shall be dewatered to provide a dry condition while placing bedding material and setting the base.



- G. Inverts: Brick invert channels shall be constructed in all manholes to provide a smooth channel for sewage flow through the structure, and shall correspond in shape to the lower half of the pipe. At changes in directions, the inverts shall be laid out in curves of the longest possible radii tangent to the centerline of the sewer pipes at the manhole side. Brick shelves shall be constructed to the elevation of the highest pipe crown and sloped to drain toward the flow channel. Only red sewer brick shall be used for any invert, brick shelves and manhole frame adjustments. Brick shall comply with ASTM Standard Specification for Sewer Brick (made from clay or shale), Designation C32, for Grade SA, hard brick.

Special care shall be taken in laying brick inverts. Joints shall not exceed three-sixteenth inch in thickness and each brick shall be carefully laid in full cement mortar joints on bottom, side and end in one operation. No grouting or working in of mortar after laying of the brick will be permitted. Bricks forming the shaped inverts in manholes shall be laid on edge.

Invert channels shall be built for future extensions where shown on the Drawings and where directed by the Engineer.

Inverts shall not be built above ground. All inverts shall be built with the manhole in place (i.e. at the design elevation) and with all pipes installed.

- H. Precast Manholes: Precast manholes shall be installed only after Shop Drawings have been approved.
- I. The top grade of the precast concrete cone section shall be set sufficiently below finished grade to permit a maximum of five and a minimum of two courses (laid in the flat position) of eight inch brick to be used as risers to adjust the grade of the manhole frame. Manhole frames shall be set on a grout pad to make a water-tight fit.
- J. Grout fill lifting holes on all manhole sections.

3.3.1.5 Connections to Existing Facilities

- A. General Requirements: The Applicant shall make all required connections of the proposed sewer into existing sewer system, where and as shown on the Drawings and as required by the Engineer.
- B. Applicant to verify the location, size, invert and type of existing pipes at all points of connection prior to ordering new utility materials.
- C. Compliance with Requirements of Owner of Facility: Connections into existing sewer facilities shall be performed in accordance with the requirements of the Owner of the facility. The Applicant shall comply with all such requirements, including securing of all required permits, and paying the costs thereof.

3.3.1.6 Manhole Connections

- A. Manhole pipe connections for precast manhole bases may be accomplished by any method described below. The Applicant shall make sure that the outside diameter of the pipe is compatible with the particular pipe connection used.
1. A tapered hole filled with non-shrink waterproof grout after the pipe is inserted. This connection method will not be allowed when connecting PVC pipe to manholes.
 2. The LOCK JOINT Flexible Manhole Sleeve cast in the wall of the manhole base. The stainless steel strap and exposed sleeve shall be protected from corrosion with a bitumastic coating.



3. PRESS WEDGE II gasket cast into the wall on the manhole base. The rubber wedge shall only be driven into the V slot from the outside of the manhole.
 4. The RES-SEAL, a cast iron compression ring which compresses a rubber "O" ring gasket into a tapered hole in the wall of the manhole base. Exposed metal shall be protected from corrosion with a bitumastic coating.
 5. KOR-N-SEAL neoprene boot cast into the manhole wall. The stainless steel clamp shall be protected from corrosion with a bitumastic coating.
- B. Sewer manholes shall be constructed with drop connections when the proposed invert of the connection is at least 2 feet above the manhole invert. Drop connections for differences of less than 2 feet shall also be provided if required by the Town.

3.3.1.7 Service Connections

- A. General Requirements: The Applicant shall make all required connections of the building sewer service pipes into the sewer system. Work shall include making the service pipe connections into the sewer system pipes or into the manholes located ten (10) feet outside of the proposed building lines. If stubs are constructed for later connection to the building pipes, the ends shall be sealed with watertight plugs.
- B. Coordination with Building Applicant: The Applicant shall coordinate the work with the work of the Building Applicant to determine the exact location and elevation of the point of entry into the building.
- C. Connection into Sewer System: Sewer service pipe connections to the pipe of the sewer system shall be made with fittings supplied by the pipe manufacturer.

The Applicant shall install 45 degree wye branch or 90 degree tee fittings in the sewer pipes at all locations where building sewer service pipe connections are shown on the Drawings. Connections of the sewer service pipes shall be made into the wye branches or tees by means of 45 degree bends. The connections shall be made thoroughly watertight and concrete shall be placed under each connection to bear on undisturbed earth and firmly support the connection. Sewer chimneys shall be encased in concrete unless directed otherwise by the Town.

- D. Any sewer lateral that contains a 45-degree (45°) bend or greater shall require a manhole. Alternative connections shall be allowed only if reviewed and approved by DPW.
- E. Chimney drop sewer services shall only be allowed where the depth of the mainline sewer crown is more than 12-feet from the ground surface. Installation of chimney when the mainline crown is less than 12-feet deep will not be allowed without the prior review by DPW. Service connections shall preferably be installed utilizing the most direct (shortest) route from building to main. Services should be laid out to run perpendicular to the main.

3.3.1.8 Rehabilitation of Sewers with Cured-In-Place Pipeliners

- A. Pipeline rehabilitation using cured in place pipeliners (CIPP) may be approved by DPW for existing public sewers 8-inches in diameter and greater. CIPP rehabilitation of public sewers less than 8-inches in diameter is not permitted.
- B. The CIPP shall conform to the provisions and all test requirements specified in ASTM D790 – Test Methods for Flexural Properties of Un-reinforced and Reinforced Plastics and Insulating



Materials, ASTM F1216 – Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube, and ASTM F2561-11 Standard Practice for Rehabilitation of a Sewer Service Lateral and Its Connection to the Main Using a One Piece Main and Lateral Cured-in-Place Liner.

- C. The CIPP shall be designed based on a fully deteriorated condition of the existing host pipe in which it is assumed that the existing host pipe provides no structural support. The CIPP shall be designed to carry soil, groundwater, and other superimposed loads.
- D. The CIPP shall be designed in accordance with ASTM F1216 under the following conditions:
 - 1. Fully deteriorated host pipe
 - 2. Height of groundwater above pipe invert = Ground surface elevation
 - 3. Height of soil above pipe = Final design ground surface elevation
 - 4. Life Load = AASHTO HS-20
 - 5. Soil density = 120 lbs. / cubic foot
 - 6. Ovality = 2% to 8%
- E. The applicant shall prepare and submit a design submittal prepared and stamped by a registered professional engineer that includes the following:
 - 1. Description of materials and product samples
 - 2. Design parameters
 - 3. Installation process
 - 4. Long term creep data, testing duration 10,000 hours minimum
 - 5. Proposed flexural modulus and flexural strength
 - 6. Proposed wall thickness supported by design calculations
 - 7. Bypass pumping plan
 - 8. Installer's qualifications and relevant experience
- F. The existing sewer shall be cleaned and closed circuit television inspected prior to the CIPP installation to prepare the host pipe and locate the existing service connections.
- G. Installation, curing, cool down, finish, and sealing at manhole and service connections shall conform to CIPP manufacturer's requirements. Curing shall be performed using steam unless otherwise approved by DPW and MWRA.
- H. All service connections shall be reinstated after the CIPP is installed to no less than 95% of the existing service connection diameter and ground or brushed as required to form a neat lateral opening free of any jagged edges, lips, or protuberances. All service connections shall be sealed to prevent infiltration from the edge of lined sewer main to a minimum distance of 12-inches up the service connection utilizing a "top hat" style liner insert or equal.
- I. Post construction acceptance testing of the rehabilitated sewer shall conform to manufacturers requirements, ASTM D5813-04 (2012 or latest edition) - Standard Specification for Cured-In-Place Thermosetting Resin Sewer Piping Systems, and the requirements of Section 3.3.2.
- J. For each separate manhole to manhole segment of CIPP installed, at least one "flat plate" sample and at least one "restrained" sample shall be prepared and tested in accordance with ASTM F1216 and ASTM D790. The proposed testing laboratory shall be submitted for approval to DPW.



Samples shall be tested to verify that the flexural modulus, flexural strength, and wall thickness of the CIPP are at least equal to the parameters proposed in the approved design submittal.

3.3.2 Testing of Public Sewer

- A. If the visual inspection of the completed sewer or any part thereof shows any pipe, manhole or joint which allows infiltration of water, the defective work or material shall be replaced or repaired as directed. After completing installation and backfill of sewer pipe to the satisfaction of the DPW, the applicant shall conduct a line acceptance test under the following procedures.

3.3.2.1 Gravity Main

- A. All gravity sewers that will become the property of the Town of Framingham shall undergo mandrel testing, televised inspection and, as directed by the Town, pressure testing. All televised inspections shall be recorded and provided to the Town in digital format.
- B. Pressure Testing Gravity Sewers – After a manhole to manhole reach of pipe has been backfilled and cleaned, pneumatic plugs shall be placed in the line at each manhole and inflated to 25 psig. Low pressure air shall be introduced into this sealed line until the internal air pressure reaches four psig greater than the average back pressure of any groundwater that may be over the pipe. A minimum two minutes shall be allowed for the air pressure to stabilize. After the stabilization period (3.5 psig minimum pressure in the pipe), the air hose from the control panel to the air supply shall be disconnected. The portion of line being tested shall be termed “Acceptable” if the time required in minutes for the pressure to decrease from 3.5 to 2.5 psig (greater than the average back pressure of any groundwater that may be over the pipe), shall not be less than the time shown for the given diameters as indicated in the Uni-Bell PVC Pipe Association’s, Handbook of PVC Pipe, current edition.

If testing is not feasible between manholes due to live sewer service connections the contractor shall conduct low pressure air testing at each pipe joint.



Pipe Diameter (inches)	Minimum Time (min:sec)	Allowable Maximum Length (L = ft) for Minimum Time	Time for Longer Length (sec)
8	3:46	597	0.380L
10	5:40	398	0.854L
12	7:34	298	1.520L
15	14:10	159	5.342L
18	17:00	133	7.692L
24	22:40	99	13.674L
30	28:20	80	21.366L
36	34:00	66	30.768L
42	39:48	57	41.883L
48	45:34	50	54.705L

Vacuum testing of service connections may be required as directed by the Town.

- C. Deflection testing shall be performed on all flexible pipes. The tests shall be conducted after the final backfill has been in place for at least 30 days to allow for stabilization. Pipe shall be installed so there is no more than a maximum deflection of five (5.0) percent. Deflection testing shall be performed using a specially designed gauge assembly (mandrel) pulled through the complete section. The gauge assembly shall have a diameter of not less than 95 percent of the base inside diameter or the average inside diameter as specified by ASTM. The pipe shall comply with ASTM D2122, Standard Test Method of Determining Dimensions of Thermoplastic Pipe and Fittings. The deflection test shall be performed without mechanical pulling devices. Other testing methods such as electronic deflectometers, calibrated video cameras, or laser profilers must be submitted for review and approval by DPW prior to use.

3.3.2.2 Manholes

- A. All tests shall be observed by a representative of the DPW and the Applicant on each manhole. Manholes shall be tested by vacuum methods [see below].
- B. Vacuum Testing of Manholes – Leakage tests for four and five foot diameter manholes may be made using vacuum testing equipment. This type of test may be used only immediately after assembly of the manhole and only prior to backfilling. The manhole to pipe connection should only be a flexible connector. All lift holes shall be plugged with a non-shrinking mortar. For this test, each four or five foot diameter manhole shall be tested under 10 inches of Hg vacuum. Manholes shall be vacuum tested per ASTM C1244 – 11. Manholes shall be prepared by plugging all lift holes and pipes entering the manhole. Care shall be taken to securely brace the pipes and plugs to prevent them from being drawn into the manhole. The test head shall be placed at the top of the manhole in accordance with manufacturer's recommendations and a vacuum of 10 inches of mercury shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop to 9 in. of mercury. The manhole shall pass if the time for the vacuum reading to drop from 10 in. of mercury to 9 in. of mercury



meets or exceeds the values indicated in the table below. If the manhole fails the initial test, necessary repairs shall be made by an approved method. The manhole shall then be retested until a passing test is obtained.

Depth (feet)	Testing Time (Seconds) for 48 and 60-Inch Diameter Manhole (inches)	
	48-Inch	60-Inch
8 (and less)	20	26
10	25	33
12	30	39
14	35	46
16	40	52
18	45	59
20	50	65
22	55	72
24	59	78
26	64	85
28	69	91
30	74	98

All excess material including dirt, loose concrete, bricks, grit, stones and any other material, shall be removed from all manholes prior to final acceptance by DPW.

3.3.2.3 Pipe and Structure Abandonment

- A Pipes left in place that are greater than 2 inches in diameter shall be filled with CDF regardless of material (e.g., DI, PVC).
- B Pipes left in place that are equal to or less than 2 inches in diameter may be left unfilled.
- C Structures left in place shall be demolished down to five feet below ground surface, the bottom shall be cracked and compacted, and the remaining structure filled with CDF. Demolition debris shall be removed, and the area regraded and compacted over the filled structure.

3.4 General – Pressure Sewers

- A. Whenever possible, the force main will be designed on a continuous slope so that no “high points” exist, which may result in entrapment of gases and so that no “low points” exist which may induce settlement of solids. If unavoidable, all “high points” will have an air/vacuum release valve, and “low points” will have a cleanout. Details for these appurtenances will be provided and they will be accessible for maintenance without the need for excavation. During backfill, a polyethylene warning tape will be buried two feet below the ground surface along the entire length of the force main. Restrained joints on the force main should be used in place of thrust blocks.
- C. The Work of this section includes the installation of a new sewage pump station and pressure sewer as shown on the Drawings and specified herein.
- D. Work under this section shall comply with federal, state, and local requirements for the design, installation, testing, and certification of an operational sewage pump station and pressure sewer



system. The Applicant shall be required to submit Shop Drawings, and Equipment cut sheets for items specified and required in this Section.

- E. Work shall comply with local, state and federal electrical codes to provide watertight and corrosion resistant installations. Electrical junctions of any kind are prohibited within the confines of the wet well.
- F. Work shall comply with the Commonwealth of Massachusetts Plumbing Code.
- G. Pipe color shall be in accordance with Uniform Color Code as established by the American Public Works Association Utility Location and Coordination Council (adopted September 2000).
- H. All pressure sewers and force mains shall be constructed of DI or SRD 21 (pressure rated) PVC. Reference the appropriate AWWA standards latest version for tightness testing. At minimum, all force mains shall be pressure tested with minimum pressure of 150 psi for minimum two hours.

3.5 Materials – Pressure Sewers

3.5.1 Pressure Sewer Pipe and Fittings

- A. Polyvinyl Chloride (PVC) Plastic Pipe and Fittings:
 - 1. Size 1-1/2 inch to 12 inch diameter, SDR 21, ASTM D-2241, with material per ASTM D-1784, Grade 1, Type 1.
 - 2. Push on joint, bell and spigot type with pressure rating of 200 psi.
 - 3. Joints to meet ASTM F477 and tested to ASTM D-3139 standard.
 - 4. Install at locations and sizes indicated on drawings.
- B. Ductile Iron Pipe and Fittings:
 - 1. Pipe size 4 to 12 inches diameter, push-on joint, pressure Class 350, ANSI/AWWA C150/A21.50, inside epoxy coating per manufacturer standard.
 - 2. Pipe size 12 to 24 inches diameter, push-on joint, pressure Class 250, ANSI/AWWA C150/A21.50, inside epoxy coating per manufacturer standard.
 - 3. Fittings, size 4 to 12 inches diameter, pressure Class 350, ANSI/AWWA C153/A21.53, push-on joints per ANSI/AWWA C111/A21.11.
 - 4. Gaskets shall conform to ANSI/AWWA C111/A21.11. Restrained joints shall be provided by a field lock gasket supplied by the manufacturer of the pipe for that purpose. (U.S. Pipe – “FIELDLOK”, Clow – “SUPER-LOCK,” or U.S. Pipe – “TRFLEX”).
 - 5. Pipe and fittings to have an outside coating of asphaltic material per ANSI/AWWA C153/A21.53 and ANSI/AWWA C110/A21.10.
 - 6. Valves and fittings to have an inside coating of epoxy lining applied in accordance with AWWA C550.
- C. Flanged Ductile Iron Pipe and Fittings:
 - 1. Pipe and fitting sizes 3 inches to 24 inches, pressure Class 250 psi, per ANSI/AWWA C115 A21.15 with asphaltic coating outside and epoxy coated inside.
 - 2. Flange bolt circle and holes per ANSI/AWWA/C115/A21.15.
 - 3. Gaskets per ANSI/AWWA C111/A21.11.



4. Flange adapters to push-on joint pipe sections shall be supplied by the manufacturer of the pipe.

3.5.2 Couplings and Connectors

- A. Sleeve Type, Buried:
 1. Cast iron or epoxy coated steel, middle rings, ASTM A513
 2. Reducer type where required
 3. Followers, two steel rings epoxy coated
 4. Bolts ANSI 21.11/AWWA C111, galvanized
 5. Two wedge section compressible gaskets
 6. Dresser Manufacturing Co. – Style 38, 162, or 128 as appropriate
- B. Sleeve Type, Exposed:
 1. Steel middle ring, shop prime.
 2. Reducer type for different pipe sizes.
 3. Two steel follower rings.
 4. Two wedge section compressible gaskets.
 5. Steel bolts.
 6. Dresser Manufacturing Co., Style 38.
- C. Flexible Connectors:
 1. Do not use rubber or elastomeric PVC type flexible couplings to connect pressure sewers.
 2. Material shall be compatible with pipes being joined.
 3. Maximum allowable deflection per joint shall be 15 degrees or per manufacturer's recommendation, whichever is less.
 4. Stainless steel metal retaining rings.
 5. Use suitable retaining control rods.
- D. Air Release and Drain Manholes:
 1. Precast concrete sections with a one-pour monolithic base in accordance with ASTM C478.
 2. Air Release and Air and Vacuum Release Valves of size and type specified herein are to be able to fit into structure with ample room for access and maintenance of these units.

3.5.3 Air Release Valves

- A. Air Release and Vacuum Valve shall be similar to a Clow F 3077, Valmatic VM-49BW.3 or approved equivalent, threaded joint end, valve with cast iron body and bronze body seat, all in accord with APCO 400 Sewage Valves with a working pressure of 150 psi. ASTM A48, Class 30 and ASTM B62.

Air Release and Vacuum Valve shall be installed in the Air Release chamber as shown along the pressure pipe and at any high points constructed due to changes in the pressure pipe route or elevations.



3.5.4 SDR 21 PVC Force Main, Flange Adapter and Thrust Blocks

- A. Joints
 - 1. All joints are to be made water-tight in accordance with the requirements specified herein.
 - 2. Pipe shall be jointed in strict accordance with the pipe manufacturer's instruction. Jointing of all pipe shall be done entirely in the trench.
 - 3. Lubricant for jointing of ball and spigot PVC pipe shall be applied as specified by the pipe manufacturer. Use only lubricant supplied by the pipe manufacturer.
 - 4. Ball and spigot PVC Pipe shall be pushed home by hand or use of bar and block. The use of power equipment such as a backhoe bucket is not recommended and shall only be used at the direction of the manufacturer.
 - 5. To join field-cut pipe, pipe shall be cut square. The cut end of the pipe surface shall be properly beveled to the size and shape of a factory-finished beveled end. All sharp edges shall be rounded off.

3.6 Execution – Pressure Sewers

3.6.1 Sleeve Couplings

- A. Thoroughly clean pipe ends for a distance of 8 inches from the ends prior to installing couplings, and use soapy water as a gasket lubricant.
- B. Slip a follower ring and gasket (in that order) over each pipe and place the middle ring centered over the joint.
- C. Insert the other pipe length into the middle ring the proper distance.
- D. Press the gaskets and followers evenly and firmly into the middle ring flares.
- E. Insert the bolts, finger tighten and progressively tighten diametrically opposite nuts uniformly around the adapter with a torque wrench applying the torque recommended by the manufacturer.
- F. Insert and tighten the tapered threaded lock pins.
- G. Insert the nuts and bolts for the flange, finger tighten and progressively tighten diametrically opposite bolts uniformly around the flange applying the torque recommended by the manufacturer.

3.6.2 Piping

- A. The minimum pipe diameters for pressure building sewers shall be two inches. All pipe should be sized based on sound engineering principals.
- B. Pipe shall be handled in an approved manner, using slings or other approved devices. No pipe shall be dropped from trucks or into trenches.
- C. Pipe shall be laid accurately to line and grade in three-quarter (3/4") crushed stone. The depth of the crushed stone shall be one half (1/2) the diameter of the pipe under the main and one half (1/2) the diameter of the pipe over the main or 6 inches both under and over the pipe, whichever is greater. Stone shall be placed in layers not over six inches thick, and each layer shall be thoroughly compacted by tamping and chinking on each side of pipe to provide uniform support. Impervious material may be required on service connections for a distance 10 feet from the inside wall of the foundation to where crushed stone can start. Pipe shall be laid with the spigot end pointing in the direction of the flow.



- D. Sewer pipe shall be laid at a minimum of ten feet from the water main. Should local conditions prevent a lateral separation of ten feet, a sewer may be laid closer than ten feet from a water main if:
- Approved by DPW
 - It is laid in a separate trench.
 - The elevation of the top (crown) of the sewer will be at least 18 inches lower than the bottom (invert) of the water main.
- E. Sewer pipe shall be laid at a minimum of 5 feet horizontally from a drainage main and 18 inches vertically from a drainage main (see 4.3.7)

3.6.3 Testing Pressure Sewer Pipe

- A. Except as otherwise directed, pressure sewers (force mains) shall be given combined pressure and leakage tests in sections of approved length. The Applicant shall furnish and install suitable temporary testing plugs or caps; necessary pressure pumps, pipe connections, meters, gauges, gates, and other necessary equipment; and required labor. The Owner and Engineer shall have the option of using their own gauges.
- B. Subject to approval and provided that the tests are made within a reasonable time considering the progress of the project as a whole, and the need to put the section into service, the Applicant may make the tests when he desires. However, pipelines in excavation or embedded in concrete shall be tested after the backfilling of the excavation or curing of the concrete and exposed piping shall be tested prior to field painting.
- C. The section of pipe to be tested shall be filled with water of approved quality, and air shall be expelled from the pipe. If blowoffs are not available at high points for releasing air, the Applicant shall make the necessary excavations and do the necessary backfilling and make the necessary taps at such points and shall plug said holes after completion of the test.
- D. The section under test shall be maintained full of water for a period of 24 hours prior to the combined pressure and leakage test being applied.
- E. The pressure and leakage test shall consist of first raising the water pressure (based on the elevation of the lowest point of the section under test corrected to the gage location) to the pressure rating of the pipe or alternately, to two times the maximum calculated operating pressure of the pipe, as approved by the Engineer. If the Applicant cannot achieve the specified pressure and maintain it for a period of one hour, the section shall be considered as having failed the test.
- F. Following or during the pressure test, the Applicant shall make a leakage test by metering the flow of water into the pipe while maintaining in the section being tested a pressure equal to the pressure rating of the pipe. If the average leakage during the two-hour period exceeds a rate of leakage indicated in AWWA Section C600 per 24 hours per mile of pipeline, the section shall be considered as having failed the leakage test.
- G. If the section fails to pass the pressure and leakage test, the Applicant shall do everything necessary to locate, uncover, and repair or replace the defective pipe, fitting, or joint, all at his own expense and without extension of time for completion of the work. Additional tests and repairs shall be made until the section passes the specified test.
- H. If, in the judgment of the Town of Framingham, it is impracticable to follow the foregoing procedure exactly for any reason, modifications in the procedure shall be made as approved, but in any event the Applicant shall be responsible for the ultimate tightness of the line within the above leakage and pressure requirements. Passing the test does not absolve the Applicant from his responsibility if leaks develop later within the period of warranty.



- I. The sewer lines shall be inspected via closed-circuit television (CCTV) after completion with a 2 gpm flow of water to reveal pipe bellies. The remote camera shall also pan to view up the service connections to the Fernco fitting.

3.6.4 Pipe and Structure Abandonment

- A. Pipes left in place that are greater than 2 inches in diameter shall be filled with CDF regardless of material (e.g., DI, PVC).
- B. Pipes left in place that are equal to or less than 2 inches in diameter may be left unfilled.
- C. Structures left in place shall be demolished down to five feet below ground surface, the bottom shall be cracked and compacted, and the remaining structure filled with CDF. Demolition debris shall be removed, and the area regraded and compacted over the filled structure.
- D. In a guidance letter dated July 17, 1991, Identified as Control # C99 within the Agency Applicability Determination Index, the U.S. EPA determined that “the pumping of grout into buried lines is not a process which, in and of itself, would cause asbestos cement pipe to become regulated asbestos containing material.” Therefore when abandoning asbestos cement pipe, care shall be used to prevent pipe material from becoming friable, thereby rendering it as regulated asbestos containing material.

3.7 Grease Traps

3.7.1 Exterior Grease Traps

- A. Exterior grease traps shall be designed by a registered Professional Engineer. The plans shall be stamped and include the design criteria and calculations used to size the grease trap.
- B. Grease traps shall be sized in accordance with Massachusetts Uniform State Plumbing Code 248 CMR 10.00 and shall have a minimum capacity of 1,000 gallons. The grease trap shall be sized to provide a minimum of 24 hours of detention time for the design flow.
- C. The discharge concentration for grease trap effluent fats, oils, and grease (FOG) shall not exceed 100 mg/l.
- D. The grease trap shall be located a minimum of 10 feet from buildings, property lines, water services, and in compliance with all applicable building and zoning codes. The grease trap shall be located where it is accessible for inspection and cleaning.
- E. Piping to and from the grease trap shall be in accordance with the *Sewer Construction Standards*. Inlet and outlet piping shall be 6-inch minimum diameter PVC (SDR 35), with allowable slopes between 2% and 6%.
- F. Sanitary wastewater flow into the grease trap is strictly prohibited. Sanitary flow from the building shall connect to a manhole located downstream of the grease trap. A manhole shall be provided upstream and downstream of the grease trap to facilitate bypass and treatment of flows if the grease trap must be temporarily taken out of service.
- G. The grease trap shall be constructed of reinforced concrete and shall be designed for AASHTO HS-20 loading at a minimum. A 1-inch thick butyl rubber gasket shall be provided between precast sections of tank. Buoyancy calculations shall be provided by the applicant, and if necessary, sufficient ballast (such as a buoyancy slab) shall be provided to counteract buoyancy forces when the grease trap is empty, assuming the groundwater table is at the ground surface.



Interior baffles shall be provided to retain collected grease and other materials and prevent the discharge of these materials into the Town's sewer system.

- H. The grease trap shall have inlet and outlet tees constructed of ductile iron or Schedule 40 PVC pipe. The inlet tee shall extend down a minimum of 12-inches below the normal operating fluid depth in the tank. The outlet tee shall extend down to within 12-inches of the floor of the tank. The outlet invert shall be 2 inches lower than the inlet invert. A minimum of 2 access openings with a minimum diameter of 24-inches shall be provided, and shall be located directly over the inlet and outlet tees. Access openings shall be raised to grade with brick or concrete risers and frames and covers that conform to the Town's *Sewer Construction Standards*.
- I. Water cooled grease traps are prohibited.
- J. The grease trap shall be tested to demonstrate watertightness prior to acceptance and use. Testing shall consist of a water infiltration / exfiltration test. The grease trap shall be filled to 4 inches below the outlet invert. Leakage into or out of the tank shall not exceed 10 gallons per 1,000 gallons of tank volume in a 72-hour period. Test shall be performed before backfilling, and shall be witnessed by the Department.
- K. The grease trap shall be filled to its normal fluid operating depth with clean water prior to its first use.
- L. Unless otherwise required by a schedule established by the DPW, owners or operators shall clean grease traps of accumulated grease and oil in accordance with all applicable local, state and federal laws, and no less frequently than a minimum of once every three months or whenever one quarter of the liquid depth of the trap consists of grease or oil, whichever occurs first. Grease traps shall be cleaned by physically removing accumulated grease, scum, oil or other floating substances and solids. Chemical, biological, or physical means (including flushing with water) shall not be used to release fats, wax, oil, or grease into the sewer, bypass the trap, or otherwise make the trap operate less effectively.
- M. Copies of cleaning and disposal logs shall be provided to the DPW Wastewater Division at 100 Western Avenue.

3.7.2 Interior Grease Traps

- A. At locations where Exterior Grease Traps cannot be constructed to serve a building, an interior grease trap shall be provided. Interior grease traps shall be the automatic grease and oil removal type and sized and installed in accordance with Massachusetts Uniform State Plumbing Code 248 CMR 10.00. The grease trap shall be sized using a one (1) minute draindown period. The grease trap shall be cleaned of accumulated grease and oil based on the manufacturer's recommendations, applicable local, state, and federal laws, or at a minimum monthly, or on a more frequent basis at the discretion of the DPW.
- B. Copies of cleaning and disposal logs shall be provided to the DPW Wastewater Division at 100 Western Avenue.

3.8 References

- A. All materials and execution shall conform to the highest applicable standards. If there is a conflict between other standards, or between other standards and these Design standards, then the most stringent criteria shall be used.



- B. The Town commonly references ASTM standards as guidance for the materials and execution of work performed on the Town's Infrastructure. The following summarizes select ASTM standards applicable to the sections in these Design Standards. This list is not exclusive as other standards may apply. The latest revision of each standard shall be referenced.

Standards	Title/Subject
248 CMR 10.00	Massachusetts Uniform State Plumbing Code 248 CMR 10.00
ANSI/AWWA C110/A21.10	Ductile-Iron and Gray-Iron Fittings for Water
ANSI/AWWA C111/A21.11-07	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
ANSI/AWWA C115/A21.15	Standard for Flanged Ductile-Iron Pipe With Threaded Flanges
ANSI/AWWA C150/A21.50-08	Thickness Design of Ductile-Iron Pipe
ANSI/AWWA C153/A21.53-06	Ductile-Iron Compact Fittings for Water Service
ASTM A48	Standard Specification for Gray Iron Castings
ASTM A513	Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
ASTM A74	Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM A746	Standard Specification for Ductile Iron Gravity Sewer Pipe
ASTM B62	Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM C1244	Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill
ASTM C144	Standard Specification for Aggregate for Masonry Mortar
ASTM C150	Standard Specification for Portland Cement
ASTM C270	Standard Specification for Mortar for Unit Masonry
ASTM C32	Standard Specification for Sewer and Manhole Brick (Made From Clay or Shale)
ASTM C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C478	Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C564	Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM D-1784	Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D207	Standard Specification for Shellac Varnishes
ASTM D2241	Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D3034	Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC)
ASTM D3139	Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D478	Standard Specification for Zinc Yellow (Zinc Chromate) Pigments
ASTM D5813-04	Standard Specification for Cured-In-Place Thermosetting Resin Sewer



Piping Systems

ASTM D790	Test Methods for Flexural Properties of Un-reinforced and Reinforced Plastics and Insulating Materials
ASTM F1216	Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube
ASTM F2561-11	Standard Practice for Rehabilitation of a Sewer Service Lateral and Its Connection to the Main Using a One Piece Main and Lateral Cured-In-Place Liner
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F679	Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings





4 Drainage Construction Standards

4.1 General

- A. On-site retainage of stormwater and implementation of other stormwater management measures to control the rate, volume and characteristics of stormwater discharged to the Town's storm drainage systems shall be required whenever feasible, with exceptions to be approved by the Town. Storm drains, culverts, catch basins, manholes, retention/detention structures, water quality structures, permeable surfaces, and related best management practices (BMPs), shall be installed where necessary to provide adequate treatment and onsite infiltration or offsite disposal of surface water from all streets and adjacent land as shown on the proposed plans that require approval by the Town prior to construction. Structural BMPs shall follow design practices outlined in Volume 2 of the Massachusetts Department of Environmental Protection (DEP) Stormwater Management Standards: "Structural BMP Specifications for the Massachusetts Stormwater Handbook".
- B. All projects that are reviewed for approval must meet the requirements set forth in the Stormwater Management Standards promulgated by the DEP under the Clean Water Act, M.G.L.c. 21, §§ 26-53 and its accompanying regulations 314 CMR 9.0 *Water Quality Certification for Discharge of Dredged or Fill Material, Dredging, and Dredged Material Disposal in Waters within the Commonwealth*; and 310 CMR 10.0 *Wetlands Protection Act Regulations*. Projects include all commercial and industrial construction or renovation; and all subdivisions as defined under the *Rules and Regulations Governing Subdivision of Land in the Town of Framingham*.
- C. No stormwater discharge shall cause or contribute to an exceedance of water quality standards. Additional stormwater quality controls may be required to reduce pollutant loading from drainage systems that ultimately discharge to a water body listed as an impaired water on the most recent Massachusetts Integrated Report of Waters
- D. Stormwater drainage systems shall incorporate Low Impact Development (LID) techniques, where feasible.
- E. All proposals shall include plans that show the size and location of existing storm drainage facilities which the proposed system will tie into. Plans shall provide designs and calculations using a recognized engineering formula showing that the no additional runoff will be introduced into the drainage system as well as calculations and designs showing how the drainage system will meet the DEP Stormwater Management Standards. The plans shall include details and descriptions of erosion control and stormwater management during construction.
- F. Driveways and other entrances to the street shall be constructed to prevent roadway drainage from entering the private property.
- G. This manual contains standards for some common Best Management Practices (BMPs), which can also be found in the DEP's *Massachusetts Stormwater Handbook*. The inclusion of these standards is not meant to be an exhaustive listing of approved BMPs. The *Massachusetts Stormwater Handbook* shall be considered as a guide for other BMPs.

4.2 Private Connections to Town Drainage System

- A. It is the responsibility of the property owner to manage and contain all stormwater drainage and groundwater on their property. Cellar floors and basement floors should be a minimum of 1 foot above the seasonal high ground water table to minimize the need for sump pumps. This is in accordance with the Town's Rules and Regulations Governing Subdivision of Land, Section VII I (21) but is also a useful benchmark for all construction in the Town.



- B. Private drains, including building storm drains for new or existing buildings, groundwater sump drains, cellar drains, and drains from irrigation systems, shall generally not be connected directly to the Town's drainage system. Connections made after February 15, 2009 without Town approval shall be considered as illicit connections and shall be removed by the property owner or the DPW. Please see separate regulations regarding private drainage connections to the Town's drainage system.

4.3 Materials

- A. The Materials section summarizes the Town's standardized components to be used. All materials shall conform to the latest version of the MassDOT Standard Specifications, as amended, and policies and technical guidance in DEP's Stormwater Management Standards and the Massachusetts Stormwater Handbook.

4.3.1 Bedding Material

- A. Pipe, manholes, catch basins, and leaching basins shall be laid in any of the following materials, as specified hereafter or as approved by the inspector.
- Pea stone (3/8 inch in size)
 - Angular crushed stone or rock, dense or open graded with little or no fines (1/4 inch to 1 1/2 inches in size).
 - AASHTO classifications A1 and A3: Clean, coarse grained materials, such as gravel, coarse sands and gravel/sand mixtures (1 1/2 inches maximum in size).
 - AASHTO classifications A-2-4 and A-2-5: Coarse grained materials with fines including silty or clayey gravels or sands. Gravel or sand must comprise more than 50 percent of Class III materials (1 1/2 inches maximum size).
 - Approved material shall be sifted to remove rocks larger than 3 inches.
- B. Backfill material placed above the bedding material and below the roadway foundation shall conform to 6.2.1. Roadway foundation and surface restoration shall conform to Section 5, Roadway Construction Standards, and Section 6, Existing Road Openings, as applicable.

4.3.2 Pipe

Polyvinyl chloride (PVC) pipe shall not be used in drainage systems within the Town right-of-way or other roadways.

4.3.2.1 High Density Polyethylene (HDPE) Pipe

- A. The pipe shall conform to MassDOT Section M5.03.10. Pipe shall be smooth interior wall and corrugated exterior wall, and be water-tight. Pipe shall be minimum 12-inch diameter. Ends shall be bell-and-spigot unless approved by the DPW for the specific application. Pipe shall comply with the requirements for test methods, dimensions and markings found in AASHTO Designations M252 and M294. Pipe shall support an HS-20 live load with a maximum deflection of 5% of the minimum pipe diameter. Pipe and fittings shall be made from virgin polyethylene compounds which conform to the applicable current edition of the AASHTO Material Specifications for cell classification as defined and described in ASTM D3350. Nominal sizes of 12- to 60-inch shall be either AASHTO Type 'S' or Type 'D.'



4.3.2.2 Polypropylene (PP) Pipe

- A. Pipe shall have a stiffness of 46 psi when tested in accordance with ASTM D2412. Pipe with 12" up to 30" ID shall have smooth interior wall and corrugated exterior wall, and be water-tight. Pipe from 30" to 60" ID shall have smooth interior wall and exterior wall with annular inner corrugations, and be water-tight to meet ASTM D3212. Pipe shall be minimum 12-inch diameter. Ends shall be bell-and-spigot unless approved by the DPW for the specific application. Pipe shall comply with the requirements for test methods, dimensions and markings found in AASHTO Designations M252 and M294. Pipe shall support an HS-20 live load with a maximum deflection of 5% of the minimum pipe diameter. Pipe and fittings shall be made from virgin polypropylene compounds which conform to the applicable current edition of the AASHTO Material Specifications as defined and described in ASTM D4101. Nominal sizes of 12- to 60-inch shall be either AASHTO Type 'S' or Type 'D.'

4.3.2.3 Reinforced Concrete Pipe (RCP)

- A. Pipe and flared ends shall conform to the AASHTO M170 for Standard Strength Reinforced Concrete Culvert Pipe for class III Pipe, Wall B. or ASTM C76 for Reinforced Concrete Culvert and Storm Drain Pipe. All pipe 24 inches in diameter or smaller shall be of the bell and spigot type. Pipes larger than 24 inches in diameter shall be tongue and groove or bell and spigot. A preformed flexible plastic sealing compound of Butyl Mastic Rope Sealer " 1" size, "EZ Stick" as manufactured by Concrete Products supply or an approved equal shall be used for sealing water-tight joints.

4.3.2.4 Pipe Ends

- A. The DPW prefers headwalls to pipe ends for most drainage conditions. Designs for pipe ends shall be submitted for approval by the DPW.
- B. Flared end HDPE sections shall conform to MassDOT Section M5.03.10. They shall also meet AASHTO Designations M252 and M294 as well as cell specifications in ASTM D3350.
- C. Flared end RCP sections shall be fabricated to conform to the requirements of AASHTO M170, Class III except the edge bearing tests shall not be required. The flare shall be of the same thickness and materials as the barrel and shall have steel reinforcement equaling or exceeding the requirements of AASHTO M170, Class III except that a double row of steel will not be required. The end sections shall meet MassDOT Standard Specifications Section 230 and MassDOT Construction and Traffic Standard Details Drawing 206.8.0.

4.3.3 Drainage Structures

4.3.3.1 Manholes

4.3.3.1.1 General

- A. Manholes over 12 feet in depth shall have minimum of 5 feet inside diameter. When drop manholes are used the drop shall not be more than 3 ½ feet. Risers shall be brick, not concrete blocks. Risers shall be clay or shale brick, and shall conform to the requirements of AASHTO M 91, Grade MM or as specified in MassDOT M4.05.

4.3.3.1.2 Precast Manholes

- A. Precast Manholes shall be constructed of reinforced precast concrete monolithic base section, barrel section and dome section meeting the latest applicable requirements of ASTM C478 I and AASHTO M 199, or latest revision thereto. Special manholes shall also meet the requirements of



MassDOT Standard Specifications, section M4.02.14, Precast Units. After curing a minimum of 14 days, the outside surface of the tapered or cone section of precast cement concrete drainage structures shall be dried and cleaned.

- B. Tongue and groove sections between barrel sections shall be mortared or use butyl rubber sealants. Live load design shall be H-20 loading. A 26-inch opening will be cast in the top section to accept a standard cast iron frame and cover. Inside diameter shall be a minimum of 4 feet.

4.3.3.1.3 Constructed in Place Manholes

- A. Constructed in Place Manholes shall be built of precast sump, 6-inch concrete barrel blocks, and 4-inch (pie) plates with an inside diameter of 4 feet unless set in the groundwater table. Such manholes shall have a solid (impenetrable) sump. Cement concrete blocks shall conform to ASTM C139. Live load design shall be of H-20 loading.

4.3.3.2 Catch Basins

4.3.3.2.1 General

- A. All basins shall have a sump of at least 48 inches (4 feet) below the invert of the outlet pipe, or otherwise approved by the DPW, and an inside diameter of 4 feet minimum.

4.3.3.2.2 Precast Catch Basins

- A. Precast Catch Basins shall conform to ASTM C478 and AASHTO M 199, or latest revision thereto. A 12-inch opening shall be left in center of the precast base section and filled with washed, screened gravel and left open except when the catch basin is placed in an area of high groundwater. Precast units shall have 2 weep holes built into the walls at floor level of new basins placed in areas above the seasonal high groundwater table. Each weep hole shall consist of 4-inch pipe or equivalent opening to carry water through the wall of the structure. The ends of the pipe shall be left flush with the wall of the structure and covered with ¼-inch mesh galvanized wire screen 23 gauge satisfactorily fastened against wall. The drain weep hole shall be excavated and backfilled with 2 cubic feet of 1 ½-inch washed stone.
- B. Live load design shall be H-20 loading. Catch basins which are limited by height shall be installed with a flat top slab, cast in place, designed for H-20 loading and cast iron frame cast in place.
- C. Direct inlet catch basins shall conform to D-4.1.

4.3.3.2.3 Constructed in Place Catch Basins

- A. Constructed in place catch basins shall be constructed of a precast sump, 6-inch cement block and 4-inch (pie) plates that conform to ASTM C139. The basin shall have a 4 foot inside diameter minimum. Live load design shall be HS-25 loading.

4.3.3.2.4 Leaching Basins

- A. Leaching basins shall be per MassDOT Construction and Traffic Standard Details, Drawing 205.20. Leaching basins shall only be used in areas with highly permeable soils where the bottom of the basin is at least 2 feet above seasonal high groundwater. Safe overflow of these devices shall be provided in the event of severe storm events or of clogging of the soils surrounding the device.



4.3.3.2.5 Drop Inlet Catch Basins

- A. Drop (aka Direct) inlet catch basins may be connected to standard catch basins. They shall not be connected to drainage manholes unless otherwise approved by DPW.

4.3.4 Frames and Covers

- A. Cast Iron shall meet requirements of ASTM A888 "Grey Cast Iron, Cast Iron Class 20." All castings shall be clean and without blow holes, sand holes or defects of any kind. Cast iron frames and covers shall be clean of all rust, dirt, and scale. Grates shall have the following wording cast into the outside borders: "Dump No Waste" and "Drains to Waterway". Text shall be bold capital letters, at least 1 inch high. Placement may be as per manufacturer.

4.3.4.1 Manhole Covers

- A. Manhole frames and covers shall be at least Class 25 conforming to ASTM A48 "Standard Specification for Gray Iron Castings." Manhole frame shall have a clear opening of 24 inches and be a minimum of 8 inches in height. The surface of the cover shall have a diamond pattern with the words "FRAMINGHAM DRAIN" cast thereon for drainage manholes, as manufactured by East Jordan Iron Works (formerly LeBaron Foundry Co.) (EJIW) 2110Z/2111A, or equal.

4.3.4.2 Catch Basin Grates

- A. Catch basin grates located at low points shall be 24-inch square grate, East Jordan Iron Works (formerly LeBaron Foundry Co.), LF248-2-4F. Single or dual catch basin grate shall consist of a 24-inch square grate LeBaron Foundry Co. L24SG1-000 or approved equal with an 8-inch heavy duty frame (MassDOT Standard). Frames shall be set upon a full bed of mortar, and mortar shall be brought up alongside of frame to provide a water-tight joint.
- B. Catch basin cascade grates shall consist of a 24-inch square grate with an 8-inch heavy duty frame (MassDOT Standard) East Jordan Iron Works (formerly LeBaron Foundry Co.), L24SG18L-000 or a L24SG18R-000 (depending on water flow direction) or approved equal with an 8-inch frame. Frames shall be set upon a full bed of mortar, and mortar shall be brought up alongside of frame to provide a water tight joint. Water flowing from left to right requires a Right-Hand Grate. Water flowing from the right to left requires a Left-Hand Grate.

4.3.4.3 Catch Basin Hoods

- A. Catch basin hoods shall be used in off-roadway operations such as parking lots and service areas to minimize the entry of oil, gasoline, and debris into drainage pipes. Catch basin hoods shall also be used in urbanized roadways where drainage is contained by vertical curbs and sidewalks are adjacent to the roadway (increasing the likelihood of litter). Catch basin hoods shall protrude no more than 12 inches beyond the end of pipe into the structure. Acceptable hoods are Ground Water Rescue Inc. Eliminator, Best Management Practices Inc. Snout® or equal approved by the DPW.

4.3.5 Granite Curb Inlets (Throat Stones)

- A. Granite shall conform to MassDOT Standard Specifications Sections M9.04.0, M9.04.1, and M9.04.2. The back face for a distance of 3 inches down from the top shall have no projections greater than 1 inch. The front shall be straight split, free from drill holes, and shall have no projection greater than 1 inch or depression greater than 1/2 inch for a distance of 10 inches down from the top. For the remaining distance there shall be no depression or projection greater than 1 inch. The ends shall be squared with the top for the depth of the face finish. The granite curb inlet shall be 6 feet in length, plus or minus 1/2 inch from 17 to 19 inches in depth, 6 inches wide at the



top and at least 6 inches wide at the bottom. The reveal shall be 10 inches. Curb inlets set on a radius of 160 feet or less shall be cut to that radius. The gutter mouth at least 3 inches in depth and at least 2 feet in length shall be cut in the front face of the stone. If there is no other curbing, or as applicable, transitional curbing shall be required on both sides of the inlet. The transitional curbing shall be 6 feet in length, with a height equal to the inlet and tapering to grade at the end.

4.3.6 Box Culverts, Headwalls, Wing Walls, and Endwalls

- A. Culvert, headwall, wingwall, and endwall materials and specifications shall meet MassDOT Standard Specifications Sections 230 and M4, and as shown on MassDOT Construction and Traffic Standard Details, Drawings 206.40 through 206.70, and 207.1.0 through 207.3.0.
- B. Stone shall conform to MassDOT, Section 258 and MassDOT Construction and Traffic Standard Details Drawing 206.7.0. Stone size shall be determined by the design storm flow discharging from the pipe. Stone for drainage swales shall be no smaller than 3 inches, unless otherwise approved by the Department.

4.3.7 Perforated Drain Pipe Trenches (Subdrain)

- A. Drain Pipe Trenches shall meet MassDOT Standard Specifications Section 260 and MassDOT Construction and Traffic Standard Details Drawing 209.1.0. Perforated pipe shall be either of the following.
 - Polyvinyl chloride (PVC) pipe up to and including 15 inches in diameter, conforming to ASTM D3034, SDR 35.
 - Perforated, polyethylene (PE) (flexible) pipe and fittings per ASTM D2737. Joints shall be coupling type.
- B. Filter fabric shall meet MassDOT Standard Specifications Section 9.50.0 (Table III – Type III Geotextile Fabric: Filtration/Drainage). Filter fabric shall be nonwoven needle-punched geotextile, manufactured for subsurface drainage, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288. Apparent opening size shall be US Sieve 50 or higher.
- C. Subdrain bedding and fill material shall be crushed stone, 3/8 inch to 1 inch.

4.3.8 Dry Wells

- A. A dry well shall consist of either an excavated pit or a perforated concrete structure with an inside diameter of 5 feet to 12 feet. If an excavated pit, the dry well shall be filled with clean aggregate greater than 1-1/2 inches up to 3 inches. Fill shall be surrounded by filter fabric (Filter fabric shall be as for Perforated Drain Pipe Trenches). An optional observation well may be placed using 4-inch PVC flush with ground surface, and using a screw-top cap with lock.
- B. The DEP's Underground Injection Control regulations (310 CMR 27.00) define injection well as "a well into which fluids are being introduced", and specifically cites dry wells as a type of injection well. Therefore, if the dry well is designed so that the depth is greater than the diameter or width or length (whichever is greater), the well must conform to 310 CMR 27.00.
- C. The bottom of the dry well shall be at least 3 feet above seasonal high water table or bedrock. The depth of the well shall be 3 to 12 feet.
- D. Dry wells shall be designed to treat the runoff volume generated by the 3.25-inch/24-hour (2-year) Stormwater Quality Design Storm (NOAA). Dry wells shall be placed only in soil where the permeability allows a percolation rate of at least 0.50 inch /hour. The dry well shall be designed to empty within three days of filling under normal conditions.



- E. Dry wells shall not be used in the following locations:
- In industrial and commercial areas where petroleum products, herbicides, pesticides, or solvents may be loaded/unloaded, stored, or applied within the drainage area, especially locations with soluble heavy metals and toxic organics in the runoff;
 - Where the soil around and below the dry well does not have the necessary permeability to infiltrate the entire Stormwater Quality Design Storm runoff volume; or
 - Where dry well installation would create a significant risk for basement seepage or adversely impact a septic system's disposal field.

4.3.9 Subsurface Infiltration

- A. Subsurface infiltration is stormwater runoff impoundment constructed beneath the surface over permeable soils. They may include: infiltration pits, chambers, perforated pipes, and galleys. Infiltration systems shall be designed and constructed in accordance with The Massachusetts Stormwater Handbook.
- B. Pretreatment BMPs shall remove at least 25% TSS, unless in the following areas in which 44% TSS shall be removed:
- Areas with rapid infiltration (greater than 2.4 inches/hour);
 - Land use with a higher potential pollutant loads (LUHPPL);
 - Zone II or an Interim Wellhead Protection Area of a Public Drinking Water Source/Supply;
 - Discharge to or near a critical area (Outstanding Resource Waters or bathing beaches).
- C. The bottom of the infiltration system shall be at least 3 feet above seasonal high water table or bedrock.
- D. Infiltration systems shall be designed to treat the runoff volume generated by the 2-year and 10-year 24-hour storms.
- E. The infiltration system shall be designed to drain within three days of filling under normal conditions, and completely dewater between storms.
- F. Infiltration systems shall be placed only in soil where the permeability allows a percolation rate of at least 0.17 inch/hour. Percolation rates shall be field verified prior to completion of design, when feasible.
- G. An appropriate number of observation wells, access ports, or manholes shall be installed to enable inspections and maintenance.
- H. Infiltration systems shall not be used in the following locations:
- In industrial and commercial areas where petroleum products, herbicides, pesticides, or solvents may be loaded/unloaded, stored, or applied within the drainage area, especially locations with soluble heavy metals and toxic organics in the runoff;
 - In areas with documented soil contamination;
 - Where the soil around and below infiltration basin does not have the necessary permeability to infiltrate the entire Stormwater Quality Design Storm runoff volume; or
 - Where infiltration would create a significant risk for basement seepage or adversely impact a septic system's disposal field.



4.3.10 Drainage Swales

- A. The use of swales draining across a sidewalk into the gutter is generally unacceptable. In those cases where necessary, Department approval shall be required for the design. Flow shall be limited to less than one (1) cfs. These flows must be included in gutter capacity. Private drainage swales may not be used to drain more than two (2) adjacent subdivision lots. If private drainage facilities are required to drain more than 2 lots the system shall be piped and contained within a recorded private drainage easement. Maintenance of private systems shall be the responsibility of the adjacent property owners.

4.4 Execution

- A. All steps shall be inspected and approved by the Department of Public Works before the next step in the process shall begin.

4.4.1 Pipe Laying

4.4.1.1 Minimum Cover over Drainage Pipes

- A. The minimum flow line depth for drainage pipes shall be 4 feet. The minimum cover over drainage pipes shall be 3 feet below the pavement slab or as specified by the type of pipe per manufacturer's specifications, whichever is greater. Where the clearance is less than 1 foot below the pavement, provide a design method to maintain the integrity of the pipe and right of way. For drainage pipe outside of the pavement, the minimum cover shall be 18 inches or as specified by the type of pipe, whichever is greater. Drainage pipe shall be installed with minimum distance from sewer / septic pipe as summarized in Section 3.3.1.2 H (substituting drainage for water).
- B. No backfilling of the pipe in the trench shall take place unless approved by a DPW inspector.

4.4.1.2 Minimum Drain Pipe Grades

- A. Main lines and cross runs – grades 1% minimum
- B. Building storm drainage stubs – 1% minimum
- C. Subdrain – 0.5% minimum
- D. All other – 0.5% minimum.
- E. Any slope greater than 8% requires Department approval.

4.4.1.3 RCP Pipe

- A. Pipe shall be carefully laid to the lines and grades as shown on the approved plans. The Contractor, when possible, shall use laser beam aligning equipment.
- B. See Section 4.3.1 for bedding material. The bottom of the trench shall be excavated to a flat grade 6 inches below the pipe invert for trenches in suitable earth and 12 inches below pipe invert for trenches in rock. When rock or ledge is encountered it shall be removed to such widths as will give a clearance of at least 12 inches on each side of the pipe or other structure and a sand cushion used. The width of trenches shall be sufficient to allow thorough compacting of the refill adjacent to the lower quarters of the pipe.
- C. RCP Pipe Trenches shall meet MassDOT Standard Specifications Section 260 and MassDOT Construction and Traffic Standard Details Drawing 208.10.
- D. Trenches at pipe joints shall be excavated as necessary to give ample room for properly making and inspecting the pipe joints. RCP pipe joints shall be cement mortared (as specified in



MassDOT Section M4.02) carefully placed in the joints around its entire perimeter and mixed relatively dry, in the ratio of one part cement to two parts sand.

- E. Pipe bedding material shall be carefully and lightly tamped under pipe to provide uniform support. Fill to a minimum depth of 12 inches above the top of the pipe. Material for backfilling the rest of the trench, except for sub base (top 15 inches) shall be suitable material, approved by the Department. The compaction process shall be material placed in 12-inch lifts and thoroughly compacted by mechanical rammers, vibrators, or other methods to be approved by the Department (e.g., hydraulic plate compactors) to 90 percent Modified Proctor density in off-road or nonstructural areas and 95% in roadway or structural areas. Bucket compaction will not be accepted.
- F. When laying pipe in groundwater, pipe material and method of installation shall be approved by the Department. Water must not be permitted to rise in the trench until all pipes have been securely bedded, jointed and observed by the town and until backfilling has progressed to an elevation at least one foot above the top of the pipe. Temporary plugs shall be installed in open ends of pipe to prevent silt from washing into pipe during construction; and open ends of the pipe shall be closed with suitable plugs upon suspension of the work for any reason.

4.4.1.4 HDPE Pipe

- A. The requirements for laying of RCP pipe also apply to HDPE pipe. The following additional requirements apply to HDPE pipe.
- B. Installation of HDPE pipe shall be in accordance with either AASHTO Section 30 or ASTM D2321 and as recommended by the manufacturer.
- C. Because HDPE pipe will float in standing water, a dry trench shall be provided prior to laying the pipe. A qualified engineer shall be consulted to determine dewatering methods.
- D. Haunching large-diameter pipes (greater than 30 inches) shall be performed using maximum 8-inch lifts and compacted to 90 percent standard proctor density.
- E. Water tight joints shall be used. Pipe shall be watertight according to the ASTM D3212. Joint design shall be bell-and-spigot with an elastomeric rubber gasket meeting ASTM F477 or equal approved by the Engineering Division.

4.4.1.5 PP Pipe

- A. The requirements for laying of HDPE pipe also apply to PP pipe. The following additional requirements apply to PP pipe.
- B. Minimum cover in traffic areas through 48-inch ID pipe shall be one foot. Minimum cover for 60-inch ID pipe shall be two feet.

4.4.1.6 Pipe Ends

- A. Pipe ends shall be accurately aligned on compacted gravel fill unless otherwise approved by the Department. Rip Rap stone shall be placed to line and grade as shown on the plans on a prepared bed of embankment material or existing materials. Each stone shall be placed by hand, normal to the slope and firmly embedded. Larger stones shall be placed directly at the drainage end to prevent erosion and displacement. Stone size shall be determined by the design storm flow discharging from the pipe.



4.4.1.7 Pipe Testing

- A. At the discretion of the Department, a mandrel test shall be conducted following completion of pipe laying. Placement of curb, gutter, sidewalk, or asphalt concrete pavement shall not occur until the DPW Inspector has approved the mandrel test. The DPW Inspector shall be present through the duration of the mandrel testing. Alternatively, a television survey may be performed on the line after installation, with the results being provided to the Department in electronic format as directed by the Department.
- B. The allowable deflection (reduction in vertical inside diameter) for all non-rigid pipe shall be 7.5 percent maximum. The deflection shall be tested by pulling a mandrel which is 92.5 percent of the inside pipe diameter through all installed pipe. The mandrel shall be the "go/no-go" type and shall be pulled without mechanical assistance. At each location in which the mandrel cannot pass, the cause shall be ascertained. Obstacles in the pipe shall be removed. If it is determined that the deflection exceeds 7.5 percent, that a gasket has been improperly installed or that the pipe has been damaged due to trenching for another utility, the respective section of pipe shall be re-bedded or removed, replaced and re-bedded using water tight repair couplings. A passing mandrel retest is required. At the contractor's discretion, any sections of non-rigid pipe not passing the mandrel test may be televised to ascertain the problem.

4.4.2 Manholes, Catch Basins, and Leaching Basins

- A. Contractor shall excavate to a depth of 12 inches below the bottom of and all around the proposed manhole or catch basin base, compact and fine grade and install washed screened gravel as a sub-base material. Pipes shall extend no more than 3 inches inside the interior wall and all openings around pipe entrances and lift holes shall be thoroughly grouted with non-shrink grout prior to back filling. Compaction process shall be the same manner as compaction around pipe.
- B. The tops of frames and covers shall be set 1/8 inch below finish grade pavement in the street. Final grade locations for installations outside of the paved roadway shall be as approved by the Department.
- C. All joints between the frame, grade rings, dome, barrels and base shall be set in place with non-shrink mortar. Inside the manhole, all joints where the sealing material is not flush with the inside wall shall be grouted with nonshrink mortar and finished by hand / wet-brushed.
- D. Grade adjustments shall be made using either precast grade rings/risers or clay/shale bricks.
- E. No backfilling of the structure in the excavation shall take place unless approved by a DPW inspector.

4.4.2.1 Manholes

- A. Manholes shall be constructed in series shall have a distance of no more than 250 feet between manholes, unless otherwise approved by DPW.
- B. When ground water is encountered in manholes, 3/4-inch to 1-inch washed stone shall be placed around structure to a distance of at least half-way up the barrel of the highest pipe.
- C. As circular concrete block walls are laid, the horizontal joints and key ways shall be flush full with mortar. As rectangular blocks are laid, all horizontal and vertical joints shall be flushed full with mortar.

4.4.2.2 Catch Basins

- A. When ground water is encountered in catch basins, 3/4-inch to 1-inch washed stone shall be placed 2 feet all around structure to a distance of the high ground water elevation. The stone shall be



placed against and over the end of the pipe opening to prevent entrance of the finer filling material. All catch basins that do not have a flat top slab designed for H-20 loading and cast iron frame cast in place shall be installed using blocks to make a square hole that will accept a frame and grate, and there shall be at least two full courses of brick for frame adjustment.

- B. Circular concrete block walls are laid up the horizontal and key ways shall be flush full with mortar above the outlet invert. The dome or cone section shall be constructed in the same manner. The opening between the pie plates shall be filled with washed, screened gravel and left open. A 24-inch opening shall be left open at the top for a frame and grate.

4.4.2.3 Leaching Basins

- A. Leaching basins shall be set in an excavation lined with a geotextile. The basin shall be placed on a pad of free draining crushed stone, with the excavation around the basin back-filled with similar material. Leaching catch basins shall be used as “off-line” devices (that is, they should not generally be piped in series as “flow-through” devices).

4.4.3 Box Culverts, Headwalls, Wingwalls, and Endwalls

- A. Headwalls, Wingwalls, and Endwalls shall be constructed at open ends of any drainage pipes where the same serve as outlets or inlets to the drainage system. Metal beam guard rails or chain link fencing may be required by the Department at culverts, headwalls, box culverts, and on steep side slopes.
- B. Box culverts shall be designed and installed as per MassDOT Standard Specifications, as amended.
- C. Stone shall be placed to line and grade as shown on the plans on a prepared bed of embankment material or existing materials. Each stone shall be placed in a controlled manner, normal to the slope and firmly embedded. Larger stones shall be placed directly at the drainage end to prevent erosion and displacement

4.4.4 Perforated Drain Pipe Trenches (Subdrain)

- A. The trench drain shall be excavated to a minimum of 24 inches below grade and lined with filter fabric with a 12-inch overlap on the top of the trench. If the pipes have a single line of perforation, pipe shall be installed with perforations down and backfilled. If there are two lines of perforation, the pipe shall be installed with the perforations on the sides of the pipe and then backfilled. The width of the trench shall be at 12 inches or double the diameter of the drainage pipe, whichever is greater. The end of the pipe shall be capped.
- B. Stones or other anchoring objects should be placed on the fabric at the edge of the trench to keep the trench open during windy periods. When overlaps are required between rolls, the uphill roll should lap a minimum of 2 feet over the downhill roll in order to provide a shingled effect.
- C. The drainage bedding and fill material shall be placed in lifts and compacted using plate compactors. A maximum loose lift thickness of 12 inches is recommended.
- D. Following the stone aggregate placement, the filter fabric shall be folded over the drainage bedding and fill material to form a 12-inch minimum longitudinal lap. The drainage bedding and fill material shall be placed over the lap at sufficient intervals to maintain the lap during subsequent backfilling.
- E. Voids can be created between the fabric and the excavation sides and shall be avoided. Removing boulders or other obstacles from the trench walls is one source of such voids; therefore, natural



soils should be placed in these voids at the most convenient time during construction to ensure fabric conformity to the excavation sides.

- F. Keep trenches dry until pipe is in place and granular material backfill is completed to one foot (12 inches) above top of pipe, unless otherwise noted.

4.4.5 Dry Wells

- A. Dry wells shall not be placed in a public way or a public easement, and shall not be placed into service until the drainage area is stabilized. Dry wells shall be sited a minimum of 10 feet away from the building. Excavated material shall be placed away from the excavated sides to prevent wall instability during excavation and backfilling. Large tree roots shall be trimmed flush with the sides to prevent puncturing or tearing of filter fabric during installation. The side walls shall be roughened where sheared and sealed by heavy equipment.
- B. An overland flow path of surface runoff exceeding the capacity of the well shall be identified. An overflow system leading to a stabilized channel or watercourse including measures to provide non-erosive flow conditions shall be provided.
- C. The following requirements apply to dry wells that do not utilize a concrete structure.
- The bottom, sides and top of the well surface shall be lined with filter fabric. The fabric shall be wrapped and tied with wire or nylon twine or otherwise tightly secured around the horizontal inflow pipe where the pipe protrudes through the fabric. Fabric shall be wrapped over the top of the aggregate fill with a minimum of 12 inches of overlap in any direction. Fabric shall be overlapped 6 inches in “shingle” fashion when more than one section is required to enclose the aggregate.
 - The dry well shall be filled to within 12 inches of the finished surface elevation, leaving sufficient depth for topsoil placement (in areas where surface stabilization is accomplished through the use of vegetation).
 - Drainage aggregate shall be placed in lifts of no more than 12 inches and compacted using plate compactors. Voids between the fabric and excavation sides due to boulders or other obstacles shall be filled with natural soils to ensure fabric conformity to excavation sides.

4.4.6 Drainage Swales

- A. The maximum depth of a swale shall be 24 inches. Side slopes shall be no steeper than 2:1 (horizontal:vertical) with a minimum grade of 0.5 percent and carrying no more than 3 cfs during a five-year design event. The minimum bottom width for a swale, whether earthen, gravel, or paved is 2 feet.

4.4.7 Separation of Storm Drains and Water or Sewer Mains

- A. Horizontal Separation: Drainage mains shall be located at least 5 feet horizontally from sewer mains. Locations with respect to water mains are described in the Water Standards portion of these Construction Standards. The distance shall be measured from inside edge of pipe.
- B. Vertical Separation: Drainage mains shall be laid to provide a separation of at least 18 inches from either water or sewer lines. The minimum vertical separation is measured from outside of water or sewer main to outside of the storm drain main.
- C. Unusual Conditions: Storm drain crossings under unusual conditions must be approved on a case by case basis by the Department.



4.5 Maintenance

4.5.1 Maintenance of Drainage Systems on Private Property

- A. The owner of any property on which a drainage system is located is responsible for the maintenance and upkeep of the system. Prior to construction of said drainage system, the owner shall provide documents describe the long term operation and maintenance of all permanent erosion control and stormwater management measures. The inspection and maintenance of the drainage systems shall be performed at minimum on an annual basis, and more frequently depending on the circumstances.

4.5.2 Access for Maintenance of Drainage within Easements

- A. Access to all drainage in drainage easements shall be a minimum of 20 feet wide and maintained to allow earth-moving and other construction activities to occur within the easement (see 4.1.2.2).

4.6 Definitions

- A. Drainage Swale: A long narrow trench dug into the ground designed to manage stormwater runoff. Swales can be earthen (normally seeded or otherwise vegetated), gravel, or paved.
- B. Backflow Preventer: Device that stops the backflow of water into the drainage system.
- C. Fiber Rolls: coir (coconut fiber), straw, or excelsior woven roll encased in netting of jute, nylon, or burlap
- D. Mandrel Test: The roundness of a pipeline is tested by moving a slightly smaller steel shank, called a mandrel, through the inside of the pipeline. If the pipeline is out of round, the mandrel will be held and kept from moving forward.
- E. Haunching: During pipe installation, the action of holding the pipe in a fixed position in terms of lateral movement, usually by filling in both sides of the pipe at the same time.

4.7 References

- A. All materials and execution shall conform to the highest applicable standards. If there is a conflict between other standards, or between other standards and these Design standards, then the most stringent criteria shall be used.
- B. These standards draw and refer to the *Massachusetts Stormwater Management Standards* and the *Massachusetts Stormwater Handbook* (Massachusetts Department of Environmental Protection, January 2008 et seq.). These standards also draw significantly on the *Commonwealth of Massachusetts - Massachusetts Highway Department: Standard Specifications for Highways and Bridges* (1995 et seq.) and the *Commonwealth of Massachusetts - Massachusetts Highway Department: Construction and Traffic Standard Details* (1996 et seq.). These two documents are referred to collectively as the MassDOT Standards. In addition to the MassDOT Standards, the Town references AASHTO, and ASTM as guidance for the materials and execution of work performed on the Town Drainage Infrastructure. The following summarizes select standards applicable to the sections in these Design Standards. This list is not exclusive; other standards may apply. The latest revision of each standard shall be referenced.



Standard	Title/Subject
N/A	Massachusetts Department of Transportation: Standard Specifications for Highways and Bridges, Construction and Traffic Standard Details (1996 et seq.)
AASHTO Section 30	Division II (General-Interim 1998)
AASHTO M 91	Sewer and Manhole Brick (Made from Clay or Shale)
AASHTO M 170	Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
AASHTO M 199	Standard Specification for Precast Reinforced Concrete Manhole Sections (ASTM C478)
AASHTO M 252	Corrugated Polyethylene Drainage Pipe
AASHTO M 288	Standard Specification for Geotextile Specification for Highway Applications
AASHTO M 294	Corrugated Polyethylene Pipe, 300- to 1500-mm Diameter
ASTM A 48	Standard Specification for Gray Iron Castings
ASTM A 888	Grey Cast Iron, Cast Iron Class 20
ASTM C 76	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 139	Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM C 478	Precast Reinforced Concrete Manhole Sections
ASTM D 2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity — Flow Applications
ASTM D2412	Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D 2487	Standard Practice for Classification of Soils for Engineering Purposes (USCS)
ASTM D 2737	Standard Specification for Polyethylene (PE) Plastic Tubing
ASTM D 3034	Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3350	Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
ASTM D4101	Standard Specification for Polypropylene Injection and Extrusion Materials
ASTM F 477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
NOAA	National Oceanographic and Atmospheric Administration: Technical Paper No. 40, May 19“1 "Rainfall Frequency Atlas of the United States"
OSHA 1926	29 CFR 1926 Safety and Health Regulations for Construction





5 Roadway Construction Standards

5.1 Roadway Design

5.1.1 General

- A. All plans shall be on 24-inch x 36-inch sheets.
- B. Plan and Profile of sections shall be on separate sheets.
- C. The horizontal scale of the plan and profile shall be the same.
- D. Boring or test pits shall be taken as determined by the Department of Public Works. These shall show soil strata and high ground water elevations. Drought conditions shall be noted.
- E. Electric, telephone, cable television and fire alarm cables and ducts shall be placed in the grass strip or sidewalk outside of the traveled way, on the opposite side of the centerline of the street as the water main.
- F. Street light standard locations shall be determined by the Department of Public Works and Eversource Electric Company.
- G. DIG SAFE shall be contacted to determine the location of all existing underground utilities prior to any excavation. Call the Framingham Fire Department to mark out their lines.
- H. A note shall be placed on all plans stating "The Town of Framingham Department of Public Works and Engineering Department shall be notified seventy-two (72) hours in advance of any roadway or municipal service construction. No portion of any utility shall be backfilled until approval for such backfilling is obtained from the Department of Public Works. Such approval does not constitute acceptance of such utilities by the Town of Framingham."

5.1.2 Streets and Roadways

- A. For the purposes of these Standards, streets shall be classified as Local, Collector and Arterial. These classifications are shown in the Town Subdivision Rules and Regulations as Residential Access, Residential Subcollector and Primary.
- B. Street design minimum standards for Primary Streets shall conform to the best accepted design practice as recommended by the Institute of Traffic Engineer's Street and Highway Design Manual and the MassDOT Project Development and Design Guide, in consultation with the Department of Public Works.
- C. Location and alignment shall conform to the requirements contained in the current edition of the Town of Framingham Subdivision Regulations.
- D. Property lines at residential street intersections shall be rounded or cut back to provide for a radius of at least 7 feet less than the curb radius.
- E. The maximum grade for cul-de-sacs shall be four percent (4%).
- F. The pavement cross section shall be designed to provide a 20-year life based on soil and traffic conditions. The pavement cross section shall be approved by the Town Engineer. The minimum pavement cross section shall be:



1. Local Streets: 1.5 inches of Top Course material placed on 2.5 inches of Binder Course material founded on 4 inches of Dense Graded Crushed Stone on 8 inches of Processed Gravel or Dense Graded Crushed Stone. This pavement structure shall be placed on the backfill.
 2. Collector Streets: 2 inches of Top Course material placed on 4 inches of Binder Course material placed in two equal courses founded on 4 inches of Dense Graded Crushed Stone on 8 inches of Processed Gravel or Dense Graded Crushed Stone.
 3. Arterial Streets: 3 inches Modified Top Course material placed in two courses on one 5-inch course of Binder Course material founded on 4 inches of Dense Graded Crushed Stone on 8 inches of Processed Gravel or Dense Graded Crushed Stone.
- G. The existing water table shall be located and particular attention given to changes in the present and in the possible future water table caused by the movement of earth and other construction work.

5.1.3 Curbing

- A. Granite curbing shall be type VA-4, conforming to the requirements of MassDOT Standard Specifications.
- B. Hot mix asphalt (HMA) curbing shall be type 1, 2, or 3, conforming to the requirements of MassDOT Standard 106.2.0.

5.1.4 Sidewalks

- A. Sidewalks and wheelchair ramps shall be constructed of Portland cement concrete or HMA concrete, conforming to the requirements of MassDOT Standard Specifications, with a minimum width of five (5) feet. Wheelchair Ramps (WCR) and brick red Detectable Warning Panels shall be installed in accordance with the "Rules and Regulations of the Architectural Access Board – 521 CMR."

5.1.5 Walls or Slopes

- A. Where walls or slopes must be constructed to properly support the street or adjacent land, such construction must be done in accordance with the specifications set forth in Section 5.2.14.

5.1.6 Driveways

- A. Driveways and private entrances shall be designed, permitted and constructed to conform to Town of Framingham Bylaw (Article VI, Section 8) and MassDOT standards. Driveways shall be located a minimum of 25 feet from any intersecting street corner radius. For commercial and industrial development, a plan stamped by a licensed professional engineer showing the manner in which the proposed entrance meets these specifications must be submitted to the Department of Public Works and approved before such entrance is constructed. The engineer's plan must include calculated safe sight distances in each direction.

5.1.7 Protection of Utilities

- A. A subdivider shall protect all utilities and appurtenances installed under these standards from any and all damage until the ways are accepted by the Town. Any damage to these utilities and appurtenances prior to acceptance by the Town shall be repaired in a manner satisfactory to the Department of Public Works and the full cost of such repair shall be paid by the sub-divider. Any material used which does not meet the standards of the Department of Public Works shall be replaced by the sub-divider at no cost to the Town.



5.2 Roadway Materials

5.2.1 Special Borrow

- A. Special borrow for fill shall conform to MassDOT Standard Spec. M1.02.0.

5.2.2 Processed Gravel for Subbase

- A. Gravel shall conform to MassDOT Standard Spec. M1.03.1.

5.2.3 Gravel Borrow

- A. Gravel shall conform to MassDOT Standard Spec. M1.03.0, Type b.

5.2.4 Crushed Stone for Subbase

- A. Washed crushed stone shall range in size from $\frac{3}{4}$ inch to $1\frac{1}{2}$ inch, conforming to MassDOT Standard Spec. M2.01.4 to M2.01.2 and shall be hard, durable and reasonably free from flat or laminated particles to furnish free draining material.

5.2.5 Dense Graded Crushed Stone for Subbase

- A. Dense graded crushed stone shall conform to MassDOT Standard Spec. M2.01.7.

5.2.6 Loam Borrow

- A. Loam Borrow shall conform to MassDOT Standard Spec. M1.05.0 or shall be the product of a commercial sand and gravel processing facility. It shall be uncontaminated by saltwater, foreign matter, or substances harmful to plant growth. The acidity range of the Loam Borrow shall be pH 5.5 to 7.0.

5.2.7 Fertilizer

- A. Fertilizer shall be of a 10-6-4 composition.

5.2.8 Grass Seed

- A. Seed composition shall be 60% Red Fescue, 20% Red Top, 20% Kentucky Blue. Seed shall be of the previous year's crop and in no case shall the weed seed content exceed 1% by weight.

5.2.9 Hot Mix Asphalt

5.2.10 A. Hot Mix Asphalt (HMA) shall conform to MassDOT Standard Section M 3.11.00.Superpave

- A. Superpave shall conform to MassDOT Document 00717

5.2.11 Portland Cement Concrete for Sidewalks

- A. Portland Cement Concrete for sidewalks shall conform to the applicable requirements of Section M4 and Section 701 of the MassDOT Standard Specifications. FIBERMESH fibers (100% virgin polypropylene, collated, fibrillated fibers) at a rate of 1.5 lb. per cubic yard of concrete shall be added for reinforcement. Installation shall be per manufacturer's recommendations.



5.2.12 Granite Curbing

- A. The stones shall conform to MassDOT Standard Spec. M9.04.1 for VA4.

5.2.13 Granite Curb Inlets

- A. Curb inlets shall conform to MassDOT Standard Spec. M9.04.5.

5.2.14 HMA Berm and Curb

- A. HMA Berm shall conform to MassDOT Standard Section M3.11.0. HMA Curb shall conform to MassDOT Standard Section M3.12.0.

5.2.15 Retaining Walls

- A. Walls shall be constructed of cast-in-place, precast reinforced concrete, stone and mortar, or prefabricated block. Prefabricated block retaining walls shall conform to all dimensional requirements as specified by the manufacturer. Methods of concrete construction shall conform to the applicable requirements of Section 901 of the MassDOT Standard Specifications. Cement shall be Portland cement meeting the requirements of ASTM C150. Steel reinforcement shall meet ASTM A615 or A616, whichever is applicable. Reinforcing steel shall be free of rust and dirt. The aggregate shall be crushed stone or screened gravel, and clean hard sand, and shall conform to ASTM C 33 latest revision. Water for concrete shall be clean and free from injurious amounts of mineral and organic substances.

5.2.16 Granite Bounds

- A. Bounds shall conform to MassDOT Standard Spec.M9/04.8. They shall be 4 feet in length. Granite bounds shall be of sound granite, the top and bottom faces parallel and the front and back shall be straight split. The bounds shall be cut to the dimensions shown on the detail and shall be plain or lettered as indicated on the plans or as directed. The stone shall be pointed on the top and on four sides and for a distance of not less than 6 inches below the top. The top shall be 6 inches square and shall have a drill hole in the center 1.5 inch in depth and 0.5 inch in diameter, with the bottom somewhat flared.

5.2.17 Guard Rail

- A. Guard Rail shall be COR-TEN® with steel or wood posts in conformance with MassDOT Standard M8.07.0.

5.2.18 Pavement Markings

- A. For existing pavement marking applications, pavement markings shall be white or yellow reflectorized thermoplastic, epoxy, or other matching material conforming to MassDOT Standard M7.01.
- B. For all new roadway construction, pavement markings shall be white or yellow reflectorized epoxy pavement markings conforming to MassDOT Engineering Directive E-05-003, dated June 16, 2005 and to MassDOT Standard Section 860.

5.2.19 Street Signs

- A. Street signs shall use only upper-case white letters with a blue background. Sign dimensions, material, colors, text and post height shall conform to the latest version of the MUTCD.



5.2.20 Traffic Signs

- A. Traffic Signs shall be reflectorized aluminum in conformance with MassDOT Standard Sections 828 and M9.30.0.
- B. Signs shall not be screen printed, with the exception of STOP, YIELD, and DO NOT ENTER signs. All should be of a vandal / graffiti proof type.
- C. Sign orientation to roadway shall follow the latest version of the MUTCD.

5.2.21 Dust Control

- A. Dust control may be required by the Town. The process shall consist of the application of calcium chloride per the approval of the Town, to be measured in specified amounts (gallons per square yard for liquid form and pounds per square yard for flake form). The contractor may be required to furnish sprinkler trucks or hoses to wet down surfaces in lieu of applying calcium chloride, if approved in advance by the Department of Public Works.

5.2.22 Handholes

- A. Handholes shall have minimum internal dimensions of 36 inches length and 36 inches width and internal depth of 24 inches unless otherwise approved by DPW. Handholes shall be designed to meet ASTM C-858 and ACI 318 with AASHTO HS-20 highway loading. Handholes shall be of Quazite® polymer concrete or equal. Handholes shall have 5,000 psi strength after 28 days. Reinforcing steel shall meet ASTM A-615 grade 60 with a minimum of 1-inch of cover provided. Handholes shall be provided with 12-inch by 18-inch knockouts as required.

5.2.23 Handhole Frame and Covers

- A. Handhole frame and covers shall be cast iron conforming to the details shown on the drawings. Cast Iron shall be minimum Class 25 conforming to ASTM A48 and as follows:
 - 1. Castings shall be free from scale, lumps, blisters, and sand holes.
 - 2. Frames and covers shall be of cast iron with diamond cover surface design. Machine contract surfaces to prevent rocking.
 - 3. Thoroughly clean and hammer inspect.
 - 4. Capable of meeting or exceeding AASHTO HS-20 loading unless otherwise indicated or specified.
 - 5. Handhole frames and covers include the words "TOF COMMUNICATIONS" written on their tops. Handhole frames and covers shall be East Jordan (EJ) Iron Works catalog no. 8047 with bolted gasketed cover, or equal.

5.2.24 Manhole Frame and Covers

- A. Manholes shall have minimum internal dimensions of 36 inches length and 36 inches width and maximum internal depth of 24 inches unless otherwise approved by DPW. Manholes shall be designed to meet ASTM C-858 and ACI 318 with AASHTO HS-20 highway loading. Concrete shall have 5,000 psi strength after 28 days. Reinforcing steel shall meet ASTM A-615 grade 60 with a minimum of 1-inch of cover provided. Handholes shall be provided with 5" knockouts as shown on the drawings and as required.
- B. Handhole frame and covers shall be cast iron conforming to the details shown on the drawings. Cast Iron shall be minimum Class 25 conforming to ASTM A48 and as follows:



1. Castings shall be free from scale, lumps, blisters, and sand holes.
2. Frames and covers shall be of cast iron with diamond cover surface design. Machine contract surfaces to prevent rocking.
3. Thoroughly clean and hammer inspect.
4. Capable of meeting or exceeding AASHTO HS-20 loading unless otherwise indicated or specified.
5. Handhole frames and covers shall have the words "TOF COMMUNICATIONS" written on their tops. Handhole frames and covers shall be East Jordan Iron Works catalog no. 8047 with bolted gasketed cover, or equal.

5.3 Roadway Execution

5.3.1 General Conditions

- A. All street, sidewalk, sewer, water and drain construction and all materials used in such work shall conform to all requirements of the MassDOT Standard Specifications, except as superseded by the Town of Framingham standards. All work and materials shall be subject to the inspection and final approval of the Department of Public Works.
- B. Clearing of street locations and major changes in the grading of land and streets brought to rough grade with proper compaction shall be completed before the installation of utilities and before the finished street is begun.
- C. The setting of granite curbing, the installation of utilities, and any other construction that is required in a street shall be completed before the finish course of bituminous concrete is laid.
- D. New roadways shall be constructed in conformance with the plans approved by the Planning Board.
- E. Where a subdivision road under construction connects to a public way, a dirt trap shall be constructed, to meet the requirements set forth in the National Pollutant Discharge Elimination Construction Permit requirements. The trap shall be the width of the proposed street, at least 15 feet in length and filled with 6 inches of 2-inch crushed stone. Regular maintenance to remove trapped dirt and to replace stone shall be provided to keep the public way clean.

5.3.2 Procedure

- A. It is assumed that under normal conditions work will proceed in accordance with the following schedule. Major shifts in the schedule must be approved by the Department of Public Works or their designate. Each step must be approved by the Public Works inspector on the job.
 - a. Clearing and cleaning, including excavating or stripping poor material.
 - b. Earthwork, including necessary cuts and fills.
 - c. Installation of sewer mains.
 - d. Installations of water mains.
 - e. Test water and sewer mains.
 - f. Installation of drainage system.
 - g. Installation of other underground utilities.



- h. Installation of road sub-drain where conditions warrant.
- i. Installation of sewer services.
- j. Installation of water services.
- k. Preparation of sub-grade surface.
- l. Gravel and dense graded crushed stone approved by Town Engineer
- m. Application of gravel and dense graded crushed stone on approved sub-grade.
- n. Compaction testing.
- o. Certification of sub-base grades by Professional Engineer or Surveyor.
- p. Application of roadway binder courses.
- q. Installation of curbing.
- r. Application of gravel in sidewalks.
- s. Slope grading and wall construction.
- t. Regulatory and street signs
- u. Construction of sidewalks.
- v. Guard rails (if required)
- w. Application of asphalt concrete top course for roadway.
- x. Pavement markings
- y. Installation of stone bounds.
- z. Application of loam and seed for lawns and slopes.
- aa. Installation of street lights and street trees.
- bb. Restoration of the public ways as required by the Department of Public Works.

5.3.3 Clearing (including excavating or stripping poor material)

- A. All vegetation and debris shall be removed within the Right of Way unless specified by the Department of Public Works to remain. Then all muck (peat) and topsoil shall be entirely removed from the Right of Way. All material that does not conform to Special Borrow (MassDOT Standard Spec. M1.02.0) shall be removed to a depth of 16 inches below finish grade. No utilities shall be installed until this requirement is completed.

5.3.4 Preparation of Subgrade

- A. All fill areas within 4 feet of the proposed subgrade shall be filled with Special Borrow except it shall contain no stone larger than 6 inches in greatest dimension and shall be placed and compacted in layers not exceeding 12 inches in depth, compacted measurement.

All cut areas shall be excavated to 16 to 20 inches below finish grade, unless the material meets the standard for Gravel Borrow. Fill areas with a depth 4 feet or greater shall be filled with Special Borrow. All filled areas shall be rough graded and compacted to not less than 95 percent of the maximum dry density of the material as determined by the Standard AASHTO Test Designation T 99, Compaction Test Method C at optimum moisture content.



The subgrade shall be shaped to a true surface conforming to the proposed cross section of the roadway and compacted in accordance with the procedure stated above. All depressions and high spots shall be filled with special borrow or removed and compacted until smooth and satisfactorily compacted. A tolerance of 1/2 inch above or below the finish subgrade will be allowed provided that 1/2 inch above or below grade is not maintained for a distance longer than 50 feet and that the required grade is maintained in the subgrade. Any portion of the subgrade which is not accessible to a roller shall be compacted with mechanical tampers. The Department of Public Works shall approve subgrade construction before sub-base material and pavement is applied.

5.3.5 Gravel Sub-base

- A. Before the gravel is spread, the subgrade shall be prepared as noted above and shaped to a true surface conforming to the proposed profile and cross section of the road. Gravel shall be spread and rolled true to lines and grades with an approved three-wheel roller or approved equal, weighing not less than ten (10) tons to yield an 8-inch depth after rolling. All sub-base layers shall be compacted to not less than ninety-five (95) percent of the maximum dry density of the material as determined by the Standard AASHTO T99 compaction test: method C. at optimum moisture content. Any depression that appears during or after rolling shall be filled with gravel borrow or dense-graded crushed stone and recompact until the surface is true and even. When required by the Department of Public Works, samples of the gravel to be used shall be tested for gradation by a sieve analysis and the compacted gravel shall be tested for compaction. All tests shall be paid for by the developer.

5.3.6 Dense Graded Crushed Stone

- A. Dense graded crushed stone shall be placed and compacted to produce a 4-inch layer on top of the gravel sub-base in conformance with MassDOT Standard Spec. Section 402.

5.3.7 Hot Mix Asphalt Roadways

- A. The binder course material shall be applied to the prepared sub-base with a 3/8-inch pitch per foot from crown to gutter line. Tack coat shall be required between the binder course and top course as specified in the MassDOT Standard Sections 460 and M3.11.06. In no case shall any hot mix asphalt be laid until the sub-base has been inspected and approved. Hot Mix Asphalt placement shall conform to MassDOT Standard Section 460. Pavement shall not be placed on frozen material or when weather conditions predict freezing temperatures. When binder course will be left over winter months, all castings shall be set to surface grade of the binder course of asphalt for the winter season and then reset before the top course of pavement is applied. No permanent asphalt pavement shall be laid after November 15th or before April 1st, unless approved by the Department of Public Works.

5.3.8 Sidewalks and Driveway Aprons

- A. Concrete shall be installed on an 8-inch gravel sub-base prepared in the same manner as for the traveled way with a minimum width of five feet six inches (5'6"). Satisfactory forms shall be installed to assist in securing proper alignment. The cement concrete walk surface shall be laid in one course to a finished depth of 4 inches. The walk shall have a cross slope of 1.5 percent toward the roadway to provide proper drainage. Driveway aprons and other sidewalk areas where vehicular traffic may reasonably be expected to occur shall be laid in one course, 6 inches thick, and shall be constructed to the same specifications as sidewalks and meet the proposed sidewalk grades.
- B. In no case shall sidewalks and aprons be laid until the gravel sub-base has been inspected and approved. The Town of Framingham Department of Public Works shall be notified at least 24



hours prior to any planned sidewalk concrete pour to allow inspection of the gravel sub-base. Testing of grade shall be done with a 10-foot straight edge placed parallel to the center line of the course; there shall be no deviation from a true surface in excess 1/4 of an inch. Sidewalks shall be broom finished prior to scoring. The sidewalk slab shall be scored to form 5-foot panels. Sidewalks shall be 5 feet wide. Traverse preformed expansion joints shall be installed at 30-foot intervals.

- C. Wheelchair ramps shall be 6 inches thick and shall be installed in strict compliance with the current AAB/ADA Rules and Standards.
- D. The loam in the grass strip shall be 6 inches thick. Fertilizer shall be applied to the loam at a rate of 0.2 pounds per square yard and worked into the seed bed with an application of lime, if needed to achieve the required pH range. As soon as the seed is sown, it shall be covered with a thin layer of loam, rolled and watered. The grass strip shall be seeded at the rate of 3.6 pounds per 100 square yards. Grass shall grow to a satisfactory cover before being accepted by the Town. In locations where erosion is possible, erosion controls shall be in place until the vegetation has substantially rooted (see Section 1.4 for Erosion Control requirements).
- E. Truncated dome warning panels shall be brick red in color.

5.3.9 Granite Curbing

- A. Granite curbing shall be installed in the gutter line of all proposed roadways. Curbing shall be set with a 7-inch reveal. Granite Curb Inlets shall be installed at all catch basins. Granite curb and inlets shall be constructed in conformance with MassDOT Standard Specification Section 501, except that cement concrete shall be placed beneath the center section of each curbstone and as backfill in front and behind the curb.
- B. Bituminous Berm shall conform to MassDOT Standard Section 470. Bituminous Curb shall conform to MassDOT Standard Section 501.

5.3.10 Retaining Walls

- A. Walls shall be constructed in accordance with Section 5.2.14 in locations designated by the Department of Public Works if, in its opinion, such retaining walls are necessary for the public interest and safety, and the protection of abutters and the general public. All retaining walls shall be constructed outside the street lines and shall not interfere with the sight distance of the traveled way. Prefabricated retaining walls shall be constructed in accordance with the manufacturer's specifications. Retaining walls greater than 4 feet in height shall require review and approval of the design by the Town Engineer.

5.3.11 Slopes

- A. Side slopes shall be constructed at a maximum slope of 4 feet horizontally to 1 foot vertically (4:1) from the edge of the street side lines to the existing ground surface. Slopes shall be covered with loam, 6 inches in compacted depth, and fertilized, limed and seeded as described in Section 5.3.8.D. The slopes shall be maintained to repair erosion, gullies and other damage and reseeded as necessary until an adequate growth of grass is achieved.

5.3.12 Granite Bounds

- A. An inventory of all existing roadway monumentation shall be taken. All existing roadway monumentation shall remain and be protected. Any damage to roadway monuments prior to acceptance by the Town shall be repaired in a manner satisfactory to the Department of Public Works and the full cost of such repair shall be paid by the Contractor. Any material used which



does not meet the standards of the Department of Public Works shall be replaced by the Contractor at no cost to the Town. The monumentation shall be replaced, realigned, and/or reset to its intended position and certified as to the correct location by a Massachusetts registered professional land surveyor. All proposed impacts shall immediately be brought to the attention of the Engineering Division. Bounds shall be of granite as directed and shall be set at points designated by the Engineer and in conformity with these specifications. Replacement or new bound installation shall be directly overseen by a Professional Land Surveyor licensed in the Commonwealth of Massachusetts. Surveyor's notes and layout data shall be provided to the Engineering Division.

- B. Bounds shall be set in conformance with MassDOT Standard Specification Section 710. The bounds shall be set at the depth and position as directed, and they shall not project above the ground more than 6 inches after final grading. Bounds located in lawns shall be set with the top of the bound 2 inches below the surface. Bounds located in sidewalks or drives shall be set with the top of the bound flush with the surface. Material for backfilling shall consist of suitable excavated material carefully placed about the bound and thoroughly tamped. When the excavation is in earth not suitable for backfilling, the Contractor shall furnish clean gravel or sand for backfill.
- C. When the bound location falls on solid ledge and the use of a drill steel rod is directed by the Engineer, a 1.5 inch hole shall be drilled to a depth of 18 inches and a drill steel rod as specified under Subsection 710.40 shall be placed in the hole. The rod shall be set so that the hole is on the bound point. The drill steel rod shall project above the ledge from 1 inch to 2 inches, and shall be grouted with a 1:1 mortar mix.

5.3.13 Guard Rail

- A. Guard Rail shall be constructed in conformance with MassDOT Standard Section 601. See Construction Details for requirements.

5.3.14 Pavement Markings

- A. For existing pavement marking applications, pavement markings shall be placed in conformance with MassDOT Standard Section 860
- B. For all new roadway construction, pavement markings shall be placed in conformance with MassDOT Engineering Directive E-05-003, dated June 16, 2005.
- C. Traffic markings must be restored by end of day, either after removal or paving. Temporary markings are allowed.

5.3.15 Traffic Signs

- A. Proposed sign locations shall be staked in the field for review and approval by the Town prior to installation.

5.3.16 Street Signs

- A. Proposed sign locations shall be staked in the field for review and approval by the Town prior to installation.

5.3.17 Inspections

- A. Each step in the construction process shall be inspected and approved by the Department of Public Works before the next step shall begin.



5.3.18 Handhole Installation

- A. Handholes shall be set on 12-inches of crushed stone bedding and set level. Top of frame on handholes shall set even with finished grade.
- B. Handhole frames shall be set with tops conforming accurately to grade of pavement or finished ground surface or as indicated on drawings. Frames shall be set concentric with top of handhole and on a minimum of 2 courses of red brick and mortar bedding. A full bed of mortar shall be placed so that the space between the top of the brick and mortar and the bottom flange of the frame shall be completely filled and made watertight. Frame shall be grouted as needed to have a smooth transition between the frame and the concrete handhole. A thick ring of mortar extending to the outer edge of the concrete shall be placed all around the flange.

5.4 References

- A. All materials and execution shall conform to the highest applicable standards. If there is a conflict between other standards, or between other standards and these Design standards, then the most stringent criteria shall be used.
- B. These standards draw and refer to the *Commonwealth of Massachusetts - Massachusetts Highway Department: Standard Specifications for Highways and Bridges* (1995 et seq.) and the *Commonwealth of Massachusetts - Massachusetts Highway Department: Construction and Traffic Standard Details* (1996 et seq.). These two documents are referred to collectively as the MassDOT Standards. In addition to the MassDOT Standards, the Town references AASHTO, and ASTM as guidance for the materials and execution of work performed on the Town Roadway Infrastructure. The following summarizes select standards applicable to the sections in these Design Standards. This list is not exclusive; other standards may apply. The latest revision of each standard shall be referenced.

Standard	Title/Subject
AAB	Architectural Access Board
ADA	Americans with Disabilities Act
MUTCD	Manual on Uniform Traffic Control Devices
NA	Massachusetts Department of Transportation: Standard Specifications for Highways and Bridges
NA	Massachusetts Department of Transportation: Construction and Traffic Standard Details (1996 et seq.)
521 CMR	Rules and Regulations of the Architectural Access Board
AASHTO T 99	Standard Method of Test for the Moisture-Density Relations of Soils Using a 5.5-lb Rammer and a 12-in. Drop (Compaction Test Method C)
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A616	Standard Specification for Rail-Steel Deformed and Plain Bars for Concrete Reinforcement.
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C150	Standard Specification for Portland Cement





6 Existing Road Openings

6.1 General

- A. Any contractor, corporation, public utility or person desiring to open a public way must comply with the Town's Street Opening Permit (SOP) policy and the associated standard operating procedures. For further information, please refer to Town of Framingham Web site link as follows: http://www.framinghamma.gov/public_works/sop/default.htm.
- B. All work in a public way shall be done in compliance with the minimum standards of the Framingham Department of Public Works as set forth herein.
- C. All trench repair work must be guaranteed and bonded as required in the Town's Street Opening Permit (SOP) policy.
- D. All work shall be conducted in strict accordance with the latest OSHA regulations.
- E. No excavation shall remain open after working hours (7:30 a.m. to 4:30 p.m. or as specified in specific Town requirements). All excavations shall be backfilled and paved, or covered with steel plates as approved by DPW at the end of work each day. Steel plate use requires approval by the Engineer or Highway Operations Manager or Highway and Sanitation Division Director. Steel plates are generally not accepted.
- F. All trenches, whether on public or private property, that are at least 3 feet in depth and less than 15 feet in width, regardless of the length, shall be permitted throughout the Town of Framingham as required by Massachusetts law.
- F. All pavements shall be cut before excavation is to begin.
- G. Length of Trench Opening:
 - 1. The maximum length of open trench permissible at any time shall be two hundred (200 feet) feet, and no greater length shall be opened for pavement removal excavation, construction, backfilling, repairing, or any other operation without the express written permission of the Town.
- H. Workmanship:
 - 1. The Permittee shall furnish all materials and conduct the job in an orderly, timely, quality controlled manner.
 - 2. The Permittee shall keep a competent foreman and sufficient competent employees to carry on the work with proper speed and in accordance with the requirements of law and other public authorities and to the reasonable satisfaction of the Department of Public Works.
 - 3. The Permittee shall conduct the work in a manner that will not unreasonably interfere with other work being done by the Town, by contract or otherwise. If deemed necessary by the Department of Public Works, the work done under these standards shall conform to the progress of said other work. The Permittee shall cooperate with the contractors or employees who may be doing work for the Town, and with public service corporations affected by the work in arranging for storage places, temporary support for structures, repairs, etc.
 - 4. All temporary repairs shall be properly maintained by the Permittee to assure good rideability conditions until the end of the guarantee period or until permanent restoration has been made, whichever first occurs.



5. Permanent pavement restoration accomplished by utility companies shall be properly maintained to assure good rideability conditions until acceptance by the Department of Public Works.
 6. All existing roadway monumentation shall be inventoried and protected. Any and all impacts shall be brought to the attention of the Engineering Division immediately.
- I. Pavement markings shall conform to MassDOT Standard Section 860.

6.2 Traffic Management

- A. Contractor shall be responsible for all traffic management for the construction work zone, in compliance with the guidance set forth by the ATSSA Guide to Temporary Traffic Control, the MassDOT Work Zone Safety Guidelines, the MUTCD and all federal and state regulations.
- B. The DPW may require that a traffic management plan be prepared and submitted for review and approval. The plan shall show the routing of traffic during construction. The plan shall show the area and dimensions of the roadway pavement available for traffic during each stage of the work. The plan shall include all temporary barriers, signs, pavement markings, drums and other traffic control devices required to maintain traffic together with the limits of temporary pavement and necessary steel plates. The plan shall include all the requirements contained in the Town of Framingham Policy on Street Opening Permits.

6.3 Excavation

- A. Removal of asphalt pavement:
1. All initial excavations into paved street surfaces shall be precut in a neat line with pavement breakers or saws. The initial cutting of the pavement shall be restricted to the area directly over the sidewalls of the proposed trench to be excavated, or as directed by the Department of Public Works.
 2. Heavy duty pavement breakers may be prohibited by the Town when the use endangers existing substructures or other property.
 3. No irregular shapes will be allowed. No shape will be allowed that would prevent compaction equipment from adequately compacting all of the area. The shape of pavement cutouts shall be rectangular, or a combination of rectangular and square shapes unless otherwise agreed to by the Town and Permittee.
 4. Pavement edges shall be trimmed to a neat vertical face free of loose materials and neatly aligned with the centerline of the trench.
 5. Unstable pavement shall be removed over cave outs and overbreaks and the subgrade shall be treated as the main trench.
 6. The Permittee shall make every effort to avoid damage to existing pavement to remain. Any damage shall be promptly repaired by the Permittee.
- B. Removal of concrete pavement:
1. Sawcutting of reinforced Portland cement concrete is required with the depth of the cut being the full depth of the pavement unless otherwise directed by the Department of Public Works to retain reinforcement. Sawcutting may be required by the DPW outside of the limits of the excavation over cave-outs, overbreaks and small floating sections.
 2. Reinforced concrete pavement, to the extent possible, shall be removed without cutting the reinforcement. The bars or mesh, when cut, shall be severed as close to the center of the



trench as practicable and bent back to permit accomplishment of the work. When the pavement is ready to be permanently replaced, the reinforcement shall be bent back into position and reinforced with other bars or mesh which shall overlap the ends of existing reinforcement not less than twelve (12) inches and be securely wired together. Contact faces between new and existing concrete pavement shall be bonded using an approved epoxy binding agent installed and applied in accordance with the manufacturer's instructions, unless otherwise directed by the Department of Public Works.

- C. All material excavated from trenches and piled adjacent to the trench or in any street shall be piled and maintained in a manner that will not endanger those working in the trench, pedestrians or users of the streets, and so that as little inconvenience and obstruction as possible is caused to those using streets and adjoining property. The excavated material shall be hauled away from the site by the end of each working day.
- D. The Permittee shall secure the necessary permission and make all necessary arrangements for all required storage and disposal sites.
- E. When excavated material is laid along the side of the trench, it shall be kept trimmed. Whenever necessary in order to expedite the flow of traffic or to abate the dirt or dust nuisance, toe boards or bins may be required by the Department of Public Works to prevent the spreading of dirt into traffic lanes. If any portion of the excavated material is allowed to be used as backfill, it shall be stockpiled separately from all other materials.
- F. Sections of sidewalks and curbs shall be removed to the nearest real joint or scoreline.
- G. Tunneling, boring or other methods may be required by the Department of Public Works to avoid or minimize pavement removal.

6.3.1 Backfill

- A. Before backfilling, the Permittee shall notify the Department of Public Works for inspection. Backfilling shall not occur without DPW approval.
- B. In unpaved areas, excavations shall be backfilled as directed by the Department of Public Works with approved material conforming to MassDOT Spec M1.02.0 Special Borrow thoroughly compacted in layers not to exceed twelve inches (12 inches) in thickness until flush with the surrounding ground surface. All backfill shall be rough graded and compacted to not less than 95 percent of the maximum dry density of the material as determined by the Standard AASHTO Test Designation T 99, Compaction Test Method C at optimum moisture content. If the backfilled material settles, additional approved materials shall be installed by the Permittee, as required, to keep the surface even. After settlement is completed, the excavated area shall be left by the Permittee in as good a condition as before the work was started.
- C. Temporary sheeting and bracing used to support the side walls shall be removed, unless otherwise directed by the Department of Public Works, as backfilling progresses. When backfilling has reached the bottom of a brace, the latter and its horizontal rafter shall be removed, and this procedure shall be repeated throughout the backfilling operation. The sheeting shall be pulled in short increments, care being taken to avoid significant lateral movements of the sides of the trench. During and after pulling the sheeting, the backfill in the space formerly occupied by the sheeting shall be compacted.
- D. Whenever water is found standing in the excavation area, the water shall be removed by pump or other means before backfilling operations may commence.
- E. Backfilling shall be performed as soon as practicable so that the least possible subsequent settling will occur. In most cases backfilling shall occur on the same day as the excavation was begun. If



this is not feasible due to the complex nature of work, emergency, or unpreventable conditions, the Permittee shall notify the Department of Public Works that same day, if not sooner, and take appropriate measures to protect public safety and infrastructure until work commences again the following day.

- F. Backfill in paved areas shall be granular gravel borrow, processed gravel, sand or crushed stone material. At the Town's discretion, in-situ material conforming to MassDOT Spec M1.02.0, Special Borrow may be used for trench backfill above the pipe bedding material and below the roadway foundation materials. The backfill shall be spread in layers not exceeding eight inches (8 inches) in loose depth and thoroughly compacted, up to the pavement subgrade surface. All backfill shall be rough graded and compacted to not less than 95 percent of the maximum dry density of the material as determined by the Standard AASHTO Test Designation T 99, Compaction Test Method C at optimum moisture content.
- G. Broken pavement, large stones, roots and other debris shall not be used in backfill. Unused excavated material shall be removed from the jobsite and disposed of in a manner that will minimize interference and obstruction with pedestrian and vehicular traffic. No material shall be left within the right-of-way once the repair and/or installation is complete.
- H. Backfill material shall be in conformance with 6.2.4.

The Town will allow, and may in some cases require under certain conditions, as an alternate, Controlled Density Fill (CDF) under the following conditions:

1. Only Type IE, Excavatable, Fill will be allowed.
2. This material shall not be used for bedding material or in situations that will cause floating of the utility lines, or in the presence of cast iron or steel pipes.
3. CDF placement in trenches shall be fully barricaded or police protected for a minimum of three (3) hours after the pour or until a set is reached that will prevent a hazard to animals or humans.
4. CDF shall be placed up to the pavement subgrade surface.
5. CDF shall be separated from gas lines with a minimum of six (6) inches of sand cover over the lines.

6.3.2 Temporary Pavement

- A. Upon the completion of proper backfilling, the Permittee shall install temporary pavement. The Permittee shall take all reasonable measures to complete temporary pavement on the same day excavation work was begun. If same day paving is not achievable due to complexity of work, emergency, or unpreventable conditions, the Permittee must notify the Department of Public Works as soon as practicable that same day, if not sooner, and take appropriate measures to protect the public safety and infrastructure until work commences again the following day. The most stringent measures will be required on primary streets. Same day paving will typically be required if work is not expected to be continued the next day, regardless of location.
- B. The Permittee shall notify the Department of Public Works 48 hours prior to beginning paving operations for inspection. All hot mixed asphalt paving must first be approved by the Department of Public Works or designee as to depth and materials; this *applies to both temporary and permanent paving activities*.
 1. Notification of the anticipated timing of all paving activity must be acknowledged by the Department of Public Works. Any notification delivered by facsimile machine must be preceded or followed up by a telephone conversation to assure its proper and timely receipt.



2. Permittees shall endeavor to make a follow-up notification by 9:00 a.m. of each workday that paving is still anticipated. In the event of schedule changes or emergencies, the Permittee shall provide a minimum of one-hour notification to assure inspection availability.
 3. If a Town inspector is not able to be on site within 24 hours of the acknowledged anticipated start time of paving activity, the Permittee may be allowed to commence paving. Inspector may sample in-place material for specification compliance.
 4. Permittees who do not provide proper notification of paving activities may be subject to required removal and replacement of pavement for the purpose of inspection.
- C. All temporary pavement shall be hot mixed asphalt, conforming to MassDOT Standard Section 460, placed in two (2) inch compacted courses to a total depth of four (4) inches. If existing pavement depth is greater than eight (8) inches, temporary pavement shall be placed in two (2) inch compacted courses to a total depth of six (6) inches. If a layer of concrete, cobblestone, granite pavers, or other supporting material also exists, the Permittee shall install concrete to match that depth prior to installing temporary pavement.
- D. If excavation (or pavement damage) occurs at or within twenty four (24) inches of the edge of trench, the Permittee shall place temporary pavement to the edge of existing sound pavement.
- E. Hot mixed asphalt paving of trenches deemed by the Department of Public works to be major excavation shall be paver applied, unless otherwise authorized by the Department of Public Works.
- F. The Permittee shall maintain the temporary pavement and shall keep the temporary pavement in acceptable condition until the end of the guarantee period, or until permanent pavement is installed.
- G. The Permittee shall perform the necessary restoration beyond the limits of the street pavement, including lawns, esplanades, shrubs, gardens, curbing, sidewalks, underdrains, separations fabrics, fences, walls, etc. Upon completion of the permanent repairs outside the limits of the street pavement, the Permittee shall notify the Department of Public Works in writing that the permanent repairs and/or replacements have been completed, setting forth the date of completion. The Permittee shall maintain the repaired area outside of the pavement for a period of three (3) years after completion, with the exception that once proper horticultural growth has been established, no further horticultural maintenance will be required.
- H. Refilling of bar holes made in the street or sidewalk shall immediately, upon completion of the work, be filled with compacted, granular material up to three (3) inches below the paved surface and the remaining three (3) inches filled with an approved asphalt plug.
- I. All traffic control signs (i.e. STOP, YIELD, DO NOT ENTER, ONE WAY, NO PARKING, SPEED LIMIT, CURVE WARNINGS, etc.) approved by the DPW for removal, relocation, replacement, etc. shall be immediately replaced by the Permittee, unless otherwise directed by the Town's Traffic Engineer. No such traffic control sign shall be removed, relocated or replaced without the express approval of the DPW.
- J. All traffic devices, signs, pavement markings or traffic loops disturbed, damaged, altered or removed by the Permittee shall be promptly replaced by the Permittee, unless otherwise directed by the Department of Public Works, in accordance with Town and State of Massachusetts rules and regulations at the expense of the Permittee. The Permittee shall promptly repair all other damage caused by the work or activities. Street markings (centerlines, crosswalks, stop bars, lane markings, etc.) and traffic loops shall be replaced no later than thirty (30) days after completion of work or as may be directed by the Town's Traffic Engineer. If work disturbs centerlines or lane markings on primary streets, the Permittee shall place temporary reflective markers immediately



after the pavement is placed. Traffic markings must be restored by end of day, either after removal or paving. Temporary markings are allowed.

- K. The total thickness of the gravel base material and temporary pavement shall be of an adequate thickness to allow for the proper permanent roadway cross section. Extra gravel base may need to be installed.

6.3.3 Permanent Pavement

- A. The existing pavement shall be sawcut a minimum of six (6) inches beyond the initial excavation limits to expose a six (6) inch width of undisturbed soil.
- B. The temporary pavement, backfill and undisturbed soil shall be removed to the depth of the proposed pavement and disposed of off the site.
- C. The permanent pavement shall be:
 - 1. Local Streets: 1.5 inches of Top Course material placed on 2.5 inches of Binder Course material founded on 4 inches of Dense Graded Crushed Stone on 8 inches of Processed Gravel or Dense Graded Crushed Stone. This pavement structure shall be placed on the backfill.
 - 2. Collector Streets: 2 inches of Top Course material placed on 4 inches of Binder Course material placed in two equal courses founded on 4 inches of Dense Graded Crushed Stone on 8 inches of Processed Gravel or Dense Graded Crushed Stone.
 - 3. Arterial Streets: 3 inches Modified Top Course material placed in two courses on 5-inches of Binder Course material placed in two equal courses founded on 4 inches of Dense Graded Crushed Stone on 8 inches of Processed Gravel or Dense Graded Crushed Stone.
- D. Trench backfill and roadway foundation materials shall be checked for compliance with 95 percent compaction requirement. If compaction is found to be less than 95 percent, trench shall be re-compacted before paving will be allowed.
- E. Permanent pavement restorations shall not be allowed to commence until at least one hundred twenty (120) days have passed since the installation of approved temporary hot-mixed asphalt pavement.
- F. In cases where the existing pavement adjoining a proposed excavation is in need of rehabilitation, the Town and Permittee may enter into a mutual agreement such that the Permittee undertakes the pavement rehabilitation as part of their pavement restoration.
- G. The Permittee will not be required to repair or replace damaged pavement existing prior to commencement of the work unless excavation operations result in small, unstable sections. These shall be removed and replaced as part of the work.
- H. Each course of hot-mixed asphalt shall be compacted separately, meeting the requirement of 92 percent minimum compaction of standard laboratory maximum theoretical density for the specific material.
- I. Mechanical compactors will be permitted for repairs less than 10 square yards. Repairs exceeding 10 square yards shall be rolled with an appropriately sized, power-driven, steel-wheeled roller to obtain specification density.
- J. Hot-mixed asphalt materials shall be laid upon an approved clean, dry, compacted surface, spread and struck off to the established grade and elevation, giving regard to the loss in depth between loose and compacted mixtures. Immediately after the hot mix asphalt mixture has been spread, struck off, and surface irregularities adjusted, it shall be thoroughly and uniformly compacted.



- K. All sawcut vertical faces of existing pavement shall be neat, free of loose materials, and tack coated with an approved asphalt emulsion by applying the emulsion material in conformance with MassDOT Standard Specifications Section 460.62, to fully cover the surfaces prior to pavement installation.
- L. A tack coat shall be applied to the sub-base surface, or previous course surface.
- M. If two or more excavations are made for the same utility or client in the same construction season and are within six (6) feet of each other, edge to edge, they shall be permanently restored as one trench, including the pavement between excavations.
- N. Same requirement shall apply, if in a future season, an excavation for the same utility or client occurs within six (6) feet and the first has not yet been permanently restored.
- O. If an excavation for the same utility or client falls within six (6) feet of another excavation already permanently restored, the permanent pavement of the second excavation shall include all surface pavement between both excavations.

6.3.4 Material Specification – Trenches

- A. Special borrow shall conform to MassDOT Spec. M1.02.0.
- B. Granular gravel borrow and processed gravel material backfill shall conform to MassDOT Spec. M1.03.0, Gravel Borrow Type (b) and MassDOT Spec. M1.03.01, respectively.
- C. Sand borrow shall conform to MassDOT Spec. M1.04.0.
- D. Controlled Density Fill (CDF) Type IE Excavatable shall conform to MassDOT Spec. M4.08.0.
- E. Pavement structure subbase material shall be either MassDOT M1.03.1 Processed Gravel for Subbase or MassDOT M2.01.7 Dense Graded Crushed Stone for Subbase. The material shall be spread in layers not exceeding eight (8) inches in loose depth and compacted to no less than 95 percent of the maximum dry density of the material, ASTM D1557.
- F. Temporary pavement shall be hot-mixed asphalt MassDOT Type I top course material conforming to MassDOT M3.01.0 and M3.11.07.
- G. Steel Plates. Steel plates shall not be used without DPW approval . See Section 6.3, Special Conditions, for design and construction requirements.
 - 1. Plates and supporting members shall be steel, either new or used.
 - a. All materials shall be sound and free of damage or deterioration that would adversely affect functions.
 - b. Load and deflection calculations shall be used on ASTM A36 / A36M steel unless Contractor provides evidence that all steel used for the plate systems will be a higher strength grade.
 - 2. Steel plates in vehicular and pedestrian traffic areas shall be coated with an approved skid-resistant coating. Preparation of the surface and application of the coating shall be in accordance with all of the manufacturer's guidelines. Coatings shall be maintained on 100 percent of the surface of plates carrying vehicular and pedestrian traffic. Repairs shall be made to worn or deficient areas.
- H. Permanent pavement materials shall conform to the same MassDOT Standard Specifications as required for temporary pavement.
- I. Portland Cement Concrete shall conform to the requirements of Section M4 of the MassDOT Standard Specifications.



- J. Reinforcing shall be FIBERMESH fibers (100 percent virgin polypropylene, collated, fibrillated fibers) at a rate of 1.5 lbs. per cubic yard of concrete will be allowed for non-structural reinforcement. Installation shall be per manufacturer's recommendations.
- K. Loam shall conform to MassDOT Standard Specification Section 1.05, Loam Borrow. Loam shall have a finished depth of six (6) inches (minimum).
- L. Seeding shall conform to MassDOT Specification Section M6.03. Permittees shall be required to continually seed and water areas of loam until a satisfactory growth of grass is established.
- M. Filter fabric for underdrain shall be equivalent to Mirafi 140 by Fiber Industries.

6.4 Special Condition(s)

- A. Steel Plates
 - 1. Design Requirements:
 - a. The Permittee shall select and design the temporary steel plate and supporting system. The design calculations and Drawings shall be prepared, signed, and stamped by a Professional Engineer registered in the Commonwealth of Massachusetts experienced in design of temporary traffic decking.
 - b. Design shall be in accordance with Loads and Design Criteria standard to the industry for this type of work, and with the following requirements:
 - (i) For vehicular ramps, limit maximum grade to 5 percent.
 - (ii) For pedestrian ramps, limit maximum grade to 8 percent.
 - (iii) Conform with Americans with Disabilities Act Accessibility Guidelines (ADAAG) at all pedestrian traffic locations.
 - (iv) Design of support members shall allow clearances for existing and relocated utilities.
 - (v) Provide access to utilities, fire hydrants, and other facilities requiring unique access. Requirements at each site shall be obtained from the respective agencies affected.
 - (vi) Plates shall overlap the trench width by at least 2 feet on each side.
 - 2. Construction Methods:
 - a. Install and maintain the temporary steel plate systems only with express DPW approval.
 - b. Not more than two (2) steel plates shall be used at any time.
 - c. Steel plates shall not be used between November 15 and April 1 or at any time when snow is forecasted.
 - d. Place 48" x 48" orange and black construction sign, stating "Steel Plates 100 feet" to provide drivers with advanced notice.
 - e. Provide wood wedges under plate edges at uneven surfaces to minimize movement.
 - f. Pin plates to existing asphalt as shown in the details provided in the Street Opening Permit "Steel Plate Detail 2009" available at <http://www.framinghamma.gov/index.asp?nid=207>.
 - 3. Illumination:
 - a. Provide illumination in plated areas that will carry pedestrian traffic.
 - 4. Maintenance:
 - a. Inspect the condition of temporary steel plates at least once a day. Continuously maintain plates to conform to design requirements and construction requirements. Immediately



repair defects such as broken, bent, or loose plate members, and protruding fasteners. Patch adjacent paving as potholes develop, and immediately re-secure and bed loose transition members, plates, and ramps to the existing pavement.

- b. Maintain steel plates free of accumulations of snow, ice, water, mud, and debris.
- c. Perform maintenance, repair, or replacement whenever there is noticeable deterioration of any material or component from its original conditions.

6.5 References

All materials and execution shall conform to the highest applicable standards. If there is a conflict between other standards, or between other standards and these Design standards, then the most stringent criteria shall be used.

These standards draw and refer to the *Commonwealth of Massachusetts - Massachusetts Highway Department: Standard Specifications for Highways and Bridges* (1995 et seq.) and the *Commonwealth of Massachusetts - Massachusetts Highway Department: Construction and Traffic Standard Details* (1996 et seq.). These two documents are referred to collectively as the MassDOT Standards. In addition to the MassDOT Standards, the Town references AASHTO, and ASTM as guidance for the materials and execution of work performed on the Town Roadway Infrastructure. The following summarizes select standards applicable to the sections in these Design Standards. This list is not exclusive; other standards may apply. The latest revision of each standard shall be referenced.

Standard	Title/Subject
ATSSA	Guide to Temporary Traffic Control in Work Zones
MassDOT	Work Zone Safety Guidelines for Massachusetts Municipalities and Contractors
MassDOT Standards	Massachusetts Department of Transportation: Standard Specifications for Highways and Bridges
MassDOT Standards	Massachusetts Department of Transportation: Construction and Traffic Standard Details (1996 et seq.)
ADAAG	Americans with Disabilities Act Accessibility Guidelines
ASTM A36 / A36M	Standard Specification for Carbon Structural Steel
ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³)
US DOT	Manual on Uniform Traffic Control Devices
US DOT	Manual on Uniform Traffic Control Devices





Plan Content Requirements

The following are required to be included on Site Utility Plans submitted to the Department of Public Works for advance project review, comment input and approval. Only plan submittals containing the proper level of information presented in the specified format will be plan reviewed and processed. Hence, to avoid rejections or delays the applicant should accurately prepare the appropriate Plan Submittal Package following the content items outlined below.

1. Drawing must be drawn to scale with the scale preference being 1"=20' including the depiction of a North Arrow.
2. All drawing sheets shall have a border, title, and revision block that includes at a minimum:
 - a. Engineering firm name and address/contact information including telephone and email
 - b. Project name
 - c. Property address and street name
 - d. Drawing creation date
 - e. Scale
 - f. Revision block represented to facilitate the documentation of any follow-up revision plan submittals numbers/revision description/revision date with all revision information made on the drawing (layout or annotation) clearly cloud circled and each cloud noting the revision number
3. All existing vs. all proposed design construction conditions (drawing and annotation) must be distinguished by different line weight treatment as follows: Existing conditions depicted lighter or narrower and proposed design conditions shown heavier or bolder line weight representation.
4. Original Massachusetts licensed Professional Engineer's or Professional Land Surveyor's stamp and signature on all drawings.
5. In addition to key dimensions and location ties, the size, material, and vintage must be shown for all existing and proposed infrastructure (mains and services or branches) needed to support the project be it Town and/or public and/or private owned (i.e. Water, Sewer, Storm Water, Traffic Signal, Telecom, Electric, Gas, etc.)
6. Locus map showing the parcel in relation to the surrounding properties
7. Name of record owner(s) of land shown on the plan
8. Identification of parcel by sheet, block, and lot number of Assessors Maps.
9. Property lines, easements and/or other legal rights within the property lines. Locations of all existing and proposed roadway monumentation.
10. Location of all buildings and lot lines on the lot, including ownership of lots, and street lines, including intersections within 300 ft.
11. Boundaries and existing and proposed topography of the property, including contours at a 2-foot interval, using (National Geodetic Vertical Datum 1929) NGVD29 as it may be updated from time to time and specifying NGVD29 on all elevation drawings, specifically indicating the areas on which the activity is proposed to occur, and clearly noting if the activity is on an area greater than 4,000 square feet or on Slopes 15% or greater
12. Dimensions of proposed buildings and structures, including gross floor area, floor area ratio, total lot coverage of building, and breakdown of indoor and outdoor floor area as to proposed use. Area dimensions to include Lot Coverage of Building, Paved Surface Coverage, and Landscaped Open Space and Other Open Space, with percentages of these items to be provided and to total 100 percent of the lot area.
13. Locations and dimensions, including total ground coverage, of all driveways, maneuvering spaces and aisles, parking stalls and loading facilities, and proposed circulation of traffic.
14. Location of pedestrian areas, walkways, flow patterns and access points, and provisions for handicapped parking.
15. Location, size, and type of materials for surface paving, curbing, and wheel stops.
16. Location, dimension, type and quantity of materials for open space, planting, and buffers where applicable.



17. Provisions for storm water drainage affecting the site and adjacent parcels, and snow disposal areas. Drainage computations and limits of floodways shall be shown where applicable.
18. Accurate depiction of rim and invert elevations for storm drainage and sanitary sewer, sanitary service wyes with distances to nearest structure, water line gates and water service valves
19. Cross sections, design details or profiles as appropriate
20. Curbing, sidewalk, driveway curb opening, parking areas, walkways, and road layout identified and dimensioned
21. Photometric plan showing the intensity of illumination expressed in foot-candles at ground level within the interior of the property and at the property boundaries; location, orientation, height, wattage, type, and style of outdoor luminaire.
22. Zoning Table to be located on both the front page of the submitted plans and on the Parking Plan/Site Plan page.
23. Water service, sewer, waste disposal, and other public utilities, accurately positioned, on and adjacent to the site.
24. The size and location of all existing and proposed buildings, structures, utilities, roads, driveways, parking areas, and areas of cut and fill on the site and the location of all structures on abutting properties within 100 feet of the property lines of the parcel
25. All wetlands and wetland resource areas as defined in M.G.L. Ch. 131, §40, and the Framingham Wetlands Protection Bylaw, Article V, §18 of the General By-laws, drainage patterns, and watershed boundaries. Also include a delineation of the 100-year floodplain and all bodies of water, including vernal pools, streams, ponds, and coastal waters within 125-feet of the project site/limit of work and the delineation of a 30-foot no-cut/no alteration zone
26. Location of any rare and endangered species as mapped by the Massachusetts Natural Heritage Program
27. The location of any proposed stockpile locations
28. Detailed drawings and design calculations of all temporary and permanent stormwater management and Erosion and Sediment control structures and devices. Drawing Legend depicting all symbols and line types



As-built Plan Requirements

An as-built plan of project improvements (roadway, sitework, and utilities), in both hardcopy and electronic formats, shall be submitted for review and approval. A stamped paper hardcopy of the as-built plan shall be submitted for review. Once approved, a stamped hard copy and electronic copies (AutoCAD and PDF) of the as-built plan shall be submitted for archival. All drawing sheets shall not exceed ARCH Size D (24" x 36") and shall be prepared at readable plan scale, preferably consistent with the design plan scale. Plans shall be prepared in monochrome format utilizing gray scale and line types to differentiate features (color as-built plans will not be accepted).

Electronic as-built information shall be in both AutoCAD 2008 and Acrobat PDF formats. The AutoCAD file shall conform to the current version of the MassGIS Standard for Digital Plan Submission. The electronic CD/DVD media shall be properly labeled with the Project Name, date, and all file names.

The as-built plan shall include:

1. North arrow, scale, and date
2. Name of record owner(s) of land shown on plan
3. Identification of parcel by sheet, block, and lot number of Assessor's Maps
4. Property lines, easements, and/or legal rights within the property lines
5. Location of all buildings and lot lines on the lot, including ownership of lot, and street limits
6. Boundaries and final topography of the property, including contours at a minimum 2 foot interval, using (National Geodetic Vertical Datum 1929) NGVD1929 as it may be updated from time to time and specifying NGVD on all elevation drawings
7. Original Massachusetts licensed Professional Engineer's or Professional Land Surveyor's stamp and signature on all drawings
8. All drawing sheets shall have a border and a title block that include project name/street location, and Engineering Firm telephone contact numbers/address information
9. Drawing Legend depicting all symbols and line types
10. Utilities accurately positioned (Cable, Drainage, Electric, Gas, Telephone, Sewer, Water, Etc.) as applicable
11. Size and materials identified for all new Town utilities and service connections (Storm Drainage, Sanitary Sewer and Water)
12. Key dimensions (and ties) depicted for all new Town utilities and service connections. Ties shall include dimensions from fixed objects to water valves, angle fittings, reducing fittings, sleeves, service taps, etc. and dimensions from fixed objects to sewer cleanouts, main taps, couplings, angle fittings, etc.
13. Rim and invert elevations for storm drainage and sanitary sewer, sanitary service wyes with distances to nearest structure, water line gates and water service valves shall be accurately depicted
14. Cross sections, design details or profiles as appropriate
15. Curbing, sidewalk, driveway curb opening, parking areas, walkways, and road layout identified and dimensioned





Construction Details

Detail Number	Detail Title
G-1.0.0	Fiber Rolls and Silt Fences for Erosion Control
W-2.1.0	Typical Water Connection for 1" Service
W-2.1.1	Typical Water Connection for 1-1/2" to 2" Service
W-2.1.2	Typical Fire Service for 1 1/2" to 2"
W-2.1.3	Typical Fire Service (Tapping Sleeve)
W-2.1.4	Typical Connection (Tapping Sleeve)
W-2.2.0	Typical Thrust Restraint Wedge Action Type Joints
W-2.2.1	Typical Thrust Restraints Using Tie Rods and Friction Clamps
W-2.2.2	Typical Thrust Block Detail
W-2.3.0	Water Main Trench Detail
W-2.4.0	Gate Valve
W-2.4.1	Typical Anchor Tee Installation
W-2.4.2	Air Release Valve/Blow Off
W-2.4.3	Valve Location at Intersection
W-2.4.4	Water Gate Covers
W-2.4.5	Water Valve Box
W-2.5.0	Fire Hydrant Installation
W-2.6.0	Water Main Lowering Detail
W-2.6.1	Water Crossing Under Railroad
W-2.7.0	Detail of Cut and Remove of Water Connection 4" and Over
W-2.7.1	Detail of Cut and Capping of Water Connection 4" and Over
W-2.8.0	Meter Installation
S-3.1.0	Service Connection (Gravity)
S-3.1.1	Service Connection (Saddle)
S-3.1.2	Chimney
S-3.1.3	Service Connection (Grinder)
S-3.2.0	Above Grade Clean Out
S-3.3.0	Plug for Abandoning Sanitary Sewer
S-3.3.1	Plug for Sanitary Sewer
S-3.4.0	Typical Sewer Manhole
S-3.4.1	Typical Drop Manhole (Outside)
S-3.4.2	Forcemain Manhole
S-3.4.3	Sewer Manhole Cover
S-3.4.4	Manhole Seal
S-3.5.0	Sewer Crossing
S-3.6.0	Backwater Valve Assembly
S-3.7.0	Typical Grease Trap



Detail Number	Detail Title
S-3.7.1	Typical Grease Trap Sizing and Notes
D-4.1.0	Single Grate Catch Basin
D-4.1.1	Direct Inlet Catch Basin
D-4.1.2	Dual Grate Catch Basin
D-4.2.0	Drain Manhole
D-4.2.1	Eccentric Manhole
D-4.2.2	Sump Manhole
D-4.3.0	Manholes and Catch Basins General Notes and Dimensions
D-4.3.1	Raising Castings
D-4.4.0	Rip Rap Apron at Pipe Outfalls
D-4.4.1	Rip Rap Plunge Pool
D-4.5.0	Typical HDPE Pipe Trench Detail
D-4.6.0	Flared HDPE End Sections
D-4.7.0	Subdrain
D-4.8.0	Dry Well
R-5.1.0	Roadway Cross Section
R-5.1.1	Cut and Fill Slopes
R-5.1.2	Granite Curbs
R-5.1.3	Bituminous Berms
R-5.1.4	Pavement Transition
R-5.1.5	Roadway Widening and Overlay 6-Ft Wide or Greater
R-5.1.6	Roadway Widening and Overlay 6-Ft Wide or Less
R-5.1.7	Pavement Details for Trench Restoration
R-5.1.8	Continuous Zone Trench Restoration
R-5.2.0	Guard Rail
R-5.2.1	Guard Rail (Double Face)
R-5.3.0	Wheelchair Ramp Notes
R-5.3.1	Wheelchair Ramp Type A
R-5.3.2	Wheelchair Ramp Type B
R-5.3.3	Wheelchair Ramp Type C
R-5.3.4	Wheelchair Ramp Type D
R-5.3.5	Wheelchair Ramp Type E
R-5.3.6	Detectable Warning Panel
R-5.4.0	Typical Curb Cut Plan – Residential Driveways No Sidewalk
R-5.4.1	Full Depth Driveway Apron – Section No Sidewalk
R-5.4.2	Sidewalk Through Driveway
R-5.4.3	Full Depth Driveway – Section Cement Concrete Sidewalk Crossing
R-5.5.0	Cross Walk



Detail Number	Detail Title
R-5.5.1	Decorative Cross Walk
R-5.6.0	Steel Plate Installation
R-5.7.0	Traffic Sign Installation Notes
R-5.7.1	Traffic Sign Detail Sidewalk or Median Installation
R-5.7.2	Traffic Sign Detail Non-sidewalk Installation
R-5.7.3	Street Name Sign Installation Notes
R-5.7.4	Street Sign Detail Sidewalk Installation
R-5.7.5	Street Sign Detail Non-sidewalk Installation
R-5.7.6	Granite Bound Detail
R-5.8.0	Trench Detail for Communications Conduit