



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 Holbrook*.
- 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. No stormwater discharge (point or sheet flow) shall cause flooding or erosion on adjacent properties.
- 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.
- H. All private and public stormwater management systems shall comply with the most current NPDES Small MS4 permit, especially with respect to treatment of design storm flows and redevelopment requirements.



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.
- C. Private drains, including building storm drains for new or existing buildings, groundwater sump drains, cellar drains, and drains from irrigation systems, shall not be connected directly to the Town's sanitary sewer system. Illicit connections shall be removed by the property owner at their expense.

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; policies and technical guidance in MassDEP's Stormwater Management Standards and the Massachusetts Stormwater Handbook; and the EPA NPDES Small MS4 permit.

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, except for underdrains.



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

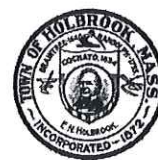
- A. All basins shall have a sump of at least 48 inches (4 feet) below the invert of the outlet pipe, or otherwise approved by the DPW, and an inside diameter of 4 feet minimum.

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.
- 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 3 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.
- B. 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.

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 word "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

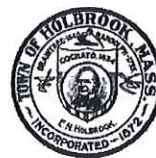
- A. Catch basin grates located at low points shall be 24-inch square grate, East Jordan Iron Works (formerly LeBaron Foundry Co.), LF248-2-4F. Single or dual catch basin grate shall consist of a 24-inch square grate LeBaron Foundry Co. L24SG1-000 or approved equal with an 8-inch heavy duty frame (MassDOT Standard).
- 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. 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 to minimize the entry of oil, gasoline, and debris into drainage pipes. 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

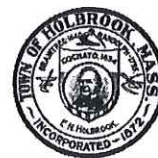
- A. Culvert, headwall, wingwall, and endwall materials and specifications shall meet MassDOT Standard Specifications Sections 230 and M4, and as shown on MassDOT Construction and Traffic Standard Details, Drawings 206.40 through 206.70, and 207.1.0 through 207.3.0.
- B. Stone shall conform to MassDOT, 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

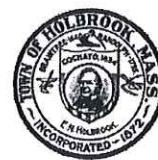
- A. A dry well shall consist of either an excavated pit or a perforated concrete structure with an inside diameter of 5 feet to 12 feet. If an excavated pit, the dry well shall be filled with clean aggregate greater than 1-1/2 inches up to 3 inches. Fill shall be surrounded by filter fabric (Filter 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 a stormwater runoff impoundment constructed beneath the surface over permeable soils. Examples include: infiltration pits, chambers, perforated pipes, and galleys. Infiltration systems shall be designed and constructed in accordance with The Massachusetts Stormwater Handbook and the EPA NPDES Small MS4 permit.
- B. Pretreatment BMPs shall remove at least 25% TSS. In the following areas, at least 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.
- B. Drainage swales shall be stabilized with vegetation or rip rap to prevent erosion.

4.4 Execution

- A. All steps shall be inspected and approved by the DPW 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.
- C. A concrete pipe cap shall be used when pipe cover is inadequate to prevent buoyancy of the HDPW pipe.
- 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 for diameters up to 48-inch ID pipe shall be one foot. Minimum cover for diameters between 48-inch and 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

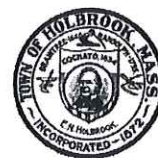
- A. At the discretion of the Department, a mandrel test shall be conducted following completion of pipe laying. Placement of curb, gutter, sidewalk, or asphalt concrete pavement shall not occur until the DPW Inspector has approved the mandrel test. The DPW Inspector shall be present through the duration 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 and shall have a distance of no more than 250 feet between manholes, unless otherwise approved by DPW.
- B. When ground water is higher than the elevation of the bottom of the manhole, 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. The manhole shall be tested for tightness prior to backfill and approval.
- 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 higher than the elevation of the bottom of catch basins, $\frac{3}{4}$ -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. The catch basin shall be tested for tightness prior to backfill and approval.
- B. 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

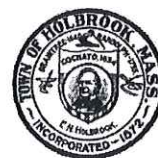
- A. Leaching basins shall be set in an excavation lined with a geotextile. The basin shall be placed on a pad of free draining crushed stone, with the excavation around the basin back-filled with similar material. Leaching catch basins shall be used as "off-line" devices (that is, they should not generally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

4.4.3 Box Culverts, Headwalls, Wing walls, and End walls

- A. Headwalls, Wing walls, and End walls 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

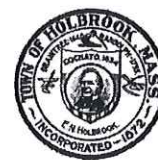
- A. Dry wells shall not be placed in a public way or a public easement, and shall not be placed into service until the drainage area is stabilized. Dry wells shall be sited a minimum of 10 feet away from the building. Excavated material shall be placed away from the excavated sides to prevent wall instability 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

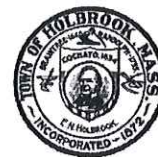
- A. Access to all drainage in drainage easements shall be a minimum of 30 feet wide and maintained to allow earth-moving and other construction activities to occur within the easement (see 4.1.2.2).

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.
- C. All stormwater designs, construction, and management shall comply with the requirements of the EPA NPDES Small MS4 permit, current version.



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
NPDES Small MS4	National Pollutant Discharge Elimination System Small Municipal Separated Storm Sewer Systems
EPA	Environmental Protection Agency



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 DPW. 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 Planning Board and DPW.
- G. DIG SAFE shall be contacted to determine the location of all existing underground utilities prior to any excavation. Call the Holbrook Fire Department to mark out their lines.
- H. A note shall be placed on all plans stating "The Town of Holbrook DPW 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 DPW. Such approval does not constitute acceptance of such utilities by the Town of Holbrook."

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 DPW.
- C. Location and alignment shall conform to the requirements contained in the current edition of the Town of Holbrook 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, with at least 4 inches of natural subbase.
 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. with at least 4 inches of natural subbase.
- 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 with fiber mesh 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

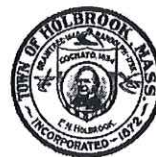
- A. Where walls or slopes must be constructed to properly support the street or adjacent land, such construction must be done in accordance with the specifications set forth in Section 5.2.14.

5.1.6 Driveways

- A. Driveways and private entrances shall be designed, permitted and constructed to conform to Town of Holbrook Bylaw 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 DPW 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 DPW 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 DPW 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.

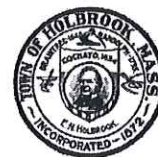
5.2.9 Hot Mix Asphalt

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

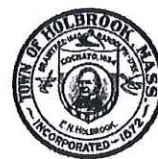
- A. Guard Rail shall be COR-TEN® with steel or wood posts in conformance with MassDOT Standard M8.07.0.

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 maroon 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 DPW.

5.2.22 Handholes

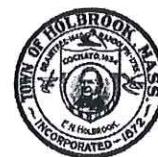
- A. Handholes shall have minimum internal dimensions of 36 inches length and 36 inches width and internal depth of 24 inches unless otherwise approved by DPW. Handholes shall be designed to meet ASTM C-858 and ACI 318 with AASHTO HS-20 highway loading. Handholes shall be of Quazite® polymer concrete 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 "TOH 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. Manhole 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. Manhole frames and covers shall have the words "TOH COMMUNICATIONS" written on their tops. Manhole 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. Work within public roadways is not permitted between November 15 and April 1, unless special approval is granted by the DPW.
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 Holbrook standards. All work and materials shall be subject to the inspection and final approval of the DPW.
- 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 DPW 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.



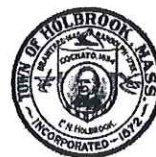
- f. Installation of drainage system.
- g. Installation of other underground utilities.
- h. Installation of road sub-drain where conditions warrant.
- i. Installation of sewer services.
- j. Installation of water services.
- k. Preparation of sub-grade surface.
- l. Gravel and dense graded crushed stone 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 DPW.

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 DPW 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 DPW 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 compact until the surface is true and even. When required by the DPW, 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 DPW.

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 Holbrook DPW 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 DPW 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 DPW and the full cost of



such repair shall be paid by the Contractor. Any material used which does not meet the standards of the DPW 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

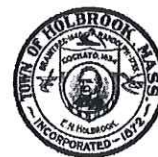
- A. Proposed sign locations shall be staked in the field for review and approval by the Town prior to installation.

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 DPW before the next step shall begin.



5.3.18 Handhole Installation

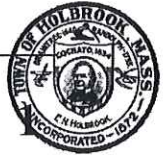
- A. Handholes shall be set on 12-inches of crushed stone bedding and set level. Top of frame on handholes shall set even with finished grade.
- B. Handhole frames shall be set with tops conforming accurately to grade of pavement or finished ground surface or as indicated on drawings. Frames shall be 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.

<u>Standard</u>	<u>Title/Subject</u>
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

Section 6



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 Holbrook Web site link as follows: https://www.holbrookma.gov/sites/g/files/vyhlf3261/f/uploads/street_opening_permit_sop.pdf
- B. All work in a public way shall be done in compliance with the minimum standards of the Holbrook DPW 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 (7:00 a.m. to 4:00 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 Superintendent or Supervisor. 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 through the Town of Holbrook Trench Permit 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, 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 DPW (DPW).
 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 DPW, 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 DPW.



6. All existing roadway monumentation shall be inventoried and protected. Any and all impacts shall be brought to the attention of the Department of Public Works 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 requires 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 Holbrook 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 DPW.
 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. Saw cutting 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 DPW 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 DPW.

- 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 DPW 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 scored line.
- G. Tunneling, boring or other methods may be required by the DPW to avoid or minimize pavement removal.

6.3.1 Backfill

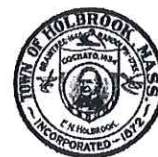
- A. Before backfilling, the Permittee shall notify the DPW for inspection. Backfilling shall not occur without DPW approval.
- B. In unpaved areas, excavations shall be backfilled as directed by the DPW with approved material conforming to MassDOT Spec M1.02.0 Special Borrow thoroughly compacted in 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 DPW, 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 DPW 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 DPW 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 DPW 48 hours prior to beginning paving operations for inspection. All hot mixed asphalt paving must first be approved by the DPW 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 DPW. 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.



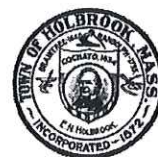
3. If a Town inspector is not able to be on site within 24 hours of the acknowledged anticipated start time of paving activity, the Permittee may be allowed to commence paving. Inspector may sample in-place material for specification compliance.
 4. Permittees who do not provide proper notification of 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 DPW to be major excavation shall be paver applied, unless otherwise authorized by the DPW.
 - 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 DPW 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 DPW. 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 DPW, 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

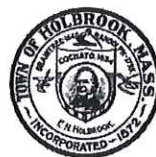
- A. The existing pavement shall be saw cut a minimum of six (6) inches beyond the initial excavation limits to expose a six (6) inch width of undisturbed soil.
- B. The temporary pavement, backfill and undisturbed soil shall be removed to the depth of the proposed pavement and disposed of off the site.
- 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 saw cut 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's 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. Disposal of removed pavement, concrete, soil, or other material shall comply with the DPW's Waste Management and Soil Management specifications. The disposal location and management plan shall be pre-approved by the DPW, prior to the start of any work.

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 detail R-5.6.0.
- 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.

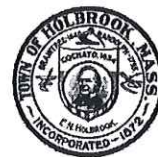
<u>Standard</u>	<u>Title/Subject</u>
ATSSA	Guide to Temporary Traffic Control in Work Zones
MassDOT	Work Zone Safety Guidelines for Massachusetts Municipalities and Contractors
MassDOT Standards	Massachusetts Department of Transportation: Standard Specifications for Highways and Bridges
MassDOT Standards	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



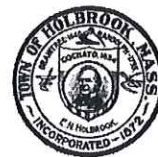
Plan Content Requirements

The following are required to be included on Site Utility Plans submitted to the DPW 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. Orient such that North does not point towards the bottom of the sheet.
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 Holbrook 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



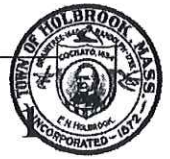
As-built Plan Requirements

An as-built plan of project improvements (roadway, site work, 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.

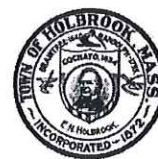
The as-built plan shall include:

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

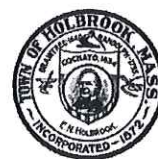


Construction Details

<u>Detail Number</u>	<u>Detail Title</u>
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-2.5.0	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 Connection
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

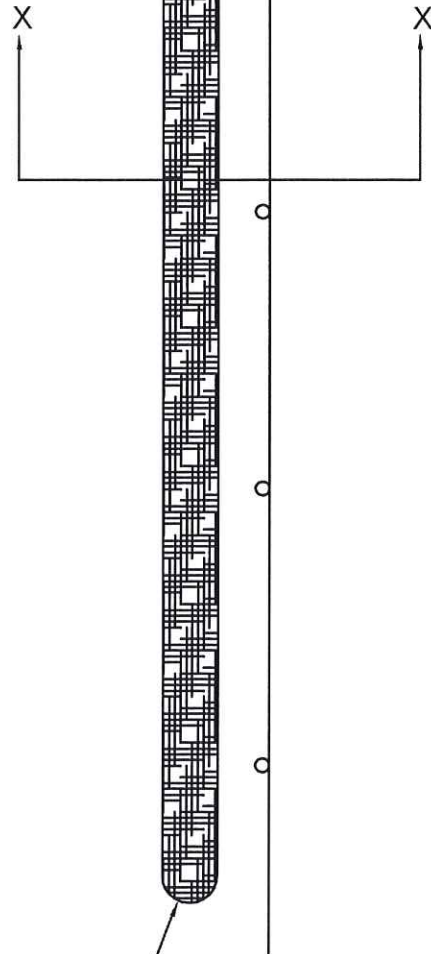
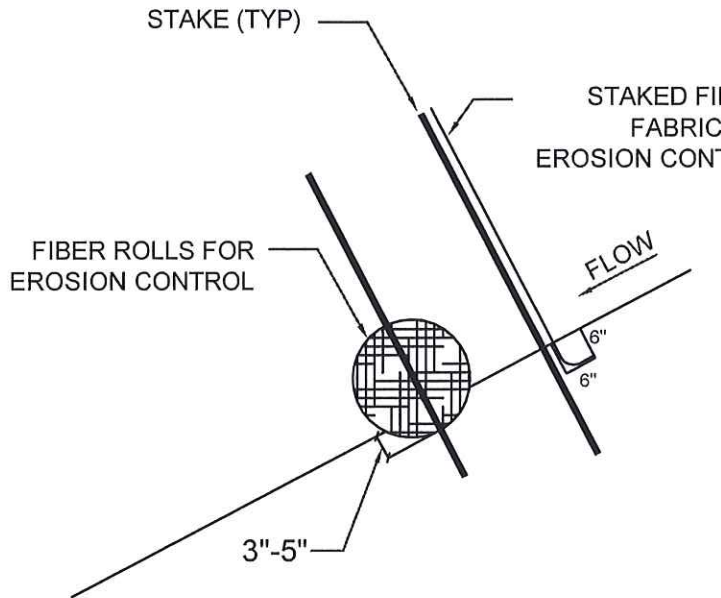


Detail Number	Detail Title
S-3.7.1	Typical Grease Trap Sizing and Notes
D-4.1.0	Single Grate Catch Basin
D-4.1.1	Direct Inlet Catch Basin
D-4.1.2	Dual Grate Catch Basin
D-4.2.0	Drain Manhole
D-4.2.1	Eccentric Manhole
D-4.2.2	Sump Manhole
D-4.3.0	Manholes and Catch Basins General Notes and Dimensions
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	HDPE Flared 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-5.7.1	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
R-5.8.1	Hand Hole for Communications Conduit
R-5.8.2	Transition From Communications Hand Hole to Trench

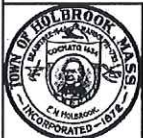
FILTER FABRIC FOR
EROSION CONTROL
(STAKE FILTER
FABRIC EVERY 6 FT)



SECTION X-X

FIBER ROLLS FOR
EROSION CONTROL
(STAKE EVERY 3' - 4')

NOT TO SCALE



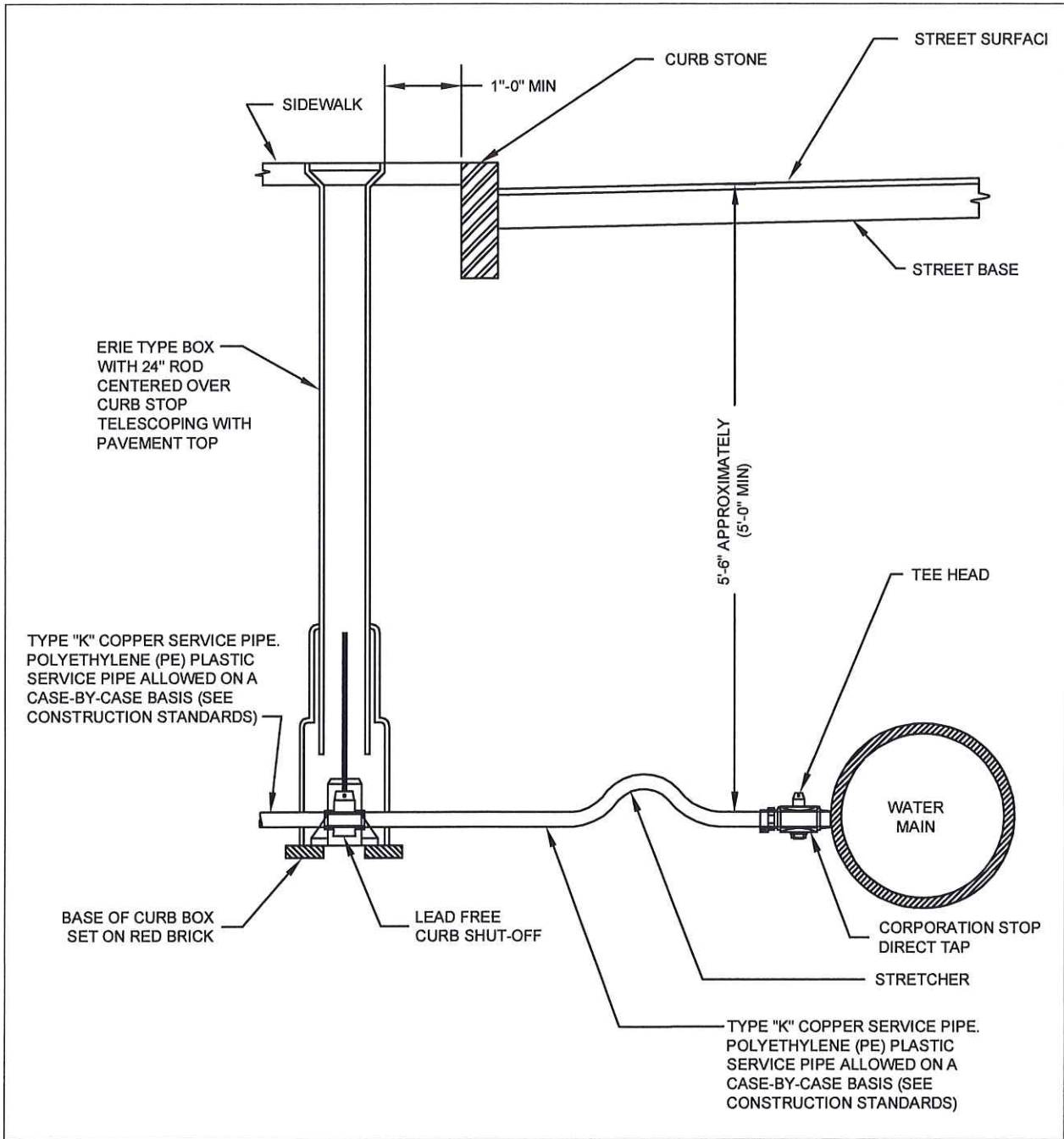
TOWN OF HOLBROOK
DEPARTMENT OF PUBLIC WORKS

FIBER ROLLS AND SILT FENCES FOR
EROSION CONTROL

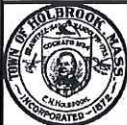
DATE: SEPT. 2020

REV: 0

G-1.0.0



NOT TO SCALE



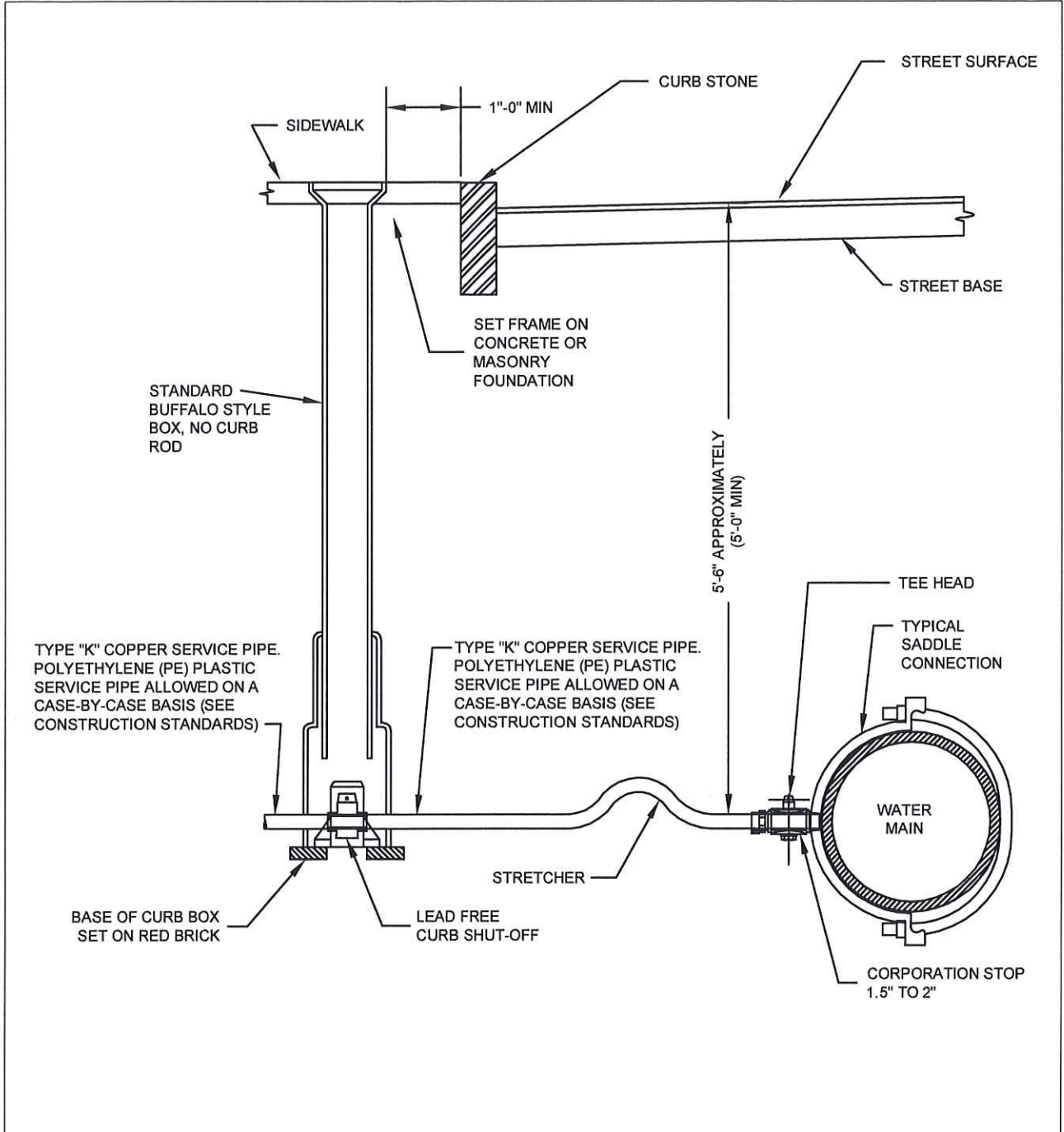
TOWN OF HOLBROOK
DEPARTMENT OF PUBLIC WORKS

TYPICAL WATER CONNECTION
FOR 1" SERVICE

DATE: SEPT. 2020

REV: 0

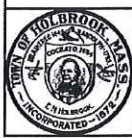
W-2.1.0



TYPE "K" COPPER SERVICE PIPE.
POLYETHYLENE (PE) PLASTIC
SERVICE PIPE ALLOWED ON A
CASE-BY-CASE BASIS (SEE
CONSTRUCTION STANDARDS)

TYPE "K" COPPER SERVICE PIPE.
POLYETHYLENE (PE) PLASTIC
SERVICE PIPE ALLOWED ON A
CASE-BY-CASE BASIS (SEE
CONSTRUCTION STANDARDS)

NOT TO SCALE



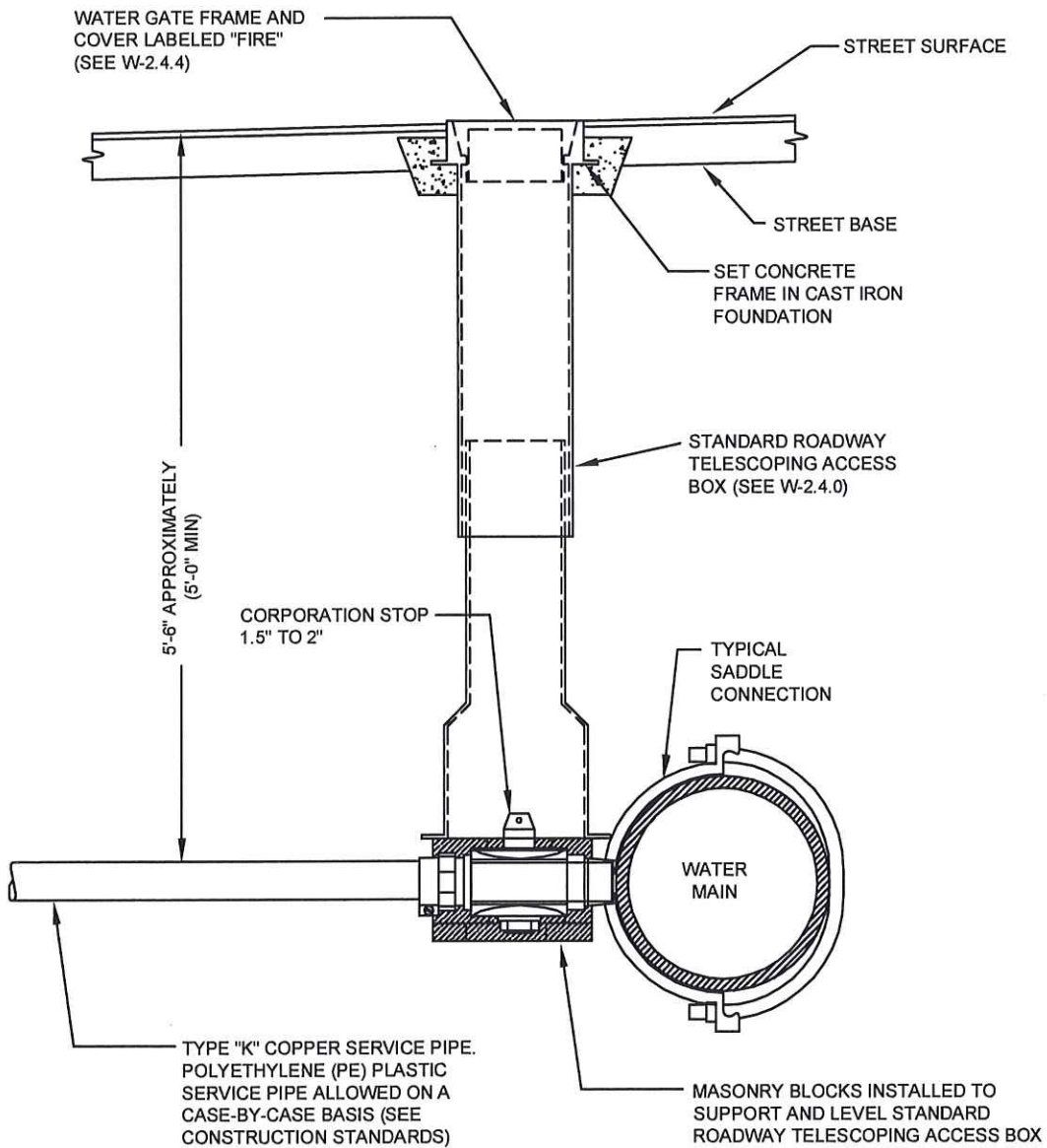
TOWN OF HOLBROOK
DEPARTMENT OF PUBLIC WORKS

TYPICAL WATER CONNECTION
FOR 1-1/2" TO 2" SERVICE

DATE: SEPT. 2020

REV: 0

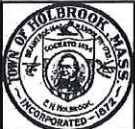
W-2.1.1



NOTES:

1. SEPARATE DOMESTIC AND FIRE SERVICES SHALL BE INSTALLED FROM THE BUILDING SERVICED TO THE PUBLIC WATER MAIN.
2. THE PROPERTY OWNER IS RESPONSIBLE FOR MAINTENANCE OF THE FIRE SERVICE FROM THE BUILDING SERVICED TO THE PUBLIC WATER MAIN.
3. SADDLE AND CORPORATION STOPS SHALL BE AWWA TAPER THREADS (MUELLER "CC") AS DESCRIBED IN AWWA STANDARD C800

NOT TO SCALE



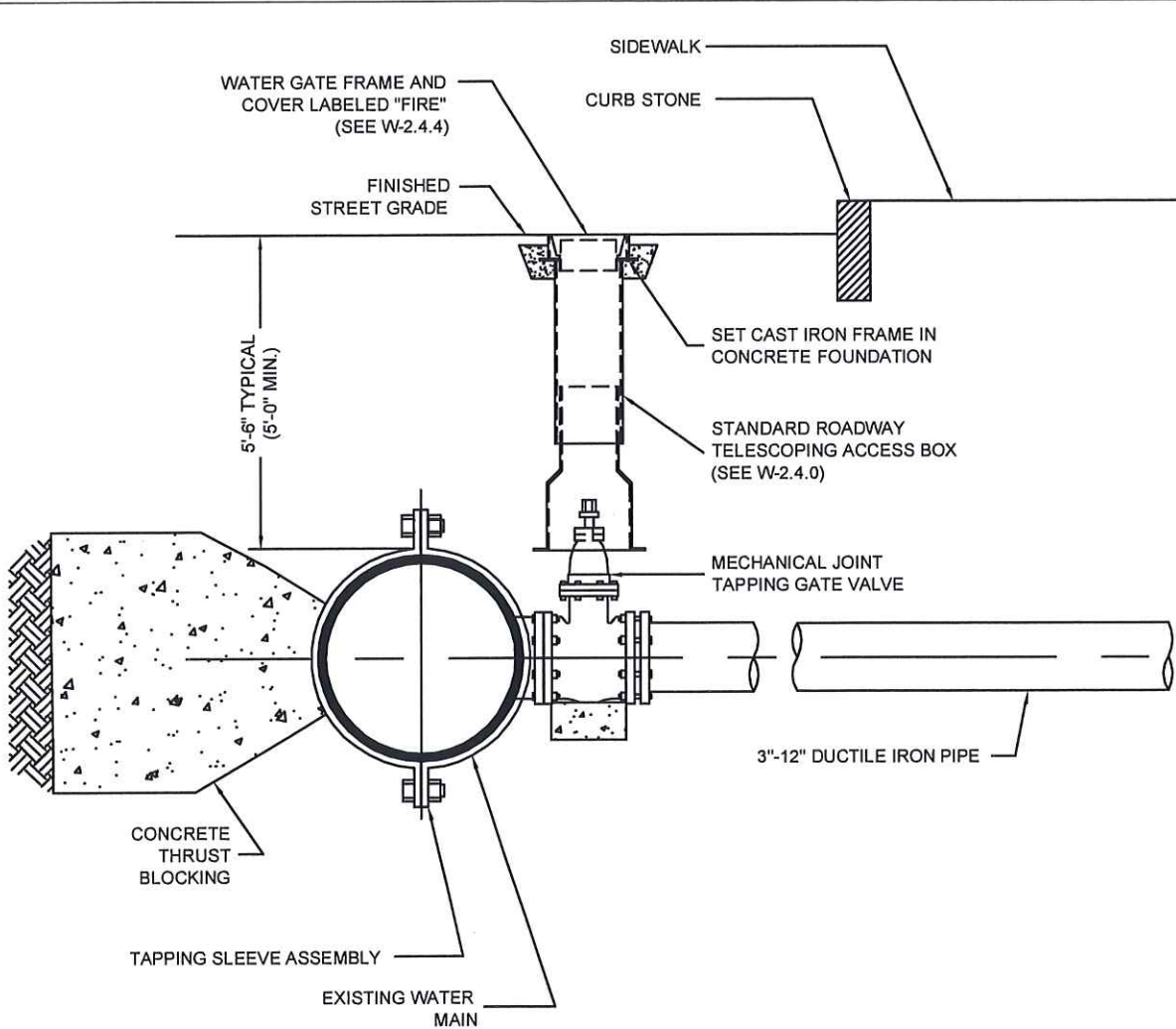
TOWN OF HOLBROOK
DEPARTMENT OF PUBLIC WORKS

TYPICAL FIRE SERVICE
FOR 1- $\frac{1}{2}$ " TO 2"

DATE: SEPT. 2020

REV: 0

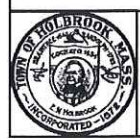
W-2.1.2



NOTES:

1. MAXIMUM TAPPING SLEEVE SHALL NOT BE GREATER THAN 1/2 DIAMETER OF CONNECTING MAIN.
2. MEGA LUG RESTRAINTS ON ALL MECHANICAL JOINTS.
3. SEPARATE DOMESTIC AND FIRE SERVICES SHALL BE INSTALLED FROM THE BUILDING SERVICED TO THE PUBLIC WATER MAIN.
4. THE PROPERTY OWNER IS RESPONSIBLE FOR MAINTENANCE OF THE FIRE SERVICE FROM THE BUILDING SERVICED TO THE PUBLIC WATER MAIN

NOT TO SCALE



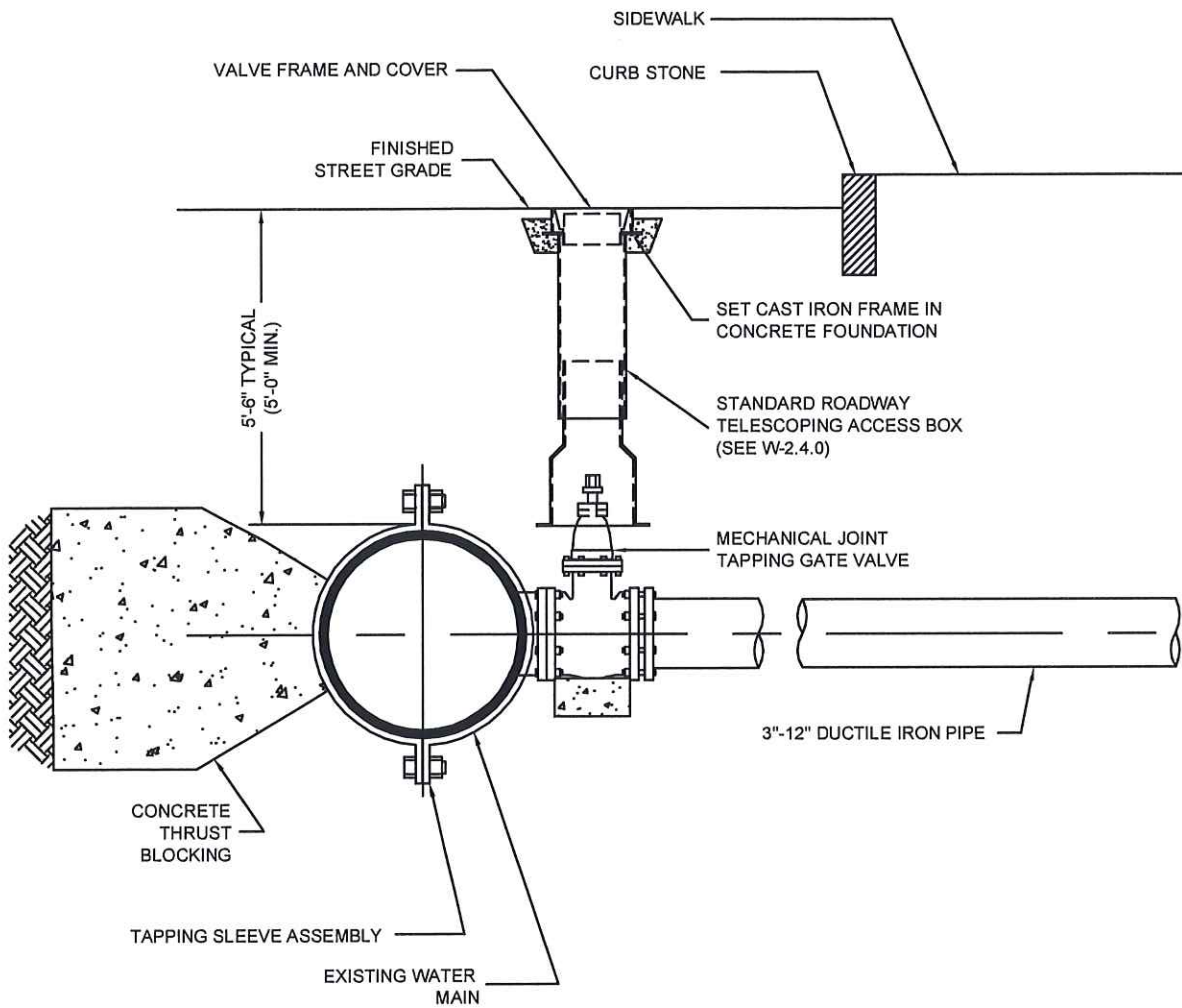
TOWN OF HOLBROOK
DEPARTMENT OF PUBLIC WORKS

TYPICAL FIRE SERVICE
(TAPPING SLEEVE)

DATE: SEPT. 2020

REV: 0

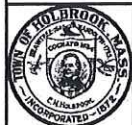
W-2.1.3



NOTES:

1. MAXIMUM TAPPING SLEEVE SHALL NOT BE GREATER THAN $\frac{1}{2}$ DIAMETER OF CONNECTING MAIN.
2. MEGA LUG RESTRAINTS ON ALL MECHANICAL JOINTS.

NOT TO SCALE



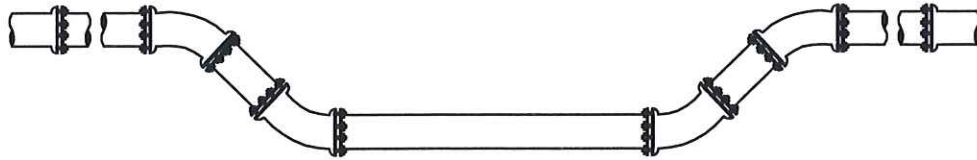
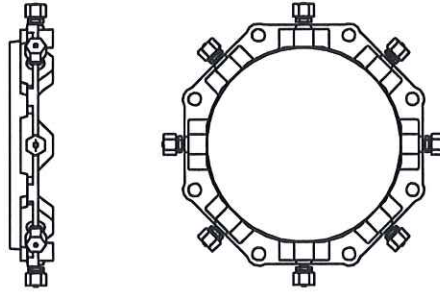
TOWN OF HOLBROOK
DEPARTMENT OF PUBLIC WORKS

TYPICAL CONNECTION
(TAPPING SLEEVE)

DATE: SEPT. 2020

REV: 0

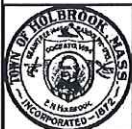
W-2.1.4



NOTES:

1. DEVICES NEED TO BE PLACED BEYOND THE AREA OF RESTRAINTS IN ACCORDANCE WITH MANUFACTURES RECOMMENDATIONS.

NOT TO SCALE



TOWN OF HOLBROOK
DEPARTMENT OF PUBLIC WORKS

TYPICAL THRUST RESTRAINT
WEDGE ACTION TYPE JOINTS

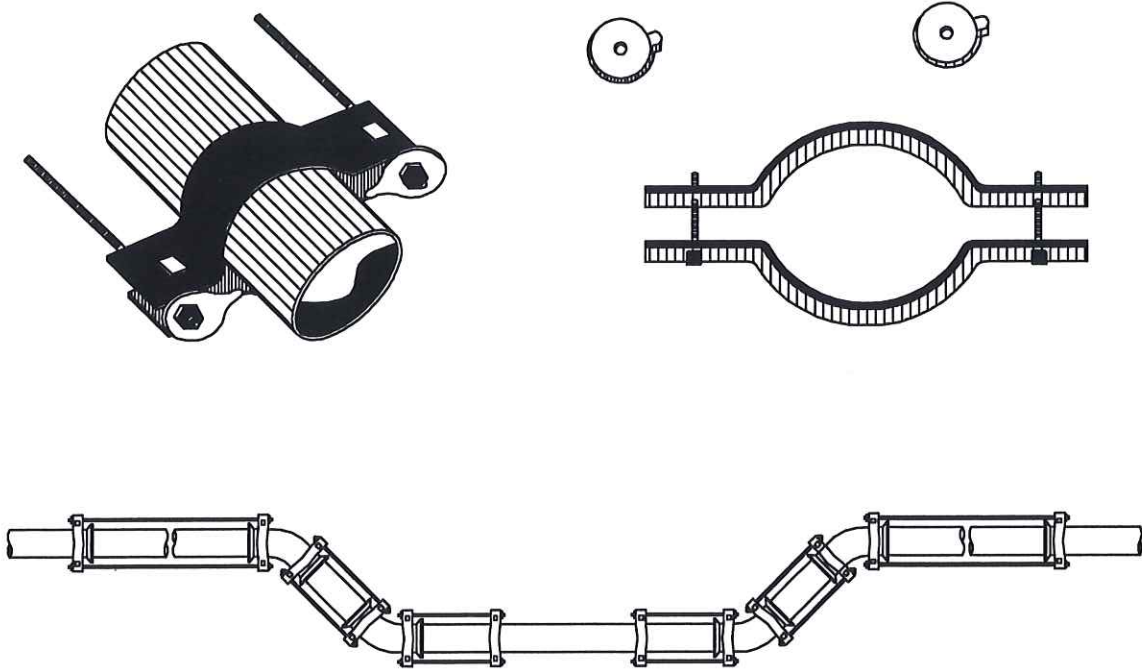
DATE: SEPT. 2020

REV: 0

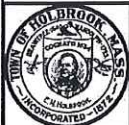
W-2.2.0

SCHEDULE OF TIE RODS

PIPE SIZE	NUMBER OF RODS PER FITTING	DIAMETER OF RODS
4" - 12"	2	3/4"
16"	4	3/4"
20" - 24"	4	1 1/2"



NOT TO SCALE



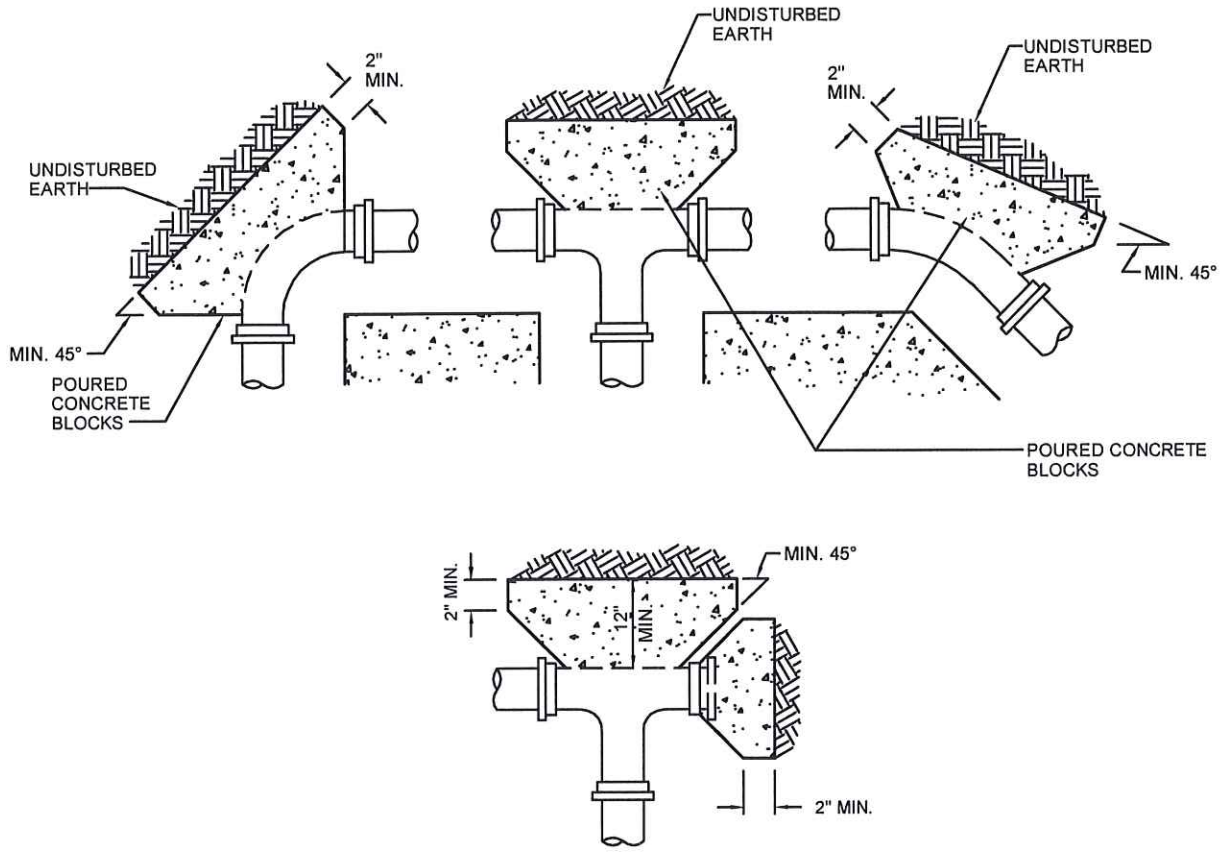
TOWN OF HOLBROOK
DEPARTMENT OF PUBLIC WORKS

**TYPICAL THRUST RESTRAINTS USING
TIE RODS AND FRICTION CLAMPS**

DATE: SEPT. 2020

REV: 0

W-2.2.1

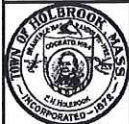


PLAN VIEWS

NOTES:

1. SPECIFIC THRUST BLOCK DESIGN SHALL CONFORM TO AWWA GUIDELINES.
2. PLACE 4 mil. POLYETHYLENE BETWEEN CONCRETE AND FITTING (CONCRETE SHALL NOT INTERFERE WITH JOINT).
3. MINIMUM CONCRETE THICKNESS SHALL BE 12 INCHES.
4. THRUST BLOCK ORIENTATION SHALL BE SUCH THAT THE CENTER OF THE FITTING CORRESPONDS WITH THE CENTER OF THE THRUST BLOCK.
5. THE MINIMUM ALLOWABLE ANGLE (EITHER VERTICAL OR HORIZONTAL) SHALL BE 45 DEGREES.

NOT TO SCALE



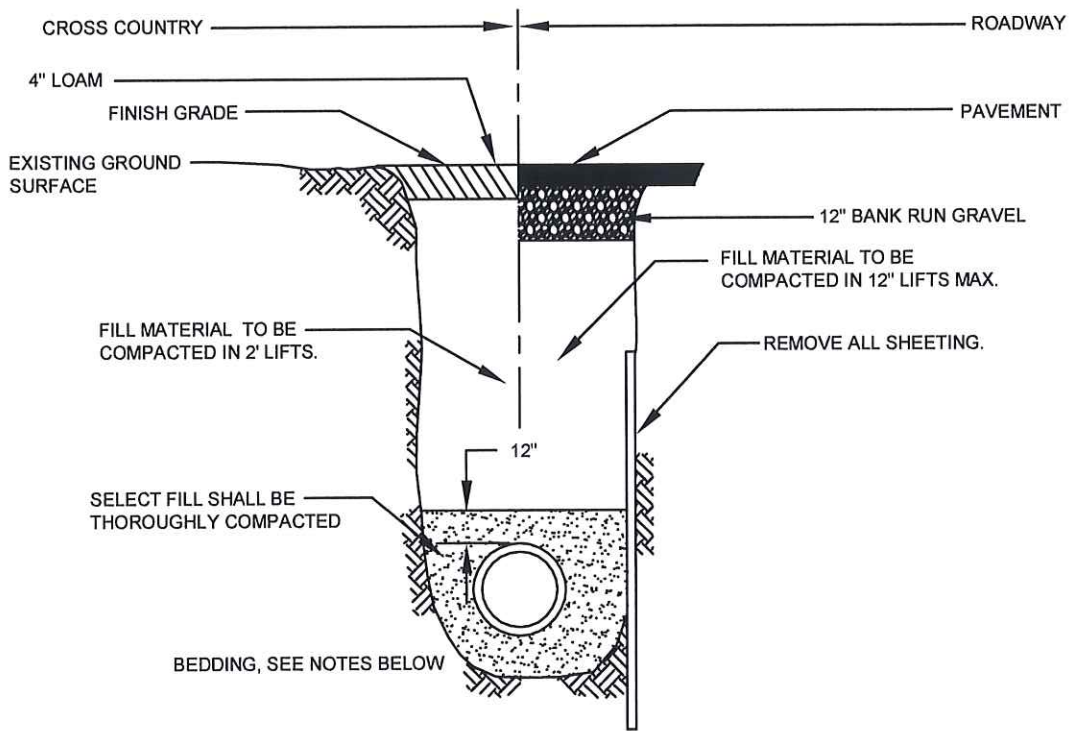
TOWN OF HOLBROOK
DEPARTMENT OF PUBLIC WORKS

TYPICAL THRUST
BLOCK DETAIL

DATE: SEPT. 2020

REV: 0

W-2.2.2

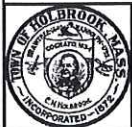


NOTE: 5'-0" MIN. COVER

NOTES:

1. TOWN OF HOLBROOK MAY REQUIRE FLOWABLE FILL AT ITS DISCRETION.
2. FOR LOCATIONS WHERE LEDGE IS NOT ENCOUNTERED IN TRENCH, PIPE CAN LAY ON UNDISTURBED EARTH, OR ON SAND BEDDING CONSISTENT WITH AWWA GUIDELINES.
3. FOR LOCATIONS WHERE LEDGE IS ENCOUNTERED, SAND BEDDING SHALL BE MINIMUM OF 12" THICK UNDER PIPE.
4. FILL MATERIAL SHALL BE COMPACTED TO 95 % PROCTOR DENSITY.

NOT TO SCALE

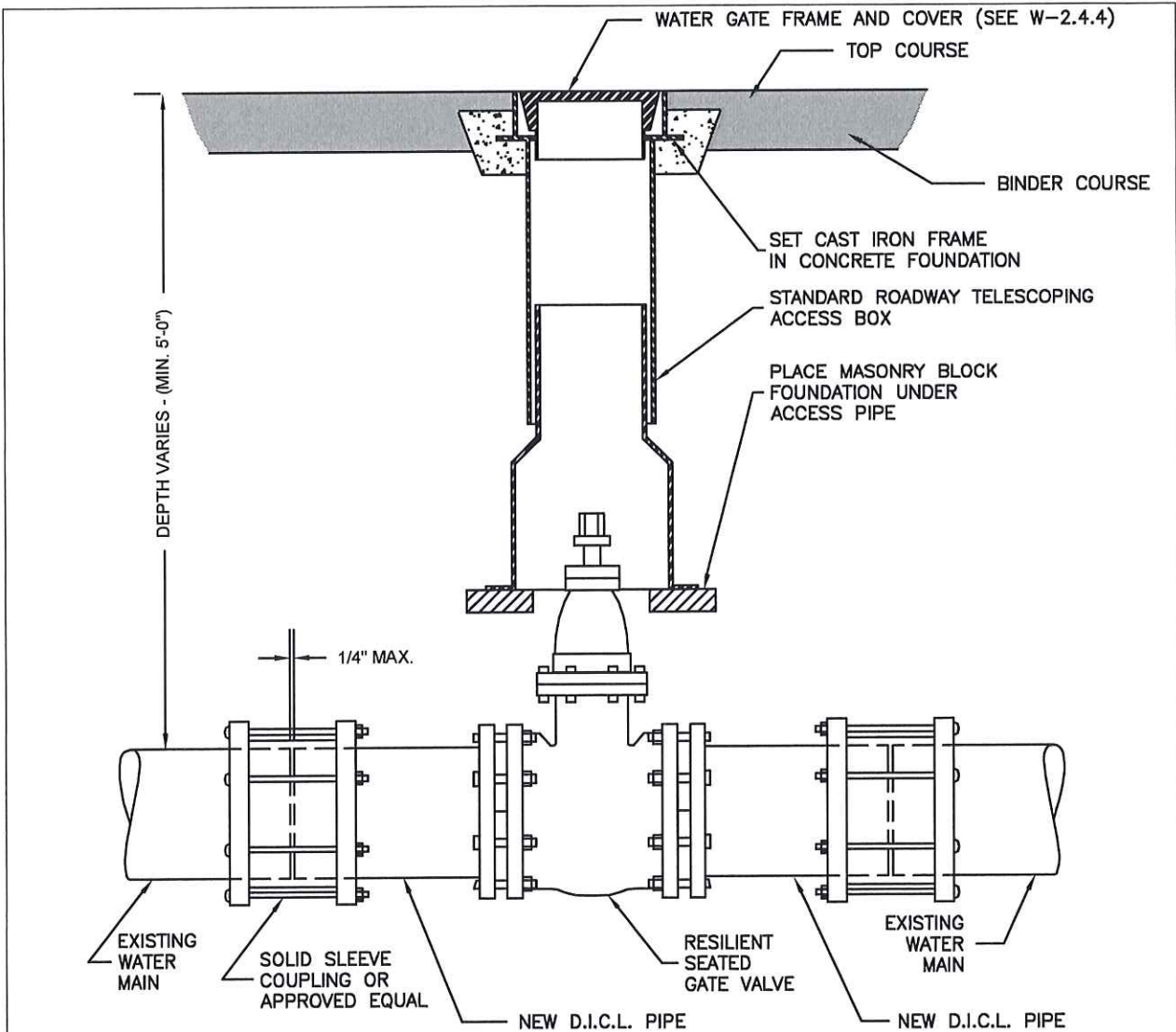


TOWN OF HOLBROOK
DEPARTMENT OF PUBLIC WORKS

WATER MAIN TRENCH DETAIL

DATE: SEPT. 2020
REV: 0

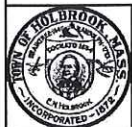
W-2.3.0



NOTE:

1. ALL EXCAVATION, BACKFILLING AND PAVING SHALL BE IN ACCORDANCE WITH THE TOWN OF HOLBROOK REQUIREMENTS.
2. WATER GATE COVER SHALL HAVE A MINIMUM HEIGHT OF 3.5 INCHES AND A MINIMUM WEIGHT OF 13 POUNDS, BRAND NAME BIBBY-STE-CROIX OR EQUAL.

NOT TO SCALE

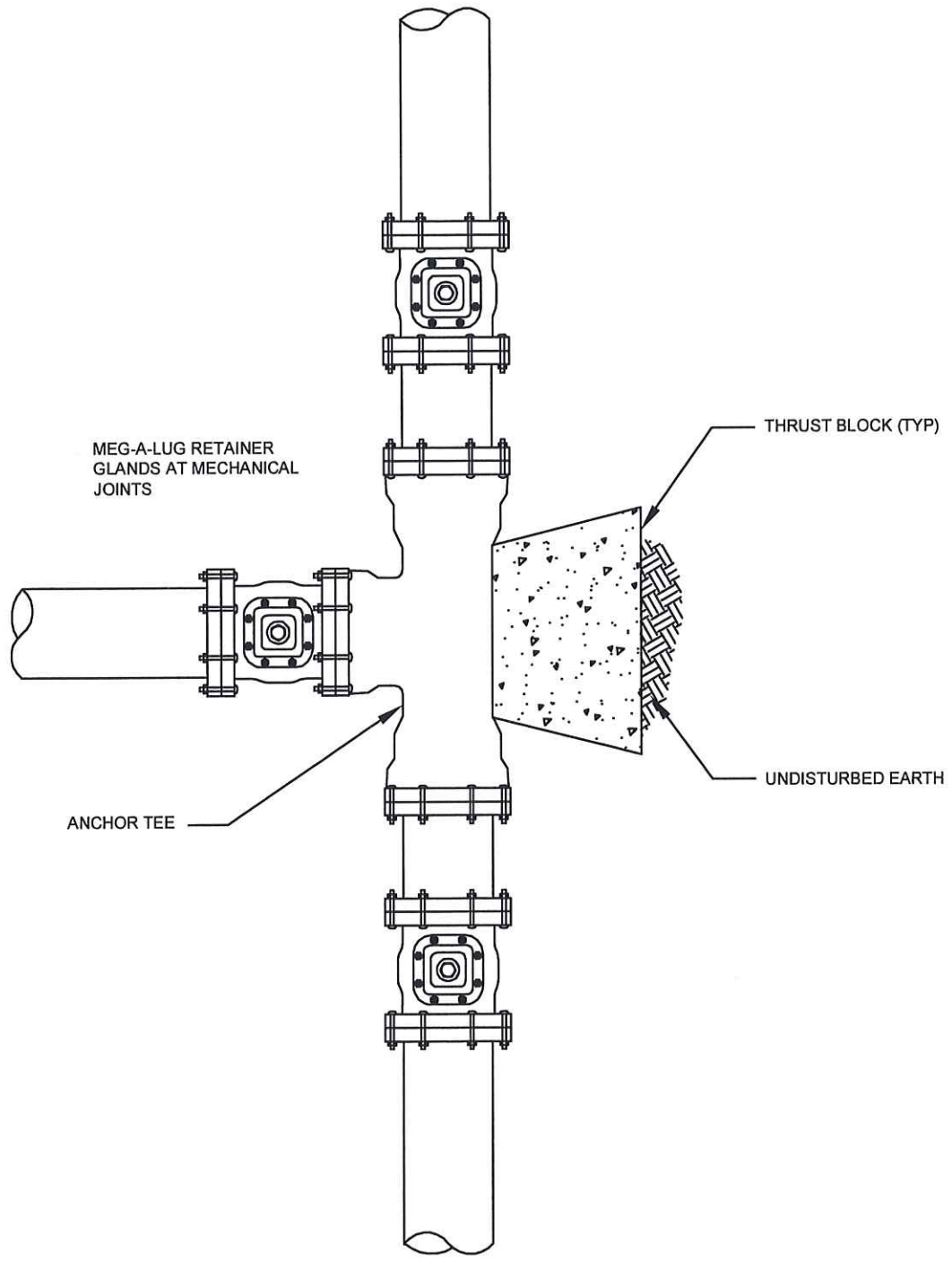


TOWN OF HOLBROOK
DEPARTMENT OF PUBLIC WORKS

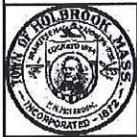
GATE VALVE

DATE: SEPT. 2020
REV: 0

W-2.4.0



NOT TO SCALE



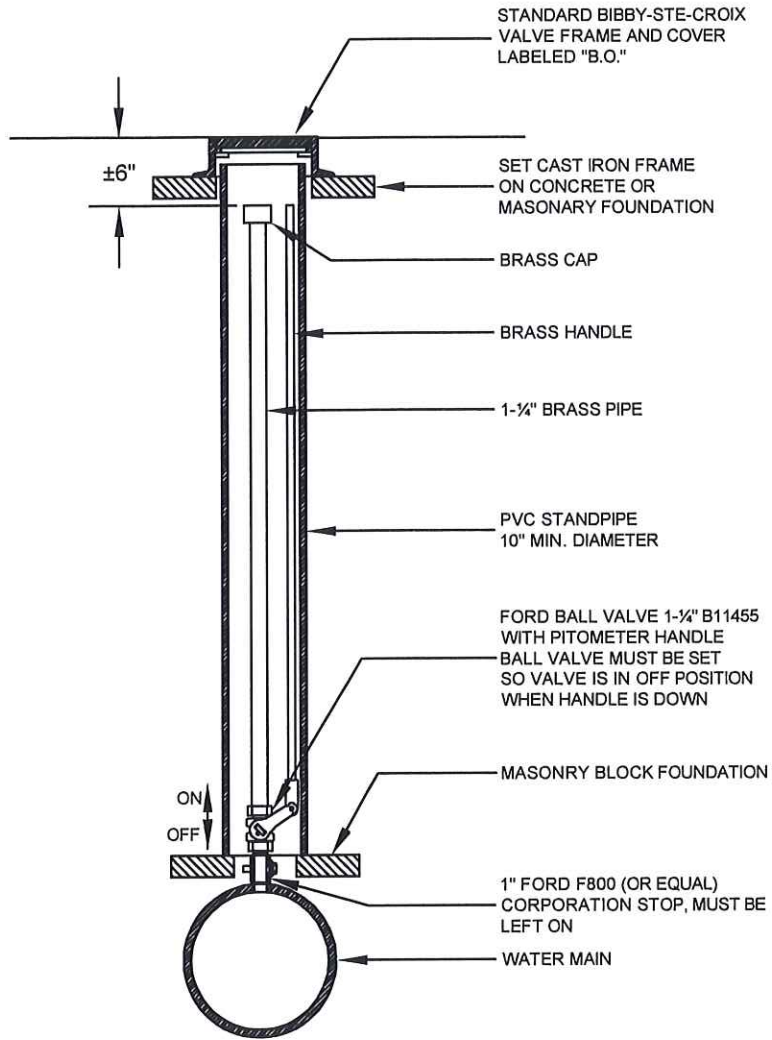
TOWN OF HOLBROOK
DEPARTMENT OF PUBLIC WORKS

TYPICAL ANCHOR TEE
INSTALLATION

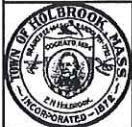
DATE: SEPT. 2020

REV: 0

W-2.4.1



NOT TO SCALE



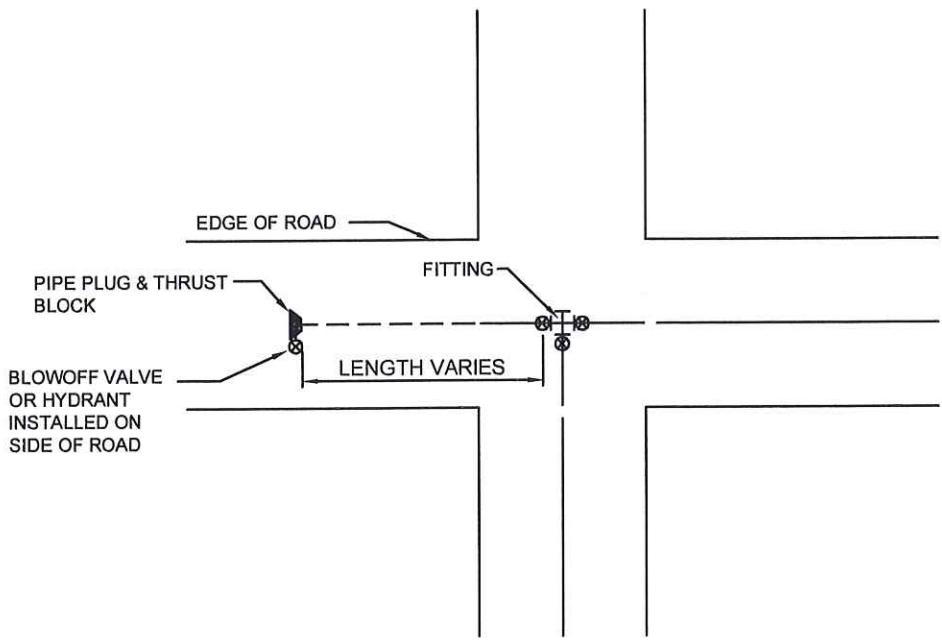
TOWN OF HOLBROOK
DEPARTMENT OF PUBLIC WORKS

AIR RELEASE VALVE/BLOW-OFF

DATE: SEPT. 2020

REV: 0

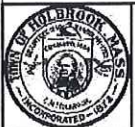
W-2.4.2



NOTES:

1. INSTALL VALVES AT INTERSECTION IN A CLUSTER CONFIGURATION. PROVIDE A MINIMUM 18" TO 24" MAXIMUM NIPPLE FROM FITTING TO VALVE.

NOT TO SCALE



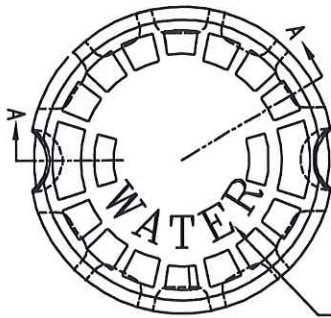
TOWN OF HOLBROOK
DEPARTMENT OF PUBLIC WORKS

VALVE LOCATION AT INTERSECTION

DATE: SEPT. 2020

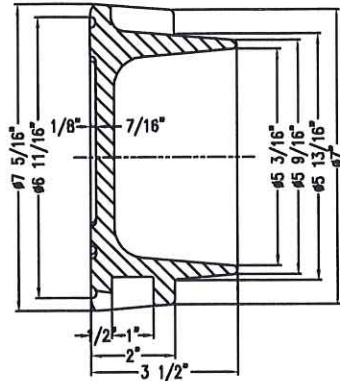
REV: 0

W-2.4.3

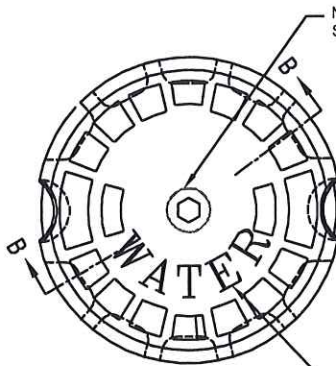


NOTE: COVER READS:
"WATER" IN 1/4"
LETTERS

GATE COVER



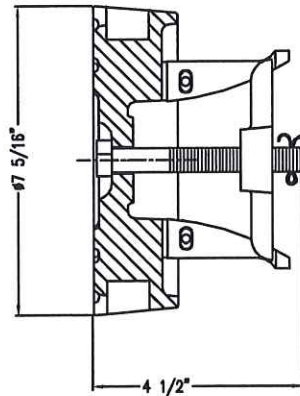
SECTION A-A



NOTE: LOCKING COVER.
STAINLESS STEEL BOLT

NOTE: COVER READS:
"WATER" IN 1/4"
LETTERS

DIVISION GATE COVER

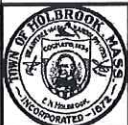


SECTION B-B

NOTE:

1. WATER GATE COVER SHALL HAVE A MINIMUM HEIGHT OF 3.5 INCHES AND MINIMUM WEIGHT OF 13 POUNDS, BRAND NAME BIBBY-STE-CROIX OR EQUAL.

NOT TO SCALE



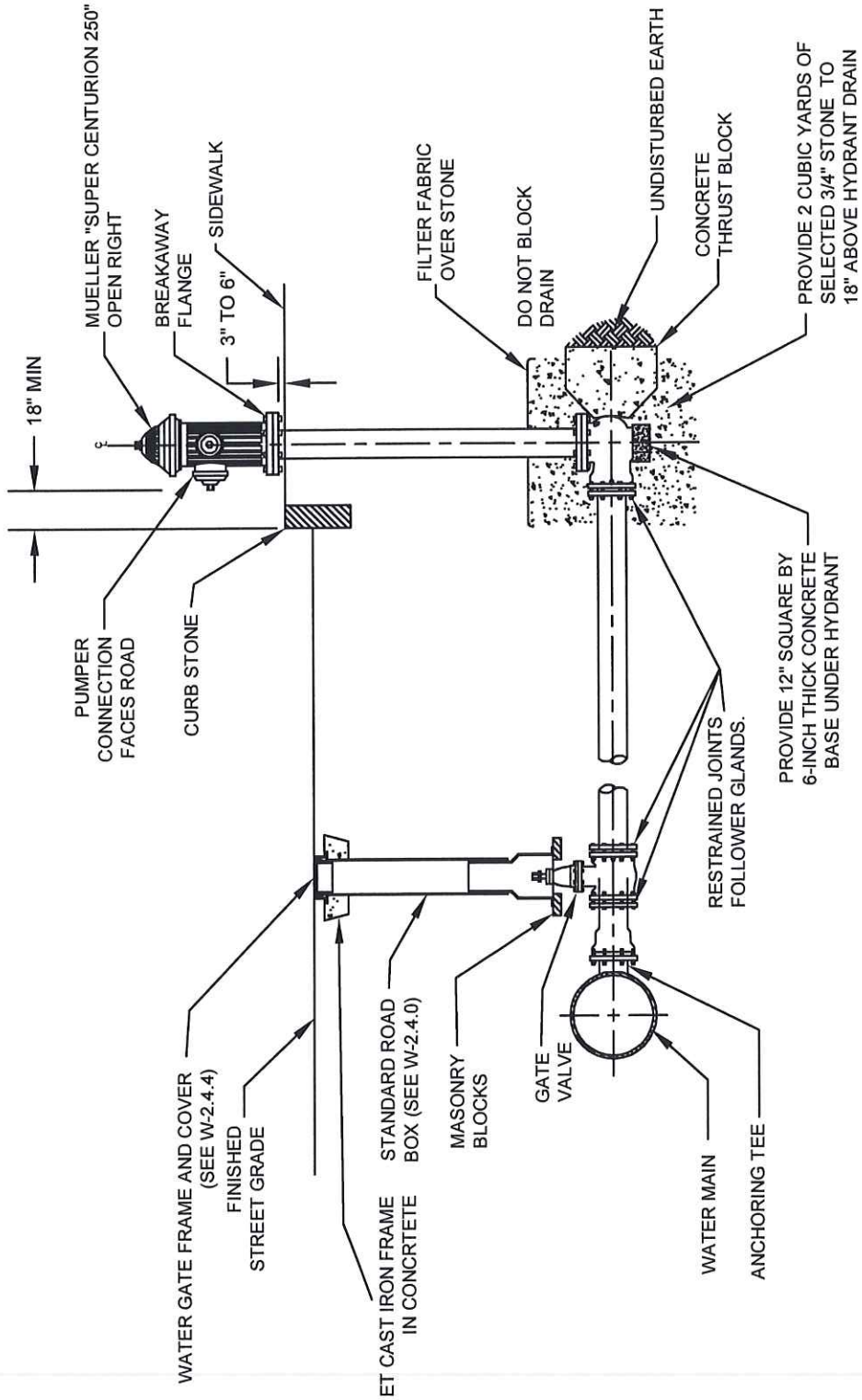
TOWN OF HOLBROOK
DEPARTMENT OF PUBLIC WORKS

WATER GATE COVERS

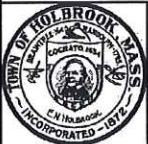
DATE: SEPT. 2020

REV: 0

W-2.4.4



NOT TO SCALE



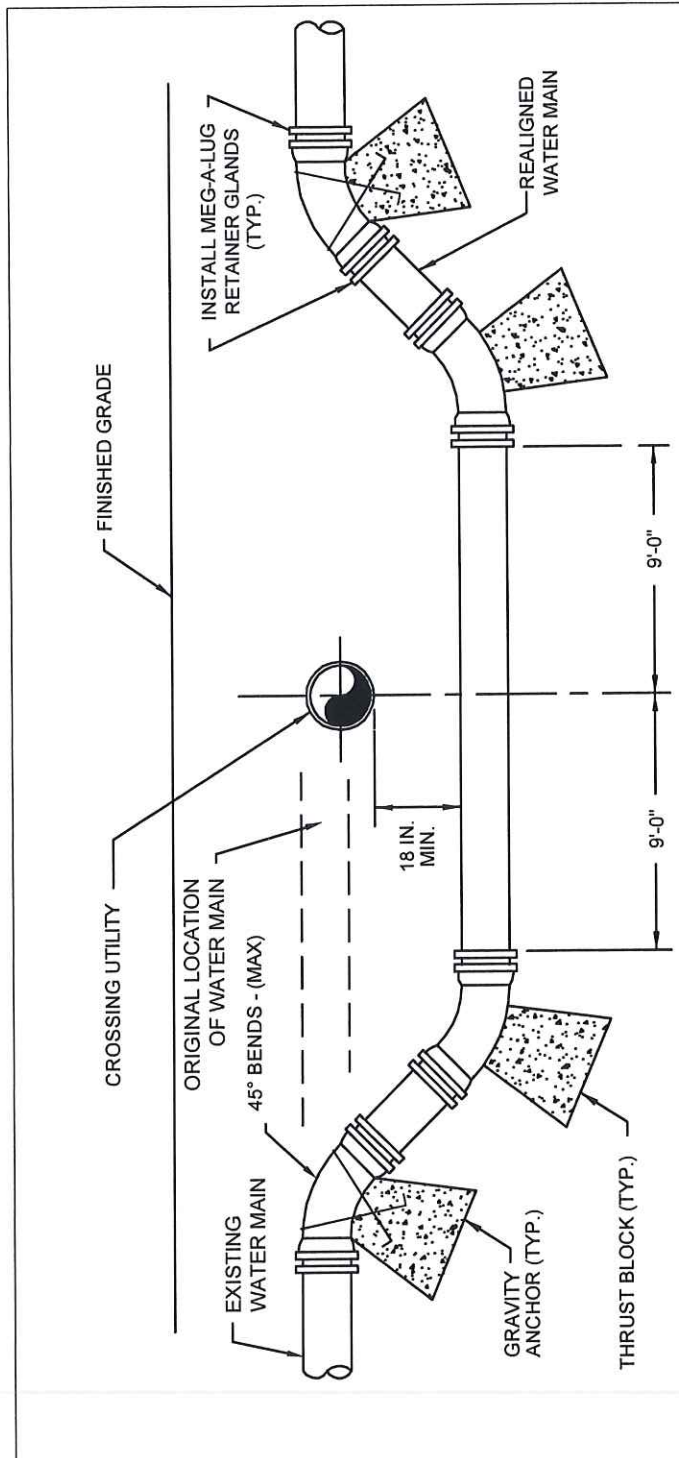
TOWN OF HOLBROOK
DEPARTMENT OF PUBLIC WORKS

FIRE HYDRANT INSTALLATION

DATE: SEPT. 2020

REV: 0

W-2.5.0



NOTES:

1. ALL FITTINGS AND JOINTS IN LOWERING AREA TO BE RESTRAINED.
2. WHEN IT IS IMPOSSIBLE TO OBTAIN HORIZONTAL OR VERTICAL SEPARATION AS INDICATED IN THE DETAIL ABOVE, BOTH THE WATER AND THE SEWER SHOULD BE ENCASED IN CONTROL DENSITY FILL FOR A DISTANCE OF 10 FEET ON EITHER SIDE OF THE CROSSING.
3. ALL DUCTILE IRON PIPE AND FITTINGS SHALL BE WRAPPED WITH POLYETHYLENE ENCASEMENT WHEN CONTACTING CONTROL DENSITY FILL.

NOT TO SCALE



TOWN OF HOLBROOK
DEPARTMENT OF PUBLIC WORKS

WATER MAIN LOWERING DETAIL

DATE: SEPT. 2020

REV: 0

W-2.6.0



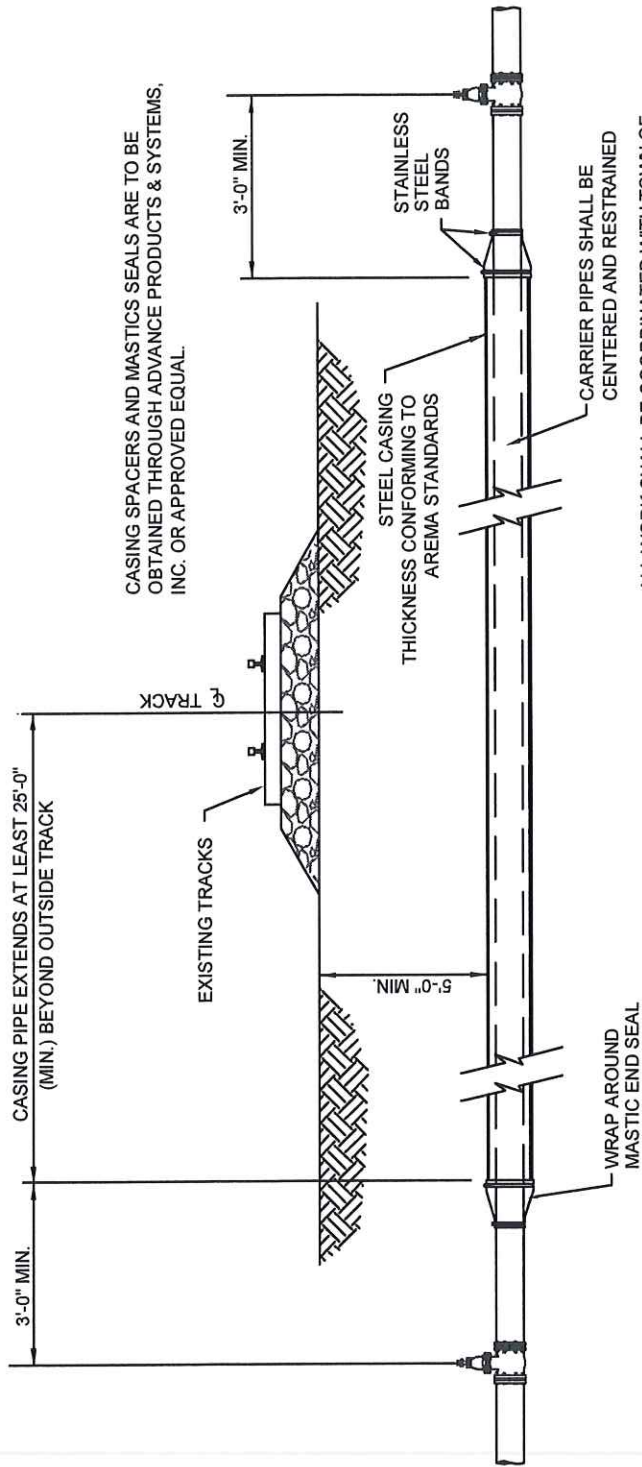
TOWN OF HOLBROOK
DEPARTMENT OF PUBLIC WORKS

WATER CROSSING
UNDER RAILROAD

DATE: SEPT. 2020

REV: 0

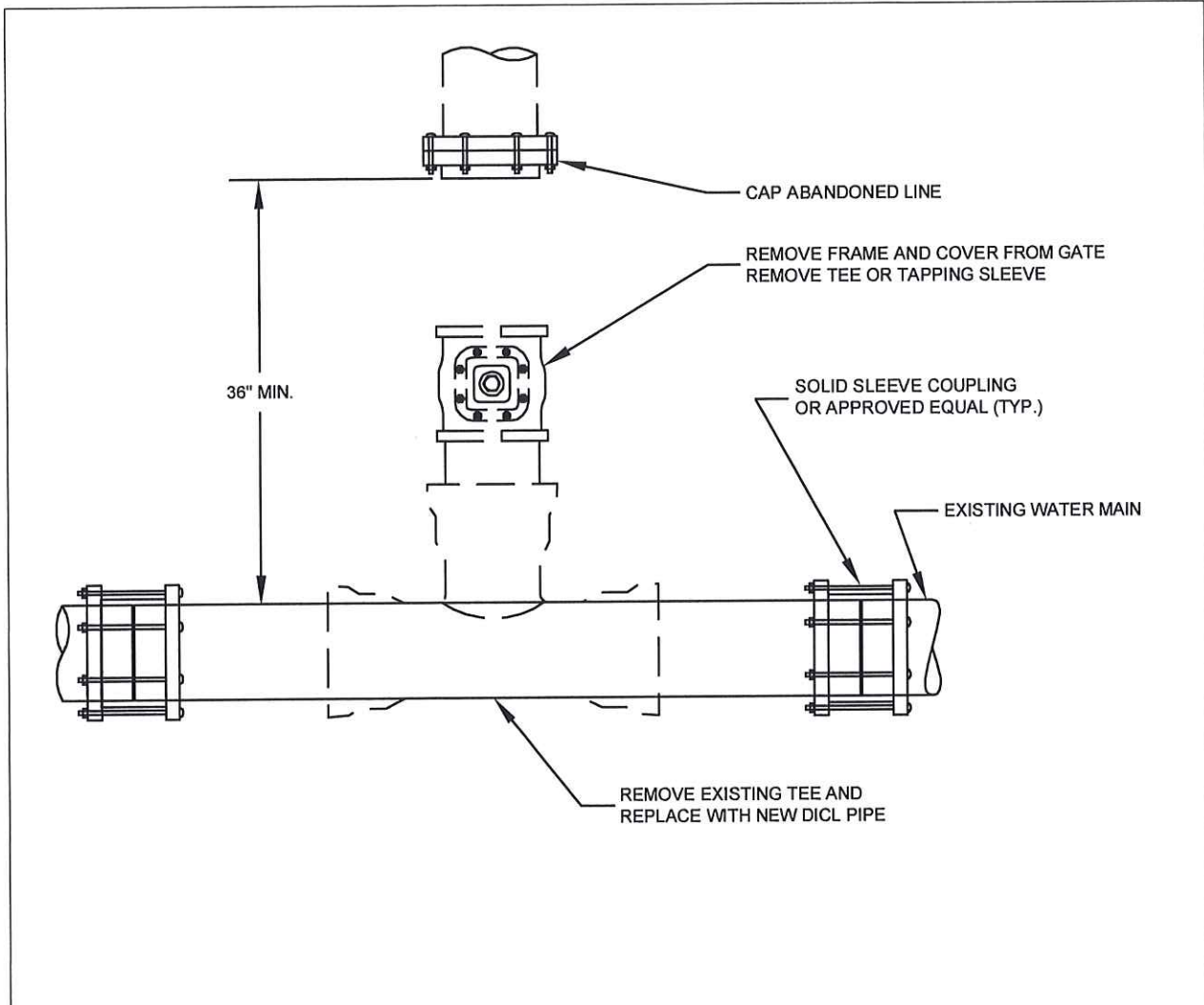
W-2.6.1



CASING SPACERS AND MASTICS SEALS ARE TO BE OBTAINED THROUGH ADVANCE PRODUCTS & SYSTEMS, INC. OR APPROVED EQUAL.

ALL WORK SHALL BE COORDINATED WITH TOWN OF HOLBROOK AND APPLICABLE RAILROAD. ALL WORK SHALL CONFORM TO AWWA AND AREMA STANDARDS.

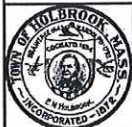
NOT TO SCALE



NOTES:

1. ALL WORK MUST BE PERFORMED BY A TOWN OF HOLBROOK LICENSED AND BONDED CONTRACTOR.
2. THIS PROCEDURE WILL INVOLVE A MAIN LINE SHUT DOWN THAT THE CONTRACTOR WILL COORDINATE WITH HOLBROOK'S D.P.W. WATER OPERATIONS DIVISION.
3. 48-HOUR PRIOR WRITTEN NOTIFICATION OF ALL AFFECTED CUSTOMERS MUST BE PERFORMED BY THE CONTRACTOR.
4. ALL WORK MUST BE PERMITTED BY HOLBROOK AND ALL OTHER APPROPRIATE AGENCIES.
5. ALL WORK MUST BE INSPECTED BY A HOLBROOK INSPECTOR OR DESIGNEE PRIOR TO BACKFILLING.

NOT TO SCALE

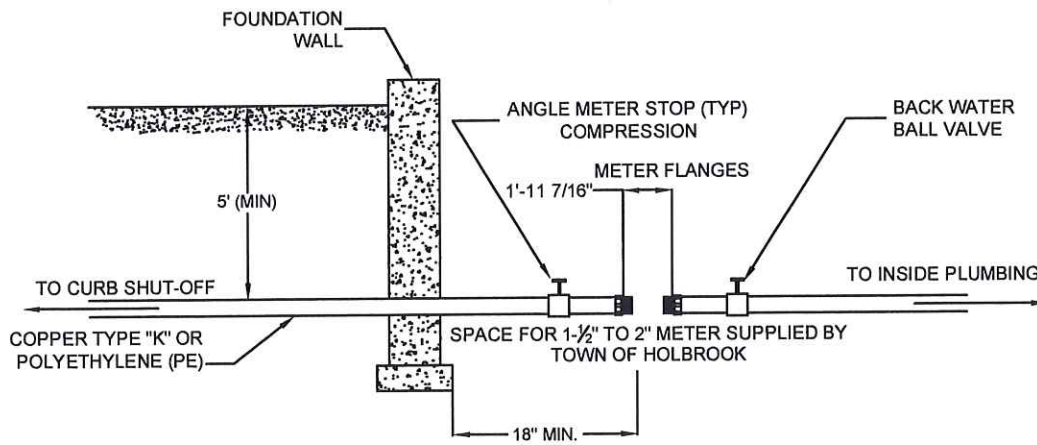
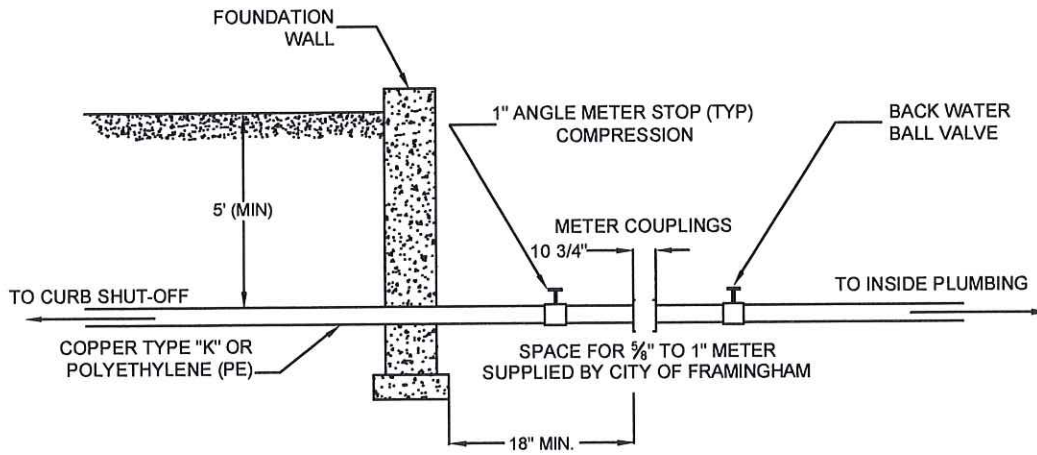


TOWN OF HOLBROOK
DEPARTMENT OF PUBLIC WORKS

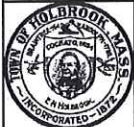
DETAIL OF CUT AND REMOVE OF WATER
CONNECTION 4" AND OVER

DATE: SEPT. 2020
REV: 0

W-2.7.0



NOT TO SCALE



TOWN OF HOLBROOK
DEPARTMENT OF PUBLIC WORKS

METER INSTALLATION

DATE: SEPT. 2020

REV: 0

W-2.8.0