



Standard Specifications and Details

Issued By:

Town of Milton

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Milton, DE 19968
302-684-4110

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SECTION 1 - GENERAL PROVISIONS

PART 1 - GENERAL

1.1 PURPOSE

- A. The purpose of these Standard Specifications and Details is to set forth the minimum requirements of the Town of Milton, Delaware, for the planning, design, construction and acceptance of water systems, wastewater systems, storm water systems, and streets constructed within the Town of Milton.
- B. These Standard Specifications and Details shall be used, when applicable, in conjunction with referenced chapters of the Town Code.
 - 1. Chapter 85 Building Construction
 - 2. Chapter 136 Housing Standards
 - 3. Chapter 183 Streets and Sidewalks
 - 4. Chapter 188 Subdivision and Land Development
 - 5. Chapter 215 Water
 - 6. Chapter 220 Zoning

1.2 AUTHORITY

- A. The authority for these Standard Specifications is set forth in The Milton Town Charter, adopted by the State Laws of Delaware (81 Del. Laws c. 70).

1.3 INTERPRETATIONS

- A. The provisions of these Standard Specifications shall be held to be minimum requirements. Where these Standard Specifications impose a greater restriction than is imposed or required by other provisions of law or by other rules or regulations or resolutions, the provisions of these Standard Specifications shall control.
- B. Where other laws, rules, regulations, or resolutions require greater restrictions than are imposed by these Standard Specifications, the provisions of such other laws, rules, regulations or resolutions shall control.
- C. For the purpose of these Standard Specifications, the word "shall" is mandatory and not discretionary. The word "may" is permissive.

1.4 DEFINITIONS AND TERMS

- A. Contractor - Any individual or firm performing construction work governed by these Standard Specifications.

- B. Developer - Any individual, firm, association, syndicate, partnership, corporation, trust or any other legal entity commencing proceedings to effect a development or subdivision of land for their organization or for another.
- C. Street - Any avenue, boulevard, road, lane, parkway, viaduct, alley or other way open to public travel and which is an existing state or municipal roadway for public use. A street shall include the land between the street lines, whether improved or unimproved, and may comprise pavement, shoulders, gutters, sidewalks, parking areas and other areas within the street lines.
- D. Town – Town of Milton, Delaware (referenced herein as the Town or the Town’s Authorized Representative such as the Town Manager or Public Works Supervisor)
- E. Town Engineer - The individual, firm or association designated by the Town of Milton to provide professional engineering services for the Town

1.5 REFERENCES

- A. ACI - American Concrete Institute
- B. ANSI - The American National Standards Institute
- C. ASA - The American Standards Association
- D. ASTM - The American Society of Testing and Materials
- E. AWWA - The American Water Works Association
- F. AASHTO - The American Association of State and Highway Transportation Officials
- G. EPA – Environmental Protection Agency
- H. DNREC – Delaware Department of Natural Resources and Environmental Control
- I. DelDOT – Delaware Department of Transportation
 - 1. Delaware Department of Transportation Manual for Uniform Traffic Control Devices
- J. IRC - International Residential Code
- K. IPMC - International Property Maintenance Code
- L. IEBC - International Existing Building Code
- M. NEC – National Electric Code
- N. OSHA - Occupational Safety and Health Administration
- O. Recommended Standards for Water Works, latest edition
- P. SCD – Sussex Conservation District

1.6 ABBREVIATIONS

- A. GPD – Gallons per Day
- B. GPH – Gallons per Hour
- C. GPM – Gallons per Minute
- D. SCADA – Supervisory Control and Data Acquisition

1.7 CONSTRUCTION DRAWINGS AND SPECIFICATIONS

- A. Construction drawings and specifications shall be prepared to show in detail the proposed utility services and other required improvements for the subdivision and land development in accordance with Chapter 188 Subdivision of Land of the Code of the Town of Milton.
- B. The drawing sheet size shall be 24 x 36 inches.
- C. The drawings shall include the following minimum detail and information:
 - 1. Title Sheet
 - a. Project title
 - b. Project phase, if applicable
 - c. Date
 - d. Developer's name and address
 - e. Design engineer's name and address
 - f. Sheet index
 - g. Location map
 - h. Sussex County parcel identification number(s)
 - i. Developer's certification approving the drawings
 - j. Design engineer's certification as to accuracy
 - k. Design engineer's seal and signature
 - l. Approval block for Town official signature and date
 - 2. Street Plans
 - a. Scale, date and north arrow
 - b. Horizontal scale of 1 inch = 50 feet or larger
 - c. Locations, elevations and datum of all project benchmarks
 - d. Survey references and horizontal control points
 - e. Centerline stationing
 - f. Bearings of centerline tangents
 - g. Centerline curve data
 - h. Stations of intersecting roads
 - i. Existing and proposed contour lines at 1-foot intervals
 - j. All existing and proposed utilities
 - k. Locations and identification of all drainage structures and storm sewers
 - l. Locations and elevations of parallel swales at 50-foot intervals
 - m. Drainage flow arrows
 - 3. Street Profiles
 - a. Drawn at the same horizontal scale as the plans

- b. Vertical scale of 1 inch = 5 feet or larger
 - c. Preferably on the same sheet as the horizontal street plan
 - d. Centerline stationing
 - e. Existing and proposed grade at centerline
 - f. Vertical curvedata
 - g. Size, length and slope of storm sewers
 - h. Invert elevations of storm sewers at drainage structures
 - i. All existing and proposed utilities
- 4. Street Sections and Details
 - a. Typical detail for each major change of section
 - b. Width of street and shoulders
 - c. Point ofgrade
 - d. Depths and types of pavement materials
 - e. Cross slopes of pavement, shoulders and swales
 - f. Type of curb
 - g. Sidewalk
 - h. Intersection details
 - i. Driveway details
 - j. Locations of topsoil, seed and mulch
- 5. Buried Pipe Plans
 - a. Scale, date and north arrow
 - b. Horizontal plans drawn at a scale of 1 inch = 50 feet or larger
 - c. Legend to identify existing and proposed features
 - d. Locations, elevations and datum of all project benchmarks
 - e. Centerline stationing
 - f. Existing and proposed contour lines
 - g. Locations of all existing utilities and structures
 - h. Property lines
 - i. Existing and proposed easements
- 6. Buried Pipe Profiles
 - a. Drawn at the same horizontal scale as the plans
 - b. Vertical scale of 1 inch = 5 feet or larger
 - c. Centerline stationing
 - d. Existing and proposed grade at centerline
 - e. Invert elevations at all structures and inflection points
 - f. All existing and proposed utilities
- 7. Pumping station plans, sections, and details shall be prepared in accordance with the requirements of Tidewater Utilities Inc., its successors or assigns.
- 8. Landscape Plans
 - a. Scale, date, and northarrow
 - b. Horizontal scale of 1 inch = 50 feet or larger
 - c. Locations, elevations, and datum of all project bench marks
 - d. Survey references and horizontal control points
 - e. All existing and proposed utilities
 - f. Locations and identification of all drainage structures and stormsewers
 - g. Location and identification of proposed trees and shrubs

9. Sediment and stormwater management plans and details shall be in accordance with the latest edition of the Delaware Erosion and Sediment Control Handbook and Sussex Conservation District requirements.
10. Detail sheets shall be included as necessary for construction in addition to the details included in these Standard Specifications.
11. As-built drawings shall be submitted in accordance with the Town Code Section 188-38. The as-built drawings shall show the actual post-construction data as determined by detailed post-construction verification and certification by the developer, contractor, and engineer.

1.8 CONTRACTOR RESPONSIBILITY

- A. Initiating, maintaining, and supervising all safety precautions and programs in connection with the work.
- B. Determination and verification of materials including manufacturer's catalog numbers.
- C. Determination and verification of field measurements and field construction criteria.
- D. Checking and coordinating information in submittal with requirements of Work and of Contract Documents.
- E. Determination of accuracy and completeness of dimensions and quantities.
- F. Confirmation and coordination of dimensions and field conditions at Site.
- G. Construction means, techniques, sequences, and procedures.
- H. Coordination and performance of Work of all trades.
- I. No inspection by the Town or the Town's representative for the purpose of making inspections shall relieve the contractor from any responsibilities listed herein.

1.9 SHOP DRAWINGS AND SUBMITTALS

- A. The Contractor shall submit shop drawings and other submittals as required by these Standard Specifications to the Town and the Town Engineer for review of the intended equipment, materials, installation, and/or construction methods and other aspects of the project prior to the order, fabrication, installation, and/or construction of the improvements. This review function is to serve the Town's interest, and does not in any way, modify or affect the Contractor's responsibility to fully satisfy the requirements of these Standard Specifications and the approved project construction plans and specifications.
- B. The Contractor warrants that the Town's and Town Engineer's review of the shop drawings and other submittals and any notations issued as part of that review, do not relieve the Contractor from full compliance with the requirements of these Standard Specifications and the approved project construction plans and specifications. The Contractor will be solely

responsible for confirming and coordinating the quantities, dimensions, adjacent and related work, fabrication process, installation methods, construction methods, and all other requirements of the work.

- C. PDF files of each shop drawing and submittal shall be provided to the Town and the Town Engineer. A PDF file will be returned to the Contractor after the Town Engineer's review.
1. Each shop drawing and submittal shall include a shop drawing certification with the following information:
 - a. Project identification
 - b. A reference to the specification or drawing description
 - c. Contractor's stamp, signed or initialed, certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is according to requirements of the Town and agencies having jurisdiction.
 - d. Contractor's name
 - e. Signature of the Contractor's representative
 - f. Date of signing
 2. Allow up to 14 days for each submittal review from the date of receipt.
 3. Identify variations in product or system limitations that may be detrimental to successful performance.
 4. Allow space on submittals for Contractor and Engineer review stamps.
 5. The color "red" shall be reserved for Town's and Town Engineer's comments.
 6. When revised for resubmission, identify changes made since previous submission.
 7. When required by individual Specification Sections, provide Shop Drawings signed and sealed by a professional engineer responsible for designing components shown on shop drawings.
 - a. Include signed and sealed calculations to support design.
 - b. Submit shop drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.
 - c. Make revisions and provide additional information when required by authorities having jurisdiction.
- D. Shop drawings and submittals are required for the items listed below, and for any other items as directed in writing by the Town Engineer:
1. Pipes, valves and fittings
 2. Precast concrete structures
 3. Concrete mix designs
 4. Concrete admixtures
 5. Concrete reinforcing steel
 6. Manhole frames and covers
 7. Pumps and appurtenances
 8. Emergency generators and related equipment
 9. Electrical equipment and controls
 10. Lighting fixtures
 11. Automatic telephone dialers
 12. SCADA equipment
 13. Chemical feed equipment
 14. Chemical testing equipment

15. HVAC equipment

- E. Samples and certifications may be required for certain equipment and/or materials.
 - 1. Samples, if requested.
 - a. Submit to Town/Town Engineer for aesthetic, color, and finish selection.
 - b. Submit samples of finishes, textures, and patterns for Town/Town Engineer selection.
 - c. Submit samples to illustrate functional and aesthetic characteristics of products, with integral parts and attachment devices. Coordinate Sample submittals for interfacing work.
 - 2. Certifications, as required.
 - a. Submit manufacturer's certifications for equipment and testing to verify performance of design functions.

1.10 PRODUCT OPTIONS

- A. Particular manufacturer's product specified herein is the preferred product based on the Town's experience. Provide the product named. Substitutions may be considered with supporting documentation and reasoning for the substitution.
- B. Where a list of manufacturers' products is specified herein, provide one of the named products. Substitutions may be considered with supporting documentation and reasoning for the substitution.
- C. Where a product or list of products is specified, including the term "or approved equal," provide one of the products listed or another product that complies with requirements. Submit the following, in addition to other required submittals, to obtain approval of an unnamed product.
 - 1. Evidence that the proposed product will produce the required results, and that it is compatible with other portions of the work.
 - 2. A detailed comparison of significant qualities of the proposed product with the specified product(s).
 - 3. Significant qualities include attributes such as performance, weight, size, materials of construction, durability, and specific features.
 - 4. Evidence that proposed product provides an equivalent warranty.
 - 5. A list of completed product installations for similar projects with contact names and addresses, if requested.
 - 6. Samples, if requested.

1.11 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall provide one PDF copy and two (2) assembled hardcopy binders of manufacturers' operation and maintenance manuals for the items listed below, and for any other items as directed in writing by the Town Engineer:
 - 1. Pumps
 - 2. Valves
 - 3. Emergency generators

4. Automatic transfer switches
5. Control panels
6. Automatic telephone dialers
7. SCADA systems
8. Chemical feed systems
9. Chemical monitoring systems
10. HVAC equipment
11. Equipment and testing certifications

- B. The manuals shall be provided in suitable binders and include spare parts lists, printed instructions and diagrams required for installation, service, repair or replacement, and the name, address and phone number of agency that will perform repairs or replacements during warranty period, and/or where spare parts may be obtained.
- C. The manuals shall include clear operating instructions and recommended maintenance schedules.

1.12 WARRANTY

- A. The Contractor shall warrant that all workmanship, material, and equipment furnished and installed by the contractor shall be free of defects for a period of one year after the acceptance by the Town. In the event that portions of a project are accepted individually, the warranty shall be for one year after each certificate of acceptance. Should such defects appear, the Contractor shall repair or replace such defects at no cost to the Town.

1.13 SANITARY SEWER DESIGN AND CONSTRUCTION COORDINATION

- A. The Developer/Contractor shall coordinate design and construction of sanitary sewer with Tidewater Utilities, Inc., its successors or assigns.
- B. Confirmation of review and approval by Tidewater Utilities, Inc., its successors or assigns is required prior to final approval by the Town.
- C. Building sewer services shall be in accordance with the Town's current governing building code at the time of design and installation and shall be inspected by Town staff during construction. See Chapter 85 of the Town Code.

END OF SECTION

SECTION 2 - EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. DNREC Erosion and Sediment Control Handbook and Details, latest edition.
- B. DelDOT Standard Specifications for Road and Bridge Construction, latest edition.

1.2 SUMMARY

- A. Section Includes:
 - 1. Preparing grades for pavements, turf, and grasses.
 - 2. Subbase course for asphalt paving.
 - 3. Excavating and backfilling trenches for utilities and pits for buried utility structures.

1.3 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.
- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by the Town or Town Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in Work.
 - 2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by the Town or Town Engineer. Unauthorized excavation, as well as remedial work directed by the Town or Town Engineer, shall be without additional compensation.
- F. Fill: Soil materials used to raise existing grades.

- G. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement, or a cement concrete or hot-mix asphalt walk.
- H. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- I. Utilities: On-site underground valves, pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 ACTION SUBMITTALS

- A. Product Data shall be submitted for each of the product noted as required for construction activity.
 - 1. Controlled low-strength material, including design mixture.
 - 2. Warning tapes.

1.5 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations within the town and State-rights-of-way.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from the Town and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by the Town or authorities having jurisdiction.
- B. Permits
 - 1. The contractor shall be responsible to work with the Town to obtain permits from DeIDOT when required for the performance of work within DeIDOT rights-of-way.
 - 2. The contractor is responsible to obtain permits for work outside of DeIDOT rights-of-way and shall provide evidence of permits to the Town prior to commencing work.
- C. Utility Locator Service: Notify "Miss Utility" for area where Project is located before beginning earth-moving operations.
- D. Do not commence earth-moving operations until temporary erosion- and sedimentation-control measures are in place unless otherwise authorized by the Town or Town Engineer.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

- B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D2487, or a combination of these groups; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D2487, or a combination of these groups.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.
- F. Structural Fill: DelDOT Borrow Type G-1 or DelDOT Graded Aggregate Type "a" (CR-1), fine-grained soils from the excavation are not acceptable.
- G. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- H. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- I. Drainage Course: Narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- J. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.
- K. Sand: ASTM C33; fine aggregate.
- L. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 CONTROLLED LOW-STRENGTH MATERIAL

- A. Self-compacting, low-density, flowable concrete material in accordance with DelDOT Standard Specifications.

2.3 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4.5 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep.
 - 1. Color/Label
 - a. Blue - Caution Buried Potable Water Line Below
 - b. Brown - Caution Buried Non-Potable Water Line Below
 - c. Green - Caution Buried Sewer Line Below
 - d. Orange - Caution Buried Fiber Optic Line Below
 - e. Orange - Caution Buried Telephone Line Below
 - f. Red - Caution Buried Electric Line Below
 - g. Red - Caution Buried High Voltage Cable Below
 - h. Yellow - Caution Buried Gas Line Below
 - i. Purple - Caution Buried Reclaimed Water Line Below

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 CLEARING AND GRUBBING

- A. As indicated in Section 1.5D, do not commence clearing and grubbing operations until temporary erosion and sediment control measures are in place, unless otherwise authorized by the Town or Town Engineer.
- B. Clearing and grubbing shall consist of clearing, grubbing, stockpiling, removing, and disposing of all vegetation and debris, except such objects as are designated to remain or are to be removed. This work shall also include the preservation from injury or defacement of all vegetation, trees and objects designated to remain and the restoration of those objects designated for preservation that have been injured or defaced.
- C. All materials removed by the clearing and grubbing operation shall be disposed of in accordance with all state or local laws or regulations.

- D. Trees, shrubbery, plants, and other objects which are not to be removed shall be protected from damage. If any plants are damaged, they shall be either replaced or repaired by the Contractor or by a professional arborist. Paint required for cut or scarred surfaces of trees or shrubs selected for retention shall be asphaltum base paint prepared specifically for tree surgery.
- E. Grading operations shall not be started in any area until all the operations of clearing and grubbing within the area affected have been completed. In areas where excavation is to be made, the ground shall be cleared of all living or dead trees, stumps, brush, or other objectionable materials. All embedded stumps, root mats, etc., shall be removed to a depth of 2 feet below the subgrade or slope surfaces. All depressions made below the subgrade or slope surfaces by the removal of stumps or roots shall be backfilled with approved material and compacted as directed.

3.3 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.4 SHORING

- A. Sheet, shore, and brace excavations to prevent danger to persons, structures, and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.
- B. Support excavations more than 4 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.
- C. Design sheeting and shoring to be removed at completion of excavation work.
- D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.
- E. Repair damage from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.5 EXCAVATION, GENERAL

- A. Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
 1. Excavate trenches to allow installation of top of pipe below frost line (Minimum 42 inches).
- B. Excavate trenches to uniform widths to provide the 8 inches clearance each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for flanges, bells, joints, and barrels of pipes; and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 1. For pipes and conduit, less than 6 inches in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 2. For pipes and conduit, 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
 3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
 4. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.8 EXCAVATION FOR STRUCTURES

- A. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of structures. Shape subgrade to provide continuous support for subbase material and structure. Remove projecting stones and sharp objects along trench subgrade.
- B. Excavate to depth for the required bedding/subbase material.

3.9 SUBGRADE INSPECTION

- A. If unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

- B. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.
 - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Town or the Town's representative, and replace with compacted backfill or fill as directed.

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrowed soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for Record Documents.
 - 3. Testing and inspecting underground utilities.
 - 4. Removing concrete formwork.
 - 5. Removing trash and debris.
 - 6. Removing temporary shoring, bracing, and sheeting.
 - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.12 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for flanges, bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Backfill voids with satisfactory soil while removing shoring and bracing.
- D. Initial Backfill
 - 1. Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
 - 2. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

3. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the pipe or conduit. Coordinate backfilling with utilities testing.
- E. Final Backfill
 1. Place and compact final backfill of satisfactory soil to final subgrade elevation.
 2. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.
- F. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 1. Under grass and planted areas, use satisfactory soil material.
 2. Under walks and pavements, use satisfactory soil material.
 3. Under steps and ramps, use engineered fill.
 4. Under building slabs, use engineered fill.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers, not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D698.

1. Under structures, building slabs, steps, and pavements, scarify and re-compact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
3. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.16 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 1. Provide a smooth transition between adjacent existing grades and new grades.
 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 1. Turf or Unpaved Areas: Plus or minus 1 inch.
 2. Pavements: Plus or minus 1/2 inch.

3.17 FIELD QUALITY CONTROL

- A. The Town reserves the right to require developers to provide a qualified geotechnical engineering testing agency to perform tests and inspections.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- C. Testing agency will test compaction of soils in place according to ASTM D1556, ASTM D2167, ASTM D2937, and ASTM D6938, as applicable. Tests will be performed at the following locations and frequencies:
 1. Paved Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area but in no case fewer than three tests.
 2. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length but no fewer than two tests.
- D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify, and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.18 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by the Town or Town Engineer, and subsequently reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Transport surplus satisfactory soil to designated storage areas off-site.
 - 1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of the materials.
- B. Topsoil shall remain on-site in accordance with the Town Code Section 220.

3.20 FINISH GRADING AND RESTORATION

- A. All areas, structures, plants, pavements, facilities, and features shall be restored to equal or better than the pre-existing conditions. Non-paved areas disturbed by the work shall be topsoiled, seeded, and mulched.
- B. Excavation shall be carried to acceptable lines, grades, and slopes as determined by the Town Engineer. All earth slopes shall be finished to neat, regular lines. The work shall be done in proper sequence in relation to all other operations involved.
- C. For pipeline construction, the restoration of unpaved areas shall be accomplished at a uniform rate closely following installation of the pipeline. The area shall be neatly dressed within 1 week following backfilling operations and when the soil has consolidated after a period of time, the area shall be again dressed or permanently restored. Surface restoration shall be completed within 14 days after the installation of the pipeline.
- D. The Contractor shall use all means necessary to prevent the erosion of graded areas during construction and maintenance of restoration work.
- E. The Contractor shall maintain restoration work for a period of 12 months after final acceptance at no cost to the Town. Maintenance of the restoration shall include all labor, equipment, material, and supplies necessary, including trench refill and additional topsoil, seeding, mulching, watering, and erosion protection.

3.21 TOPSOIL, SEED, AND MULCH

- A. All disturbed areas not specified to be paved shall be topsoiled to a minimum depth of 4 inches, seeded and mulched.
- B. Before placing or depositing topsoil, the subgrade shall be approved by the Town Engineer. The topsoil shall be placed in reasonably close conformity to the desired lines, grades, and elevations.
- C. Seeding shall consist of preparing the ground and furnishing and placing all lime, fertilizer, and seed on the areas to be seeded. Seeding shall not be done during windy weather or when the ground is frozen, excessively wet, or otherwise untillable. The Town Engineer reserves the right to stop seeding operations whenever conditions are determined to be unfavorable.
- D. The area to be seeded shall be thoroughly loosened to a depth of 6 inches, and if just prior to seeding, the top 3 inches of soil is loose, friable, and free of large clods, rock, or other extraneous matter 1 inch or more in diameter, measured at the widest dimension; and if shaped to the prescribed grade, it shall be a satisfactory seedbed and require no further work. However, when the area to be seeded is partially sodded, barren, weedy, or packed and hard, any grass and weeds shall first be cut or otherwise satisfactorily removed; and the soil shall then be scarified or otherwise loosened to a depth of 4 inches. Clods and lumps shall be broken, rubbish, rocks, and other extraneous matter removed clear of the site; and the upper 3 inches shall be disced or otherwise worked into a satisfactory seedbed.
- E. Limestone shall be applied at the rate of 3,000 pounds/acre. Fertilizer shall be applied according to the quantities of actual plant food/acre required for the seed mix.
- F. The seeded area shall be mulched at a rate of 90 pounds per 1,000 square feet with either wood cellulose fiber mulch or straw mulch. A chemical mulch binder shall be used at the rate of 60 gallons/acre. Asphaltic-base binder shall not be permitted.
- G. The following maintenance procedure shall be followed prior to acceptance:
 - 1. Maintain surfaces and supply additional topsoil where necessary including areas affected by erosion.
 - 2. Water to ensure uniform seed germination and to keep surface of soil damp.
 - 3. Apply water slowly so that surface of soil will not puddle and crust.
 - 4. Cut newly planted grass for the first time when it reaches a height of 2-1/2 inches and maintain a minimum height of 2 inches. Do not cut more than 1/3 of the blade at any mowing. Remove clippings.
 - 5. After the first mowing, water grass sufficiently to moisten the soil from 3 inches to 5 inches deep.
 - 6. Apply weed killer, if weeds start developing, during calm weather when air temperature is above 50 degrees.
 - 7. Replant damaged grass areas showing root growth failure, deterioration, bare or thin spots and eroded areas.
- H. Seeded areas will be accepted at the end of maintenance period when seed areas are properly established and otherwise acceptable.

3.22 LANDSCAPING

- A. Replacement small trees and shrubs shall be furnished and installed in kind if existing plants which are to remain are destroyed beyond use.
- B. The Contractor shall remove and backfill all trees and stumps, specifically designated for complete removal for the proper installation of facilities.
- C. Tree removal shall include but not be limited to the removal of all roots and organic material to a depth of 18 inches below the surface. Blasting shall not be permitted as a method of removal. The excavated area shall be backfilled with select granular material.
- D. All precautions customary in good trade practice shall be taken in preparing plants for transplanting. Plants transplanted with workmanship that fails to meet the highest standards will be rejected. All plants shall have firm, natural balls of earth of ample proportions and diameter as specified in the "USA Standard for Nursery Stock." Plants with cracked, broken, or crushed balls which occur either before or during planting operations, will be rejected and shall be removed from the site immediately. Bare root plants shall be dug with sufficient spread and depth of roots as to insure full and prompt recovery and development of the plants. All plants shall be handled so that roots are adequately protected and moist at all times. Material that cannot be planted immediately after delivery shall be adequately protected by covering with canvas, wet straw, burlap, moss, or other suitable material and kept covered until ready to be planted. Trees shall not be planted with frozen earth balls.
- E. In all mass plant areas, the plants shall be evenly spaced to give uniform cover in the planting bed area. No excavation shall commence until all locations are approved.
- F. All trees and shrubs shall be planted in pits excavated with vertical sides. They shall be of such a depth that when planted and settled, the crown of the plant shall bear the same relation to finished grade as it did to soil surface in its place of growth. All backfill topsoil shall be covered with waterproof material after mixing. Pits shall be backfilled with specified soil mix and compacted firmly, especially under ball of roots to establish a firm foundation. Plants shall be set in the center of pits in a vertical position so that the crown of the plant is level with the finished grade after allowing for watering and settling of soil. The soil mixture shall be carefully and firmly worked and tamped under and around the base of the ball to fill all voids. When partially backfilled and compacted, the burlap shall be removed from the sides and tops of the balls and cut away to prevent air pockets, but no burlap shall be pulled from under the balls. A ring of earth shall be formed around the plant to produce a dish for watering. All plants shall be thoroughly watered immediately after planting by the contractor. This shall mean complete saturation of all backfill in the pits and beds during the same day of planting. Care shall be taken during all planting operations to ensure that no excavated material is dumped on any grassed area unless a suitable type of matting or protective underlay is used.
- G. Trees and shrubs shall be watered as necessary to maintain the plantings until established.
- H. Trees, shrubs, and ground cover shall be mulched with a 2-inch cover of mulch. Mulch shall be placed the same day of planting. All trees shall be wrapped with the wrapping material overlapping 1-1/2 inches from the lowest main branches to the base of the tree. The wrapping shall be tied at the top and bottom, and at 1-foot intervals along the trunk with twine.

- I. Upon the completion of the restoration of surfaces, final cleaning shall be done within the limits of the project and shall consist of completely cleaning the project of excess material, sweeping pavements and structures of dirt and rubbish, and the removal of any unused material which will mar the appearance of the project.

END OF SECTION

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SECTION 3 - CONCRETE

PART 1 - GENERAL

1.1 DESIGN CRITERIA

- A. Concrete in direct contact with sewage shall be minimum 4,000 psi, Class B in accordance with Article 2.1. Concrete not in direct contact with sewage shall be minimum 3,000 psi, Class C.
- B. Concrete shall conform to all provisions of the "Specifications for Structural Concrete for Buildings," ACI 301, as published by the American Concrete Institute, except as modified herein.

1.2 REFERENCE STANDARDS

- A. Concrete shall conform to all provisions of the latest edition of the following publications, which shall be incorporated as part of these Standard Specifications:
 - B. American Concrete Institute (ACI)
 - 1. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete
 - 2. ACI 305 - Recommended Practice for Hot Weather Concreting
 - 3. ACI 306 - Recommended Practice for Cold Weather Concreting
 - 4. ACI 315 - Manual of Standard Practice for Detailing Reinforced Concrete
 - 5. ACI 318 - Structures Building Code Requirements for Reinforced Concrete
 - 6. ACI 347 - Recommended Practice for Concrete Formwork
 - 7. ACI 525 - Minimum Requirements for Thin-Section Precast Concrete
 - C. American Society for Testing and Materials (ASTM)
 - 1. ASTM C31 - Construction Method of Making and Curing Concrete Test Specimens in the Field
 - 2. ASTM C33 - Specification for Concrete Aggregate
 - 3. ASTM C39 - Test Method for Compressive Strength of Cylindrical Concrete Specimens
 - 4. ASTM C138 - Test for Weight per Cubic Foot, Yield and Air Content (Gravimetric) of Concrete
 - 5. ASTM C143 - Test Method for Slump of Portland Cement Concrete
 - 6. ASTM C150 - Specification for Portland Cement
 - 7. ASTM C172 - Method of Sampling Freshly Mixed Concrete
 - 8. ASTM C173 - Test for Air Content of Freshly Mixed Concrete by the Volumetric Method
 - 9. ASTM C231 - Test Method for Air Content of Freshly Mixed Concrete by Pressure Method
 - 10. ASTM C685 - Specification for Concrete Made by Volumetric Batching and Continuous Mixing
 - D. American Welding Society (AWS)
 - 1. AWS B3.0 - Standard Qualification Procedure
 - 2. AWS D1.0 - Code for Welding in Building Construction

3. AWS D1.1 - Recommended Practice for Welding Reinforcing Steel, Metal CRS165
Recommended Practice for Placing Bar Support

PART 2 - PRODUCTS

2.1 PORTLAND CEMENT CONCRETE

- A. Portland cement concrete shall be composed of Portland cement, fine aggregate, coarse aggregate, admixtures and water, prepared and constructed in accordance with these Standard Specifications.
- B. The composition of the mix and strength requirements as established by ASTM C94 shall conform to the following:

Table 1 - Concrete Classification

CLASS OF CONCRETE	A	B	C
MIN. 28-DAY COMPRESSIVE STRENGTH (PSI)	4500	4000	3000
CEMENT CONTENT			
MINIMUM SACKS (CY)	7-1/2	7	6
MINIMUM POUNDS (CY)	705	658	564
WATER CEMENT RATIO	.45	.45	.45
PERCENT ENTRAINED AIR (%)	5-7	4-7	4-7
SLUMP (IN)	2-4	2-4	2-4

- C. Proportions shall provide proper strength, placeability, and durability.
- D. Required or permitted admixtures shall be incorporated according to the manufacturer's directions.
- E. All concrete exposed to weather and interior slabs on grade shall contain 4% to 6% entrained air as indicated in Chapter 3, ACI 301. Use an air entraining admixture and normal Portland cement or an air entraining Portland cement. Measure air content at point of discharge at job site.

2.2 CEMENT

- A. Concrete exposed to weather shall be made with not more than 6 gallons of water per bag of cement, including the free moisture in the aggregate.
- B. Cement for all concrete not in direct contact with sewage shall be Portland gray cement conforming to ASTM C150, Type I or Type IA. Only one brand of any one type shall be used for exposed surfaces.
- C. Cement for all concrete in direct contact with sewage (even if coated) may be the same as above except the C3A content shall be less than 8 percent. Portland blast furnace slag cement (ASTM

C595), Type IS (MS) or IS-A (MS) also may be used as well as Portland Pozzolan Cement (ASTM C595). Types IP or IPA, with pozzolan content not exceeding 25 percent by weight.

2.3 AGGREGATES

- A. Fine aggregate for use in concrete shall be in accordance with ASTM C33, except Section 4.2 therein does not apply, and shall be graded as follows:

Table 2 - Fine Aggregate Gradation

SIEVE SIZE	% PASSING
3/8 inch	100
No. 4	95-100
No. 16	50-85
No. 50	10-30
No. 100	2-10

- B. Coarse aggregate shall be hard, durable, uncoated, crushed stone or gravel conforming to ASTM C33. Maximum size of aggregate shall not exceed 3/4 inch. Coarse aggregate for concrete in sewage and other liquid containing structures shall conform to ASTM C33 except the following limitations shall apply:
1. Soft particles: 20 percent
 2. Chert as a soft impurity: 1.0 percent
 3. Total of soft articles and chert as a soft impurity: 2.0 percent
 4. Flat and elongated particles long dimension more than 5 times short dimension: 15.0 percent.

Table 3 - Coarse Aggregate Gradation

SIEVE SIZE	% PASSING
1 inch	100
3/4 inch	95-100
3/8 inch	20-55
No. 4	0-10

2.4 CONCRETE ADMIXTURES

- A. Calcium chloride shall not be permitted as an admixture.
- B. Admixtures for air entrainment shall conform to ASTM C260 and shall be AER as manufactured by Sika Chemical Corporation, MBOR as manufactured by Master Builders or equal.
- C. Chemical Admixtures shall conform to ASTM C494. This specification applies to:
1. Type A - Water-reducing admixtures
 2. Type B - Retarding admixtures
 3. Type C - Accelerating admixtures
 4. Type D - Water-reducing and retarding admixtures
 5. Type E - Water-reducing and accelerating admixtures

- a. Water reducing admixtures shall conform to ASTM C494 and shall be Plastiment as manufactured by Sika Chemical Corporation, Pozzolite as manufactured by Master Builders, or equal.
- D. Water used in mixing, curing, or other designated applications shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substance injurious to the finished product. Water shall meet the requirements of ASTM C94. Water known to be of potable quality may be used without a test. The water shall have a pH of 4.5 to 8.5.

2.5 REINFORCING STEEL

- A. Reinforcement bars shall meet the requirements for Deformed Billet Steel Bars for Concrete Reinforcement, ASTM A615, Grade 60. Bars shall be free of loose scale, rust, or other coatings that will reduce bond.
- B. Accessories include all spacers, chairs, bolsters, ties, other devices necessary for properly placing, spacing, supporting, and fastening reinforcement in place. Metal accessories shall be galvanized after fabrication or plastic protected where legs will be exposed in finished concrete surfaces. Accessories shall conform to requirements of The Concrete Reinforcing Steel Institute "Manual of Standard Practice of Reinforced Concrete Construction."
- C. Wire mesh shall conform to the requirements of ASTM A185. Wire mesh shall be fabricated from No. 10 gauge wire conforming to the requirements of ASTM A82. Individual wires shall be on six-inch centers in each direction.
- D. Continuous masonry wire reinforcing shall be of truss design, minimum 9-gauge welded steel wire conforming to the requirements of ASTM A82 with 0.8 oz. hot-dip zinc coating after fabrication in accordance with ASTM A116, Class 3.
- E. Wire mesh for reinforcement in concrete pavement construction shall be composed of cold drawn steel wires meeting the requirements of ASTM A82 and A185.
- F. Bar mat reinforcement shall consist of deformed bars conforming to the requirements of ASTM A185, Intermediate Grade.

2.6 CONCRETE CURING AGENTS

- A. Curing compounds shall conform to ASTM C309. The curing compound shall be compatible with subsequent finished or shall be completely removed. Curing compound shall be Hydrocide Curing Compound by Sonneborne-Contech or equal.
- B. Liquid membrane curing compounds shall meet the requirements of AASHTO M148 for Type 2, Class A or B, White Pigmented. Acceptance for continued use will be based upon satisfactory field performance.

2.7 MISCELLANEOUS MATERIALS

- A. Sheet materials used for covering the surface of concrete to inhibit moisture loss during the curing period shall conform to the requirements of AASHTO M 171 for Polyethylene Film and Waterproof Paper. The name of the waterproof paper manufacturer shall be marked or imprinted clearly on the paper for proper identification, and it shall retain 90 percent of the mix water.
- B. Mortar sand shall conform to AASHTO M45 and 100 percent of the material must pass a number 4 sieve.
- C. Rubber Joint Sealant shall be a multipart chemically curing polyurethane sealant which meets or exceeds the curing requirements of Federal Specification TT-S-00227E (3) and TT-S- 00230C (2) Nonsag type, Class A, compounds resistant to 50 percent total joint movement. The color shall be gray to match concrete. A primer shall be used as recommended by the sealant manufacturer. A bond breaker such as masking tape, polyethylene film, or backing rod as supplied by the manufacturer shall be used at the bottom of the joint. The sealant shall be Fox Industries FX-570/571 or equal.
- D. Waterstops shall be dumbbell type on horizontal joints and center bulb on vertical joints, polyvinyl chloride (PVC) compounded as necessary to meet the requirements as manufactured by Greenstreak, or equal. No reclaimed PVC from any source shall be incorporated in the compounding. The extruded material shall be dense, homogeneous, and free from porosity or other imperfections which could affect its durability of performance.
- E. Form lumber in contact with exposed concrete shall be free of debris, and conform to the following:
 - 1. For concrete exposed to view, use plywood with DFPA stamp of "B-B Plyform." Plywood shall be 5/8 inch thick for supports 12 inches on center maximum or 3/4 inch thick for supports 16 inches on center maximum. Use in as large sheets as practical to keep joints to a minimum.
 - 2. For concrete not exposed to view use clean, straight lumber, plywood, or metal.
 - 3. Form oil shall be colorless and non-staining.
 - 4. Form ties used for exposed concrete surfaces shall have a minimum working strength when fully assembled of at least 3,000 pounds. Ties shall be so adjustable in length as to permit complete tightening of forms and of such type as to leave no metal closer than 1-1/2 inch to the surface. Ties shall be factory fabricated, removable, or snap-off ties that will not allow form deflection and will not spall concrete upon removal, fitted with devices that will leave holes in the concrete subsurface not less than 1/2 inch or more than one inch in diameter and of depth not greater than the diameter at the exposed surface.
 - 5. Form snap ties shall have water stops incorporated and be as manufactured by Dayton Sure Grip, Type 42, or equal with 1-1/2 inch set back from the face of the wall as detailed in ACI 347.
 - 6. All vapor barriers shall be minimum 6 mil polyethylene.
 - 7. Slots and inserts shall be standard types to engage anchors supplied. Slots shall be dovetail type, 24-gauge galvanized sheet steel minimum with fillers.
 - 8. Grout for base and bearing plates shall be high strength, non-shrink and nonmetallic.

9. Expansion joint material shall consist of 1/2-inch-thick pre-formed strips made from clean granulated cork particles securely bound together by an insoluble synthetic resin. Other types of expansion material may be used when specifically approved by the Town or Town Engineer.

PART 3 - EXECUTION

3.1 CONSTRUCTION METHODS

- A. The Contractor shall employ a competent foreman for all concrete work. The foreman shall be thoroughly familiar with all phases of concrete construction including materials, formwork, reinforcing, mixing, and placing and protection during the initial period of curing.

3.2 FORMWORK

- A. Formwork shall be in accordance with Chapter 4, ACI 301.
- B. Lay out forms for all required cast-in-place concrete to the shapes, sizes, lines, and dimensions indicated on the Drawings, and exercise particular care in the layout of forms to avoid necessity for cutting of concrete after it is in place.
- C. Make proper provision for all openings, offsets, recesses, anchorage, blocking, and other features of the work as shown or required; perform all forming required for work of other trades and do all cutting and repairing of forms required to permit such installation; and consult with other trades as required relative to provision for openings, chases, and other items in the forms.
- D. Set all required steel frames, angles, grills, bolts, inserts, and other such items required to be anchored in the concrete before the concrete is placed.
- E. Properly brace and tie the forms together so as to maintain position and shape and to ensure safety to personnel; construct all bracing, supporting members, and centering of ample size and strength to safely carry, without excessive deflection, all dead and live loads to which they may be subjected; and properly space the forms apart and securely tie them together, using metal spreader ties that give positive tying and accurate spreading.
- F. All forms shall be straight, true, plumb, and square within a tolerance horizontally of one in 200 and a tolerance vertically of one in 500.
- G. Plywood panels shall be nailed directly to studs and applied in a manner to minimize the number of joints. All panel joints shall be tight butt joints with all edges true and square.
- H. All footing forms shall be wood unless otherwise specifically approved by the Town Engineer. Upon approval of the Town Engineer, side forms for footings may be of earth provided the soil will stand without caving and the sides of the bank are made with a neat cut to the minimum dimensions indicated on the Drawings. The Contractor shall make all necessary provisions to prevent cave-ins during placement of concrete.

- I. Reuse of forms shall be subject to advance approval of the Town Engineer. Reuse of forms shall in no way delay or change the schedule for placement of concrete from the schedule obtainable if all forms were new. Reuse of forms shall in no way impart less structural stability to the forms nor less acceptable finish to the concrete.
- J. In general, side forms of footings may be removed seven days after placement of concrete, but the time may be extended if deemed necessary by the Town Engineer.

3.3 REINFORCEMENT

- A. Reinforcement shall be in accordance with Chapter 5, ACI 301.
- B. Fabricate all reinforcement in strict accordance with shop drawings which have been reviewed by the Town Engineer. Bars with kinks or bends not shown on the Drawings or on the reviewed shop drawings shall not be used.
- C. Reinforcement shall not be bent or straightened in a manner that will injure the material. All bars shall be bent cold. Bends for stirrups and ties shall be made around a pin having a diameter not less than two times the minimum thickness of the bar. Bends for the other bars, including hooks, shall be made around a pin having a diameter not less than six times the minimum thickness of the bar.
- D. Before the start of concrete placement, accurately place all concrete reinforcement and positively secure and support by concrete blocks, metal chairs or spacers, or by metal hangers. Clearances shall be as follows:
 - 1. The clear space between bars shall not be less than 1-1/2 times the normal diameter of round bars.
 - 2. In no case shall the clear distance be less than 1-1/2 inches nor less than 1-1/3 times the maximum size of aggregate.
 - 3. The following minimum concrete covering of reinforcement shall be used:
 - a. Concrete below ground against forms: Two inches
 - b. Concrete deposited against earth: Three inches
 - 4. Place bars in horizontal members with minimum laps at splices sufficient to develop the strength of the bars. Bars may be wired together at laps except at point of support of the member, at which point preserve the clear space described above.
 - 5. Whenever possible, stagger the splices of adjacent bars. Splice 36 bar diameters minimum.
 - 6. Make all splices in wire fabric at least 1-1/2 meshes wide.
 - 7. All steel dowels shall be anchored into position before the concrete is placed.
- E. Joints and Embedded Items
 - 1. Joints and embedded items shall be in accordance with Chapter 6, ACI 301.
 - 2. Construction joints shall be constructed and located so as not to impair the strength of the structure. The location of construction and control joints shall be approved by the Town Engineer prior to starting concrete placement. Maximum spacing of vertical construction joints shall be thirty feet. All construction joints below liquid levels shall be keyed and water stopped.

3. At construction joints, erect a temporary wood bulkhead so that the jointing will follow a vertical plane at right angles with the direction of the main reinforcement. To this bulkhead fasten a wood strip 2 inch thick and of width equal to one-third the depth of the concrete slab to form a tongue and grooved joint.
4. Waterstops shall be installed continuous and shall be welded at butt joints and intersections in strict accordance with manufacturer's instructions.
5. Slots shall be installed in face of all concrete against which masonry will be installed. Space at 24 inches on centers horizontally or as required by details and/or job conditions. Slots shall also be installed where masonry will abut concrete.

F. Delivery, Storage and Handling

1. All concrete shall be ready mixed and transported in accordance with ASTM C94 except that, with the approval of the Town Engineer, concrete may be volumetrically batched, transported, and mixed in accordance with ASTM C685 and the following shall be adhered to:
 - a. Aggregate sizes, slumps, concrete strengths, and air contents shall be as specified herein.
 - b. Proportions of the concrete shall be determined by Alternate 2, with the request stipulated in Paragraph 5.3.2 of ASTM C685 being carried out.
 - c. The supplier will be required to have one person at the job site to operate the mixers. It shall be the responsibility of this person to set, record, and maintain surveillance of all gauges on the mixers at the job. No other personnel will be allowed to perform this function.
2. The Contractor shall keep a record at the job site showing the time and place of each pour of concrete, together with transit mix delivery slips certifying contents of the pour; and make the record available to the Town Engineer for his inspection upon request; and upon completion of each portion of the work, shall deliver the records and delivery slips to the Town Engineer.
3. Bagged cement shall be stored on platforms off ground and protected against the elements. Fine and coarse aggregates shall be handled separately in a manner to prevent intrusion of foreign material. All reinforcement shall be covered until used. The Contractor shall not use any frozen materials or any hardened cement.
4. Placement
 - a. Do not place concrete until forms and reinforcement are inspected by the Town Engineer. Contractor shall notify the Town Engineer of all concrete pours at least 24 hours prior to pouring concrete.
 - b. All concrete, unless otherwise specifically permitted by the Town Engineer, shall be transmit-mixed in accordance with ASTM C94.
 - c. For chuting, pumping, and pneumatically conveying concrete, the Contractor shall use only equipment of such size and design as to ensure a practically continuous flow of concrete at the delivery end without loss or separation of materials.
 - d. Place concrete as dry as possible consistent with good workmanship, never exceeding the maximum specified slump.
 - e. When placement is started, it shall be carried on as a continuous operation until the panel or section is complete. A retempered concrete or concrete that has been contaminated by foreign materials shall not be used.

- f. Do not pour a greater area at one time than can be properly finished without checking. In any case, a slab length pour greater than 60 feet shall not be placed without construction joints.
- g. Do not use concrete with a placing temperature that will cause difficulty from loss of slump, flash set, or cold joints. Do not allow concrete temperature to exceed 90°F during placement. Use all means necessary to avoid drying the concrete prior to finishing operations. Provide and use all required windbreaks, sunshades, fog sprays, and other devices to protect the concrete.
- h. Concrete placed in hot weather shall be given extra protection against moisture loss by keeping all exposed concrete surfaces constantly wet as specified and by keeping the forms continuously wet for the entire curing period.
- i. All freshly placed concrete shall be protected from the elements and from all defacement due to building operations.
- j. Concrete shall be covered and insulated to protect concrete, and the ground underneath slabs and footings from freezing. Concrete shall be placed in accordance with Chapter 8, ACI 301 and Chapter 6, ACI 304.
- k. No aluminum shall come in contact with concrete at any time during batching, transporting, placing, finishing, or curing operations.

3.4 PLACEMENT OF SLABS ON EARTH

- A. Place over a well compacted subgrade. Over subgrade, place a porous fill consisting of clean, washed gravel or crushed stone graded from 1/2 inch to 3/4 inch thickness as indicated. Roll or tamp fill until thoroughly compacted. Over porous fill lay vapor barrier, lap joints 24 inches, and seal with tape or mastic; turn up on walls approximately 4 inch, stretch and weight edges and laps to maintain their positions until concrete is placed. Provide wood runways for wheeled equipment for transporting concrete. Do not displace film. Immediately place concrete of required thickness and strike off at proper levels. Repair all holes in vapor barrier prior to placement of concrete.
- B. Tamp slabs with a jitterbug to depress the rock, and then pushfloat with a bullfloat as necessary. Care shall be taken that the set slab meets the screeds accurately and does not rise above or lower below them. Slab depressions shall be provided as required for the finishes indicated on the Drawings.
- C. Floor slabs shall be planed to a Class A tolerance, that is, true planes within 1/8 inch in 10 feet, as determined by a 10-foot straightedge placed anywhere on the slab in any direction.
- D. Slabs shall slope toward drains when required.
- E. Finishing of Formed Surfaces
 - 1. Finishing of formed surfaces shall be in accordance with Chapter 10, ACI 301 and as follows:
 - a. Provide smooth rubbed finish to all concrete exposed to view and in contact with contained liquids even if to be coated.
 - b. Provide rough or board form finish to concrete not exposed to view.
 - c. Clean exposed concrete. Remove blemishes, form oil stain, and other discolorations. Clean surfaces by brushing with a mild detergent and water.

- d. Nails, tie wires, and form ties shall be cut off flush, and all surfaces left smooth and clean. The Contractor shall remove metal spreader ties on exposed concrete by removing or snapping off inside the wall surfaces and pointing up and rubbing the resulting pockets to match the surrounding areas.
- e. The Contractor shall flush all holes resulting from the use of spreader rods and sleeve nuts, using water, and then solidly pack throughout the wall thickness with cement grout applied under pressure by means of a grouting gun. Grout shall be one-part Portland cement to 2-1/2 parts sand and shall be applied immediately after removing forms.

F. Finishing of Slabs

- 1. Finishing of slabs shall be in accordance with Chapter 11 of ACI 301 and as follows:
 - a. Concrete shall be monolithically finished. No dry cement or mixtures of dry cement and sand shall be sprinkled directly on the surface of the wearing course to absorb moisture or to stiffen the mix. Steel trowel finish, where specified, shall be done after sheen has disappeared from the surface. Keep the floor moist during the first 48 hours after placing. All high places, bumps, and other irregularities shall be ground down, and low places filled up to leave a level and smooth surface.
 - b. All interior slabs are to be screeded, floated, and steel troweled to a smooth, dense, and plane surface. These slabs shall receive a curing and sealing compound compatible with the finish. Exterior slabs subject to foot traffic shall have a nonslip, light broom finish.
 - c. Exterior stairs and entrance slabs shall have a sufficient pitch to shed water and shall be given a light broom finish after three trowelings.

G. Curing

- 1. Curing and protection shall be in accordance with Chapter 12, ACI 301.
- 2. Interior slabs shall be cured by fog mist until a curing membrane has been installed. Immediately upon finishing a slab area, apply a fog mist above the finished concrete surface, using fog nozzles to keep the air humid and to prevent loss of moisture from the concrete surface. The fog shall produce an appearance of wet sheen on the concrete but in no case shall allow a concentration of water in one place. Fogging shall be continued until a membrane has been installed.

H. Curing Membrane

- 1. As soon as possible after finishing interior slabs, the specified curing membrane shall be installed; all joints lapped six inches and securely joined together. The covering shall be weighted down to prevent damage from the wind and so constructed as to achieve a completely sealed membrane over the entire slab.
- 2. Unless otherwise directed by the Town Engineer, the curing membrane shall be kept in place and intact for at least ten days after placement of concrete. The Contractor shall make all inspections and repairs necessary to ensure proper curing.

I. Patching

- 1. Repair of surface defects shall be in accordance with Chapter 9, ACI 301.
- 2. Immediately after forms and curing membranes have been removed, inspect all concrete surfaces and patch all pour joints, voids, rock pockets, form tie holes, and other

imperfections before the concrete is thoroughly dry. Concrete shall not be notched until it has been inspected by the Town Engineer.

3. In minor defective areas, the concrete shall be chipped away to a depth of about one inch, leaving edges perpendicular to the surface; the area to be patched shall be wetted along with a space of at least six inches wide around it to prevent water from being absorbed out of the mortar. The area to be patched shall be coated with a cement wash consisting of neat cement and solution of one part "Konsest," or equal, to four parts of water; patching mortar shall be applied immediately. Patching mortar shall consist of one-part cement to three parts water to a consistency as dry as possible within the requirements of handling and the mortar shall be installed by ramming it into place. The patch shall be screed off so as to leave the patch slightly higher than surrounding surface; left undisturbed for a period of one or two hours to permit initial shrinkage, and then final finished by matching the patch to adjacent surfaces and keeping it wet for at least seven days. Protective covering shall be provided.
4. If the defects are serious or affect the strength of the structure, or if patching does not satisfactorily restore the quality and appearance of the surface, the Town Engineer may require "cement gun concrete" to be used or the concrete to be removed and replaced complete in accordance with the provisions of these Specifications.

3.5 TESTING AND ACCEPTANCE

A. Inspection

1. Notify the Town Engineer at least 24 hours in advance of all concrete pours. No concrete shall be deposited before the Town Engineer has reviewed the reinforcing and given permission to proceed. Such inspection and permission to proceed shall in no way release the Contractor of the responsibility for proper placement of reinforcing and placement of concrete, and the responsibility for adherence to the requirements of the Contract Documents.
2. Provide unobstructed access to work areas for the Town Engineer, furnish a wheelbarrow for concrete sampling and a suitable storage box for initial curing of cylinders, as specified in ASTM C31. Make running water available at the testing site.

B. Sampling

1. Contractor shall furnish concrete samples for testing.
2. Samples shall be taken by the Town Engineer in accordance with ASTM C172 and cylinders molded in accordance with ASTM C31.
3. A minimum of four test cylinders shall be made for every fifty (50) cubic yards of concrete (or fraction thereof) placed in one day.
4. Test cylinders will be cured per ASTM C31.

C. Tests

1. Slump tests shall be in accordance with ASTM C143. Make tests periodically when cylinders are made and when a change in consistency or concrete is noted. Unless otherwise noted, the slump shall be 2 inches minimum and 5 inches maximum. For slabs, the maximum slump shall be 3-1/2 inches.
2. Tests for air content shall be in accordance with ASTM C231, C173, and C138.

3. Each compression and strength test will consist of 4 standard 6" x 12" cylinders; 2 cylinders to be tested at the age of 7 days and 2 cylinders at the age of 28 days. Specimens made to check the adequacy of the design for strength of concrete or as a basis for acceptance of concrete will be made and laboratory cured in accordance with ASTM C31. Additional tests of specimens cured entirely under field conditions will be utilized to check the adequacy of curing and protection of the concrete as directed. Strength tests shall be in accordance with ASTM C39.
4. The average of five consecutive strength tests shall be equal to or greater than the specified strength, and not more than one test in ten shall have an average value less than 90 percent of the specified value. When the average of compressive tests for five (5) consecutive cylinders falls below the specified strength the design mix and water content shall be adjusted to produce the specified strength for concrete that is subsequently placed. In addition, the Town Engineer may order additional curing for that portion of the structure where the questionable concrete has been placed. In the event that such additional curing does not give the strength required as determined by load tests made in accordance with ACI 318 or cored cylinder tests, the Town Engineer may order defective parts removed and replaced, or reinforced, all at no additional expense to the Town.
5. The expense of any and all reinspection and/or retesting required due to failure of concrete to meet requirements shall be borne by the Contractor.

D. Reports

1. Test reports shall include the following:
 - a. Exact mix, including quantities of admixture, etc.
 - b. Date of pour
 - c. Exact location of pour in building
 - d. Slump
 - e. Truck number
 - f. Type of break
 - g. Air entrainment
 - h. Water content including aggregate moisture
2. Field inspection reports shall include the following:
 - a. Extent of reinforcement and formwork inspected
 - b. Date of inspection
 - c. Any problems, issues, or challenges encountered or instructions given to the Contractor

END OF SECTION

SECTION 4 - WATER DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Water distribution system extensions and improvements shall be designed in accordance with the requirements of these specifications, the Delaware Division of Public Health, Office of Drinking Water, the Delaware State Fire Prevention Regulations, and the Recommended Standards for Water Works (10 States Standards). In the event of a conflict, the stricter of the requirements shall prevail.
- B. Milton Town Code Chapters 135, 188, 215, and 220.
- C. Appendix A - Water System Details

1.2 REFERENCE STANDARDS

- A. American Society of Mechanical Engineers (ASME)
 - 1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
- B. American Society for Testing and Materials (ASTM)
 - 1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
 - 2. ASTM A123 (/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products).
 - 3. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
 - 4. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft³ (600 kN-m/m³).
 - 5. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³).
 - 6. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
 - 7. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
 - 8. ASTM D3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
 - 9. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
 - 10. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
 - 11. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

C. American Water Works Association (AWWA)

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. AWWA C110 - Ductile-Iron and Gray-Iron Fittings.
4. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. AWWA C115 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
6. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.
7. AWWA C153 - Ductile-Iron Compact Fittings.
8. AWWA C200 - Steel Water Pipe, 6 In. (150 mm) and Larger.
9. AWWA C203 - Coal-Tar Protective Coatings and Linings for Steel Water Pipe.
10. AWWA C205 - Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In. (100 mm) and Larger - Shop Applied.
11. AWWA C206 - Field Welding of Steel Water Pipe.
12. AWWA C207 - Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm).
13. AWWA C208 - Dimensions for Fabricated Steel Water Pipe Fittings.
14. AWWA C213 - Fusion-Bonded Epoxy Coatings and Linings for Steel Water Pipe and Fittings.
15. AWWA C300 - Reinforced Concrete Pressure Pipe, Steel-Cylinder Type.
16. AWWA C301 - Prestressed Concrete Pressure Pipe, Steel-Cylinder Type.
17. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service.
18. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances.
19. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.
20. AWWA C606 - Grooved and Shouldered Joints.
21. AWWA C700 - Cold-Water Meters - Displacement Type, Metal Alloy Main Case.
22. AWWA C701 - Cold-Water Meters - Turbine Type, for Customer Service.
23. AWWA C702 - Cold-Water Meters - Compound Type.
24. AWWA C707 - Encoder-Type Remote-Registration Systems for Cold-Water Meters.
25. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution.
26. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13 mm) Through 3 In. (76 mm), for Water Service.
27. AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In. (350 mm Through 1,200 mm), for Water Transmission and Distribution.
28. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.

D. Manufacturers Standardization Society of the Valve and Fittings Industry

1. MSS SP-60 - Connecting Flange Joints between Tapping Sleeves and Tapping Valves.

E. National Fire Protection Association (NFPA)

1. NFPA 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

F. NSF International (NSF)

1. NSF 61 - Drinking Water System Components - Health Effects.
2. NSF 372 - Drinking Water System Components - Lead Content.

1.3 SUBMITTALS

- A. Contractors shall be required to provide material and construction submittals to the Town and Town Engineer for verification of compliance with requirements.
- B. Submittals shall be provided for:
 1. Product data showing manufacturer data for pipe materials, pipe fittings, valves, hydrants, and other appurtenances.
 2. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
 3. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.4 SYSTEM DEDICATION SUBMITTALS

- A. Final project submittals shall be provided to document:
 1. As-built utility location referenced to Delaware State Plane coordinate system including labels for sizes, materials, and depths of buried facilities.
 2. Test results for potable drinking water distribution systems.
 3. Test results for potable drinking water storage facilities.
- B. No inspection, review or acceptance of submittals by the Town, Town Engineer or other entity hired by the Town for the purpose of making inspections shall relieve the contractor from any of its responsibilities listed in this Section 4.

1.5 QUALITY ASSURANCE

- A. Valves: Mark valve body with manufacturer's name and pressure rating.
- B. All materials in contact with potable drinking water shall be certified according to NSF 61 and NSF 372.

1.6 DESIGN CRITERIA

- A. The Developer shall provide the Town and Town Engineer with calculations supporting average, peak, and fire protection demands for the project and additional future needs. Calculations should be provided for pressure losses in the distribution system, minimum pressure availability to a service line, and a fire hydrant (if applicable). Calculations for the determination of pipe parameters and any other data required and used in the design should be provided.
- B. Water main pipe diameters shall be of a minimum size that provides fire protection. The mains shall allow withdrawal of the required fire flow while maintaining the minimum required pressure of the system.

1. A minimum pressure of 25 pounds per square inch (psi) shall be maintained at all points of the distribution system and under all flow conditions.
 2. A 35 psi to 60 psi normal working pressure shall be maintained.
 3. Minimum pipe size when connected to a fire hydrant shall have a nominal inside diameter of 6 inches.
 4. Minimum pipe size when not providing flow to a fire hydrant and less than 400 feet between connections shall have a nominal inside diameter of 6 inches.
- C. When directed by the Town Engineer, the water main pipe shall be interconnected at multiple locations in order to loop the system. The water main size, when directed by the Town Engineer, shall be increased to provide additional carrying capacity.
1. Water mains shall be interconnected to the greatest extent feasible to minimize stagnation and friction losses associated with dead-end mains.
- D. Water valves shall be located at a maximum of 800-foot intervals and other locations as required by the Town.
- E. Concrete thrust blocking or other means of restraint shall be specified on all buried lines at bends, tees, and capped or valve ends.
- F. Water mains shall be located within street rights-of-way where possible. If it is not possible to locate a water main within a street right-of-way, the water main shall be located within a utility easement to be dedicated to the Town for the water utility operation and maintenance. Utility easements and rights-of-way shall be a minimum of 20-feet wide.
- G. The minimum depth of cover from the top of a water main to finished grade shall be 42 inches.
- H. Fire hydrants shall be installed on water mains at each intersection, at the end of all dead-end water mains and other locations as required by the Town.
1. Fire hydrants shall be spaced at a maximum of 800 feet center to center.
 2. Fire hydrant locations and layout shall be approved by the Sussex County Fire Marshal.
 3. Fire hydrants shall not be within pedestrian paths.
- I. Each consuming unit shall be served in accordance with Town Code Chapter 215..
1. Minimum service size shall be 1-inch between water main through the water meter to the consuming unit.
- J. Water mains shall be located at least 10 feet away from any existing or proposed sanitary sewer, storm sewer or force main. The distance shall be measured edge to edge.
- K. Water mains crossing sanitary sewers, storm sewers or force mains shall be located to provide a minimum distance of at least 18 inches vertically between the outside of the water main and the outside of the other pipe. This shall be the case where the water main is either above or below the other pipe with preference to the water main located above the other pipe. Crossings shall be arranged so that the joints in the water main will be as far as possible from sewer joints. Water mains shall not pass through or come in contact with any sewer manhole.
1. Where separation of utilities fails to meet the 18-inch minimum requirement the water main shall be sleeved to at least 5 feet to each side of the crossing using a casing pipe and casing spacers.

1.7 SUBMITTALS

- A. Contractors shall be required to provide material and construction submittals to the Town and Town Engineer for verification of compliance with requirements.
- B. Submittals shall be provided for:
 - 1. Product data showing manufacturer data for pipe materials, pipe fittings, valves, hydrants, and other appurtenances.
 - 2. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
 - 3. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.8 SYSTEM DEDICATION SUBMITTALS

- A. Final project submittals shall be provided to document:
 - 1. As-built utility location as determined or confirmed by post construction inspection and referenced to Delaware State Plane coordinate system including labels for sizes, materials, and depths of buried facilities.
 - 2. Test results for water distribution systems.
 - 3. Test results for water storage facilities.

1.9 QUALITY ASSURANCE

- A. Valves: Mark valve body with manufacturer's name and pressure rating.
- B. Materials in Contact with Potable Water: Certified according to NSF 61 and NSF 372.

PART 2 - PRODUCTS

2.1 POLYVINYL CHLORIDE (PVC) WATER PIPE (PREFERRED PIPE MATERIAL)

- A. PVC water pipe and fittings shall be manufactured in accordance with one of the following Standard Specifications:
 - 1. AWWA C900, "Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 12 in. (100 mm through 300 mm) for Water Distribution"
 - 2. AWWA C905, "Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 in. through 48 in. (350 mm through 1,200 mm), for Water Distribution"
 - 3. AWWA C907, "Polyvinyl Chloride (PVC) Pressure Fittings for Water – 4 in. through 8 In (100 mm Through 200 mm)"
 - 4. AWWA C909, "Molecularly Oriented Polyvinyl Chloride (PVCO) pressure Pipe, 4 In. through 24 In. (100 mm through 300 mm), for Water Distribution"
 - 5. ASTM D2241, "Polyvinyl Chloride (PVC) Pressure-Rated Pipe (SDR PR Series)" JOINTS: Pipe joints shall be gasket, push-on type. Gaskets shall be part of a complete pipe section and purchased as such. Lubricant shall be as recommended by the pipe or fitting manufacturer and shall not adversely affect the potable qualities of the water to be

transported. The gasketed joint shall meet the laboratory performance requirements specified in ASTM D3139. (This is a qualification test to verify a leak-free design of the specified joint.)

- B. PVC water pipe shall be certified to NSF International Standard No. 61.
- C. Pipe may be rejected for failure to comply with any requirement of this specification.
- D. Pipe wall thickness shall be as required to provide a minimum wall thickness with a DR of eighteen (18) for pressure class two-hundred thirty-five (235) as defined in the latest edition of ANSI/AWWA C900. Maximum allowable line pressure 200 psi.
- E. The embedment requirements for PVC water pipe shall be in accordance with AWWA Standard C605 for "Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water".
- F. Preferred manufacturers:
 - 1. JM Eagle
 - 2. Northern Pipe Products
 - 3. North American Pipe Corporation
 - 4. CertainTeed

2.2 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
 - 3. Anti-Rotation T-Bolts shall be used on mechanical joints shall be of domestic origin, high strength, low alloy steel bolts only, meeting the current provisions of ANSI/AWWA C111/A21.1 for rubber gasket joints for cast iron or ductile iron pipe and fittings. Bolt manufacturer's certification of compliance must accompany each shipment. T-bolts shall be corrosion resistant to handle corrosive conditions on any buried bolts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 2. Gaskets: AWWA C111, rubber.
- C. Flanges: AWWA C115, Class 125, cast iron.
 - 1. Furnish all flanged joints with 1/8-inch thick, red rubber or styrene butadiene rubber gaskets.
 - 2. Do not use flanged joints in underground installations except within structures.
 - 3. The bolts shall have heavy unfinished hexagonal head and nut dimensions all as specified in ANSI B18.2.

4. Bolts and nuts shall be threaded in accordance with ASME/ANSI B1.1, Unified Inch Screw Threads (UN and UNR Thread Form) class 2A external and class 2B internal. For bolts of 1-3/4-inches in diameter and larger, stud bolts with a nut on each end are recommended. Material for bolts and nuts shall conform to ASTM A307, 60,000 PSI Tensile Strength, Grade B, unless otherwise specified. Bolt manufacturer's certification of compliance must accompany each shipment.
- D. Minimum pressure rating: 250 psi
- E. Coating and Lining
1. The fittings shall be coated on the outside with a petroleum asphaltic coating in accordance with AWWA C110 or fusion-coated epoxy in accordance with AWWA C116 and lined inside with cement-mortar and seal coated in accordance with AWWA C104 or fusion coated epoxy in accordance with AWWA C116.
- F. Preferred Manufacturers
1. US Pipe and Foundry Company; <http://uspipe.com/>
 2. American Cast Iron Pipe Company; <http://www.american-usa.com/>
 3. Star Pipe Products; <http://www.starpipeproducts.com/>

2.3 DUCTILE IRON MECHANICAL AND FLANGED FITTINGS

- A. Acceptable fittings for use with polyvinylchloride pipe shall include standard ductile iron fittings conforming to AWWA/ANSI C110/A21.10, or AWWA/ANSI C153/A21.53 and AWWA/ANSI C111/A21.11.
1. Connections to fusible polyvinylchloride pipe may be made using a restrained or non-restrained retainer gland product for PVC pipe, as well as for MJ or flanged fittings.
 2. Bends, tees and other ductile iron fittings shall be restrained with the use of thrust blocking or other means as indicated in the construction documents.
 3. Ductile iron fittings and glands must be installed per the manufacturer's guidelines.
 4. Linings for Ductile Iron fittings shall meet the following requirements for the following service environments:
 - a. Potable Water:
 - 1) Liquid Epoxy shall be 100% solids liquid epoxy, Tnemec Epoxyline Series FC22.
 - 2) Polyurethane shall be DuraShield 210-61 or 310-61.
 - 3) Coal tar epoxy shall be Sherwin Williams Targuard.
- B. All fittings shall be full body, 350psi rated conforming to ANSI A21.10/AWWA C110
- C. Preferred manufacturers:
1. Tyler Union
 2. U.S. Pipe
 3. American Pipe

2.4 PE PIPE AND FITTINGS

- A. PE, AWWA Pipe: AWWA C906, DR No. 7.3 or 9 with PE compound number required to give pressure rating not less than **200 psig**
 - 1. PE, AWWA Fittings: AWWA C906, socket- or butt-fusion type, with DR number matching pipe and PE compound number required to give pressure rating not less than **200 psig**.
 - 2. The pipe shall contain no recycled compound except for rework material generated in the manufacturer's own plant that has the same cell classification as the material to which it is being added. The pipe shall be homogeneous throughout and free of visible cracks, holes, voids, foreign inclusions, or other defects that may affect the wall integrity.
 - 3. Permanent identification of water piping service shall be provided by co-extruding longitudinal blue stripes into the pipe outside surface. The striping material shall be the same material as the pipe material except for color. Stripes printed or painted on the outside surface shall not be acceptable.
- B. Preferred Manufacturers:
 - 1. Performance Pipe a division of Chevron Phillips Chemical Company LP; <http://www.performancepipe.com/>; DriscoPlex® 4100
 - 2. JM Eagle; <http://www.jmeagle.com/>

2.5 PE WATER SERVICE PIPING (PREFERRED SERVICE PIPE)

- A. Polyethylene pipe shall be manufactured in accordance with AWWA C901, in accordance with for NPS 2 or less use manufactured to the requirements of ASTM D2239 for inside diameter control IPS size or ASTM D2737 for outside diameter control CTS size.
 - 1. Minimum pressure rating of 333 psi
 - 2. Minimum dimension ratio of 7
 - 3. Certified to NSF/ANSI 14 and NSF/ANSI 61.
- B. Preferred Manufacturers:
 - 1. Performance Pipe a division of Chevron Phillips Chemical Company LP; <http://www.performancepipe.com/>; DriscoPlex® 5100
 - 2. JM Eagle; <http://www.jmeagle.com/>

2.6 SPECIAL PIPE FITTINGS

- A. Ductile-Iron Rigid Expansion Joints:
 - 1. Preferred Manufacturers:
 - a. EBAA Iron, Inc.; <http://www.ebaa.com/>
 - b. US Pipe and Foundry Company; <http://uspipe.com/>
 - 2. Description: Three-piece, ductile-iron assembly consisting of telescoping sleeve with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - a. Pressure Rating: 250 psig minimum.
 - b. Expansion Required: **to be calculated per installation.**

B. Ductile-Iron Flexible Expansion Joints:

1. Flexible expansion joints shall be installed in the locations indicated on the drawings and shall be manufactured of ductile iron conforming to the material requirements of ASTM A536 and ANSI/AWWA C153/A21.53. Foundry certification of material shall be readily available upon request.
2. Each flexible expansion joint shall be pressure tested prior to shipment against its own restraint to a minimum of 250 PSI. A minimum 2:1 safety factor, determined from the published pressure rating, shall apply.
3. Each flexible expansion joint shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint, having a minimum per ball deflection of: 25°, 4" - 8"; 20°, 10" - 12"; 15°, 14+" and 8-inches minimum expansion. The flexible expansion fitting shall not expand or exert an axial imparting thrust under internal water pressure. The flexible expansion fitting shall not increase or decrease the internal water volume as the unit expands or contracts.
4. All internal surfaces (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Sealing gaskets shall be constructed of EPDM. The coating shall meet ANSI/NSF-61.
5. Exterior surfaces shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.
6. Polyethylene sleeves, meeting ANSI/AWWA C105/A21.5, shall be included for direct buried applications.
7. Preferred Manufacturers:
 - a. EBAA Iron, Inc.; <http://www.ebaa.com/>
 - b. US Pipe and Foundry Company; <http://uspipe.com/>

C. Ductile-Iron Restrained Joints and Fittings:

1. Preferred Manufacturers:
 - a. Star Pipe Products; <http://www.starpipeproducts.com/>
 - b. EBAA Iron, Inc.; <http://www.ebaa.com/>

D. Ductile-Iron Deflection Fittings:

1. Preferred Manufacturers:
 - a. EBAA Iron, Inc.; <http://www.ebaa.com/>
2. Description: Compound, ductile-iron coupling fitting with sleeve and 1 or 2 flexing sections for up to 15-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - a. Pressure Rating: 250 psig minimum.

2.7 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- B. Tubular-Sleeve Pipe Couplings:
1. Preferred Manufacturers:
 - a. Romac Industries, Inc.; <http://www.romac.com/>

- b. Smith-Blair, Inc.; <http://www.smith-blair.com/>
- c. JMC Industries, Inc.; <http://www.jcmindustries.com/>
- d. Cascade Waterworks Mfg.; <http://www.cascademfg.com/>
- 2. Description: Cast iron or stainless steel, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.
 - a. Reference Standard: AWWA C219.
 - b. Center-Sleeve Material: Stainless steel.
 - c. Gasket Material: Natural or synthetic rubber.
 - d. Pressure Rating: 200 psig.
 - e. Metal Component Finish: Corrosion-resistant coating or material.

2.8 PVC GASKETED, PUSH-ON FITTINGS

- A. Acceptable fittings for use with fusible polyvinylchloride pipe shall include standard PVC pressure fittings conforming to AWWA C900 or AWWA C905.
 - 1. Acceptable fittings for use joining fusible polyvinylchloride pipe other sections of fusible polyvinylchloride pipe or other sections of PVC pipe shall include gasketed PVC, push-on type couplings and fittings, including bends, tees, and couplings as shown in the drawings.
 - 2. Bends, tees and other PVC fittings shall be restrained with the use of thrust blocking or other restraint products as indicated in the construction documents.
 - 3. PVC gasketed, push-on fittings and mechanical restraints, if used, shall be installed per the manufacturer's guidelines.

2.9 SLEEVE-TYPE COUPLINGS

- A. Sleeve-type mechanical couplings shall be manufactured for use with PVC pressure pipe and may be restrained or unrestrained as indicated in the construction documents.
- B. Sleeve-type couplings shall be rated at the same or greater pressure carrying capacity as the pipe itself.

2.10 EXPANSION AND FLEXIBLE COUPLINGS

- A. Expansion-type mechanical couplings shall be manufactured for use with PVC pipe, and may be restrained or unrestrained as indicated in the construction documents.
- B. Expansion-type mechanical couplings shall be rated at the same or greater pressure carrying capacity as the pipe itself.

2.11 CONNECTION HARDWARE

- A. Bolts and nuts for buried service shall be made of non-corrosive, high-strength, low-alloy, stainless steel having the characteristics specified in ANSI/AWWA C111/A21.11, regardless of any other protective coating.

2.12 GATE VALVES

- A. Gate Valves shall be mechanical joint resilient wedge gate valves, conforming to AWWA C509 Specifications and approved by UL/FM.
 - 1. Shall be specified, supplied, and installed with non-rotating gland pack accessories.
 - 2. Shall have an open left non-rising stem with a 2-inch square operating nut with the word "Open" and an arrow cast in the metal to indicate left open. Stems shall be of cast bronze with integral collars in full compliance with AWWA. The non-rising stem stuffing box shall be the O-ring seal type with two rings located above the thrust collar. The two rings shall be replaceable with valve fully open and subjected to full rated working pressure.
 - 3. Shall have a wedge of cast iron completely encapsulated with rubber. This sealing rubber shall be permanently bonded to the cast iron wedge to meet ASTM tests for rubber metal bond ASTM D429.
 - 4. Shall have a body and bonnet coated with fusion bonded epoxy on both the interior and exterior, complying with AWWA C550 and approved by NSF 61.
 - 5. Shall have the manufacture's name, pressure rating, and year in which it was manufactured cast on the body.
 - 6. Prior to shipment from factory each valve shall be tested by hydrostatic pressure equal to AWWA's requirement of twice the specified working pressure and UL/FM's requirement of 400 psi.
- B. Preferred Manufacturers:
 - 1. Mueller
 - 2. US Pipe
 - 3. Clow

2.13 RETAINER GLANDS

- A. Manufactured of high strength ductile iron conforming to the requirements of ASTM A536, Grade 65-45-12; wedging mechanisms shall be manufactured of ductile iron, heat treated to a hardness of 370 BHN minimum; dimensions of the gland shall be conforming to the requirements of ANSI C21.11/AWWA C111 and ANSI A21.53/AWWA C153; the mechanical joint restraining device shall have a water working pressure rating of 350 psi minimum (in sizes 4" thru 16") with a safety factor of at least 2:1
- B. Preferred Manufacturers:
 - 1. Tyler Union
 - 2. US Pipe
 - 3. EBBA Iron

2.14 VALVE BOXES

- A. All Valve Boxes shall be manufactured by Tyler Union, or equivalent, provided the boxes meet the following specifications:
1. All Valve Boxes shall be cast iron manufactured of clean, even grain, gray cast iron with a minimum tensile strength of twenty-one thousand (21,000) psi.
 2. All Valve Boxes shall be specified and installed complete with three pieces: a bottom section, a top section, and a lid. The bottom and top sections shall be adjustable to fit the depth of the earth cover over the valve.
 3. The Valve Box shall have a nineteen (19)-inch to twenty-two (22)-inch minimum extension, a minimum five and a quarter (5¼)-inch shaft, a weight of at least sixty (60) pounds, and a wall thickness of at least one-quarter (¼) of an inch.
 4. The seating surface of both the lid cover and the top section shall be cast so that the cover shall not rock after it has been seated and shall fit tightly with little or no play in the fit.
 5. All Valve Boxes shall be designed to prevent the transmission of surface loads directly to the valve or piping.
 6. All Valve Boxes shall be smooth, true to pattern, and free from blow holes, sand holes, projections, and other harmful defects.
 7. All Valve Boxes shall have the word "WATER" cast on the lid.
 8. All valve boxes shall be set with a concrete collar at finished grade in accordance with Town details.

2.15 CHECK VALVES

- A. AWWA Check Valves:
1. Preferred Manufacturers:
 - a. Milliken
 - b. Mueller Co.
 - c. Flow Matic
 - d. DeZURIK, APCO
 2. Description: Swing-check type with resilient seat. Include interior coating according to AWWA C550 and ends to match piping.
 - a. Standard: AWWA C508.
 - b. Pressure Rating: 250 psig.

2.16 BUTTERFLY VALVES

- A. AWWA Butterfly Valves:
1. Preferred Manufacturers:
 - a. Milliken
 - b. Mueller Co.
 - c. DeZURIK APCO
 - d. Val-Matic
 2. Description: Rubber seated.
 - a. Standard: AWWA C504.
 - b. Body: Cast or ductile iron.

- c. Body Type: Wafer or flanged.
- d. Pressure Rating: 250 psig.

2.17 SERVICE SADDLE CONNECTIONS

A. Materials:

1. Outlet - 304 Stainless Steel half coupling. Fused to shell with GTAW welding. 3/4" through 3" IP and CC (depending on model). ALL threads meet AWWA C800.
2. Shell - 304 Stainless Steel per ASTM A240, gauges ranging from 24 gauge for smaller pipe OD's to 16 gauge for larger pipe OD's.
3. Sidebars - Heavy gauge 304 Stainless Steel per ASTM A240, GTAW welded to form permanent fusion with shell.
4. Lugs - 304 Stainless Steel per ASTM A240, fused to sidebars by GMAW welding.
5. Bolts - 304 Stainless Steel per ASTM A479, 1/2" or 5/8" rolled thread. Bolts are GMAW welded to sidebar.
6. Nuts - 304 Stainless Steel per ASTM A194, 1/2" or 5/8" UNC thread. Nuts coated to prevent galling.
7. Lifter Bars - 304 Stainless Steel per ASTM A240, lip curved to hold position while tightening. Heavy gauge serves as bearing surface for nuts.
8. Washers - Acetyl washer to reduce friction at nut. 304 Stainless Steel washer used on some size.
9. Gasket - made from NSF 61 Certified Nitrile Butadiene Rubber (NBR) compounded for water and sewer service and a tolerance of petroleum products in accordance with ASTM D2000 MBC 610. Other compounds available for special applications.

B. Preferred Manufacturers:

1. Wellmac
2. A.Y. McDonald
3. Romac Model 306 stainless steel
4. or approved equal in compliance with ANSI/AWWA C800.

2.18 CORPORATION VALVES AND CURB VALVES

A. Preferred Manufacturers:

1. [A. Y. McDonald Mfg. Co.; http://www.aymcdonald.com/ \(preferred\)](http://www.aymcdonald.com/)

B. Corp Stops: Comply with AWWA C800. Include no-lead brass body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.

1. A. Y. McDonald Mfg. Co. Model 74701-22

2.19 WATER SERVICE CHECK VALVE

A. Preferred Manufacturers:

1. [A. Y. McDonald Mfg. Co.; http://www.aymcdonald.com/ \(preferred\)](http://www.aymcdonald.com/)

- B. Service check valves shall be installed at the discretion of the Town in compliance with AWWA C800 and NSF 61.

2.20 ACCESSORIES

A. Detectable Warning Tape

1. Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
 - a. Red: Electric.
 - b. Yellow: Gas, oil, steam, and dangerous materials.
 - c. Orange: Telephone and other communications.
 - d. Blue: Water systems.
 - e. Green: Sewer systems.

B. Tracer Wire

1. Open Trench - Trace wire shall be #12 AWG Copper Clad Steel, High Strength with minimum 450 lb. break load, with minimum 30 mil HDPE insulation thickness.
2. Directional Drilling/Boring - Trace wire shall be #12 AWG Copper Clad Steel, Extra High Strength with minimum 1,150 lb. break load, with minimum 30 mil HDPE insulation thickness.
3. Pipe Bursting/Slip Lining - Trace wire shall be 7 x 7 Stranded Copper Clad Steel, Extreme Strength with 4,700 lb. break load, with minimum 50 ml HDPE insulation thickness. #12 Blue Insulated Solid Tracer Wire.
4. Connections
 - a. All mainline trace wires shall be interconnected in intersections, at mainline tees and mainline crosses. At tees, the three wires shall be joined using a single 3-way lockable connector. At Crosses, the four wires shall be joined using a 4-way connector. Use of two 3-way connectors with a short jumper wire between them is an acceptable alternative.
 - b. Direct bury wire connectors shall include 3-way lockable connectors and mainline to lateral lug connectors specifically manufactured for use in underground trace wire installation. Connectors shall be dielectric silicon filled to seal out moisture and corrosion; and shall be installed in a manner to prevent any uninsulated wire exposure.
 - c. Non-locking friction fit, twist on or taped connectors are prohibited.
5. Termination/Access
 - a. All trace wire termination points shall utilize an approved trace wire access box (above ground access box or grade level/in-ground access box as applicable), specifically manufactured for this purpose.
 - b. All grade level/in-ground access boxes shall be appropriately identified with "water" cast into the cap and be color coded.
 - c. A minimum of 2 ft. of excess/slack wire shall be required in all trace wire access boxes after meeting final elevation.

- d. All trace wire access boxes shall include a manually interruptible conductive/connective link between the terminal(s) for the trace wire connection and the terminal for the grounding anode wire connection.
 - e. Grounding anode wire shall be connected to the identified (or bottom) terminal on all access boxes.
- 6. Preferred manufacturer(s)
 - a. Copperhead Industries

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Perform related earthwork in accordance with Section 2.

3.2 ALIGNMENT AND GRADE

- A. Water distribution piping shall be laid to the lines and grades with a minimum of 42 inches of cover over the top of the pipe barrel to finished grade.
- B. Sufficient fittings shall be used where shown, primarily at connections or where grade or alignment changes require offsets greater than as recommended and approved by the pipe manufacturer.

3.3 PROTECTION OF UNDERGROUND AND SURFACE STRUCTURES

- A. Temporary support, adequate protection, and maintenance of all underground and surface utility structures, drains, sewers, and other obstructions encountered in the progress of the work shall be the responsibility of the Contractor.

3.4 PIPE BEDDING

- A. Pipe shall be laid on a bed of granular material equivalent to select material, or material approved by the Town Engineer.
- B. Bedding shall be a minimum of three inches thick below the grade of the bottom of the OD of the couplings and shall be wide enough such that a minimum of six inches will be on either side of the pipe barrel.
- C. Where the bottom of the trench is found to be unstable, the Contractor shall excavate and remove such unstable material to the width and depth ordered by the Town Engineer. Before the pipe is laid, the subgrade shall be made by backfilling with an approved material in layers and tamped according to the Town Engineer's direction.

- D. Pipe and fittings shall be carefully handled and placed in the trench. Special care shall be taken to ensure that each length of pipe abuts against the next in such a manner that there shall be no shoulder or unevenness of any kind along the inside of the bottom half of the pipe.

3.5 DIRECTION OF PIPE

- A. Pipe shall be laid with bell ends facing in the direction of pipe laying.

3.6 JOINTING OF PIPES

A. PVC Pipe

1. The pipe ends shall be wiped until clean and dry.
2. Connecting pipe to pipe with push-on joints
 - a. After placing a length of pipe in the trench, the gasket shall be inserted in the bell or on the spigot, as appropriate. Then both the bell and spigot ends of the pipe, as well as the gasket, shall be properly lubricated in accordance with the manufacturer's requirements.
 - b. The spigot end shall then be centered in the bell, the pipe pushed or jacked "home" and brought into true alignment.
3. Connecting pipe to mechanical joint fittings
 - a. After placing a length of pipe in the trench and preparing the end for a mechanical joint, the gasket shall be inserted in the bell by drawing the gland toward the bell.
 - b. The bolts shall be drawn up uniformly on opposite sides of the pipe according to manufacturer's specifications.

B. Ductile Iron (DI) Pipe

1. Before laying the pipes, all lumps, blisters, excess coal-tar coating, and foreign material shall be removed from the bell and spigot ends of each pipe.
2. The pipe ends shall then be wire brushed and wiped until clean and dry.
3. Connecting pipe to pipe with slip joints
 - a. After placing a length of DI pipe in the trench, the gasket shall be inserted in the bell or on the spigot, as appropriate. Then both the bell and spigot ends of the pipe, as well as the gasket, shall be properly lubricated in accordance with the manufacturer's requirements.
 - b. The spigot end shall then be centered in the bell, the pipe pushed or jacked "home" and brought into true alignment.
4. Connecting pipe to mechanical joint fittings
 - a. After placing a length of DI pipe in the trench and preparing the end for a mechanical joint, the gasket shall be inserted in the bell by drawing the gland toward the bell.
 - b. The bolts shall be drawn up uniformly on opposite sides of the pipe according to manufacturer's specifications.

C. Joint Deflection

1. Whenever necessary to deflect pipe from a straight line, either in the vertical or horizontal plane to avoid obstructions, to plumb stems, or for other reasons, the degree of deflection

shall not exceed the maximum allowable deflection as per the manufacturer's specifications.

2. Wherever the change in alignment exceeds the amount achievable by deflecting the pipe in accordance with the manufacturer's specifications, DI Bends of smallest degree possible and applicable shall be installed. See "Materials Specifications," Part 6.1, for further description of these fittings.
3. Joint deflections shall include appropriate thrust blocking and/or joint restraint as noted in 1.6.

3.7 CUTTING OF NEW PIPE BEING INSTALLED

- A. Cutting of new pipe being installed, for the purpose of installing a valve, fitting, or end cap, shall be done in a neat and workmanlike manner without damage to the pipe.
- B. Wherever it is necessary to cut pipe, the cut end of the pipe shall be adequately beveled so as to prevent the edge of the pipe from cutting or tearing the gasket as the spigot end is inserted into the bell of the adjoining pipe or fitting.

3.8 WATER SERVICE INSTALLATION

- A. Service saddles shall be used for all service connections to PVC water mains.
- B. The corporation stop shall be placed in the upper half of the water main at approximately 45° from the top center of the pipe.
- C. Service tubing shall be loosely laid without kinking.
- D. Curb stop valves and valve boxes shall be placed 1-2 feet from the face of curb in the direction to the parcel to be served. Curb stops shall be set at the proper depth, a minimum of 3 feet and maximum of 4 feet.
- E. Curb boxes shall be set plumb, adequately braced, and set to final grade.
- F. The outlet service connection from the curb stop for future services shall be fitted with a screw plug to restrict dirt from entering the curb stop.
- G. Insert stiffeners shall be provided for all connections.
- H. All valve boxes shall have a concrete collar measured a minimum of 6-inches from all sides from the outside of the curb box to the edge of concrete in accordance with Town Water System DetailsW11 provided as Appendix A.

3.9 FIRE HYDRANT INSTALLTION

- A. Hydrants shall stand plumb and shall have their nozzles parallel with, or at right angles to, the curb or centerline of roadway, with the pumper nozzle facing the curb or roadway.

- B. Each hydrant shall be connected to the water main with a minimum 6-inch pipe branch controlled by an independent 6-inch valve.
- C. A minimum of 18 inches shall be maintained between the centerline of the steamer nozzle and the ground surface for all fire hydrants. A fire hydrant extension shall be provided and installed if the fire hydrant is set too low.
- D. Fire hydrants shall be installed in locations to avoid encroachment into pedestrian pathways, sidewalks, and ADA compliant curb ramps. The locations should be reviewed to avoid potential future encroachment for pedestrian improvements such as sidewalks and other ADA compliant infrastructure.
- E. When a dry-barrel hydrant is set in soil that is pervious, drainage shall be provided at the base of the hydrant by placing coarse gravel or crushed stone mixed with coarse sand, from the bottom of the trench to at least 6 inches above the waste opening in the hydrant and to a distance of 1 foot around the elbow.
 - 1. Where groundwater rises above the drain port or when the hydrant is located within 8 feet of a sewer, the drain port shall be plugged, and water pumped from the hydrant when freezing may occur.
- F. When a dry-barrel hydrant with an open drain is set in clay or other impervious soil, a drainage pit 2 ft. x 2 ft. x 2 ft. shall be excavated below each hydrant and filled with coarse gravel or crushed stone mixed with coarse sand, under and around the elbow of the hydrant and to a level of six inches above the drain port.
- G. All hydrants shall be well braced with thrust blocking and shall be restrained by means of retainer lugs and rods between the valve and hydrant as shown on the Drawings or as approved by the Town.
- H. After testing for leaks all hydrants shall be painted. Fire hydrants shall not be painted unless the air temperature is above 50 degrees F and the weather conditions are expected to remain favorable for painting. If the paint begins to peel or flake within the first year after final acceptance the Contractor shall be responsible for repainting the fire hydrant.
 - 1. Contractor shall remove all rust, scale and dirt from the hydrant body using a power wire brush or sand blaster.
 - 2. Any excess dirt, grease or dust shall be removed using a water free cleaning or degreasing solution followed by a dry wiping.
 - 3. Immediately after the fire hydrant is cleaned, Contractor shall apply one coat of Rust-Oleum No. 5281 gray acrylic primer to all metal and painted surfaces using a paint brush.
 - 4. After allowing the primer to dry for a period of not less than 2 hours, Contractor shall apply an intermediate and final coat of Rust-Oleum No. 5265 fire hydrant red high-performance acrylic paint.
 - 5. A minimum of 3 hours shall elapse between coats. Application of the primer or paint by method of spray shall not be acceptable.
- I. Hydrant barrels shall be provided with a minimum 2" wide reflective tape around the barrel under the top flange.
- J. Hydrant bonnets shall be color classified in accordance with the hydrants rated capacity.

Table 1 - Hydrant Class, Capacity, and Color

HYDRANT CLASS	FLOW CAPACITY	COLOR
AA	> 1500 gpm	Blue
A	1000-1500 gpm	Green
B	500-999 gpm	Orange
C	250-499 gpm	Red
D	< 250 gpm	Black

3.10 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water from the Town's water system.
- B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
 1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
 2. PVC post- installation hydrostatic test shall be performed on the installed system in accordance with AWWA C605.
- C. Prepare reports of testing activities.

3.11 IDENTIFICATION

- A. Tracer wire shall be provided and placed directly on top of the pipe being marked when non-metallic water main or water service line is being installed. Each tracer wire shall be extended into a valve box with an additional three feet of excess wire measured from final grade. Each tracer wire on a service line shall be extended into the meter or terminating box with an additional two feet of excess wire.
 1. Install trace wire with all PVC piping including directional bores and service pipes.
 - a. Install trace wire continuous with all pipes and bores, by-passing around the outside of valves and fittings on the North or East side.
 - b. Splice trace wire only at intermediate junctions.
 - c. Terminate trace wire for each pipe run at structures along pipe system.
 - d. Trace wire on all water service laterals must terminate at an approved trace wire access box color coded blue and located directly above the service lateral at the edge of road right of way.
 - e. Provide extra length of trace wire at each structure such that trace wire can be pulled 3 feet out top of structure for connection to detection equipment.
 - f. Above-ground tracer wire access boxes will be installed on all fire hydrants.
- B. Detection and warning tape shall be provided and placed between 18 and 24 inches above the pipe being marked when non-metallic water main or water service line is being installed and

shall be in accordance with these Standard Specifications. At no time shall it be placed at a depth less than 6 inches.

3.12 TESTING AND ACCEPTANCE

- A. New water mains shall not be placed into service prior to pressure testing, disinfection, flushing and acceptance by the Town. Fire hydrants installed, but not yet in service shall be securely wrapped with black polyethylene film or marked with out-of-service rings.
- B. After the pipe is backfilled and all trapped air is expelled and prior to connecting the new pipe to the existing pipe network, the new pipe system shall be hydrostatically tested at a minimum pressure of 150 psi for 2 hours as measured at the highest elevation of the pipe being tested in accordance with AWWA C600.
- C. Acceptance shall be determined based on allowable leakage. If a test of pipe laid discloses leakage greater than specified, the leak shall be located, and the defective material repaired until the leakage is within the specified allowance. All visible leaks are to be repaired regardless of the amount of leakage.
- D. A leakage test shall be conducted concurrently with the pressure test. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain pressure within 5 psi of the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water.

Table 2 - Allowable leakage per 1,000 Feet of Water Main

AVERAGE TEST PRESSURE (PSI)	NOMINAL PIPE DIAMETER (IN)						
	4	6	8	10	12	14	16
150	0.37	0.55	0.74	0.92	1.10	1.29	1.47
125	0.34	0.50	0.67	0.84	1.01	1.18	1.34
100	0.30	0.45	0.60	0.75	0.90	1.05	1.20

- E. After water mains have been tested and accepted, each hydrant shall be opened with all discharge nozzles fully closed and inspected for leaks. All visible leaks shall be corrected immediately by the Contractor and the test performed again at the Developer's expense.
- F. Microbiological and other required testing shall be completed as required by the Delaware Division of Public Health at the Developer's expense.
 1. Testing shall be completed by an accredited laboratory.
 2. Test results shall be reviewed and approved by the Town.

3.13 CLEAN AND DISINFECT

- A. Clean and disinfect water-distribution piping as follows:
 1. The "Tablet Method" from AWWA C651-92, Standard for Watermain Disinfection, imparts an average chlorine dose of 25 mg/l. Procedures for this method shall be utilized for the disinfection of new water mains as follows.

2. During construction, calcium hypochlorite granules are to be placed at the upstream end of the first section of pipe, at the upstream end of each branch main, and at 500-foot intervals. The quantity of granules to be placed is based upon pipe diameter as shown in Table 3 - Calcium Hypochlorite Dosage.

Table 3 - Calcium Hypochlorite Dosage

PIPE DIAMETER (in)	CALCIUM HYPOCHLORITE (oz)	CALCIUM HYPOCHLORITE (g)
2	0.1	3.5
4	0.5	14.0
6	1.0	28.0
8	2.0	57.0
12	4.0	113.0
>12	8.0	227.0

3. During construction, five-gram calcium hypochlorite tablets are to be placed in each section of pipe. A tablet shall be placed in each hydrant branch, hydrant, and appurtenance. The number of tablets to be placed in each section of pipe is based upon the pipe length and diameter as shown in Table 4 - Calcium Hypochlorite Tablet Quantity. Divide the tablets so there is an approximate equal number of tablets at each end of pipe. The tablets are to be attached to the top of the pipe or appurtenance with a food grade adhesive. Adhesive is to be applied only to the broadside of the tablet where it will be attached to the pipe.

Table 4 - Calcium Hypochlorite Tablet Quantity

PIPE DIAMETER (in)	18' PIPE LENGTH	20' PIPE LENGTH	100' PIPE LENGTH
2	-	-	1
4	1	1	
6	1	1	
8	2	2	
12	4	4	
>12	6	7	

END OF SECTION

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SECTION 5 - DRAINAGE SYSTEMS

PART 1 - GENERAL

1.1 DESIGN CRITERIA

- A. Storm water runoff volumes, peak flows, hydrographs, and storage volumes shall be calculated in accordance with the USDA Soil Conservation Service Technical Release 55 (TR-55), latest edition.
- B. Storm water collection and conveyance systems shall be designed in accordance with the current edition of DelDOT Roadway Design Manual.
- C. The minimum interior storm sewer pipe diameter shall be 15 inches.
- D. The minimum depth of cover for storm sewers shall be 15 inches from finished grade to top of pipe.
- E. Sediment and storm water management facilities shall be in accordance with the Sediment Control Act. All erosion and sediment control practices shall be in accordance with the standards and specifications of the Delaware Erosion and Sediment Control Handbook, latest edition.
- F. A Sediment and Storm Water Management Plan for all projects shall be submitted to and approved by Sussex Conservation District before any earth-disturbing activities are initiated.

1.2 REFERENCES

- A. Milton Town Code.
- B. Delaware Code Title 7 Chapter 40. Erosion and Sedimentation Control
- C. DelDOT Standard Specifications for Road and Bridge Construction
- D. DelDOT Standard Construction Details
- E. American Association of State Highway and Transportation Officials (AASHTO)
- F. American Society for Testing and Materials (ASTM)

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Protect pipe, pipe fittings, and seals from dirt and damage.
- B. Handle structures according to manufacturer's written rigging instructions.

PART 2 - PRODUCTS

2.1 REINFORCED CONCRETE PIPE (RCP)

- A. RCP shall be in accordance with ASTM C76, Class IV. Joints shall be in accordance with ASTM C14 and may be bell and spigot, tongue and groove, or modified tongue and groove. O-ring rubber gaskets or a bituminous sealer meeting the requirements of AASHTO M 198, Type B, shall be used to seal the joints between successive sections of pipe.

2.2 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

- A. HDPE pipe for non-pressure drainage of storm water shall comply with the requirements, test methods, dimensions and markings found in AASHTO Designations M252 and M294. All sizes shall conform to the AASHTO classification "Type D" (which describes pipe with a smooth waterway). Joints shall be bell-type and classified "watertight" in accordance with ASTM D3212 and ASTM F1417. Fittings for PE pipe for non- pressure drainage of storm water shall not reduce or impair the overall integrity of function of the pipeline. Couplings shall provide sufficient longitudinal strength to preserve pipe alignment and prevent separation at the joints. Only fittings supplied or recommended by the pipe manufacturer shall be used. Neoprene or rubber gaskets shall be supplied on all fittings.

2.3 CATCH BASINS, INLETS, AND MANHOLES

- A. Catch basin, inlet, manhole, and junction box structures shall be precast reinforced concrete conforming to ASTM C913. Designations and dimensions shall be in accordance with the latest revision of the DelDOT Standard Specifications for Road and Bridge Construction.
- B. Catch basin, inlet, manhole and junction box frames, covers, and grates shall be in accordance with the latest revision of the DelDOT Standard Specifications for Road and Bridge Construction.
 - 1. All frames, covers, and grates to be installed within the street right-of-way shall meet AASHTO H20 loading requirements.

PART 3 - EXECUTION

3.1 CONSTRUCTION METHODS

- A. Excavation and backfill for storm water pipe and structures shall be in accordance with Section 2 Earthwork.
- B. RCP Installation
 - 2. RCP shall be laid with bell or hub ends upgrade, spigot ends fully entered into the adjacent hub, with true lines and grades.

3. Successive sections of RCP shall have the joints sealed with either O-ring rubber gaskets, or a bituminous jointing material as specified in the materials section above.
4. Before succeeding sections of reinforced concrete pipe are laid, the lower half of the hub on the inside of the preceding section shall be provided with the appropriate joint sealer of sufficient thickness to bring the inner surfaces of the abutting pipe sections flush and even. The upper half of the spigot of the succeeding pipe shall be similarly affixed with the appropriate joint sealer at the same time. After the pipe section is laid, the remainder of the joints shall be filled with the specified joint sealer.
5. Additional joint sealer material shall be used to form a bead around the joint.
6. Where bituminous jointing material is used for joint sealer, the material shall not be applied when the air temperature is less than 35 degrees Fahrenheit, unless special provisions are made to preheat the material before use.

C. HDPE Installation

1. HDPE storm water drainage pipe shall be installed in conformance with ASTM D2321 and the manufacturer's recommended installation procedures.

3.2 TESTING AND ACCEPTANCE

- A. Storm drainage pipe shall be subject to mirror-light testing for pipe deflection and for straight and true alignment. Mirror-light testing shall be performed between catch basins and manholes, or through partially completed sections of pipe as required by the Town or the Town Engineer.
- B. Storm drainage pipe with a deflected cross-section or not showing a full circle of reflected light shall not be accepted. Sections of storm drainage pipe determined unacceptable shall be removed and reinstalled.
- C. No inspection, review, or acceptance of submittals by the Town, Town Engineer or other entity hired by the Town for the purpose of making inspections shall relieve the contractor from any of its responsibilities listed in this Section 5.

END OF SECTION

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SECTION 6 - STREETS

PART 1 - GENERAL

1.1 DESIGN CRITERIA REFERENCES

- A. Street planning and geometric design shall conform to the Code of the Town of Milton Chapter 188-22 Street Design, DelDOT's Development Coordination Manual (latest edition) and DelDOT's Rules and Regulations for Subdivision Streets. In the event of a conflict, the provisions of the Town Code shall control within the Town's jurisdiction.
- B. Milton Town Code.
 - 1. Pavement section design shall conform to the Code of the Town of Milton Chapter 188-22 Street Design Table 1.
 - 2. Sidewalk, curb, curb ramps and curb openings shall be in accordance with the Code of the Town of Chapter 183 Streets and Sidewalks.
- C. Traffic controls and pavement marking shall conform to the latest edition of the Delaware Manual on Uniform Traffic Control Devices (MUTCD), latest edition.
- D. Construction of roadways shall conform to the latest edition of DelDOT's Standard Specifications for Road and Bridge Construction and the Americans with Disabilities Act (ADA).

1.2 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO)
- B. American Concrete Institute (ACI)
- C. American Society for Testing and Materials (ASTM)

PART 2 - PRODUCTS

2.1 STREET MATERIALS

- A. All street construction materials and equipment shall comply with the DelDOT Standard Specifications for Road and Bridge Construction, latest edition except as modified herein.

2.2 CONCRETE

- A. Concrete for sidewalks and curbs shall be a minimum 3,000 psi 28-day compressive strength, Class B conforming to Section 3 - Concrete and DelDOT Standard Specifications for Road and Bridge Construction, latest edition.

2.3 AGGREGATE

- A. Graded aggregates shall consist of crushed stone, crushed gravel or crushed slag fragments. The aggregates shall be uniform in quality and consistency, well graded, and free of silt, clay, decomposed rock, and overburden material in accordance with ASTM D2940. Material shall meet the following gradation requirements in accordance with AASHTO T2 and AASHTO T 27.

Table 1 - Aggregate Gradation Percent Passing

SIEVE SIZE	TYPE A (CR-1)	TYPE B (CRUSHER RUN)
2 1/2"	100	
1 1/2"		100
1"	50-80	
3/4"		50-95
No. 4	20-50	20-50
No. 10		15-40
No. 20	10-30	
No. 100	2-20	2-20

2.4 HOT-MIX, HOT-LAID BITUMINOUS CONCRETE

- A. The general composition limits shall be as prescribed in the DelDOT Standard Specifications for Road and Bridge Construction.

PART 3 - EXECUTION

3.1 CONSTRUCTION METHODS

- A. All street construction methods shall comply with the DelDOT Standard Specifications for Road and Bridge Construction, latest edition, except as modified herein.
- B. Pavement Removal
- Pavement removal shall be accomplished either by milling or the making of saw cuts to allow for removal of pavement material without damage to adjacent paving.
 - Removed pavement material shall be disposed of in a manner and to a location in accordance with all applicable regulations.
 - Saw cutting equipment used shall consist of a wheel-mounted, motor driven circular cutter mounted on a sturdy frame with necessary controls and accessories. The saw cutting machine proposed for this work shall be approved by the Town Engineer prior to the start of the saw cutting. The depth of the saw cut shall be a minimum of 3 inches.
 - Pavement milling equipment shall be suitable and specifically designed for use in milling and planning of bituminous and Portland cement concrete pavements.
- C. Curb and Gutter
- Curb and gutter shall be constructed in uniform sections with contraction joints at 10-foot intervals, except where shorter sections are required for closures. No section shall be less than 5 feet.

2. Expansion joints shall be formed in the curb at 40-foot intervals, at all points of curvature and tangency, where new curb abuts existing curb or other rigid structures, and between curb and all driveways. Where curb is installed by slip-forming, the expansion joint interval may be increased to 200 feet.

D. Sidewalk

1. Sidewalks shall be scored 1/2-inch deep at 5-foot intervals, with edging tools specifically designed for this use.
2. Expansion joints shall be perpendicular to the edge of the sidewalk and shall extend vertically from the surface to the subbase. Expansion joints shall be installed at 20-foot intervals and where the sidewalk abuts rigid structures.
3. Sidewalk shall be sloped to drain toward the street at 1/4 inch per foot.

3.2 BASE COURSE

- A. The subgrade shall be properly shaped and uniformly and thoroughly compacted in conformity with the lines and grades as shown on the design drawings and/or as established in the field before any subbase, base, or surfacing material is placed. The subgrade shall be free from boulders, large rocks, muck, vegetation, or other materials that would prove detrimental to the road. Depressions that develop during the rolling shall be filled with suitable material and the subgrade shall be rolled until no depressions develop.
- B. Where excavation to the finished graded section results in a subgrade of unsuitable soil, the Town Engineer may require the contractor to remove the unsuitable materials and backfill to the finished graded section with approved material. The Contractor shall conduct his operations in such a way that the Town Engineer can take the necessary cross-sectional measurements before the backfill is placed.
- C. When directed by the Town Engineer, test rolling shall be performed upon the prepared subgrade prior to the placement of any base or subbase material. Test rolling shall be performed with self-propelled equipment, which shall be of the size, type, and weight that will reveal any soft, yielding, or spongy areas. If the test rolling shows the subgrade to be unstable, the contractor shall scarify, disc, aerate, or add moisture and recompact the subgrade to the extent when retested by the above methods it will be stable.
- D. The subgrade must be maintained in such condition that it will drain. Prior to the formation of the final subgrade or of the cutting of any box section in which the subbase or base will be placed, all side ditches parallel to the center line of the project shall be cut to their plan gradient. Temporary ditches permitting drainage from box sections to side ditches shall be provided at intervals as required. All facilities necessary for complete drainage of the construction areas shall be provided and maintained by the Contractor.
- E. In no case shall vehicles be allowed to travel in a single track and form ruts in the subgrade, and if any sharp irregularities are formed the subgrade shall be scarified and recompact.
- F. Graded aggregate base course as spread shall be well graded, have no pockets of fine material, and be so handled that there will be no segregation of fine or coarse particles. No base course material shall be spread on a frozen subgrade, nor shall more than 1,000 feet be spread in

advance of rolling and filling, except by written permission by the Town Engineer. No materials shall be placed adjacent to structures until they have been set to the required grade and alignment.

- G. The graded aggregate base course shall be rolled with a self-propelled roller weighing not less than ten tons or approved vibratory equipment may be used. The rolling shall begin at the edges of the courses and on the final course the outside wheel of the roller shall cover equal parts of the material and the shoulder. The roller shall run forward and backward along the edge until the shoulder and course material are bound together firmly. When the sides have been firmly rolled, the rolling shall progress gradually toward the center, parallel with the center line of roadway, uniformly lapping each preceding track and covering thoroughly the entire surface with the rear wheel and continuing until the entire surface does not creep nor wave ahead of the roller.
- H. The development of a spongy condition in the rolling process will justify either a discontinuance of the rolling for a period of time sufficient to permit the drying of the subgrade, or the complete removal of the base course and a treatment of the subgrade, all of which will be done under the direction of the Town Engineer.
- I. After the premixed material has been thoroughly rolled, it may be necessary to apply screenings gradually over the surface in such amounts as will completely fill the interstices of the rolled material.
- J. Immediately after the voids of each course have been filled with screenings, the premixed material shall be sprinkled with an approved sprinkling device. The sprinkling and rolling shall be continued, and additional screenings applied where necessary until the course material is well bonded and firmly set. The quantity of screenings and water necessary for each course shall be determined by the Town Engineer. In no event shall the screenings remaining on the final surface be of such thickness as to be picked up by truck wheels or the finisher after the base course has been tack-coated. At all times, the rolling shall begin at the sides, overlapping the shoulders and progressing toward the center, thoroughly covering the entire surface with the rear wheels.
- K. Should the subgrade become soft and mixed through the premixed base course material, the Contractor shall, without additional compensation, remove the mixture, reshape and compact the subgrade, and replace the materials removed with clean aggregate which shall be rolled, broomed, and filled until compacted satisfactorily and uniformly with the surrounding surface.
- L. The finished surface of the base course shall not vary from that required on the plans by more than 1/2" when tested with a 10' straightedge applied to the surface parallel to the center line of the pavement and with a template cut to the cross-section of the roadway and applied to a transverse direction. Such portions of completed base course which are defective shall be taken up, removed, and replaced with a suitable material, properly laid. The transverse template shall be equal in length to the full width of the roadway, except the template lengths may be limited to a 24' maximum.

3.3 HOT-MIX, HOT-LAID BITUMINOUS CONCRETE

- A. A tack coat of RS-1 asphalt meeting the requirement of AASHTO M 140, shall be applied on all surfaces being resurfaced with hot-mix asphaltic concrete. Prior to application of tack coat, the surfaces shall be dry and broomed clean. Tack coat shall be applied at the rate of from 0.05 to 0.10 gal. per square yard. Tack coat shall be applied only as far in advance of the hot mix operation as is anticipated for the current day's operation. In residential areas, the tack coat shall be applied only as far in advance of the operation as directed by the Town Engineer.
- B. Hot-mix, hot-laid bituminous concrete shall be transported from the mixing plant to the project site in tight vehicles previously cleaned of all foreign materials, and each load shall be covered with canvas or other approved material of sufficient size to protect it from the weather. The cover shall be tightly secured on all sides to prevent loss of heat. No loads shall be sent out so late in the day as to interfere with spreading and compacting the mixture during daylight unless satisfactory artificial light is provided. The mixture shall be delivered at the spreader with a loss of not greater than 20°F from that temperature determined at the plant by the Town Engineer or his agents.
- C. The methods employed in performing the work and all equipment, tools, and machinery used in handling materials and executing any part of the work shall be subject to approval before the work is started and whenever found unsatisfactory, shall be changed or improved as required by the Town Engineer. All equipment, tools, and machinery used must be maintained in a satisfactory working condition.
- D. The bituminous concrete spreading and finishing equipment shall be of an approved, self-propelled type and capable of spreading the mixture true to the line, grade, width, and crown specified. This equipment shall also be provided with means for heating the screened members so that it will prevent the accumulation of bituminous material. All paving materials shall be equipped with automatic grade and slope controls unless approved otherwise in writing by the Town Engineer. Both the grade and slope controls shall be in working order at all times, except that, in the event of mechanical failure of the automatic controls, the Contractor will be permitted to finish the day's work using manual controls.
- E. Prior to the delivery of the mixtures on the job, the underlying course shall have been brought to line, grade, and cross-section, and all excess patching material, joint material, dirt, or foreign material shall be removed. All major cracks shall be cleaned. The mixtures shall be placed only upon a surface which is dry, and only when weather conditions are within the acceptable tolerances noted in the DelDOT requirements.
- F. The Town Engineer may permit work to continue when overtaken with sudden rain, up to the amount of material which may be in transit from the plant at the time, and provided the mixture is within the temperature limits specified.
- G. Upon arrival, the mixture shall be dumped into the approved mechanical spreader and immediately spread thereby and struck off in a uniform layer to the full width required. Machine methods of spreading and screening will be required unless otherwise permitted. Where hand spreading is required, lutes shall be used. The use of garden rakes shall not be permitted.

- H. Contact surfaces of curbing, gutters, manholes, etc., shall be painted with a thin, uniform coat of hot asphalt cement or other approved material just before the mixture is placed against said surfaces.
- I. The Contractor shall fill low places in the base with a leveling material which shall consist of binder course or surface material of hot-mix bituminous concrete. The locations along the base course to receive this leveling course material, the type of material to be used, and the method to be employed in each case shall be as directed by the Town Engineer. Hot-mix bituminous concrete shall be placed as directed, around all manholes, catch basins, valves, etc. when they are adjusted to the proper grade. This material shall be removed if directed and such removal shall be incidental to the work.
- J. After the hot-mix bituminous concrete binder course is placed, it shall not lay exposed for a period longer than ten days. If due to conditions of emergency, more than ten days elapse, an asphaltic tack coat may be required to be sprayed on the binder course so exposed, before placing the wearing course of hot- mix bituminous concrete.
- K. When placing the hot-mix bituminous binder on wearing courses, one lane shall not be carried ahead of the other a distance greater than one day's run unless approved by the Town Engineer.
- L. No hot-mix bituminous concrete shall be placed on any frozen surface.
- M. At locations where the hot-mix is tapered to meet an existing roadway, a tack coat of asphaltic material shall be applied on the tapered areas at the rate of approximately 0.15 gallon per square yard.
- N. Immediately after the bituminous mixture has been spread, struck off, and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling.
- O. The surface shall be rolled when the mixture is in a workable condition and when the rolling does not cause undue displacement, cracking or shoving. All roller marks shall be rolled out.
- P. The number, weight, and type of rollers furnished shall be sufficient to obtain the required compaction while the mixture is in a workable condition. The sequence of rolling operations and the selection of roller types shall provide the specified pavement density. All rollers shall be approved prior to use and shall be continuously maintained in a satisfactory working condition and shall bear the manufacturer's name plate on which shall be stamped the model number and the weight without ballast.
- Q. Delays in rolling freshly spread mixtures shall not be permitted. Each roller shall be operated by a competent and experienced roller operator. All rollers shall be kept in good condition and shall weigh not less than 250 pounds per inch width of tread. Rolling shall start longitudinally at the sides and proceed toward the center of the work, overlapping on successive trips by at least one-half the width of the roller. Alternate trips of the roller at all times shall be slow enough to avoid displacement of the hot mixtures, and any displacement occurring as a result of the reversing of the direction of the roller, or from any other cause shall at once be corrected by the use of lutes and of fresh mixture when required. To prevent adhesion of the mixture to the wheels of the roller, they shall be kept properly moistened, but excess water shall not be permitted.

- R. Along curbs, manholes, and similar structures and at all places not accessible to the roller, thorough compaction must be secured by means of approved tampers, and at all contacts of this character the joints between these structures and the mixture must be effectively sealed. Any mixture which becomes loose and broken, mixed with dirt, or in any way defective, shall be removed and replaced with a fresh, hot mixture, which shall be immediately compacted to conform with the surrounding area. Areas showing an excess of asphalt cement shall be removed and replaced with a fresh, hot mixture, which shall be immediately compacted to conform with the surrounding area. Areas showing an excess of asphalt cement shall be removed and replaced.
- S. Placing of bituminous concrete shall be as nearly continuous as possible and the roller shall not pass over the unprotected end of the freshly laid mixture except when necessary to form a transverse joint. When necessary to form a transverse joint between old and new pavements or between successive days' work, the joint shall be made by means of placing a bulkhead or by tamping the course in which case the edge shall be cut back to its full depth and width on a straight line to expose a vertical surface. In both methods all contact surfaces shall be sprayed with an approved asphaltic tack coat material before placing any fresh mixture against the joint.
- T. Longitudinal joints shall be rolled directly behind the layering operations. The first lane shall be true to line and grade and have vertical face. The material being placed in the abutting lane shall be tightly compacted against the vertical face of the previously placed lane. The finishing machine shall be positioned so that in spreading, the material overlaps the edge of the lane previously placed by 1" to 2" and shall be left sufficiently high to allow for compaction. Before rolling, the material overlapping the joint shall be carefully moved with a broom or lute onto the surface of the unrolled lane. When the abutting lane is not placed the same day, or the joint is distorted by traffic or other means, the edge shall be carefully trimmed to line and sprayed with a thin coat of approved asphaltic tack coat material.

3.4 TESTING AND ACCEPTANCE

- A. No subbase or base materials shall be placed until the subgrade has been approved. The subgrade shall be checked for grades by means of a string line, from grade stakes placed at intervals not to exceed 50'.
- B. The surface of the base course shall be bladed to the cross-section as required by the Drawings and the finished surface shall be tested with a 10' straightedge and shall have tolerance of 1/2" in 10'.
- C. No portion of the finished binder or surface course for hot-mix, hot-laid bituminous concrete shall be more than 1/4" below a template cut to the cross-section and width of the pavement, placed on the course at right angles to the center line of the road. If ordered, the base and/or wearing course shall be checked with a 10' straightedge placed parallel to the center line of the pavement. Deviations of more than 3/16" shall be corrected before the finished rolling is completed.
- D. No inspection, review, or acceptance of submittals by the Town, Town Engineer or other entity hired by the Town for the purpose of making inspections shall relieve the contractor from any of its responsibilities listed in this Section 6.

END OF SECTION



Standard Specifications and Details

Appendix A Water System Details

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WATER SYSTEM DETAILS

DETAIL LIST	
DETAIL DWG	DETAIL TITLE
--	WATER SYSTEM DETAILS - COVER
W1	WATER MAIN VERTICAL OFFSET AT UTILITY CONFLICT
W2	WATER MAIN - BACKFILL & RESTORATION
W3	WATER MAIN - ENCASEMENT
W4	METER PIT PLAN & LOCATION
W5	WATER SERVICE CONNECTION PROFILE
W6	METER SERVICE CONNECTION
W7	METER PIT DETAIL
W8	CURB STOP DETAIL
W9	FIRE HYDRANT DETAIL
W10	2IN BLOW OFF DETAIL
W11	GATE VALVE DETAIL
W12	TERMINAL END BLOW OFF DETAIL
W13	WET TAP CONNECTION
W14	STANDARD COMMERCIAL METER PIT
W15	WATER MAIN DISINFECTION
W16	WATER MAIN DISINFECTION
W17	TRENCH PLUG
W18	THRUST BLOCKS - HORIZONTAL & VERTICAL DOWNWARD THRUST
W19	THRUST BLOCKS - VERTICAL UPWARD THRUST

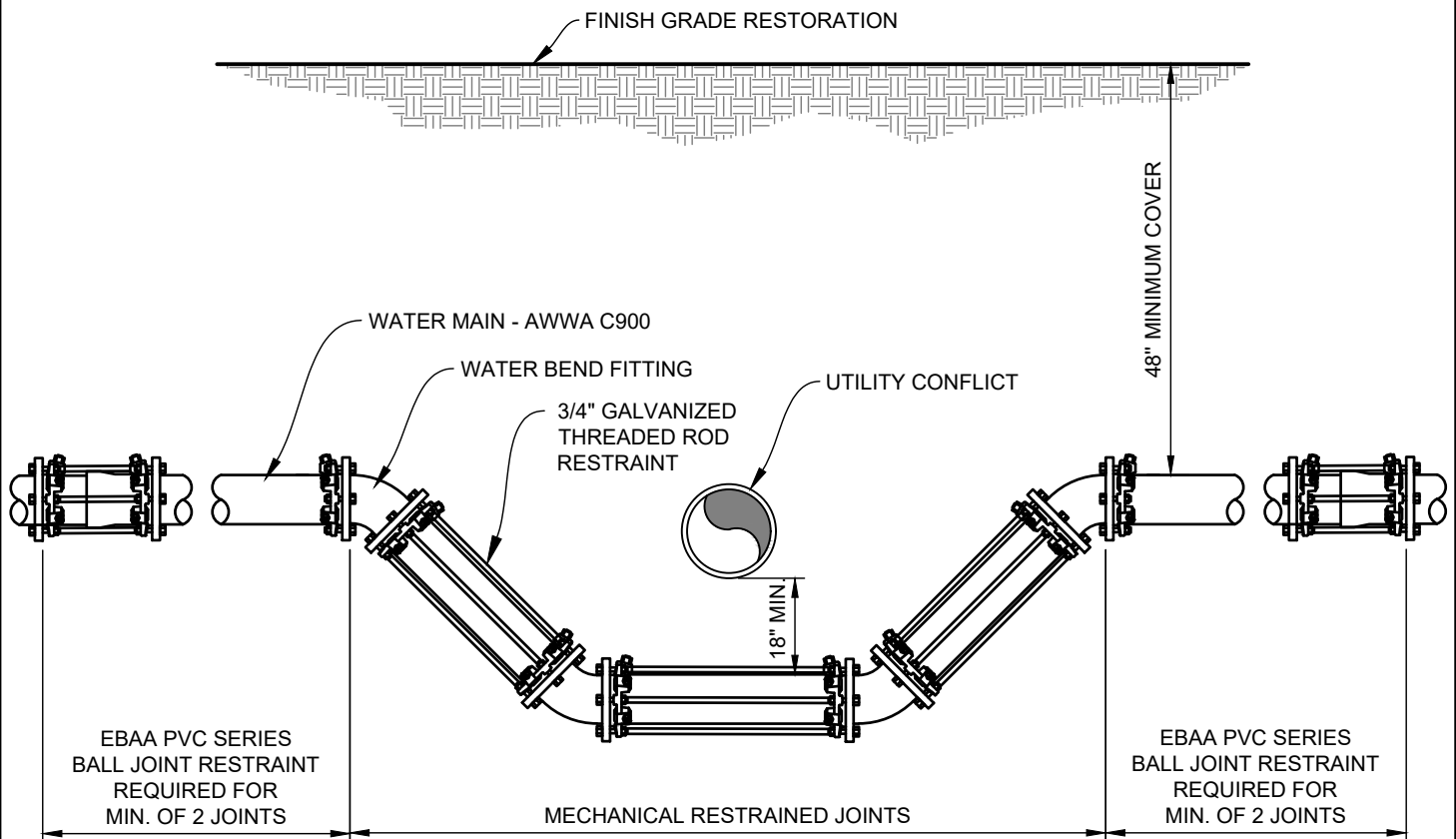
MATERIALS NOTE:

MANUFACTURERS AND MODEL NUMBERS INDICATED IN THE PROVIDED DETAILS ARE PREFERRED MATERIALS IN USE BY THE TOWN AND SHOULD BE CONSIDERED FOR FURNISH AND INSTALLATION BEFORE SUBSTITUTIONS ARE REQUESTED.

WATER METER NOTE:

WATER METERS SHALL BE PURCHASED THROUGH THE TOWN AND THEIR CURRENT SUPPLIER.

REVISIONS			
NO.	DESCRIPTION	DATE	BY



NOTE:
EBAA FITTINGS AND LENGTHS OF RESTRAINT SHALL BE VERIFIED USING THE
EBAA RESTRAINT LENGTH CALCULATOR AVAILABLE AT <http://rcp.ebaa.com/>.



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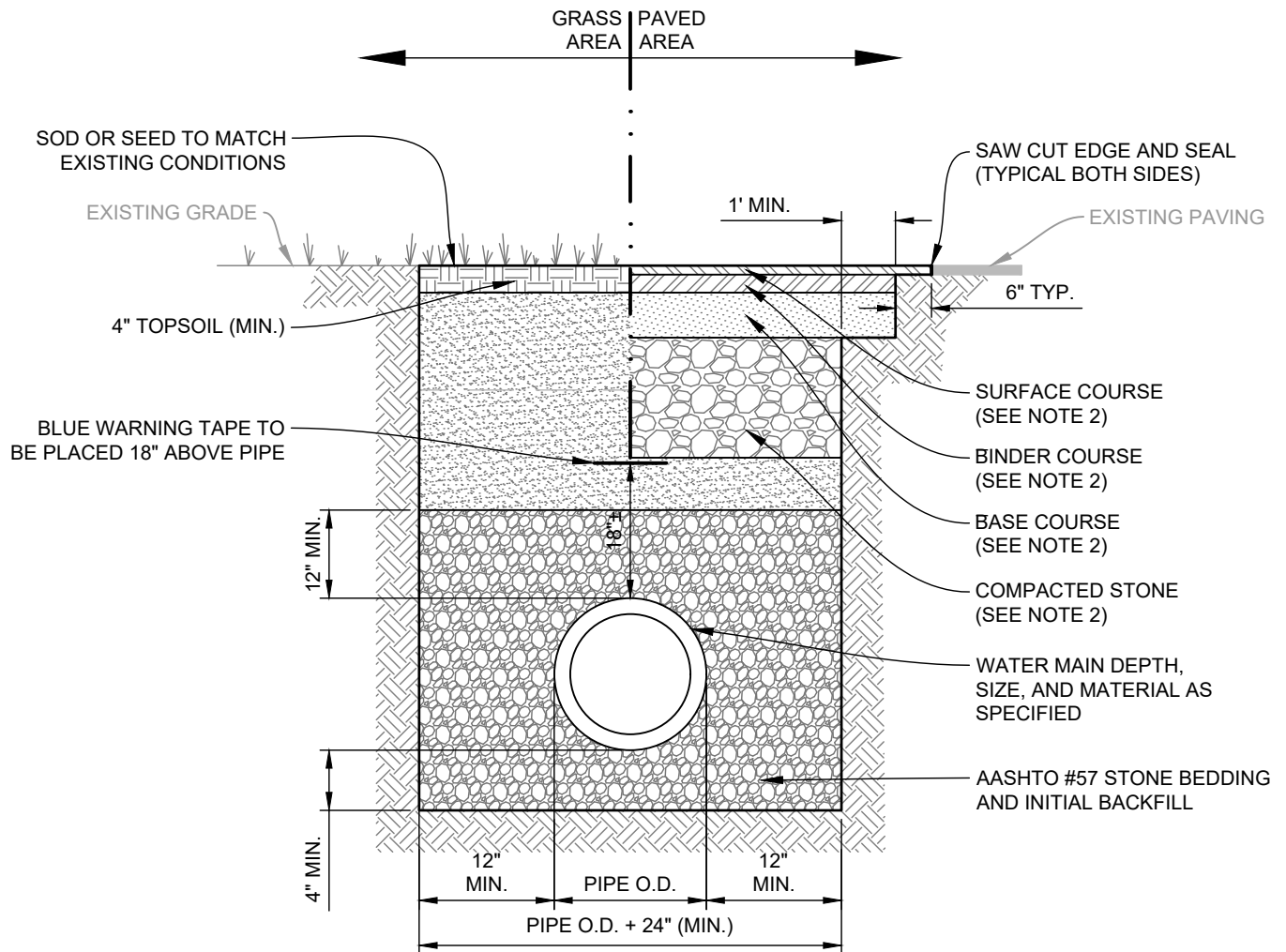
SPECIFICATIONS AND DETAILS

W1 WATER MAIN VERTICAL OFFSET AT UTILITY CONFLICT

TOWN OF MILTON
115 FEDERAL STREET
MILTON, DELAWARE 19868

ORIGINAL DATE	12/2021
LAST REVISED	
DRAWING SCALE	AS NOTED
DETAIL DRAWING	W1

REVISIONS			
NO.	DESCRIPTION	DATE	BY



NOTES:

1. AASHTO #57 STONE SHALL BE USED TO REPLACE ALL UNSUITABLE SUBGRADES.
2. ALL PAVEMENT COURSES AND SUBGRADES TO COMPLY WITH TOWN OF MILTON STANDARDS AND/OR DELDOT STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, LATEST EDITION.



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SPECIFICATIONS AND DETAILS

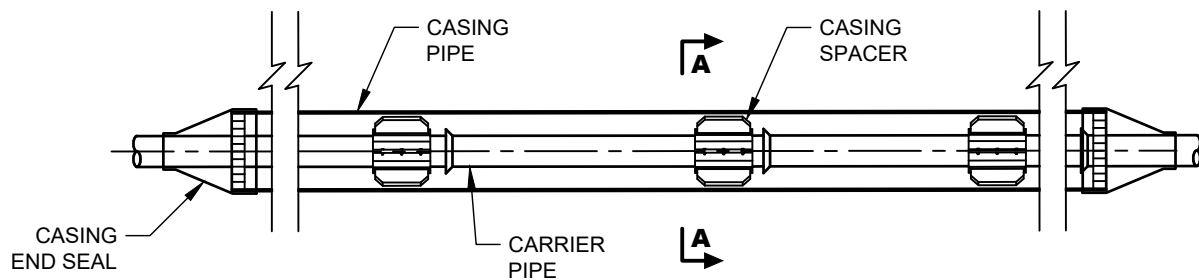
W2 WATER MAIN - BACKFILL & RESTORATION

TOWN OF MILTON
115 FEDERAL STREET
MILTON, DELAWARE 19968

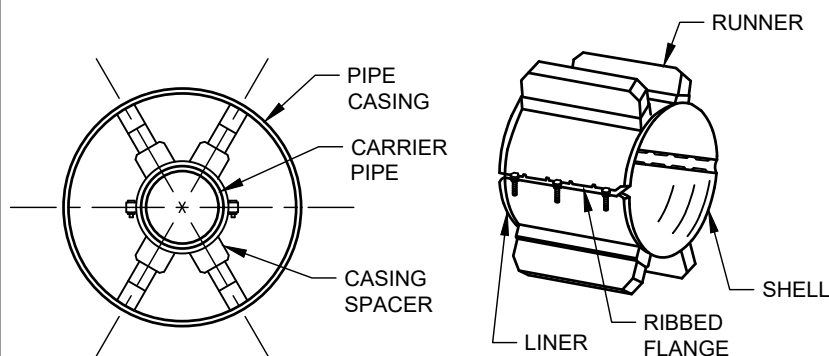
ORIGINAL DATE	12/2021
LAST REVISED	
DRAWING SCALE	AS NOTED
DETAIL DRAWING	

W2

REVISIONS			
NO.	DESCRIPTION	DATE	BY

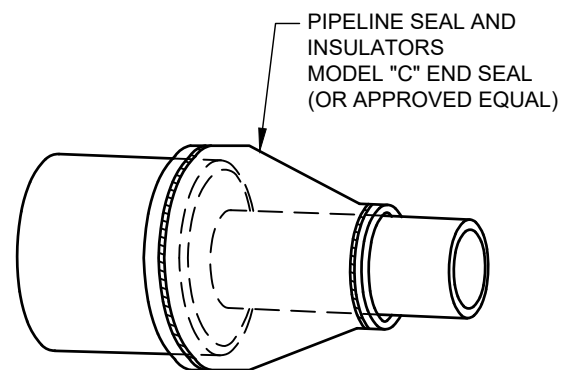


PLAN



SECTION A-A

SPACER



CASING END SEAL

CARRIER PIPE DIA. (IN)	CASING PIPE DIA. (IN)	CASING PIPE MIN. THICKNESS (IN)	NO. OF SPACERS PER 20 FT. LENGTH
4	12	.0375	3
6	16	.0375	3
8	18	0.375	3
12	22	.0375	3
16	28	.0375	3

STANDARD NUMBER OF RUNNERS REQUIRED:
 UP TO 14" CARRIER PIPE - 4 REQUIRED
 OVER 14" - 16" CARRIER PIPE - 6 REQUIRED

NOTES:

1. MINIMUM OD OF CASING PIPE SHALL ACCOMMODATE MAXIMUM OD OF CARRIER PIPE JOINTS AND/OR RESTRAINTS.
2. MINIMUM CASING PIPE DIAMETER AND THICKNESS SHALL BE PER TABLE UNLESS SPECIFIED BY ENGINEER.
3. IF CARRIER PIPE RESTRAINT IS REQUIRED, RESTRAINED CASING SPACERS SHALL BE USED.
4. GENERAL - ONE SPACER SHALL BE PLACED NOT MORE THAN TWO FEET FROM EACH END OF CASING. SUBSEQUENT SPACERS SHALL BE PLACED AT 6' TO 10' INTERVALS WITHIN THE CASING IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.
5. CARRIER PIPE SHALL BE CENTERED WITHIN CASING BY USE OF STAINLESS STEEL CASING SPACERS.



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SPECIFICATIONS AND DETAILS

W3 WATER MAIN - ENCASEMENT

TOWN OF MILTON
 115 FEDERAL STREET
 MILTON, DELAWARE 19968

ORIGINAL DATE 12/2021

LAST REVISED

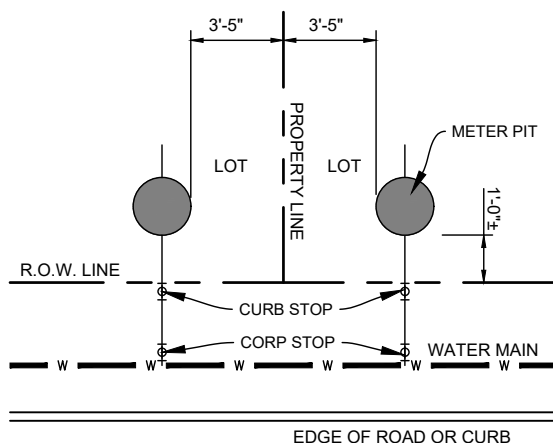
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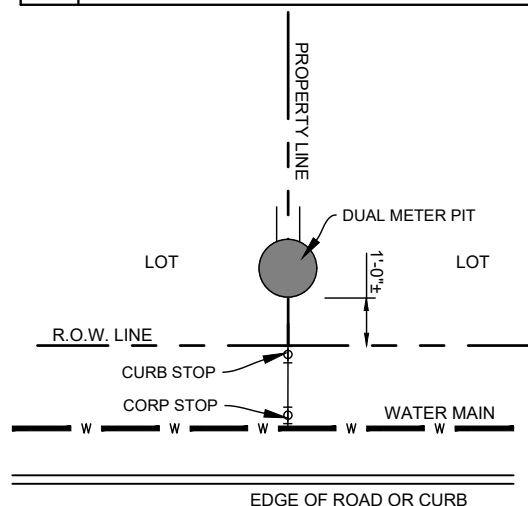
W3

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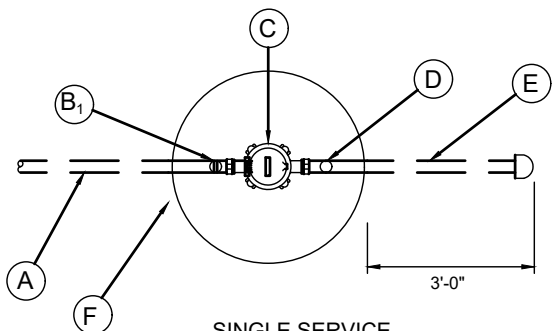
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NO.	DESCRIPTION	DATE	BY



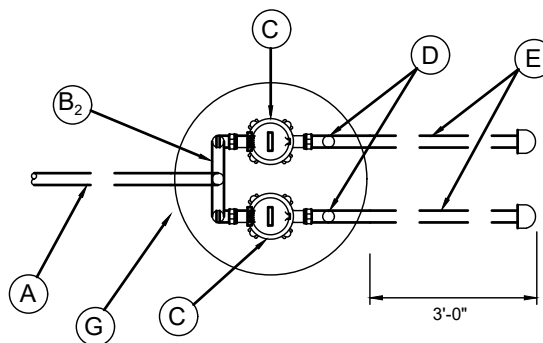
SINGLE SERVICE METER
PIT LOCATION



DOUBLE SERVICE METER
PIT LOCATION



SINGLE SERVICE
(TYPICAL INSTALLATION)
PLAN VIEW



DOUBLE SERVICE
(TYPICAL INSTALLATION)
PLAN VIEW

DESIGNATION	DESCRIPTION	MANUFACTURER	SERVICE TYPE	MODEL NUMBER
A	TUBING		SINGLE/DOUBLE	
B1	ANGLE BALL VALVE	A.Y. MCDONALD	SINGLE	
B2	BRANCH VALVE ASSEMBLY	A.Y. MCDONALD	DOUBLE	
C	METER	NEPTUNE	SINGLE/DOUBLE	E-CODER R900i
	METER	NEPTUNE	SINGLE/DOUBLE	E-CODER R900i
	METER	NEPTUNE	SINGLE/DOUBLE	E-CODER R900i
D	ANGLE DUAL CHECK	A.Y. MCDONALD	SINGLE/DOUBLE	
E	STUB PIPING		SINGLE/DOUBLE	
F	STANDARD METER BOX	DFW PLASTICS	SINGLE	
G	JUMBO METER BOX	DFW PLASTICS	DOUBLE	



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SPECIFICATIONS AND DETAILS

W4 METER PIT PLAN & LOCATION

TOWN OF MILTON
115 FEDERAL STREET
MILTON, DELAWARE 19968

ORIGINAL DATE 12/2021

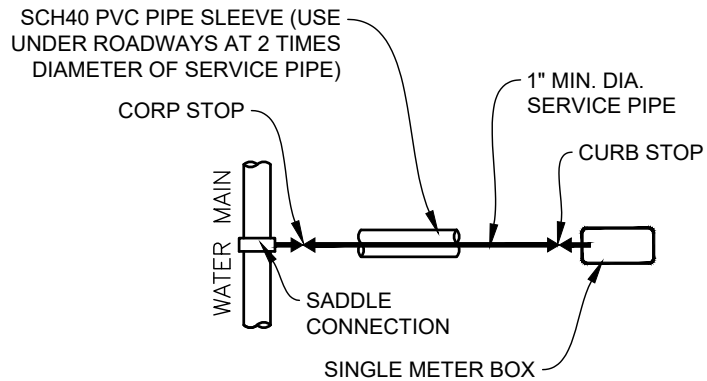
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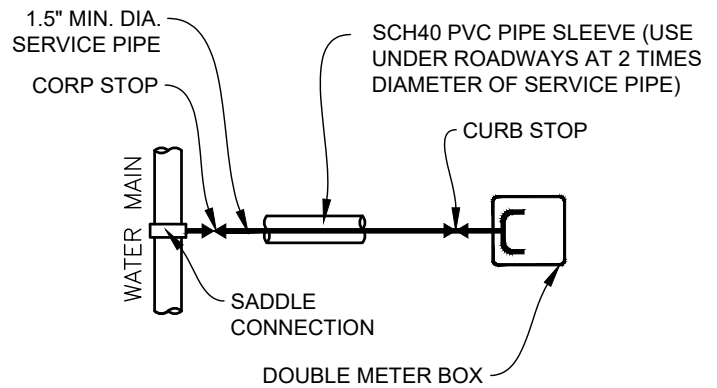
DETAIL DRAWING

W4

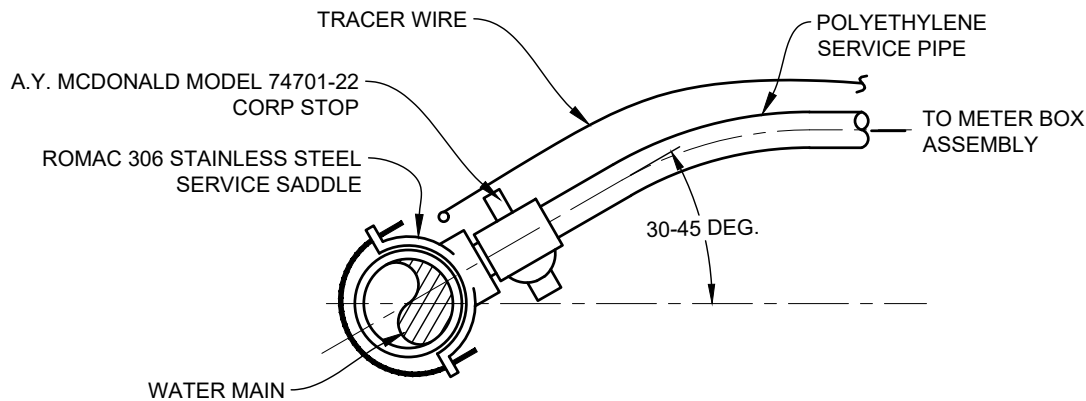
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SINGLE SERVICE



DOUBLE SERVICE



NOTES:

1. EXTEND TRACING WIRE INTO METER BOXES TO CURB STOP AND ATTACH TO PIPING FOR DOUBLE SERVICES, CONNECT TO ONE CURB STOP ONLY.

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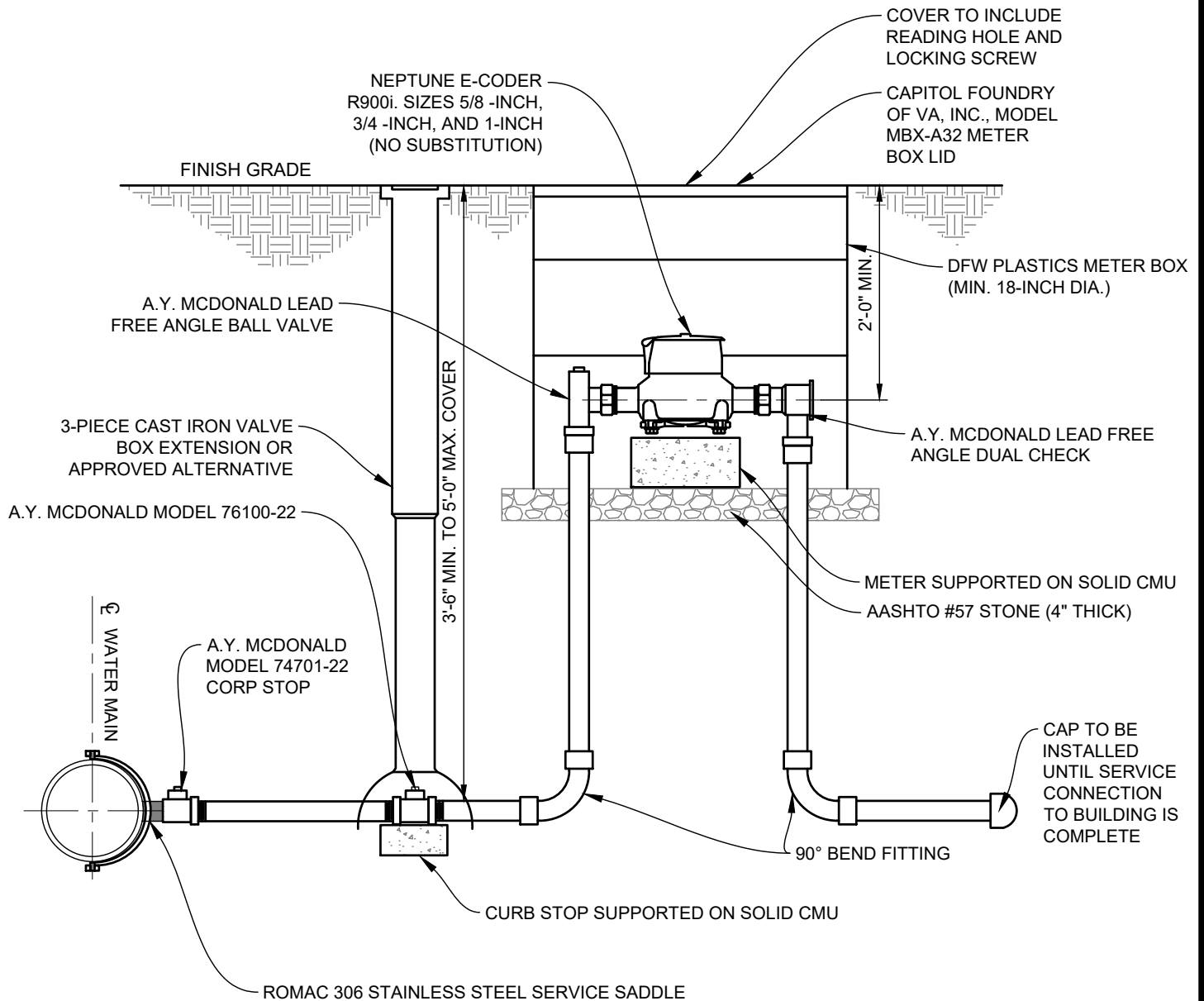
SPECIFICATIONS AND DETAILS

**W5 WATER SERVICE CONNECTION
 PROFILE**

TOWN OF MILTON
 115 FEDERAL STREET
 MILTON, DELAWARE 19868

ORIGINAL DATE	12/2021
LAST REVISED	
DRAWING SCALE	AS NOTED
DETAIL DRAWING	W5

REVISIONS			
NO.	DESCRIPTION	DATE	BY



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 PLOTTED: 12/16/2021 11:16:26 AM, BY: BRIAN MILLER, PLOTSTYLE: PENNONI NCS.STB, PROJECT STATUS: MATERIAL AND CONSTRUCTION DETAILS



PENNONI ASSOCIATES INC.
 18072 Davidson Drive
 Milton, DE 19968
 T 302.684.8030 F 302.684.8054



SPECIFICATIONS AND DETAILS

W6 METER SERVICE CONNECTION

TOWN OF MILTON
 115 FEDERAL STREET
 MILTON, DELAWARE 19868

ORIGINAL DATE 12/2021

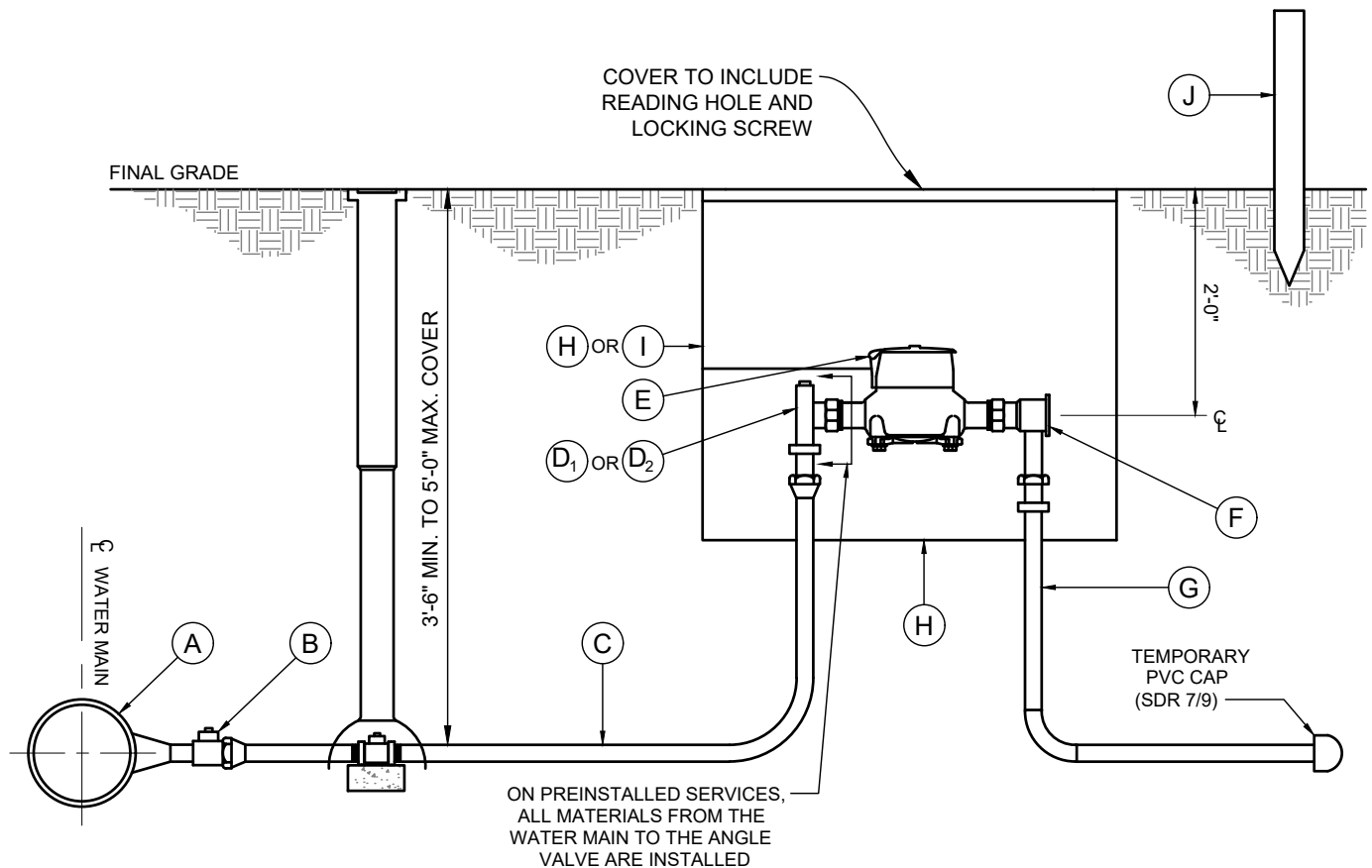
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DRAWING SCALE AS NOTED

DETAIL DRAWING

W6

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DESIGNATION	DESCRIPTION	MANUFACTURER	SERVICE TYPE	MODEL NUMBER	SIZE
A	SERVICE SADDLE	ROMAC	SINGLE/DOUBLE	ROMAC 306	4"
	SERVICE SADDLE	ROMAC	SINGLE/DOUBLE	ROMAC 306	6"
	SERVICE SADDLE	ROMAC	SINGLE/DOUBLE	ROMAC 306	8"
B	CORP. STOP	A.Y. MCDONALD	SINGLE/DOUBLE	74701-22	MATCH SIZE OF SERVICE PIPE
C	TUBING	-----	SINGLE/DOUBLE	POLYETHYLENE	
D1	ANGLE BALL VALVE	A.Y. MCDONALD	SINGLE	715-215WDPP 33X18	1" COMP. x 5/8" THRD.
D2	BRANCH VALVE ASSEMBLY	A.Y. MCDONALD	DOUBLE		1" COMP. x 5/8" THRD.
E	METER	NEPTUNE	SINGLE/DOUBLE	E-CODER R900i	5/8"
	METER	NEPTUNE	SINGLE/DOUBLE	E-CODER R900i	3/4"
	METER	NEPTUNE	SINGLE/DOUBLE	E-CODER R900i	1"
F	ANGLE DUAL CHECK	A.Y. MCDONALD	SINGLE	715-215WDPP 33X18	5/8" x 3/4" THRD.
G	STUB PIPING	-----	SINGLE/DOUBLE	POLYETHYLENE	
H	STANDARD METER BOX	DFW PLASTICS	SINGLE		SINGLE SERVICE
I	JUMBO METER BOX	DFW PLASTICS	DOUBLE		DOUBLE SERVICE
J	GROUND MARKER DEPICTING THE LOCATION OF THE END OF EACH STUB. THE GROUND MARKER IS TO BE A WOOD OR STEEL STAKE/SPIKE PAINTED BLUE TO CLEARLY MARK THE LOCATION OF THE STUB				



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SPECIFICATIONS AND DETAILS

W7 METER PIT DETAIL

TOWN OF MILTON
115 FEDERAL STREET
MILTON, DELAWARE 19868

ORIGINAL DATE 12/2021

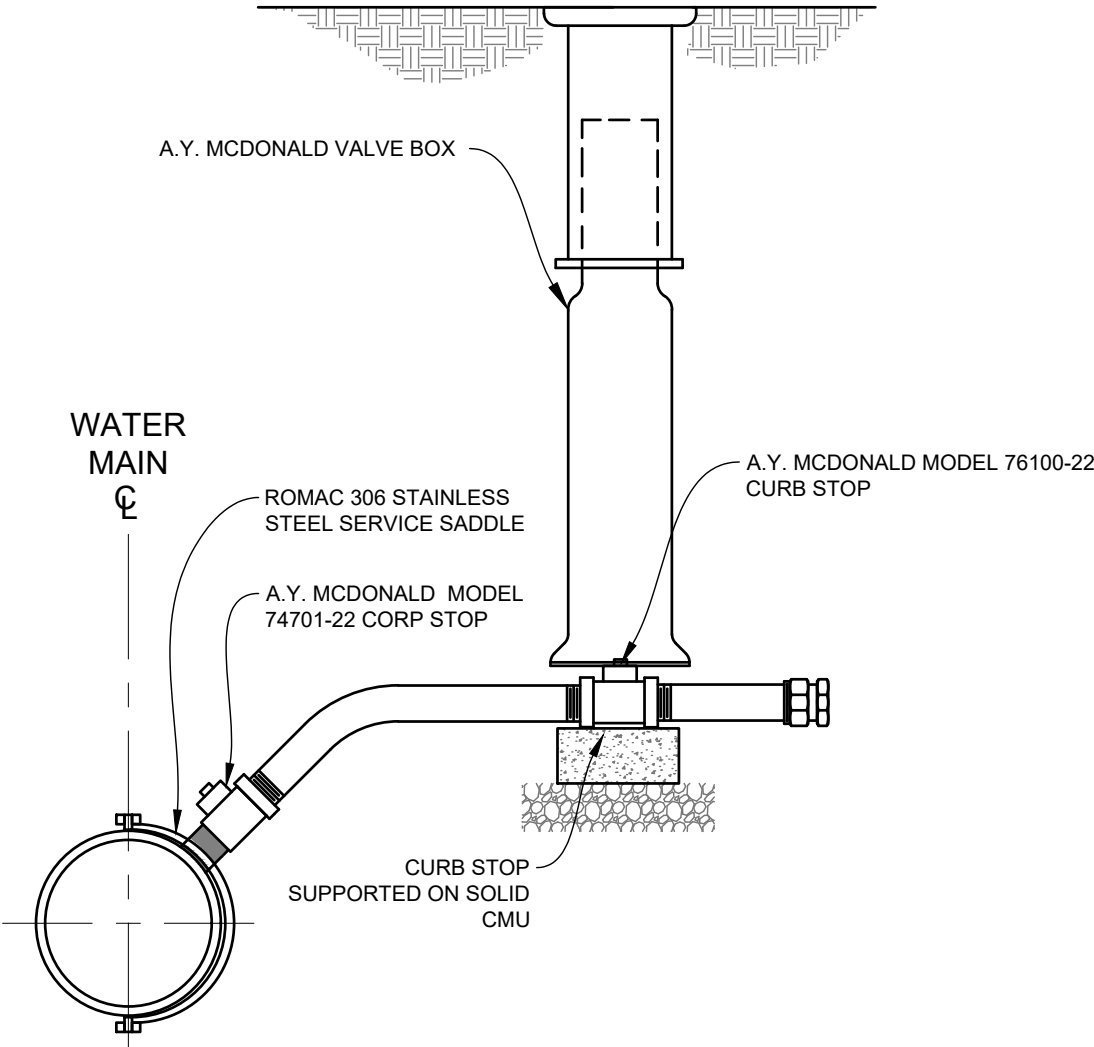
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W7

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SPECIFICATIONS AND DETAILS

W8 CURB STOP DETAIL

TOWN OF MILTON
 115 FEDERAL STREET
 MILTON, DELAWARE 19868

ORIGINAL DATE 12/2021

LAST REVISED

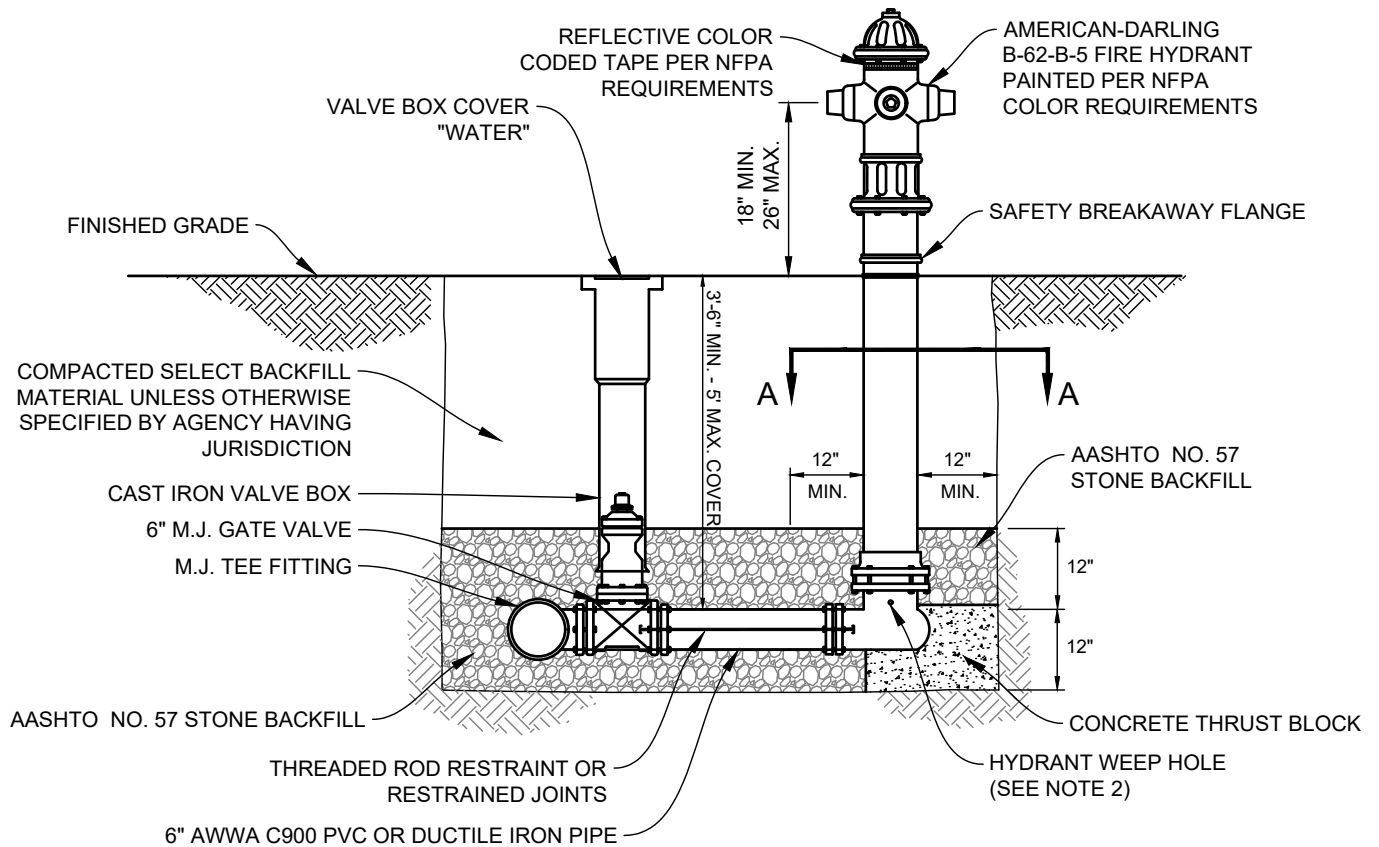
DRAWING SCALE AS NOTED

DETAIL DRAWING

W8

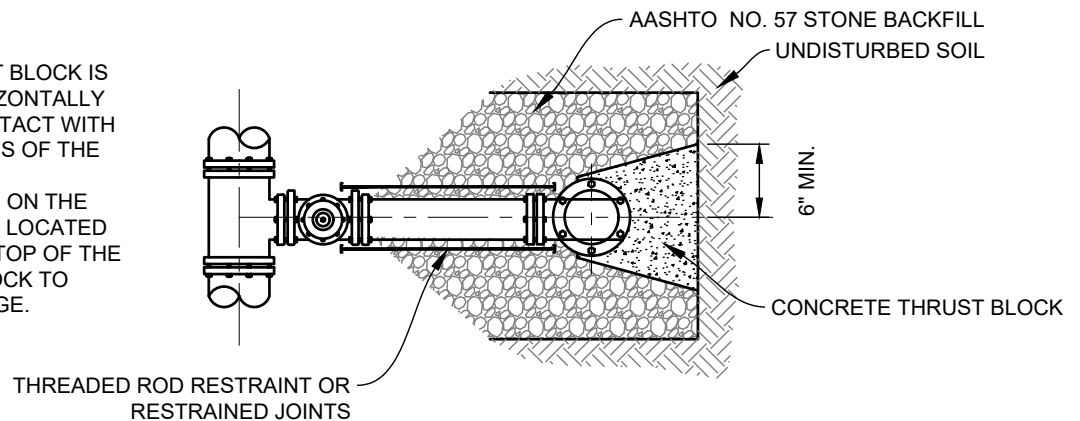
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NOTES:

1. THE CONCRETE THRUST BLOCK IS TO BE EXTENDED HORIZONTALLY UNTIL IT COMES IN CONTACT WITH THE UNDISTURBED SIDES OF THE TRENCH.
2. ALL WEEP/DRAIN HOLES ON THE FIRE HYDRANT MUST BE LOCATED AT LEAST 3" FROM THE TOP OF THE CONCRETE THRUST BLOCK TO MAINTAIN FREE DRAINAGE.



SECTION A-A



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SPECIFICATIONS AND DETAILS

W9 FIRE HYDRANT DETAIL

TOWN OF MILTON
115 FEDERAL STREET
MILTON, DELAWARE 19868

ORIGINAL DATE 12/2021

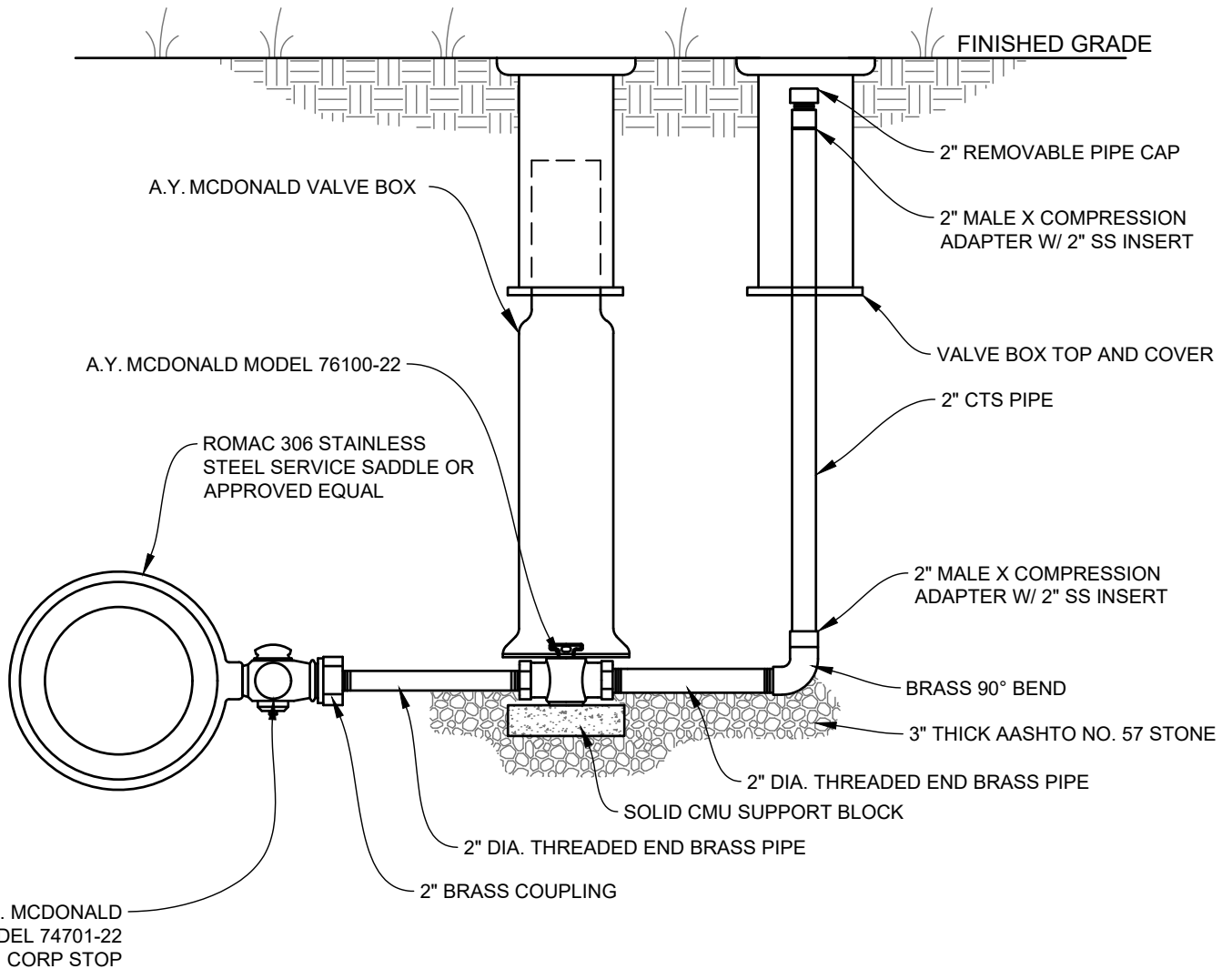
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DRAWING SCALE AS NOTED

DETAIL DRAWING

W9

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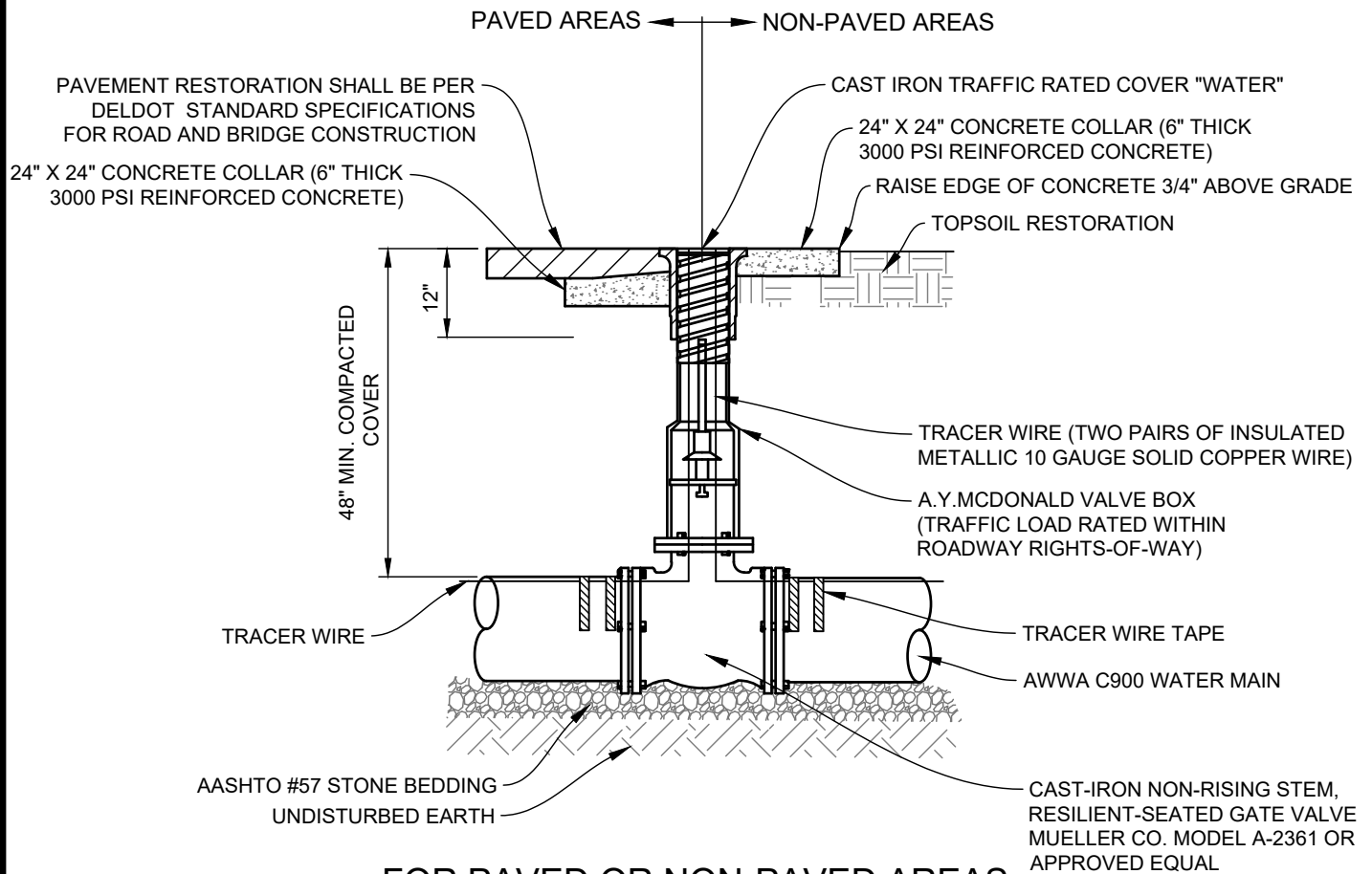
SPECIFICATIONS AND DETAILS

W10 2IN BLOW OFF DETAIL

TOWN OF MILTON
115 FEDERAL STREET
MILTON, DELAWARE 19868

ORIGINAL DATE	12/2021
LAST REVISED	
DRAWING SCALE	AS NOTED
DETAIL DRAWING	W10

REVISIONS			
NO.	DESCRIPTION	DATE	BY



FOR PAVED OR NON-PAVED AREAS

NOTES:

- EXTENSION ON VALVE BOX SHALL BE SET TO RESERVE 1/2 OF THE ADJUSTMENT LENGTH FOR FUTURE USE.
- PROVIDE EXTENSION TO HAVE OPERATING NUT WITHIN 12" OF FINISHED GRADE.
- VALVE EXTENSION SHALL BE MECHANICALLY ATTACHED AND SHALL HAVE A STAINLESS STEEL PIN AT THE VALVE AND SHEAR PIN ONLY AT THE OPERATING NUT.
- ALL PVC PIPE SHALL REQUIRE TWO PAIRS OF INSULATED METALLIC TRACER WIRES (10 GAUGE SOLID COPPER) TAPED WITH 2" WIDE DUCT TAPE TO TOP CENTERLINE OF THE PIPE AT EVERY JOINT AND AT FOUR ADDITIONAL EQUALLY SPACED POINTS PER LENGTH OF PIPE.
- TRACER WIRES SHALL TERMINATE 4" ABOVE VALVE BOX AND BE FOLDED BACK INSIDE BOX.
- TRACER WIRES SHALL BE CAPABLE OF DETECTION BY A CABLE LOCATOR AND PASS A FIELD CONDUCTIVITY TEST, OBSERVED BY TOWN OF MILTON, FROM END TO END OF WIRES.
- SPLICES SHALL BE CAPABLE OF COMPLETE SUBMERSION, SUCH AS BUTT SPLICE WITH RAYCHEM HEAT SHRINK TUBING.
- NO MORE THAN ONE SPLICE OF TRACER WIRES BETWEEN VALVES IS PERMITTED.



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SPECIFICATIONS AND DETAILS

W11 GATE VALVE DETAIL

TOWN OF MILTON
115 FEDERAL STREET
MILTON, DELAWARE 19968

ORIGINAL DATE 12/2021

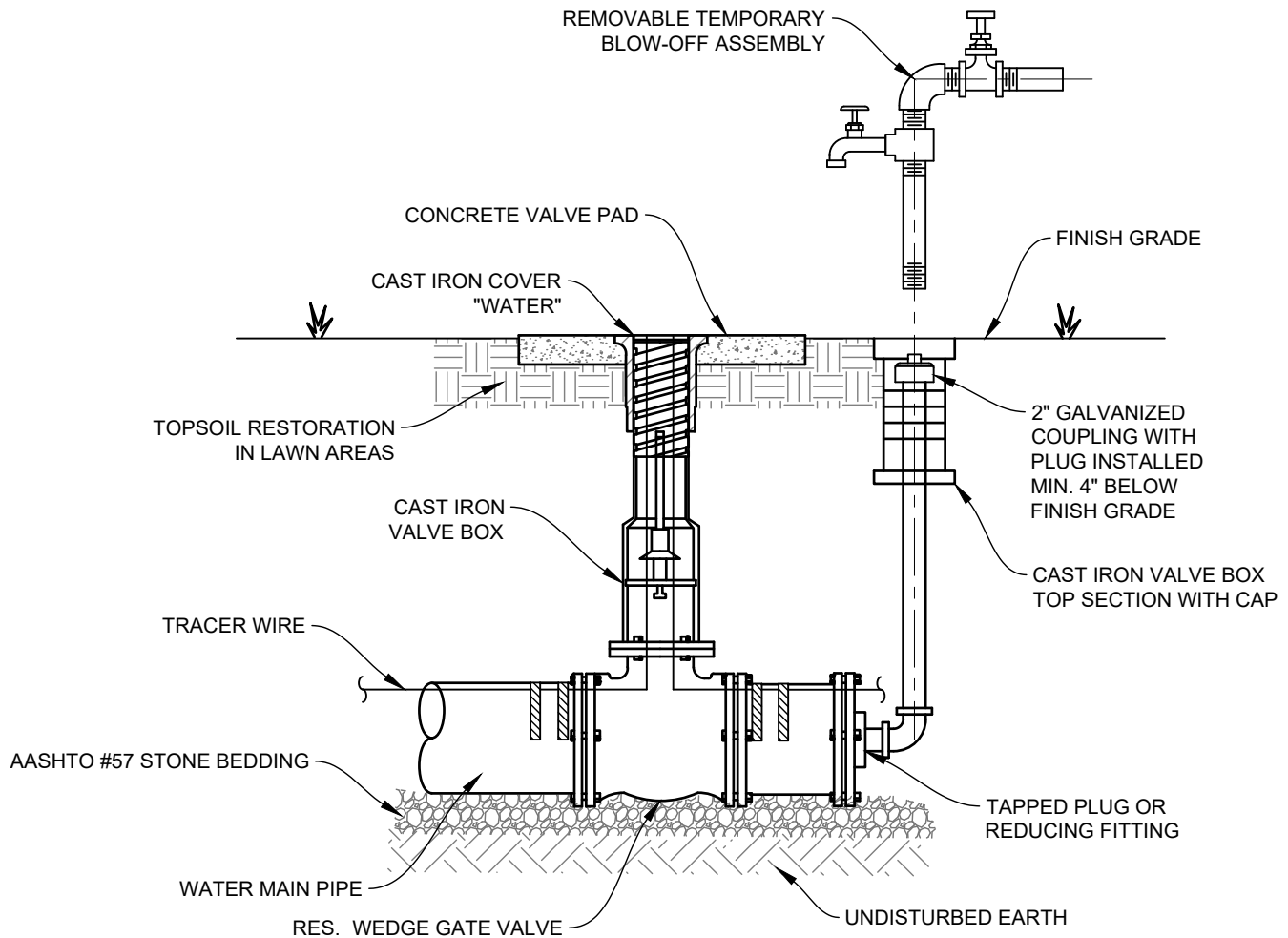
LAST REVISED

DRAWING SCALE AS NOTED

DETAIL DRAWING

W11

REVISIONS			
NO.	DESCRIPTION	DATE	BY



NOTES:

1. MECHANICAL JOINT UNDERGROUND PIPING SHALL BE RESTRAINED JOINT.
2. PROVIDE EXTENSION TO HAVE OPERATING NUT WITHIN 12" OF FINISHED GRADE.
3. VALVE EXTENSION SHALL BE MECHANICALLY ATTACHED AND SHALL HAVE A STAINLESS STEEL PIN AT THE VALVE AND SHEAR PIN ONLY AT THE OPERATING NUT.



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SPECIFICATIONS AND DETAILS

**W12 TERMINAL END BLOW OFF
DETAIL**

TOWN OF MILTON
115 FEDERAL STREET
MILTON, DELAWARE 19968

ORIGINAL DATE 12/2021

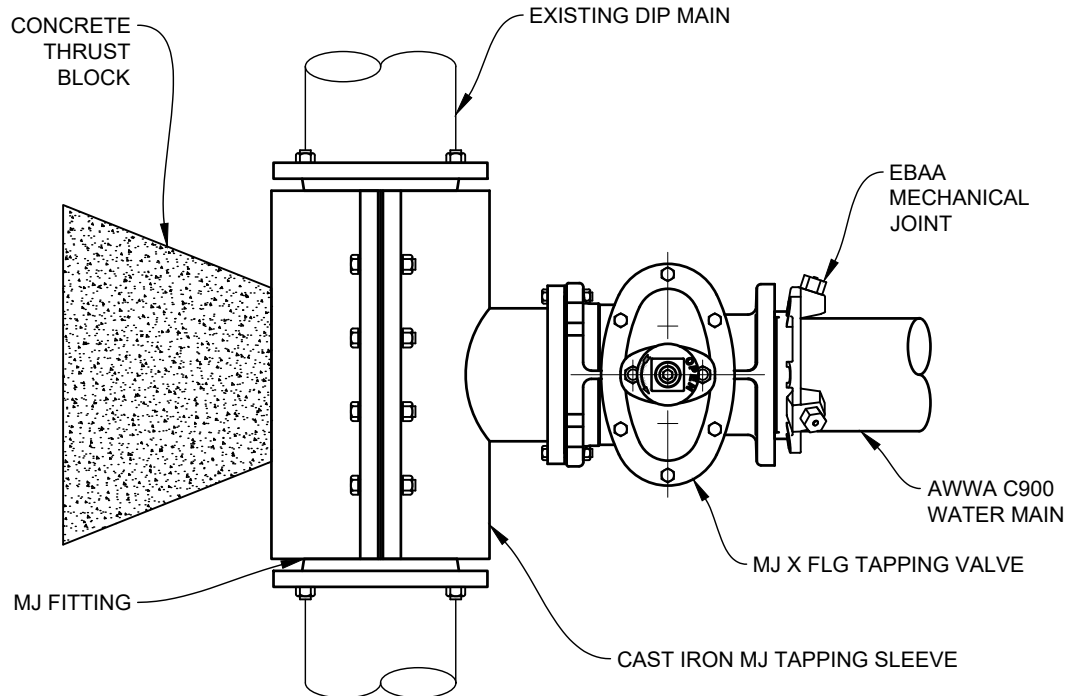
LAST REVISED

DRAWING SCALE AS NOTED

DETAIL DRAWING

W12

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NOTES:

1. TOWN OF MILTON MUST APPROVE ALL CONNECTIONS TO THE SYSTEM. WET TAPS SHALL BE COORDINATED WITH THE TOWN AND A REPRESENTATIVE SHALL BE ON SITE DURING TAP.
2. WET TAPPING DETAIL IS FOR USE ON DUCTILE IRON PIPE. ADJUSTMENTS MAY BE REQUIRED FOR PVC WATER MAINS.
3. PROVIDE THRUST BLOCKS OR RESTRAINTS PER TOWN DETAILS.
4. ALL VALVES SHALL OPEN IN THE COUNTERCLOCKWISE DIRECTION.
5. ALL TAPPING EQUIPMENT MUST BE DISINFECTED (CHLORINE MAY BE SWABBED ON INTERIOR OF ALL FITTINGS).



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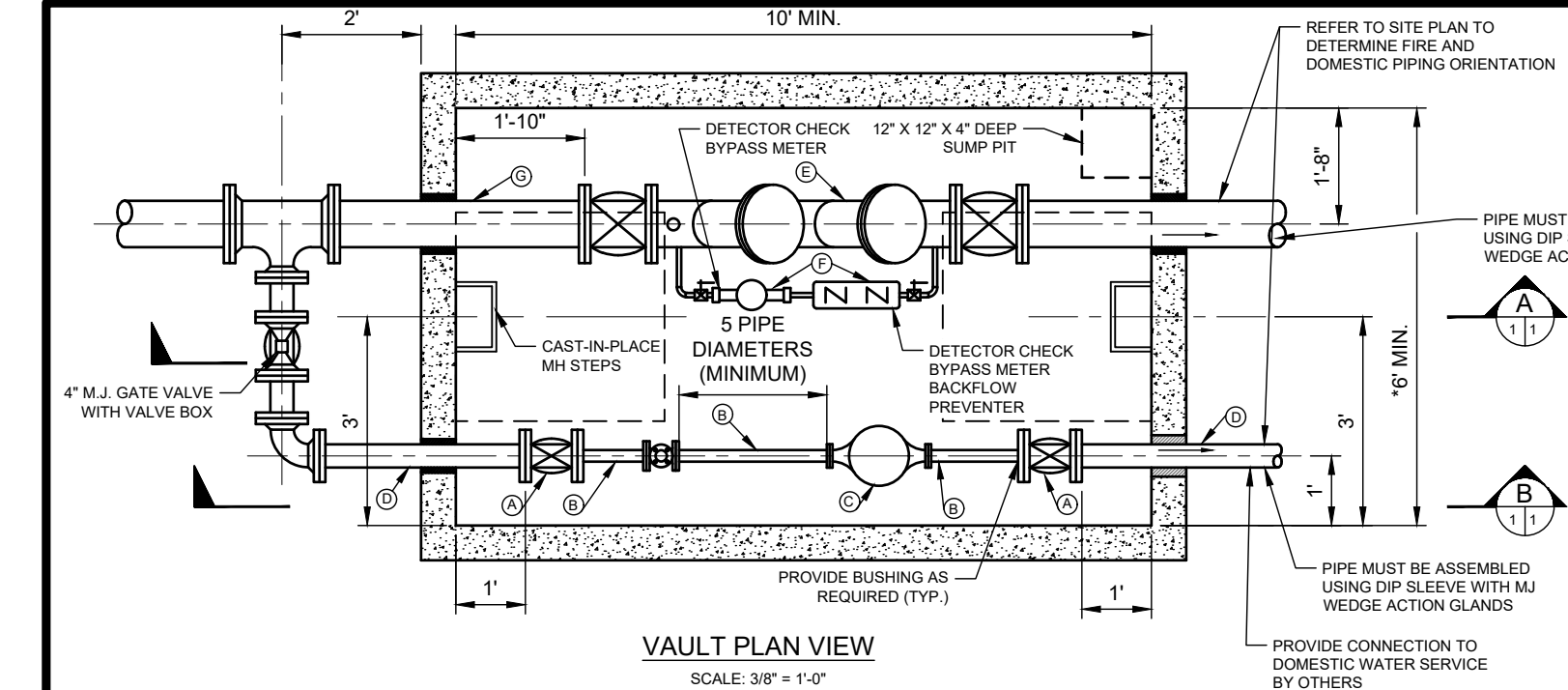


SPECIFICATIONS AND DETAILS

W13 WET TAP CONNECTION

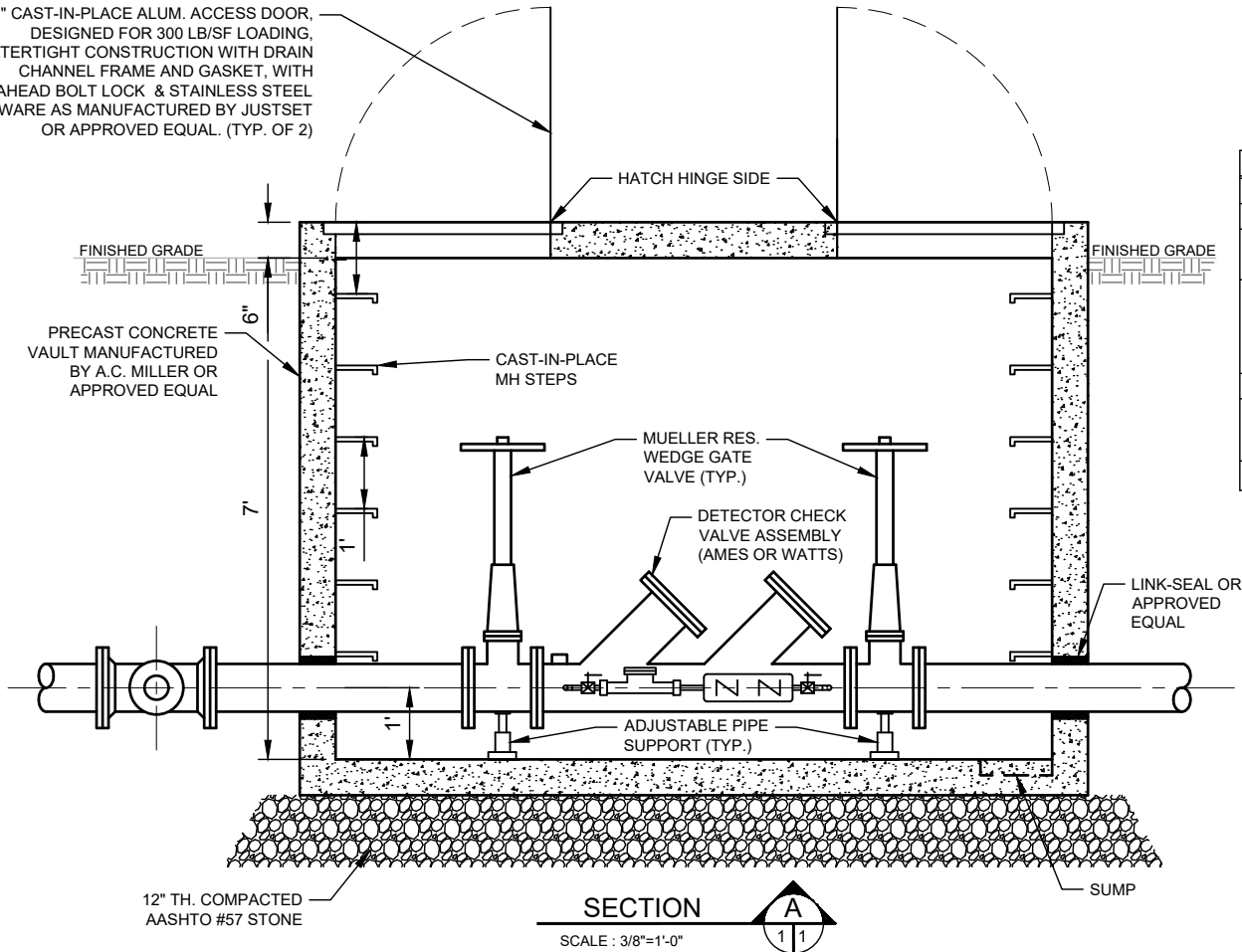
TOWN OF MILTON
115 FEDERAL STREET
MILTON, DELAWARE 19968

ORIGINAL DATE	12/2021
LAST REVISED	
DRAWING SCALE	AS NOTED
DETAIL DRAWING	W13



VAULT PLAN VIEW
SCALE: 3/8" = 1'-0"

36" x 36" CAST-IN-PLACE ALUM. ACCESS DOOR, DESIGNED FOR 300 LB/SF LOADING, WATERTIGHT CONSTRUCTION WITH DRAIN CHANNEL FRAME AND GASKET, WITH PENTAHEAD BOLT LOCK & STAINLESS STEEL HARDWARE AS MANUFACTURED BY JUSTSET OR APPROVED EQUAL. (TYP. OF 2)

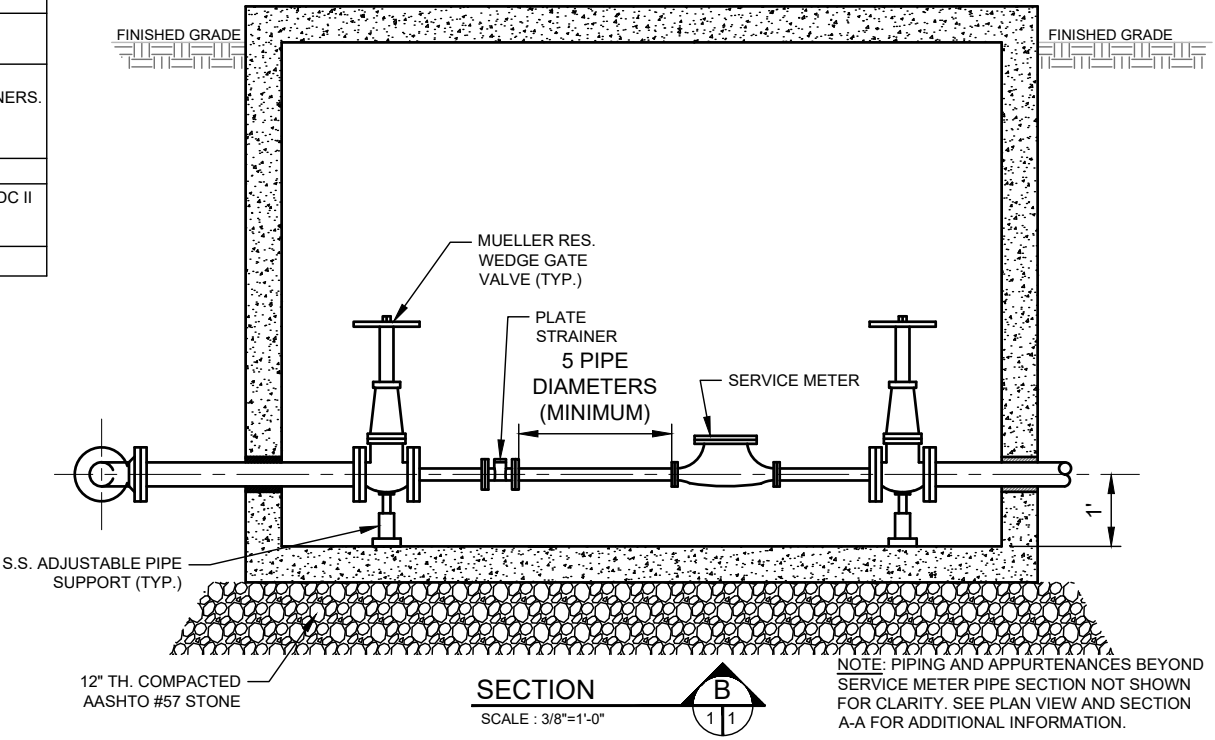


SECTION A-A
SCALE : 3/8"=1'-0"

MATERIAL LIST	
PART	
A	4" GATE VALVE, FLANGED ENDS
B	COMPANION FLANGE, SCH40 BRASS NIPPLE, METER COUPLING TO SUIT METER SIZE
C	NEPTUNE METER MODEL: 2", 3" & 4" METERS SHALL HAVE BRONZE PLATE STRAINERS. ALL METERS SHALL HAVE RADIO READ DEVICE PER FREDERICA STANDARDS.
D	4" DIP, FLANGED x PLAIN END
E	DETECTOR-DOUBLE CHECK VALVE, HERSEY MODEL DDC II OR AMES MODEL 3000 SS DOUBLE CHECK DETECTOR CHECK
F	NEPTUNE METER MODEL TO BE SELECTED BY TOWN

PIPE SIZE "G"	PIT SIZE		
	LENGTH	WIDTH	HEIGHT
6" FIRE SERVICE	10'-0"	6'-0"	7'-0"
8" FIRE SERVICE	10'-0"	6'-0"	7'-0"
10" FIRE SERVICE	10'-0"	8'-0"	7'-0"
12" FIRE SERVICE	10'-0"	8'-0"	7'-0"

- DRAINAGE NOTES:**
- A. POSITIVE DRAINAGE OF THE METER PIT SHALL BE PROVIDED AT ALL TIMES, THE OWNER SHALL SELECT ONE OF THE FOLLOWING METHODS, OR PRE-APPROVED EQUAL, TO PROVIDE REMOVAL OF WATER. IN THE EVENT THAT THE METHOD SELECTED BY THE OWNER DOES NOT PROVIDE POSITIVE DRAINAGE AT ALL TIMES, THEN A PRE-APPROVED ALTERNATIVE METHOD SHALL BE PROVIDED BY THE OWNER:
1. VERIFY THAT GROUND WATER ELEVATION IS BELOW BOTTOM OF METER PIT AT ALL TIMES AND THAT SUBSOIL WILL PROVIDE DRAINAGE, PROVIDE (2) 3" Ø HOLES THROUGH BOTTOM OF SUMP.
 2. PROVIDE GRAVITY DRAIN PIPE WITH CHECK VALVE TO STORM SEWER OR DRAINAGE SWALE.
 3. PROVIDE 120 VOLT SUBMERSIBLE PUMP WITH AUTOMATIC FLOAT CONTROL. 120 VOLT POWER SUPPLY SHALL HAVE GROUND FAULT PROTECTION DEVICE. PUMP OUTLET SHALL HAVE CHECK VALVE AND DISCHARGE TO STORM SEWER OR DRAINAGE SWALE.
- B. PROVIDE STEM EXTENSION WHERE BURIED VALVES ARE DEEPER THAN 3'-0" TO OPERATING NUT.
- CONSTRUCTION NOTES:**
1. CONTRACTOR SHALL FIELD VERIFY EXISTING CONDITIONS AND DIMENSIONS PRIOR TO ORDERING AND/OR FABRICATION OF ANY MATERIALS.
 2. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR INITIATING, MAINTAINING AND SUPERVISING ALL SAFETY PRECAUTIONS AND PROGRAMS IN CONNECTION WITH THE WORK.
 3. THE CONTRACTOR SHALL SUPERVISE AND DIRECT THE WORK. HE WILL BE SOLELY RESPONSIBLE FOR THE MEANS, METHODS, TECHNIQUES, SEQUENCES AND PROCEDURES OF CONSTRUCTION.
 4. CONTRACTOR SHALL PATCH, REPAIR AND FINISH ALL DAMAGED SURFACES CAUSED BY THE WORK, USING MATERIALS OF THE SAME KIND.
 5. FABRICATION AND INSTALLATION OF ALL MATERIALS, FINISHES, ETC. SHALL BE IN ACCORDANCE WITH MANUFACTURER'S WRITTEN INSTRUCTIONS.
 6. ALL CONSTRUCTION TO BE IN ACCORDANCE WITH LOCAL BUILDING CODES AND OSHA.
 7. CONTRACTOR SHALL FIELD VERIFY LOCATION OF ALL UTILITIES PRIOR TO CONSTRUCTION.
 8. ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH STANDARD SPECIFICATIONS AND DETAILS FOR UTILITY DESIGN AND CONSTRUCTION, LATEST REVISION.
 9. METER PITS SHALL BE PROVIDED WITH A SPOOL PIECE IN PLACE OF THE METER. ONCE THE CONTRACTOR SATISFACTORILY FLUSHES AND DISINFECTS ALL PIPING.
 10. THE DOMESTIC SERVICE LINE BETWEEN THE METER PIT AND THE BUILDING SHALL BE 4" DIAMETER DIP OR LARGER AS DETERMINED BY THE BUILDING DESIGN ENGINEER.
 11. THE DOMESTIC METER SIZE SHALL BE DETERMINED BY THE BUILDING DESIGN ENGINEER.
 12. THE FIRE SERVICE SIZE SHALL BE DETERMINED BY THE BUILDING DESIGN ENGINEER.



SECTION B-B
SCALE : 3/8"=1'-0"



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SPECIFICATIONS AND DETAILS

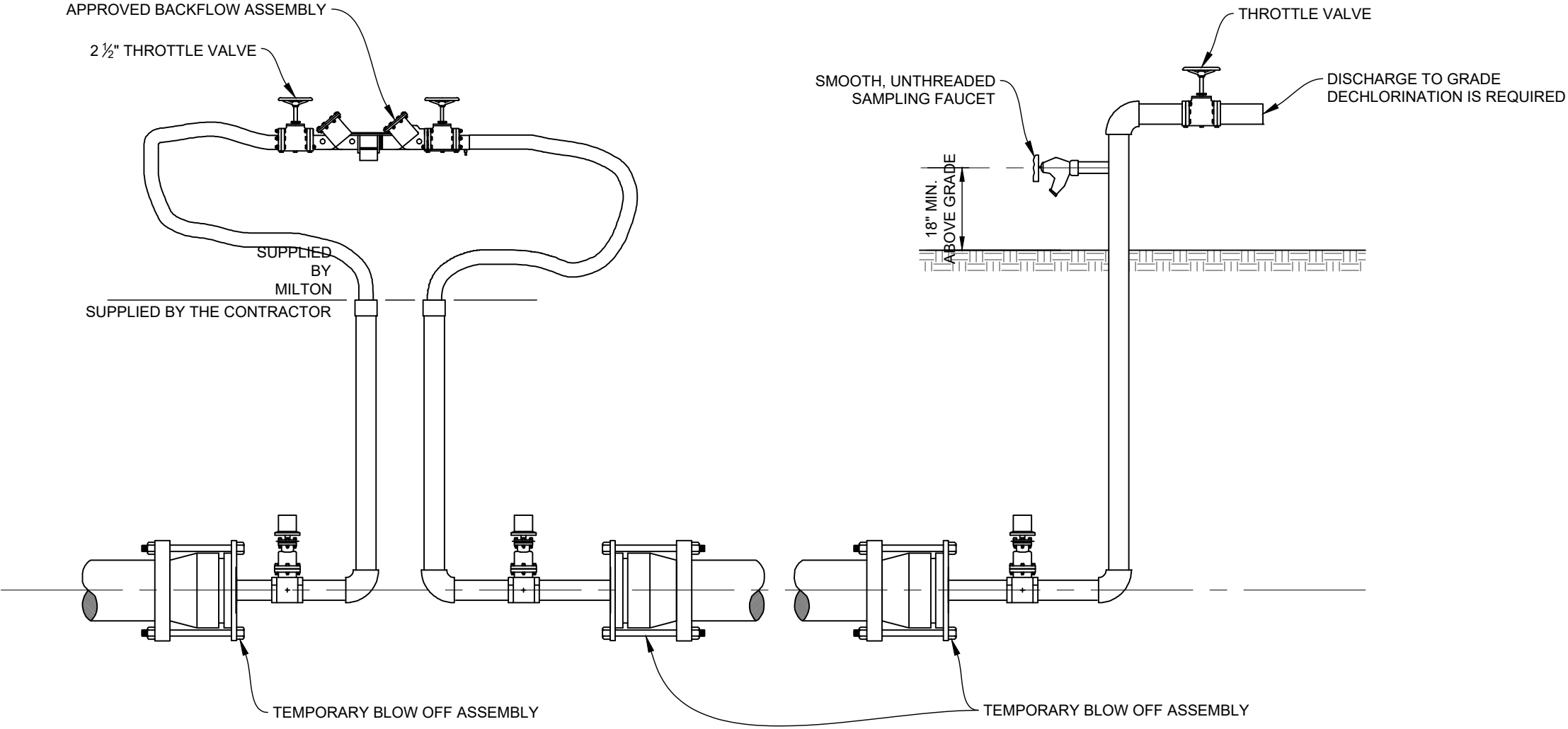
**W14 STANDARD COMMERCIAL
METER PIT**

TOWN OF MILTON
115 FEDERAL STREET
MILTON, DELAWARE 19868

ORIGINAL DATE	12/2021
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DRAWING SCALE	AS NOTED
DETAIL DRAWING	W14

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SPECIFICATIONS AND DETAILS

W15 WATER MAIN DISINFECTION

TOWN OF MILTON
115 FEDERAL STREET
MILTON, DELAWARE 19868

ORIGINAL DATE 12/2021

LAST REVISED

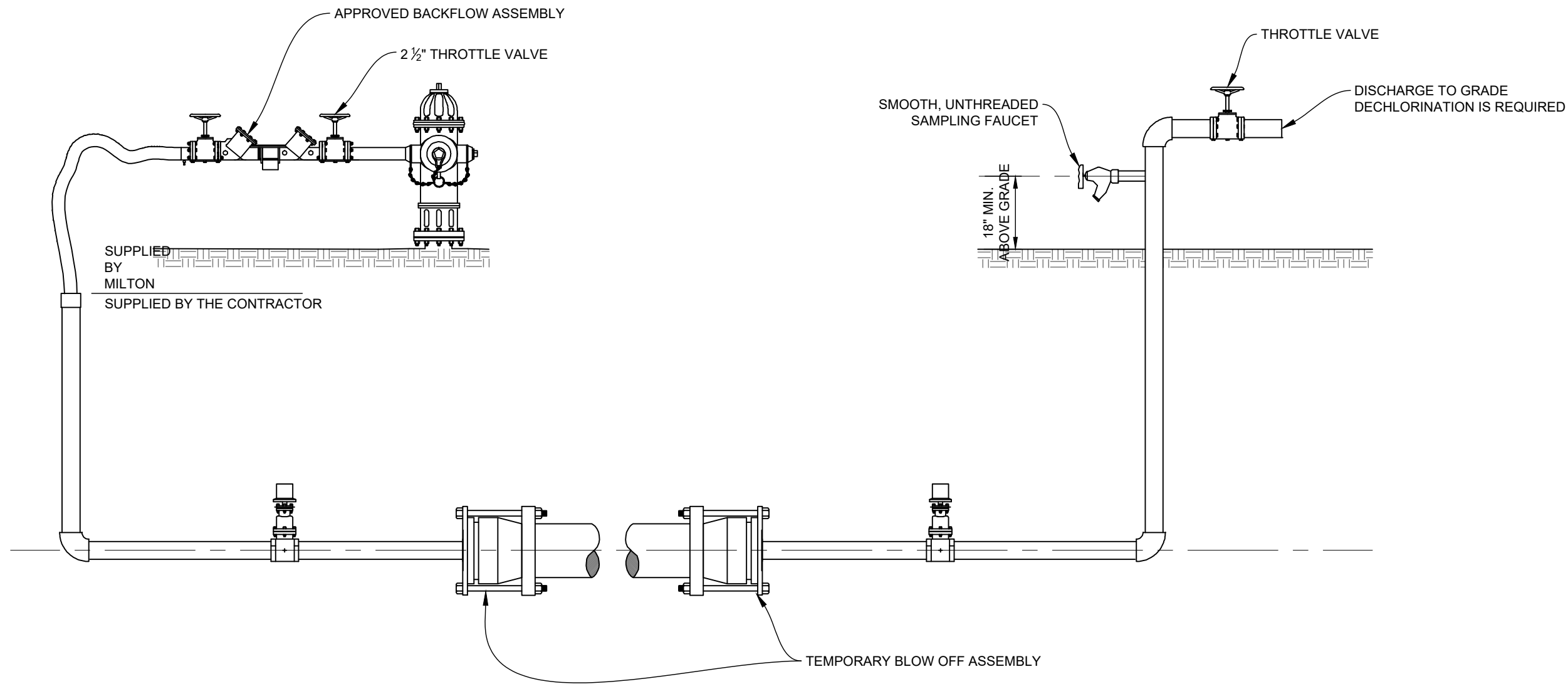
DRAWING SCALE AS NOTED

DETAIL DRAWING

W15

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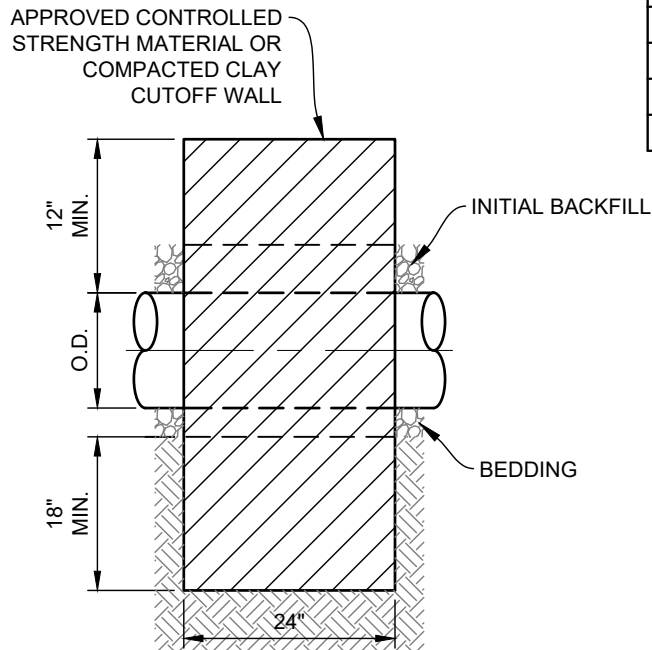
SPECIFICATIONS AND DETAILS

W16 WATER MAIN DISINFECTION

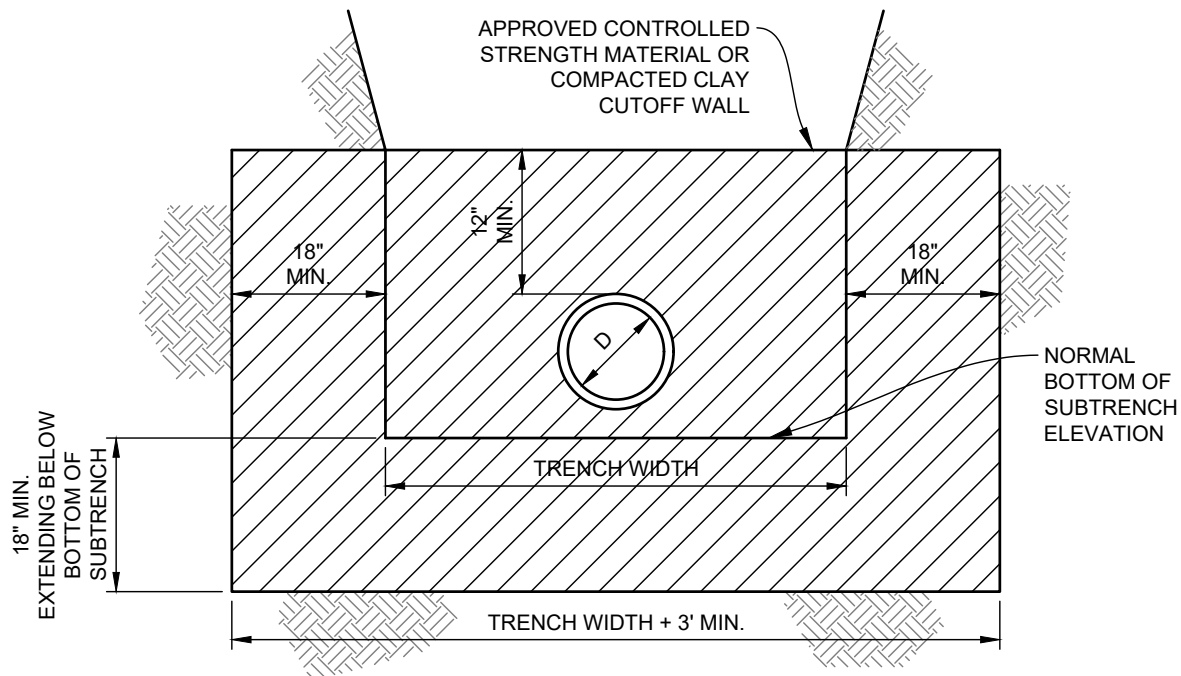
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115 FEDERAL STREET
MILTON, DELAWARE 19868

ORIGINAL DATE	12/2021
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DRAWING SCALE	AS NOTED
DETAIL DRAWING	W16

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TRENCH PLUG PROFILE



TRENCH PLUG SECTION

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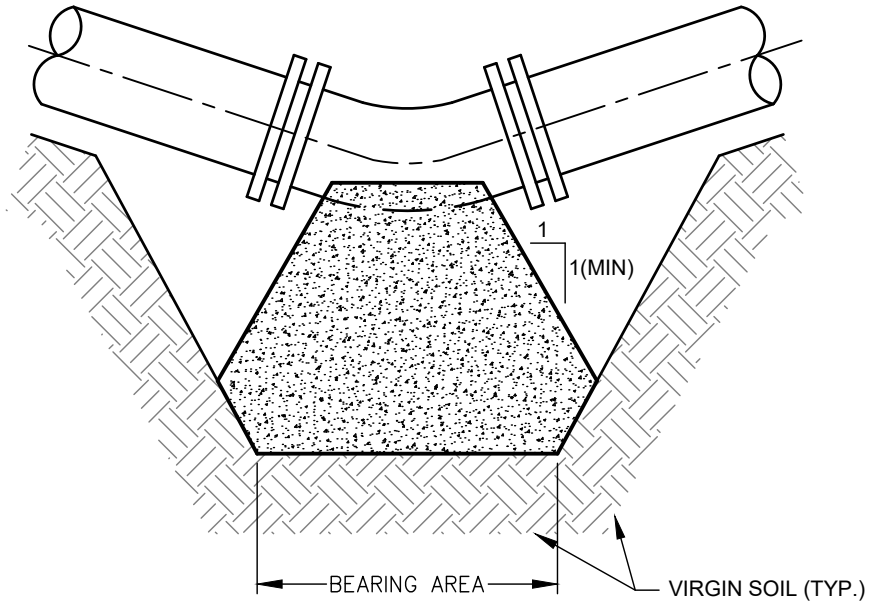
SPECIFICATIONS AND DETAILS

W17 TRENCH PLUG

TOWN OF MILTON
 115 FEDERAL STREET
 MILTON, DELAWARE 19868

ORIGINAL DATE	12/2021
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DETAIL DRAWING	W17

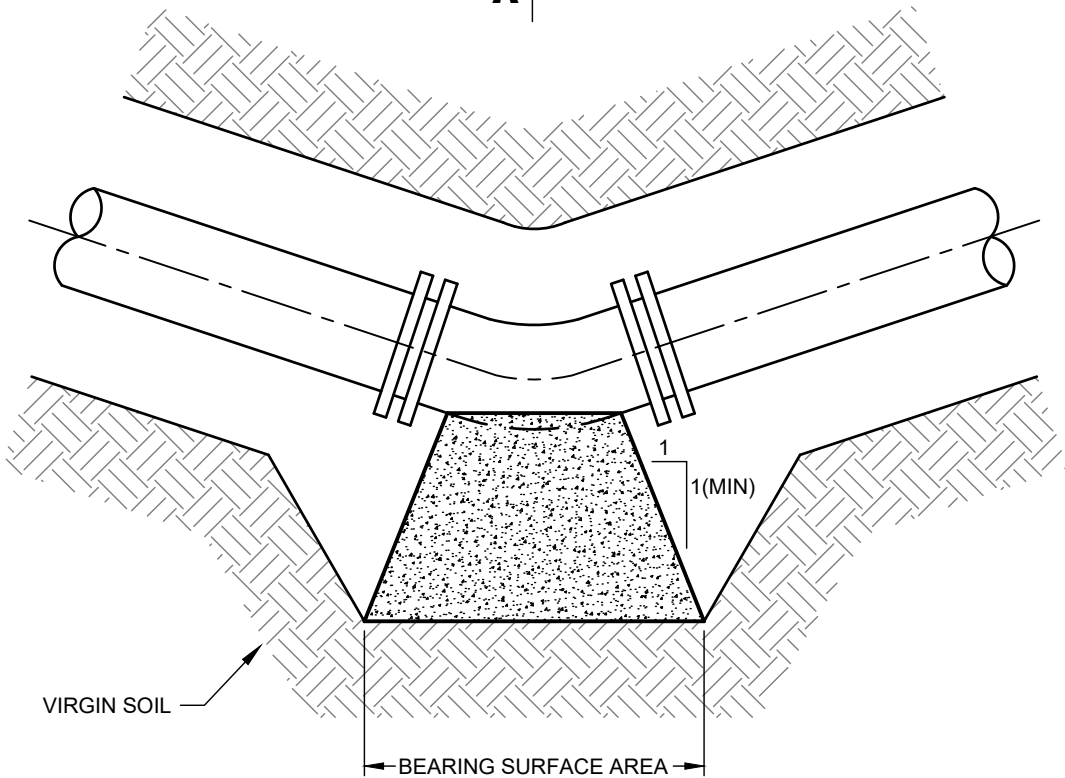
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ELEVATION

VERTICAL THRUST DOWNWARD

A'
A



A
A'

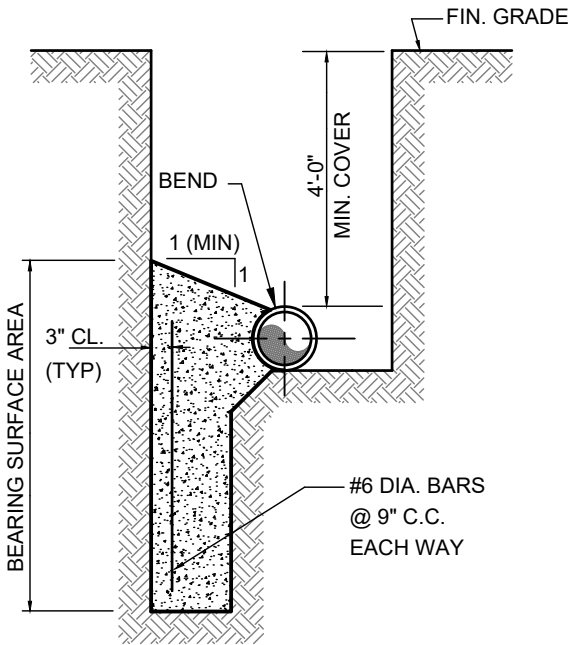
PLAN

HORIZONTAL THRUST

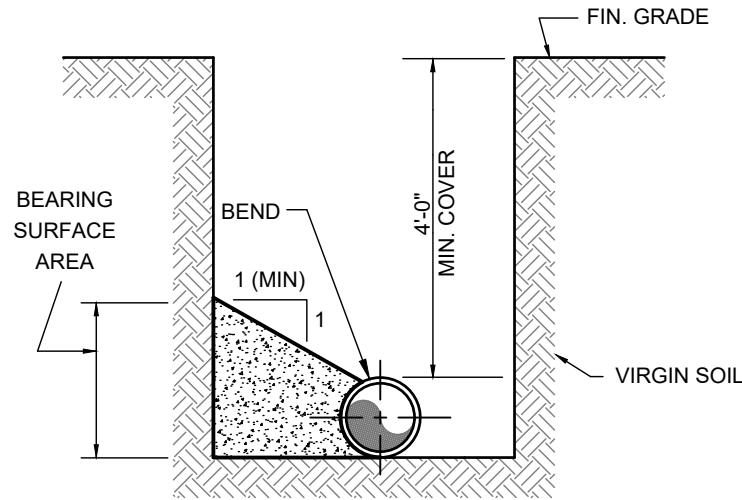
BEARING SURFACE REQUIRED - SQ. FT.
THRUST BLOCKING FOR HORIZONTAL AND VERTICAL DOWNWARD THRUSTS
*** 200 PSI WORKING PRESSURE**

PIPE SIZES		6" AND 8"				10" AND 12"				16", 18" AND 20"				24"			
TYPE OF BEARING MATERIAL	ALLOWABLE LOAD ** TON/SQ FT	DEGREE OF BEND OR DEFLECTION ***															
		22.5	45	90	D.E.	22.5	45	90	D.E.	22.5	45	90	D.E.	22.5	45	90	D.E.
SAND	0.75	6.8	12.0	22.0	14.7	13.4	25.6	46.8	32.5	35.2	69.1	127.6	90.3	52.2	99.5	183.9	130.1
SOFT CLAY	1	5.2	9.2	16.4	11.1	10.0	19.2	35.0	24.4	26.4	51.8	95.7	68.0	39.2	74.7	137.9	97.5
SAND & GRAVEL	2	2.6	4.6	8.2	5.5	5.0	9.6	17.6	12.2	13.2	25.9	47.9	33.9	19.6	37.3	69.0	48.8
CLAY	4	2.0	2.4	4.2	2.8	2.6	4.8	8.8	6.1	6.6	13.0	23.9	16.9	9.8	18.7	34.5	24.4
SOFT ROCK	5	2.0	2.0	3.3	2.2	2.0	3.8	7.0	5.0	5.3	10.4	19.1	13.5	7.8	14.9	27.6	19.5
ROCK	15	2.0	2.0	2.0	0.8	2.0	2.0	2.4	1.6	2.0	3.5	6.4	4.5	2.6	5.0	9.2	6.5

NOTES: * MUST BE ADJUSTED FOR TEST PRESSURES ABOVE 200 P.S.I.
** SOIL TESTING AGENCY TO ESTABLISH ALLOWABLE BEARING PRESSURE BASED ON FIELD CONDITIONS. AND BEARING AREAS ARE TO BE ADJUSTED ACCORDINGLY. (ALLOWANCES MUST BE MADE FOR SATURATED SOILS.)
*** D.E. DENOTES DEAD END AND APPLIES AT TEES AND PLUGS.



SECTION A-A'



SECTION A-A

SPECIFICATIONS AND DETAILS

W18 THRUST BLOCKS -
HORIZONTAL & VERTICAL
DOWNWARD THRUST

TOWN OF MILTON
115 FEDERAL STREET
MILTON, DELAWARE 19868

REVISIONS			
NO.	DESCRIPTION	DATE	BY

NOTES:

1. CONCRETE TO HAVE 3,000 P.S.I. MINIMUM 28 DAY COMPRESSIVE STRENGTH.
2. REINFORCING STEEL TO BE ASTM A-615, GRADE 60
3. COVER ALL FITTINGS AND JOINTS WITH POLYETHYLENE FILM BEFORE PLACING CONCRETE
4. COAT ALL EXPOSED FERROUS SURFACES WITH TWO COATS EPOXY, APPLIED PER MFG'S RECOMMENDATIONS.
5. CONCRETE MUST BEAR AGAINST VIRGIN SOIL.
6. KEEP CONCRETE CLEAR OF JOINTS AND LUGS.
7. FORM UNSUPPORTED AREAS OF CONCRETE.



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A
A'

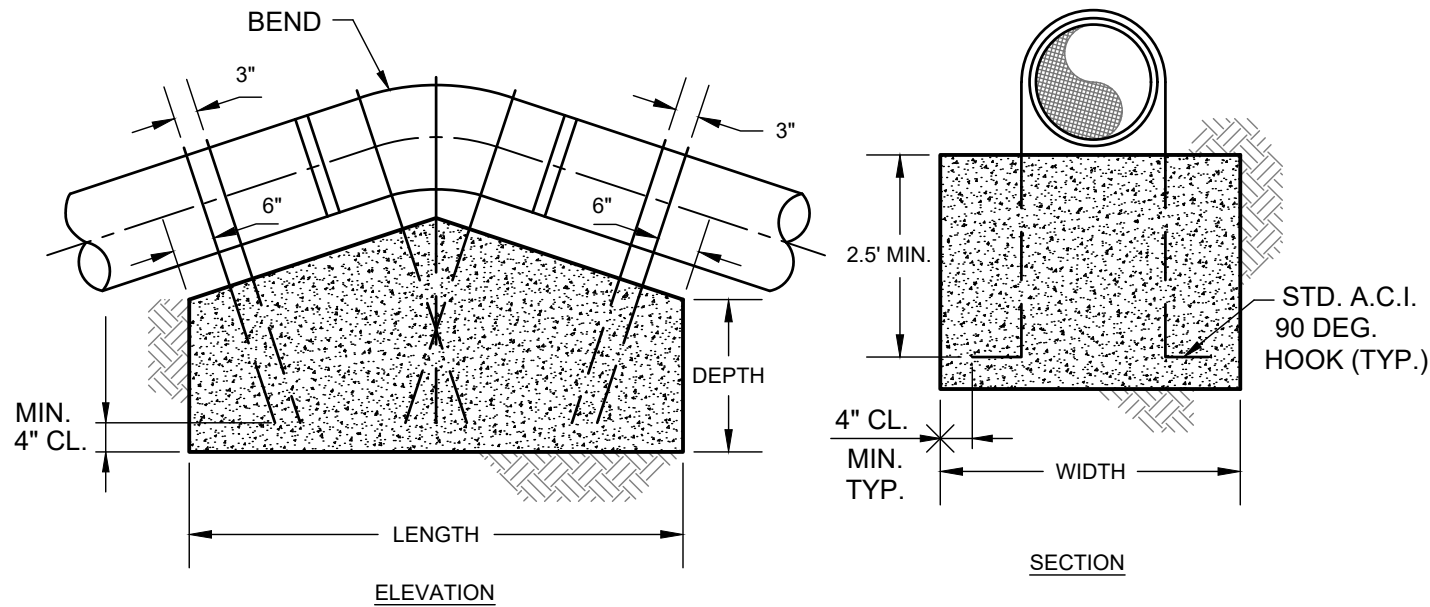
PLAN

HORIZONTAL THRUST

ORIGINAL DATE	12/2021
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DRAWING SCALE	AS NOTED
DETAIL DRAWING	

W18

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NO.	DESCRIPTION	DATE	BY



- NOTES:
1. FOR 4" AND 6" PIPE, USE THREE # 4 BARS OVER FITTING ONLY.
 2. FOR 8" THROUGH 20" PIPE, USE SIX # 6 BARS WITH TWO OVER FITTINGS AND FOUR OVER PIPES.
 3. FOR 24" PIPE, USE SEVEN # 7 BARS AS SHOWN.
 4. CONCRETE TO HAVE 3,000 P.S.I. MINIMUM 28 DAY COMPRESSIVE STRENGTH.
 5. REINFORCING STEEL TO BE ASTM A-615, GRADE 60
 6. COVER ALL FITTINGS AND JOINTS WITH POLYETHYLENE FILM BEFORE PLACING CONCRETE
 7. COAT ALL EXPOSED FERROUS SURFACES WITH TWO COATS BITUMASTIC, APPLIED PER MFG'S RECOMMENDATIONS.
 8. BEND REINFORCING BARS TO U SHAPE CONFORMING TO OUTSIDE PIPE DIAMETER.
 9. KEEP CONCRETE CLEAR OF JOINTS AND LUGS.
 10. FORM UNSUPPORTED AREAS OF CONCRETE.

**MINIMUM THRUST BLOCKING DIMENSIONS *
FOR VERTICAL UPWARD THRUST
200 P.S.I. TEST PRESSURE**

PIPE SIZES (IN.)	DEGREE OF BEND OR DEFLECTION								
	11.25	22.5	45	11.25	22.5	45	11.25	22.5	45
	LENGTH (FT.)			WIDTH (FT.)			DEPTH (FT.)		
6-8	4.0	4.5	6.5	3.0	4.0	4.5	3.0	4.0	5.0
10-12	4.5	5.0	8.0	4.0	5.0	5.5	4.0	6.0	6.0
14-16	5.5	8.0	11.5	5.0	6.0	6.5	5.0	5.5	6.5
18-20	6.0	7.5	13.0	6.0	7.0	7.5	5.0	7.0	7.5
24	6.5	10.0	14.0	6.5	8.0	9.5	6.5	7.0	8.0

* ALLOWANCES MUST BE MADE FOR SATURATED SOILS AND SIZES ADJUSTED ACCORDINGLY.



PENNONI ASSOCIATES INC.
18072 Davidson Drive
Milton, DE 19968
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SPECIFICATIONS AND DETAILS

**W19 THRUST BLOCKS - VERTICAL
UPWARD THRUST**

TOWN OF MILTON
115 FEDERAL STREET
MILTON, DELAWARE 19868

ORIGINAL DATE 12/2021

LAST REVISED

DRAWING SCALE AS NOTED

DETAIL DRAWING

W19



Standard Specifications and Details

Appendix B Street Sections

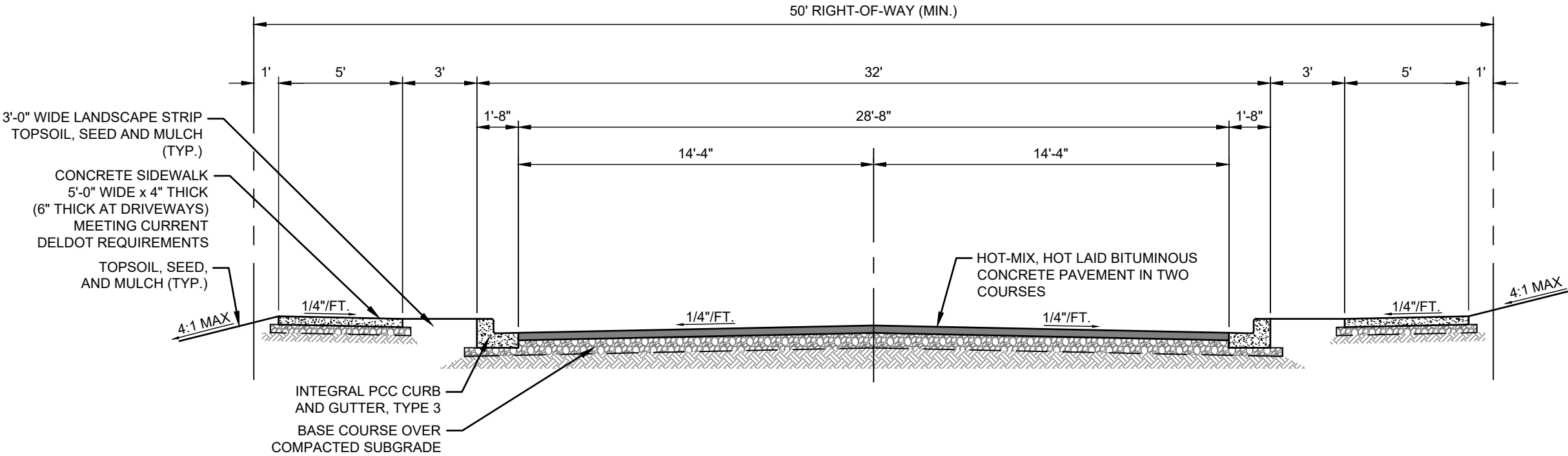
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STREET SECTIONS

DETAIL LIST	
DETAIL DWG	DETAIL TITLE
--	ROAD SECTION DETAILS - COVER
R1	TYPICAL MINOR STREET SECTION
R2	TYPICAL MINOR COLLECTOR STREET SECTION
R3	TYPICAL MAJOR COLLECTOR STREET SECTION
R4	TYPICAL ALLEY SECTION

REVISIONS			
NO.	DESCRIPTION	DATE	BY



R1 TYPICAL MINOR STREET SECTION
NOT TO SCALE

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PLOTTED: 12/16/2021 11:18:59 AM, BY: BRIAN MILLER, PLOTSTYLE: PENNONI NCS.STB, PROJECT STATUS: MATERIAL AND CONSTRUCTION DETAILS



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SPECIFICATIONS AND DETAILS

R1 TYPICAL MINOR STREET
SECTION

TOWN OF MILTON
115 FEDERAL STREET
MILTON, DELAWARE 19868

ORIGINAL DATE 12/2021

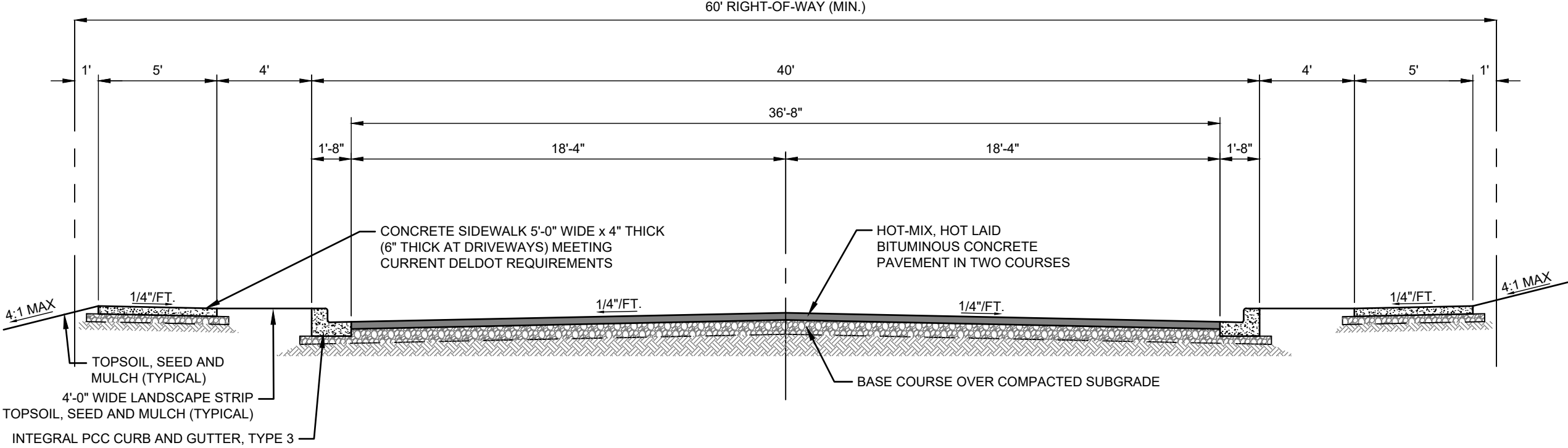
LAST REVISED

DRAWING SCALE AS NOTED

DETAIL DRAWING

R1

REVISIONS			
NO.	DESCRIPTION	DATE	BY



R2 TYPICAL MINOR COLLECTOR STREET SECTION
NOT TO SCALE

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SPECIFICATIONS AND DETAILS

**R2 TYPICAL MINOR COLLECTOR
STREET SECTION**

TOWN OF MILTON
115 FEDERAL STREET
MILTON, DELAWARE 19868

ORIGINAL DATE 12/2021

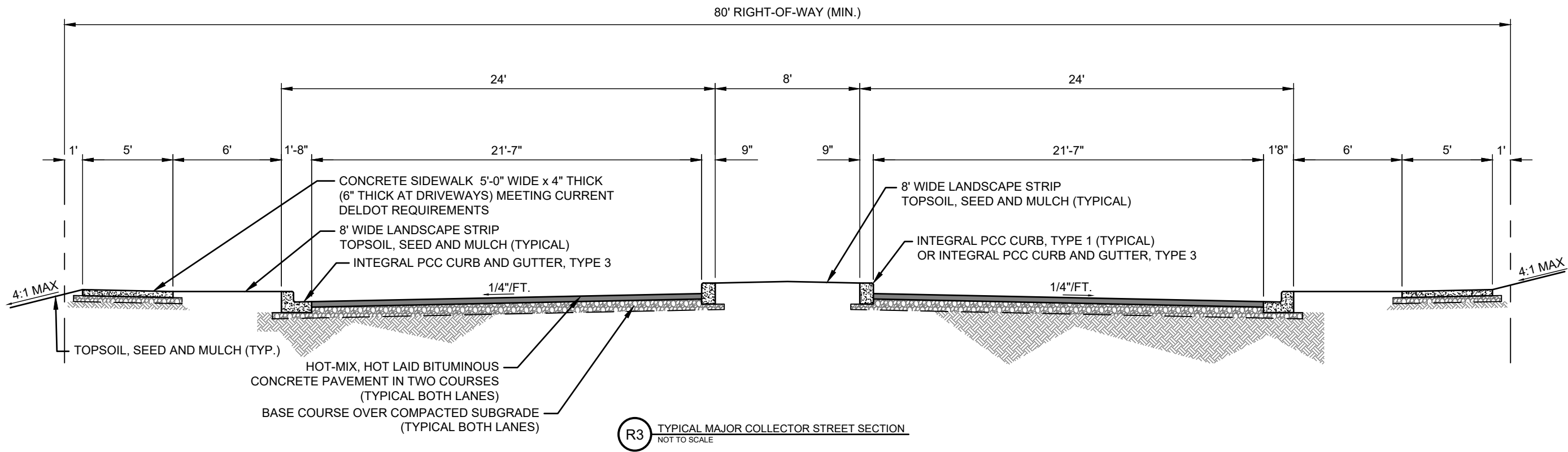
LAST REVISED

DRAWING SCALE AS NOTED

DETAIL DRAWING

R2

REVISIONS			
NO.	DESCRIPTION	DATE	BY



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SPECIFICATIONS AND DETAILS

R3 TYPICAL MAJOR COLLECTOR STREET SECTION

TOWN OF MILTON
115 FEDERAL STREET
MILTON, DELAWARE 19868

ORIGINAL DATE 12/2021

LAST REVISED

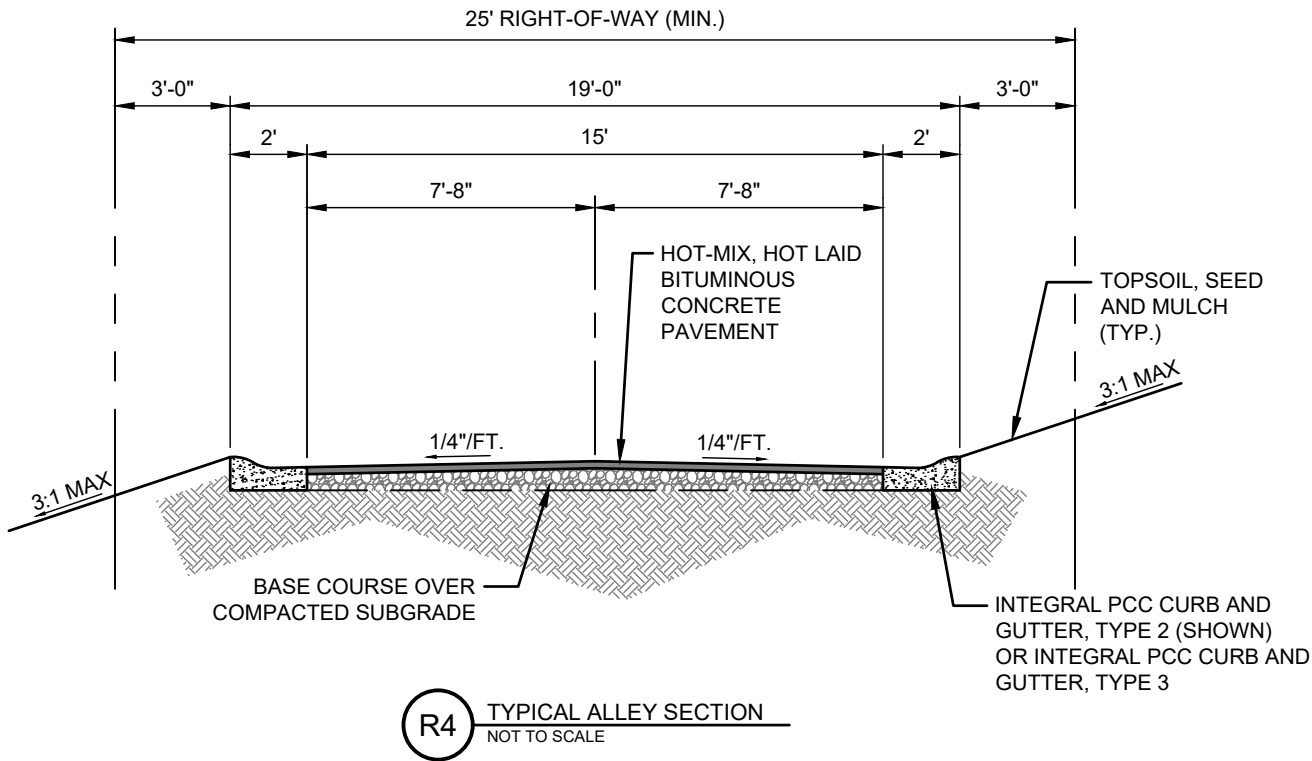
DRAWING SCALE AS NOTED

DETAIL DRAWING

R3

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REVISIONS			
NO.	DESCRIPTION	DATE	BY



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SPECIFICATIONS AND DETAILS

R4 TYPICAL ALLEY SECTION

TOWN OF MILTON
 115 FEDERAL STREET
 MILTON, DELAWARE 19968

ORIGINAL DATE	12/2021
LAST REVISED	
DRAWING SCALE	AS NOTED
DETAIL DRAWING	R4