

DIVISION 15
UTILITY CONSTRUCTION
SECTION 1500
GENERAL UTILITY REQUIREMENTS

1500-1 DESCRIPTION

Construct various utilities as required by the contract or as directed.

Apply the applicable provisions of the Rules and Regulations of the North Carolina Department of Environment and Natural Resources, Division of Environmental Health to the construction of water lines. Apply the Rules and Regulations of the North Carolina Department of Environment and Natural Resources, Division of Water Quality to the construction of sanitary sewer lines. Perform all work in accordance with the applicable plumbing codes.

1500-2 COOPERATION WITH THE UTILITY OWNER

The Utility owner owns the existing utility facilities and will own the new utility facilities after acceptance by the Department. The Department owns the construction contract and has administrative authority. Communications and decisions between the Contractor and Utility Owner are not binding upon the Department or this contract unless authorized by the Engineer. Agreements between the Utility Owner and Contractor for work that is not part of this contract or is secondary to this contract are allowed, but are not binding upon the Department.

Provide access for Department personnel and the owner's representatives to all phases of construction. Notify Department personnel and the utility owner two weeks prior to commencement of any work and one week prior to service interruption. Keep utility owners' representatives informed of work progress and provide opportunity for inspection of construction and testing.

Except in an emergency, do not operate any of the controls on the existing systems without prior approval of the owner.

Notify the owner at least 24 hours in advance of all arrangements for temporary service and for agreement with the owner as to the time that service may be interrupted.

1500-3 UTILITY LOCATIONS AND CONTRACTOR'S RESPONSIBILITY

The plans depict the best available information for the location, size, and type of material for all existing utilities. Make investigations for determining the exact location, size, and type material of the existing facilities as necessary for the construction of the proposed utilities and for avoiding damage to existing facilities. Repair any damage incurred to existing facilities to the original or better condition at no additional cost to the Department.

Make final connections of the new work to the existing system where indicated on the plans, as required to fit the actual conditions, or as directed.

1500-4 WEEKEND, NIGHT AND HOLIDAY WORK

Make connections between existing and proposed utilities at times most convenient to the public, without endangering the utility service, and in accordance with the utility owner's requirements. Make connections on weekends, at night, and on holidays if necessary.

1500-5 RELATION OF WATER MAINS TO SEWERS

Lay water mains at least 3.05 m laterally from existing or proposed sewers. If local conditions or barriers prevent a 3.05 m separation, lay the water main with at least 457 mm vertical separation above the top of the sewer pipe either in a separate trench or in the same trench on a bench of undisturbed earth.

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When a proposed water main crosses over a proposed or existing sewer, lay the water main with at least 457 mm vertical separation above the top of the sewer. If local conditions or barriers prevent an 457 mm vertical separation, construct both the water main and the sewer for a distance of 3.05 m on each side of the point crossing with ferrous pipe having water main quality joints.

When a proposed water main crosses under a proposed or existing sewer, construct both the water main and the sewer of ferrous materials with joints that are equivalent to water main standards for a distance of 3.05 m on each side of the point of crossing. Center the section of water pipe at the point of crossing.

1500-6 PROTECTION OF PEDESTRIAN AND VEHICULAR TRAFFIC

During the progress of the work, keep sidewalks and crossings open for the passage of pedestrians. Take necessary measures to keep roadways open for traffic unless lane or roadway closures are approved.

Construct and maintain adequate and approved bridges over excavations as may be necessary for the purpose of accommodating pedestrians or vehicles.

When open cut installation is allowed across a roadway and traffic is to be maintained, construct the installation in sections so that half the width of the roadway will be available to traffic. Provide all traffic control measures necessary to provide for safe traffic passage.

1500-7 SUBMITTALS AND RECORDS

Deliver only approved materials to the project. Provide sufficient information as required under Sections 105 and 106 to demonstrate the materials meet the specifications and intended use. Provide 2 copies to the Utility Owner and 6 copies to the Engineer. Identify each item's intended use. As a minimum, the submitted information shall show the material description, brand name, stock number, size, rating, and manufacturing specification.

Provide working drawings of thrust restraint designs and connection details along with schedules for performing the work.

Provide As-Built plans of the installed utility. The plans shall include notations of the size and type material installed, coordinates of utility controls, and horizontal and vertical locations of the piping. Provide 2 copies to the Utility Owner and 2 copies to the Engineer.

1500-8 LOCATING AND MARKING

Tape a continuous locator wire along the top of all piping. Mechanically fasten locator wire to valve boxes, meter boxes, fire hydrants, manhole covers and other above grade appurtenances. Install marking tape 450 to 600 mm below finished grade above all pipelines.

1500-9 PLACING PIPELINES INTO SERVICE

Make final connections to existing mains where indicated on the plans, as required to fit the actual conditions, or as directed. Provide sufficient work crews, equipment, and materials on site to assure quick and efficient connections.

Schedule and notify owners and customers in advance of any interruptions of water service with ample time to make arrangements. Limit interruption of service to water customers to a maximum of 8 hours unless otherwise required or approved. Provide temporary connections as needed.

Make final connections of the proposed sewer work to the existing system where indicated on the plans, as required to fit the actual conditions, or as directed. Notify the owner at least 24 hours in advance of all arrangements for temporary service and for agreement with the owner as to the time that service may be interrupted.

1500-10 MEASUREMENT AND PAYMENT

The general utility construction work will be considered incidental and will be paid for at the contract unit prices of the various utility items included in the contract.

**SECTION 1505
EXCAVATION, TRENCHING, PIPE LAYING AND BACKFILLING
FOR UTILITIES**

1505-1 DESCRIPTION.

Perform all excavation, undercut, foundation conditioning, pipe laying, bedding, backfill, and pavement, sidewalk and driveway repair necessary for installation of utilities.

1505-2 MATERIALS

Refer to Division 10.

Item	Section
Select Material	1016
Portland Cement Concrete	1000

Use Class III, IV, V, or VI select material for foundation conditioning and bedding.

1505-3 CONSTRUCTION REQUIREMENTS

Excavate, trench, lay pipe, bed, and backfill utilities in conformance with the applicable requirements of Division 1, Division 2, and Articles 300-1, 300-4, and 300-6. Comply with AWWA and ASTM standards along with the product manufacturer requirements for installing utilities.

(A) Shoring

Excavate trenches and pits for the installation of utilities that are safe for the workers and roadway users and that protect the roadway and other property from damage. Provide appropriate groundwater and surface water controls to stabilize the excavation and foundation and to provide a clean working area.

(1) Worker Safety

Provide any necessary shielding or shoring to protect workers.

(2) Roadway Users

Provide shielding or shoring as required under Sections 150.

(3) Roadbed and Foundation Protection

Provide shoring of excavations less than 1 horizontal to 1 vertical from existing or proposed pavement to prevent failure or weakening of the roadbed. Provide plans and designs demonstrating the methods and techniques proposed and their adequacy. Provide engineered shoring systems as required for the actual conditions.

(B) Foundation Conditioning

Undercut and replace weak or saturated soils below the pipe trench with select material to provide a firm foundation.

(C) Bedding

Provide excavations with sufficient width for placing and compacting bedding around the utility. Bed utilities in select material. Place bedding material to stable ground on both sides and to at least 50 mm below and above the pipe bells. Provide at least 150 mm of bedding material between rock and piping. Shape the bottom of trenches to fit the pipe. Compact bedding material completely in the pipe haunches. Provide recesses in the bedding to accommodate pipe joints.

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(D) Pipe laying

Lay pipe in accordance with the specifications and the manufacturer's recommendations. Except where necessary in making connections with other lines or as authorized by the Engineer, lay pipe with the bells facing in the direction of laying.

Where possible, keep joints exposed for visual inspection during testing.

Keep pipe and appurtenances clean. Provide secure watertight seals on pipe when work is not in progress.

During the progress of the work and until the completion and final acceptance, keep the pipelines and their appurtenances clean throughout and remove any obstructions or deposits.

Lay pipe upgrade with the spigot ends pointing in the direction of flow. Lay each pipe to form a close concentric joint with the adjoining pipe and to prevent sudden offsets of the flow line.

(E) Thrust Restraint

Provide thrust restraint for pressurized pipelines and appurtenances. When shown on the plans, construct as specified with modifications to match the actual field conditions. When not shown, engineer the thrust restraint system with a factor of safety of 1.25 for the test pressure specified and for the actual field conditions.

Provide thrust restraint on the existing piping system as necessary.

Use joint restraint methods, such as integral restraining bells and spigots, restraining retainer glands, restraining gaskets, or restraining clamps and lugs with tie rods. Use concrete reaction backing and thrust collars where joint restraint is impractical.

Where any section of a main is provided with concrete thrust restraint for fittings, controls, or hydrants, perform the hydrostatic pressure test after the concrete reaches appropriate strength.

(F) Backfilling

Backfill in accordance with Article 300-7 and compact to the density required by Subarticle 235-4(C).

1505-4 REPAIR OF PAVEMENTS, SIDEWALKS AND DRIVEWAYS

Repair sidewalks and driveways that are disturbed by excavation and trenching to an original or better condition using Class B Concrete.

Use asphalt plant mix to repair or replace pavement damaged by utility work. Perform all work in accordance with Section 654. Immediately upon completion of the utility removal or installation, make repairs to the pavement.

1505-5 CONCRETE ENCASEMENT OF UTILITY LINES

Encase existing or proposed utility lines in Class B concrete for protection in areas as shown on the utility plans or as directed. Place the concrete completely around the line with a minimum thickness of 150 mm.

1505-6 MEASUREMENT AND PAYMENT

Trenching, excavation, pipe laying, bedding, and backfilling for utility construction will be considered as included in the contract price for the applicable utility item and no separate measurement or payment will be made.

The following work and items will also be considered as included in the contract price for the applicable utility item and no separate measurement or payment will be made:

(A) Undercut or Wet Excavation

- (B) Dewatering of Excavation
- (C) Shoring and Sheeting
- (D) Thrust restraint
- (E) Repair of Sidewalks and Driveways

Foundation Conditioning

Foundation Conditioning Material will be measured and paid for as provided in Section 300.

Bedding Material

Bedding Material will be considered incidental and no separate measurement or payment will be made.

Select Material for Backfill

Select Material for backfill will be measured and paid for as provided in Section 300.

Asphalt Plant Mix

Asphalt Plant Mix for Pavement Repair will be measured and paid for as provided in Section 654.

Concrete for Encasing Utility Lines

Class B Concrete for Encasing Utility Lines will be measured and paid for in cubic meters of concrete, measured in place.

Payment will be made under:

Pay Item	Pay Unit
Class "B" Concrete for Encasing Utility Lines	Cubic Meter

**SECTION 1510
WATER LINES**

1510-1 DESCRIPTION

Provide water lines suitable for use in transporting potable water.

1510-2 MATERIALS

Refer to Division 10.

Item	Section
Portland Cement Concrete	1000
Water Pipe and Fittings	1036

The Contractor may use any of the water pipe specified under Section 1036 except where a particular type pipe is specified on the plans or required by environmental regulations or Departmental policy. The Contractor shall verify that the pipe is appropriate for the test pressure of the system and the external loading.

Use ductile iron fittings on water lines 100 mm or larger.

Use #12 AWG solid-copper wire with blue insulation for the utility locator wires.

Use 50 mm wide plastic marking tape colored blue with "Caution Water Line", or similar wording, permanently printed at approximately 900 mm centers.

Use Class B Concrete for reaction backing masonry. Protect steel rods and other metal clamps and lugs by galvanizing or painting with approved bituminous paint.

1510-3 CONSTRUCTION REQUIREMENTS

Meet the installation standards of the AWWA or ASTM for water line construction.

Apply all the requirements in Section 1505 for excavation, trenching, pipe laying, and backfill to water line installation.

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Install small diameter pipe (100 mm or less) under existing pavement by a trenchless method at no additional compensation.

Connect the ends of the water service piping using AWWA C800 type couplings or fittings. Make NPT screw joints with a double wrap of Teflon tape and torque as required by the manufacturer.

Store plastic pipe out of direct sunlight until placing. All plastic pipe showing discoloration or deterioration will be rejected for use and replaced with suitable pipe as specified under Article 106-9.

Install water lines with 910 to 1060 mm of cover to finished grade unless otherwise directed or approved. Install water lines with greater cover for short distances to accommodate utility controls, to make tie-ins to existing facilities, to eliminate high points in the pipeline, or to provide clearance from existing or proposed utilities, drainage, other obstacles or actual field conditions.

(A) Testing and Sterilization

Perform pressure and leakage tests and sterilization on newly installed water mains and altered water mains prior to placing such pipelines into service. Provide all equipment, piping, controls, pumps, water, and safety devices necessary for performing the tests and sterilization.

Obtain clean water for cleaning, testing, and sterilization from approved sources. Only make connections to potable water sources with approved backflow preventors until acceptance of all test results.

Perform tests using clean water and provide certified results demonstrating leakage less than the following amount when pressurized at 1380 ± 35 kPa for 2 hours.

$$W=LD(\sqrt{P})\div(715,317)$$

Where **W** equals the allowable leakage in liters per hour; **L** is the length of pipeline tested, in meters; **D** is the nominal diameter of the pipe, in millimeters; and **P** is the average test pressure during the leakage test, inkilopascals.

Repair using approved methods or replace pipe, controls, or appurtenances as necessary to reduce leakage. Additionally, repair any leaks that are visible after 2 hours duration.

Clean water lines by flushing with water at a minimum 760 mm per second velocity. Remove all debris and dirt from water mains larger than 100 mm by passing a medium density foam pig with abrasive strips through the lines.

Sterilize water lines according to DENR requirements and AWWA C651. Provide certified bacteriological and contaminant test results from an approved independent testing laboratory in accordance with DENR requirements. Operate all valves and controls to assure thorough sterilization.

Testing, cleaning and sterilization may be performed concurrently or consecutively.

Dispose of wastewater in accordance with all environmental regulations.

For short sections (less than 30 m) and tie-in sections of water lines perform visual tests for leakage after installation in lieu of separate pressure and leakage tests. Sterilize according to AWWA C651 Sections 4.6 and 4.7.

Provide copies of the test results to the Engineer and to the water line owner.

Flush with clean water until the residual chlorine is reduced to the same level as in the existing water mains.

Place new water lines into service after approval of all testing and flushing and authorization by the Engineer.

1510-4 MEASUREMENT AND PAYMENT

Water Lines of the various sizes will be measured from end to end in place with no deduction for length through valves or other fixtures and paid for by the horizontal linear meter. Water lines smaller than 50 mm and branch lines or service lines to fire hydrants, water meters, and back-flow preventors will not be measured or paid for.

If the contract does not include such pay items, measurement will not be done and the items will be incidental to other contract pay items.

Payment will be made under:

Pay Item	Pay Unit
__mm Water Line	Linear Meter

**SECTION 1515
UTILITY CONTROLS**

1515-1 DESCRIPTION

Provide appropriate control devices, valves, meters, back-flow preventors, and hydrants on water lines and force main sewers.

1515-2 MATERIALS.

Refer to Division 10.

Item	Section
Sanitary Sewer	1034
Water	1036

Deliver only approved materials to the project.

Air release valves shall meet the requirements of AWWA C512. In addition, air release valves for sanitary sewer force mains shall have long bodies, shall be equipped with back-flushing connections and shall have a hood over the outlet.

Double check valves (DCV) Back-flow Preventors shall meet AWWA C510 requirements. Reduced Pressure Principle (RPZ) Back-flow Preventors shall meet AWWA C511 requirements.

Line stops consist of a sleeve, temporary valve and closure cap. The sleeve and cap shall meet applicable AWWA standards, shall be made of cast iron or stainless steel, shall be pressure rated at 1380 kPa, and shall be sized for the type pipe to be tapped. The temporary valve shall be suitable for contact with potable water with NSF certification and designed to match the actual field conditions.

Line stop bypass pipe shall be pressure rated at 1380 kPa, shall be NSF certified, and shall be adequately restrained.

Use screw or slip type valve boxes with a base to fit the valve yoke and a removable plug cap with the word WATER or SEWER cast therein.

Precast manholes shall meet the requirements of Section 1525.

1515-3 BLANK**1515-4 GENERAL CONSTRUCTION**

Apply all the requirements in Section 1505 for excavation, trenching, pipe laying, and backfill.

Place two 100 mm by 200 mm by 400 mm concrete blocks beneath valves and fire hydrants for support.

When necessary due to project staging, install valves, meters and fire hydrants as appropriate for the current grade and make adjustments to finished grade as work progresses.

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Provide enclosures with positive drainage for utility controls.

(A) Valves

Install all valves with an approved valve box set flush with the ground or pavement. Place a 610 mm diameter precast concrete ring flush with the ground around all valve boxes not in pavement.

Test and sterilize tapping valves prior to making the tap. Do not allow cuttings to enter the tapped main.

(B) Meters

Install water meters adjacent to the right of way or as shown on the plans.

Place meter boxes with the top of the meter box flush with finished grade of the project.

(C) Back-Flow Preventors

Install back-flow preventors off of the highway right of way or as shown on the plans.

Licensed installers shall test and certify RPZ Back-Flow Preventor installations. Enclose RPZ Back-flow preventors above grade in a hot box.

Enclose DCV Back-flow Preventors below grade in a precast concrete vault with positive drainage or above grade in a hot box.

Install the hot box on a 100 mm thick concrete slab that is 150 mm larger than the box and 50 mm to 100 mm above finished grade.

(D) Fire Hydrants

Install fire hydrants outside of the vehicle recovery area of the roadway, adjacent to the right of way line, or in protected areas.

Connect fire hydrants to the main with a 150 mm valve and branch line having at least as much cover as the distribution main. Set hydrants plumb with the pumper nozzle facing the roadway and with the breakaway safety flange between 25 mm and 100 mm above the finished surrounding grade. Except where approved otherwise, place hydrants into service as soon as practicable. Place at least 0.2 cubic m of clean crushed stone around the base of the hydrant to insure drainage of the hydrant barrel.

Where necessary, remove the hydrant shoe and replace with the appropriate type to connect a relocated hydrant to the new pipe. Furnish and install or remove hydrant extension pieces to provide the proper bury of the pipe and hydrant.

(E) Line Stops

Provide line stop valves to temporarily shut down the flow in pressurized pipes. Provide line stops to temporarily dead end a pipeline when there are no available working valves on the existing piping. Provide line stops with bypass to isolate a section of the existing pipeline while maintaining the flow.

After line stop valves are removed, permanently cap the tapping sleeve and backfill the entire excavation with compacted select material.

(F) Air Release Valves

Install air release valves at the high point of pressurized pipelines. Place a precast manhole around air release valves.

(G) Miscellaneous Controls

Install corporation stops with tapping saddles for connecting 50 mm or smaller water lines to larger water lines. Install corporation stops at $45^{\circ}\pm 10^{\circ}$ from vertical on the larger line.

To aid in testing and flushing, install corporation stops at all elevated points along the pipeline in order to bleed off all entrapped air.

1515-5 MEASUREMENT AND PAYMENT

Valves, water meters, fire hydrants, line stops, and other items listed in the pay items will be measured and paid for per each for the appropriate size and type. Valves and other items on hydrant legs or service lines will not be measured or paid for.

The term *relocate* in a pay item means to physically move the existing item, either vertically or horizontally, using the appropriate materials to place the item into working order. Measurement and payment will be made per each for the appropriate size and type.

No additional compensation will be made for adjustments due to project staging on new or relocated items.

Reconnect water meter means to transfer or replace the piping from a new water line to an existing water meter that is not relocated. Measurement and payment will be made per each.

Valve boxes, meter boxes, hot boxes, vaults, and manholes for protecting and servicing utility controls are considered incidental to the appropriate pay item.

A line stop with bypass consists of installing line stops on opposite ends of the piping to be isolated, tapping the piping beyond the line stops, and providing temporary bypass piping between the taps. The entire assembly of valves and piping will be measured as one unit and paid for per each.

Corporation stops or other items to aid in testing and flushing of the piping are incidental items.

If the contract does not include such pay items, measurement will not be done and the items will be incidental to other contract pay items. All piping, fittings, controls, certifications, appurtenances, and other miscellaneous items necessary to place the new or relocated item in proper working condition are considered incidental.

Payment will be made under:

Pay Item	Pay Unit
__mm Valve	Each
__mm Tapping Valve	Each
__mm Air Release Valve	Each
__mm Blow Off	Each
__mm Water Meter	Each
Relocate Water Meter	Each
Reconnect Water Meter	Each
__mm DCV Back-Flow Preventor	Each
Relocate __mm DCV Back-Flow Preventor	Each
__mm RPZ Back-Flow Preventor	Each
Relocate __mm RPZ Back-Flow Preventor	Each
Fire Hydrant	Each
Relocate Fire Hydrant	Each

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__mm Line Stop	Each
__mm Line Stop with Bypass	Each

SECTION 1520 SANITARY SEWER

1520-1 DESCRIPTION

Provide sanitary sewers suitable for transporting sewage.

1520-2 MATERIALS

Refer to Division 10.

Item	Section
Sanitary Sewer Pipe and Fittings	1034

Use any of the pipe specified under Section 1034 except where a particular type pipe is specified on the plans or required by Environmental regulations or Departmental policy. Verify the pipe is appropriate for the test pressure of the system and the external loading.

Use ductile iron fittings on pressurized (force main) pipelines 100 mm or larger.

Use screw type plastic or brass clean-out covers.

Use #12 AWG solid-copper wire with green insulation for the utility locator wires.

Use 50 mm wide plastic marking tape colored green with "Caution Sewer Line," or similar wording, permanently printed at approximately 900 mm centers.

1520-3 CONSTRUCTION REQUIREMENTS

Apply all the requirements in Section 1505 for excavation, trenching, pipe laying, and backfill to sanitary sewer installation.

Assemble pipe in accordance with the recommendations of the manufacturer.

Install PVC pipe in accordance with approved bedding methods.

Install vitrified clay sewer pipe in accordance with ASTM C12.

Install 100 mm minimum diameter sanitary sewer clean-outs flush with finished grade on 100 mm and 150 mm service lines. Provide clean-outs at the right of way line and at changes in direction. Do not locate clean-outs within the roadway pavement or shoulders. Provide clean-outs no more than 15 m apart when beyond the roadway shoulders.

Use ductile iron pipe for sewers with 10% or greater slope.

Install sewer lines entering manholes with the crown at or higher than the sewer line leaving the manhole.

Install small diameter pipe (100 mm or less) under existing pavement by a trenchless method at no additional compensation.

(A) Gravity Sanitary Sewer

Construct gravity sanitary sewers in conformance with NCDENR *Gravity Sewer Minimum Design Criteria*.

(1) Pipe Installation

Use fittings or saddles to connect service lines to the sewer main.

Maintain sewer flow at all times. Use temporary diversions or pumping to maintain flow when connecting proposed sewers to existing sewers. Use engineered temporary pumping systems capable of handling full pipe flow. Use pumping systems with automatic reliable operation or constantly tended manual operation.

(2) Testing

Perform tests on newly installed sewers and altered sewers prior to placing into service. Provide all equipment, piping, controls, pumps, water, and safety devices necessary for performing the tests.

Test all gravity sewer lines for leakage using one of the following methods:

(a) Infiltration

For sewer lines greater than 0.9 m below groundwater, measure the amount of water infiltrating into the pipeline between manholes during a minimum of 24 hours. Repair leaks or replace piping when the rate of infiltration exceeds $W = 0.000386LD$ in which W equals the maximum allowable leakage in liters per hour; L is the length of pipe tested in meters; and D is the nominal diameter of the pipe, in mm.

(b) Exfiltration

For sewer lines above groundwater, perform an exfiltration test on the pipeline between manholes. Repair leaks or replace piping when the rate of exfiltration exceeds $W = 0.000386LD$ in which W equals the maximum allowable leakage in liters per hour; L is the length of pipe tested in meters; and D is the nominal diameter of the pipe, in mm.

The exfiltration test shall consist of securely plugging the pipe at the lower manhole and filling the pipeline with water. Allow the water to set for 24 hours in clay or concrete pipes. Raise the water level in the upstream manhole to 0.9 m above the top of pipe. After 4 hours, measure the amount of water required to bring the water level back to the level at the start of the test and record the time.

Perform exfiltration tests through a series of manhole to manhole segments to limit the length of pipe tested to between 90 m and 450 meters. Shorter sections may be tested with longer test times. No additional leakage allowance for manholes permitted.

(c) Air Test

In lieu of hydrostatic testing, sewer lines 600 mm in diameter or smaller may be air tested in accordance with ASTM C-828, ASTM C924 and the following. Securely plug the sewer pipe at the manholes. Fill the pipe with air to 30 kPa and hold this pressure for 5 minutes. Reduce the pressure to 24 kPa. Measure the time for the pressure to drop 17 kPa to the new pressure of 7 kPa. Exceed the minimum test time given in the chart below for test times per 30 m for the appropriate nominal pipe diameter.

Pipe Size (mm)	Test Time (Minutes/30. m)	Pipe Size (mm)	Test Time (Minutes/30. m)
200	1.2	450	2.4
250	1.5	530	3.0
300	1.8	600	3.6

(d) Visual Inspection

Visually inspect sewer lines larger than 600 mm from the inside using approved cameras. Correct any leakage, rolled gaskets, or defects.

(e) Line and Grade

Test all sewers for straight alignment by lamping or using a laser.

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(f) Deflection Testing

Perform deflection tests on all flexible pipes. Conduct the test after the final backfill has been in place at least 30 days to permit stabilization of the soil-pipe system. As an alternative to waiting 30 days to permit stabilization of the soil-pipe system, provide certified soil testing verifying the backfill of the trench has been compacted to at least 95% maximum density.

No pipe shall exceed a deflection of 5 percent. If deflection exceeds 5 percent, relay the pipe.

The rigid ball or nine-point mandrel used for the deflection test shall have a diameter not less than 95 percent of the base inside diameter or average inside diameter of the pipe depending on which is specified in the ASTM Specification, to which the pipe is manufactured. The pipe shall be measured in compliance with ASTM D2122 Standard Test Method of Determining Dimensions of Thermoplastic Pipe and Fittings. The test shall be performed without mechanical pulling devices.

(B) Force Main Sanitary Sewer

Construct force main sewers in conformance with NCDENR *Minimum Design Criteria for the Fast-Track Permitting of Pump Stations and Force Mains*.

(1) Installation

Install lines with 910 to 1060 mm of cover to finished grade unless otherwise directed or approved. Install lines with greater cover for short distances to accommodate utility controls, to make tie-ins to existing facilities, to eliminate high points in the pipeline, or to provide clearance from existing or proposed utilities, drainage, other obstacles or actual field conditions.

Provide automatic air release valves at all high points.

(2) Testing

Perform pressure and leakage tests on newly installed force mains and altered sewers prior to placing such pipelines into service. Provide all equipment, piping, controls, pumps, water, and safety devices necessary for performing the tests and sterilization.

Test all new sewer force mains with clean water at 1300 ± 35 kPa for a 2 hour duration. Vent all high points and expel all air. Provide certified results demonstrating leakage less than $W=0.0000518LD$ in which W equals the allowable leakage in liters per hour; L is the length of pipe tested in meters; and D is the nominal diameter of the pipe, in millimeters.

Repair leaks using approved methods or replace pipe, controls, or appurtenances as necessary to reduce leakage. Additionally, repair any leaks that are visible after 2 hours duration.

1520-4 MEASUREMENT AND PAYMENT

Sanitary Gravity Sewer and *Force Main Sewer* will be measured from end to end in place with no deduction for length through manholes, valves, or fittings and paid for per linear meter for the appropriate size. Where two different sizes enter or go from a manhole, each size will be measured to the center of the manhole. Unless otherwise shown on the plans, branch connections, ells, or other fixtures will be included in the length measurement.

Sanitary Sewer Clean-Out will be measured and paid for per each. No measurement or payment of service lines will be made.

Payment will be made under:

Pay Item	Pay Unit
__mm Sanitary Gravity Sewer	Linear Meter
__mm Force Main Sewer	Linear Meter
Sanitary Sewer Clean-Out	Each

SECTION 1525 UTILITY MANHOLES

1525-1 DESCRIPTION

Provide utility manholes on water and sanitary sewer lines.

1525-2 MATERIALS.

Refer to Division 10.

Item	Section
Portland Cement Concrete	1000
Curing Agents	1026
Brick	1040-1
Concrete Block	1040-2
Mortar	1040-8
Precast Concrete Units	1077
Reinforcing Steel	1070
Structural Steel	1072
Steps	1074-8
Gray Iron Castings	1074-7(B)
Select Material	1016

Use precast concrete manholes with monolithic bottoms which conform to ASTM C478, AASHTO M199, and are as shown on the plans or in Roadway Standard Drawings. Use ASTM C-443 gaskets or AASHTO M198 flexible sealants for joints between precast manhole sections. Use resilient connectors for piping conforming to ASTM C923. Use ASTM A48 Class 35 cast iron or Grade 60 steel reinforcement steps with polypropylene plastic coating.

Use manhole frames and covers made of cast iron conforming to ASTM A48 Class 35, which are traffic bearing, have machined contact surfaces and are sized as shown. Use covers with two 25 mm diameter air vents for vented manholes and use solid, non-vented covers with gaskets for watertight installation. Use covers with "Sanitary Sewer" or "Water" cast in large letters as appropriate for the type of utility.

Use Class B concrete unless otherwise indicated on the plans.

Use cement grout meeting the requirements of Article 1040-9 except use the mix portions of 1 part portland cement to 2 parts mortar sand.

1525-3 CONSTRUCTION REQUIREMENTS

Apply all the requirements in Section 1505 for excavation, trenching, pipe laying, and backfill.

Make connections of pipe to manholes in cored or precast holes using a resilient connector. Use horseshoe type holes only when approved. For horseshoe type holes wrap the pipe with a butyl rubber gasket and fill the space between the pipe and manhole with a non-shrinking grout.

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Provide an outside drop assembly on manholes for sewer pipes entering with 0.8 m or more vertical drop. Inside drop assemblies may be used for connections to existing manholes when the drop exceeds 1.5 m and the manhole diameter is greater than 1.2m.

In sewer manholes over 1.0 m in depth, provide steps spaced 410 mm on center. Install steps in line with the effluent opening unless otherwise specified.

Construct invert channels to confine and direct the flow through sanitary sewer manholes. Use smooth finished invert channels that provide easy transition from inlet to outlet. Finish the benches or shelves to a non-slip texture and slope toward the invert channel. Precast invert channels are recommended but not required.

On deep manholes, a transition type manhole may be used provided there is a minimum of 1.8 m from the manhole bench to the transition cone and the Engineer approves.

Construct manholes with the top of the cover

Location	Top height above finished grade
Roadway pavement	Flush \pm 6 mm
Driveways, sidewalks, Parking lots	Flush \pm 12 mm
Vehicle Recovery Area	Flush to 75 mm and above
Manicured Areas, such as lawns	Flush to +50 mm with concrete pad
Flood Zones less than 0.9 m above finished grade	0.5 m above 100 year flood elevation
Flood Zones greater than 0.9 m above finished grade	600 mm above finished grade with watertight frame and cover and vent pipe to 0.5 m above 100 year flood
Other areas	600 mm above finished grade

For manholes installed prior to finished grading or paving, construct the top flush with the current grade to provide access during all phases of construction and adjust as grading and paving work progresses in accordance with Section 858.

(A) Cast-In-Place Concrete, Brick, and Block Masonry

Construct concrete manholes in accordance with Section 825 with an ordinary surface finish. Construct brick masonry in accordance with Section 830. Furnish and place reinforcing steel in accordance with Section 425. Construct block masonry in accordance with Section 834 except that reinforcing will not be required.

Where necessary to fit field conditions, vary the dimensions of the manhole and footings as directed.

(B) Installation of Precast Units

Assemble precast manhole units in accordance with the manufacturer's instructions and grout together to form a sound structural unit. Fill all lifting holes with non-shrink grout. Where it is necessary to use cast-in-place, brick masonry, or block masonry construction as part of the structure, apply the requirements of Subarticle 1525-4 (B) to such construction.

(C) Fittings and Connections

Where fittings enter the manhole, place them as the work is built up, thoroughly bonded, and accurately spaced and aligned.

Make pipe connections so that the pipe does not project beyond the inside wall of the manhole, and grout smooth and uniform surfaces on the inside of the manhole.

Set metal frames for covers in full mortar beds and mechanically secure by an approved method.

(D) Testing

Vacuum test all manholes prior to grouting and backfilling. Test according to ASTM C1244.

1525-4 MEASUREMENT AND PAYMENT

The height of the manhole will be measured and paid to the nearest tenth of a meter from the inside bottom (invert) of the manhole to the final finished top of the manhole ring.

Utility Manholes will be measured and paid for by appropriate diameter per each for manholes of 0 to 1.8 m height and per linear meter of height over 1.8 m. No additional payment will be made for adjusting manholes to finished grade.

Drop assemblies will be incidental.

Payment will be made under:

Pay Item	Pay Unit
__mm Dia Utility Manhole	Each
Utility Manhole Wall __mm Dia	Linear Meter

**SECTION 1530
ABANDON OR REMOVE UTILITIES**

1530-1 DESCRIPTION

Abandon or remove utility facilities.

1530-2 MATERIALS

Refer to Division 10.

Item	Section
Portland Cement Concrete	1000
Select Materials	1016
Cement Grout	1040-9
Flowable Fill	340

Prepare cement grout to a consistency that will flow and be vibrated in order for the mix to flow uniformly into the pipe to be filled.

Use flowable fill in accordance with Section 340.

1530-3 CONSTRUCTION REQUIREMENTS

Apply all the requirements in Section 1505 for excavation, trenching, pipe laying, and backfill.

(A) Abandoning Pipe

Abandon utility pipes shown on the plans or designated by the Engineer by emptying the pipeline contents and plugging the ends with portland cement grout or flowable fill. Use the construction methods in Subarticle 340-3.

Fill or remove the following abandoned utility pipes:

- (1) Pipe larger than 600 mm.
- (2) Pipe located within the greater of the roadway typical section or the project slope stake line and one of the following:
 - (a) Pipe 300 mm to 600 mm diameter located less than 6 m below finished grade.

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- (b) Pipe 150 mm to 300 mm diameter located less than 3.66 m below finished grade and not made of cast iron, ductile iron or PVC.
- (c) Located below groundwater table that could become a conduit for water movement.

Excavate, remove, and dispose of properly any abandoned pipe to be removed. Backfill the resulting trench and properly compact using local excavated material or select backfill as required.

Fill abandoned pipe with grout or flowable fill to at least 90% full.

Remove any abandoned utility pipe exposed by grading operations to a minimum depth of 300 mm below subgrade elevation of the proposed roadbed or completed grading template.

Plug all abandoned utility pipes. Use grout to plug all abandoned utility pipes at the entrance to all manholes whether the manhole is to be abandoned or not. Use grout to plug all abandoned water mains after new mains are placed in service.

(B) Abandoning Manholes

Abandon utility manholes in the construction limits by removing the top of the manhole to the manhole spring line or to an elevation of 600 mm below the roadway subgrade, whichever is greater, and filling the manhole barrel with approved material.

Plug connecting utility pipes before filling or removing the manhole.

Remove the manhole taper, wall, and base on all manholes to be removed.

Removed frames and covers become the property of the Contractor for proper disposal.

(C) Remove Water Meter

Remove water meters by disconnecting and plugging the water service piping at the source main and plugging the piping at the right of way line. Return the meter to the utility owner. Dispose of all other parts, piping and boxes.

(D) Remove Fire Hydrant

Remove fire hydrants by disconnecting and plugging the hydrant leg piping as close to the water main as possible. If the hydrant valve is within 1.2 m of the main, close the valve, plug the outlet side of the valve and remove the valve box.

Removed hydrants become the property of the Contractor for proper disposal.

1530-4 MEASUREMENT AND PAYMENT

Utility pipe that is abandoned by filling or removal will be measured and paid for by the linear meter for the size of pipe. Utility pipe that is abandoned by plugging the ends only and leaving in place will not be measured or paid for. Cement grout used for plugging of abandoned utility pipe is incidental to the various utility items. Utility pipe that is removed by other work of the contract will be incidental to the other work.

Abandon Utility Manholes will be measured and paid for per each.

Remove Utility Manholes will be measured and paid for per each.

Remove Utility Water Meters and *Remove Fire Hydrants* will be measured and paid for per each.

Payment will be made under:

Pay Item	Pay Unit
Abandon ___mm Utility Pipe	Linear Meter
Abandon Utility Manhole	Each
Remove Utility Manhole	Each
Remove Water Meter	Each
Remove Fire Hydrant	Each

SECTION 1540 ENCASEMENT

1540-1 DESCRIPTION

Furnish and install encasement or casing pipes. For the purposes of this specification the words encasement, casing, encasement pipe and casing pipe are interchangeable.

1540-2 MATERIAL

Refer to Division 10.

Item	Section
Steel Encasement Pipe	1036-4 (B)
Treated Timber	1082-2
Concrete Pipe	1034-3
PVC Pipe	1034-2
Vitrified Clay Pipe	1034-1
Flowable Fill	340-2

Other pipe as designed by a licensed Professional Engineer.

Submit material certifications and obtain approval from the Engineer prior to installation.

1540-3 CONSTRUCTION REQUIREMENTS

(A) Open Cut

Apply all the requirements in Section 1505 for excavation, trenching, pipe laying, and backfill.

(B) Jointing

Provide watertight joints on casing pipe less than 900 mm in diameter.

(C) Welding

Butt weld steel encasement pipe. Weld continuously around the circumference of the pipe to ensure that welds are watertight. Do not leave unwelded sections or holes in joints.

(D) Marker Posts

Mark encasements for future use with a treated wooden marker post. Place wooden marker post at the right of way or at the ends of encasements if encasements extend beyond the right of way.

(E) Carrier Pipe Installation

Install carrier pipe through casing using spacers or insulators to support the carrier pipe. Place spacers at intervals sufficient to support the carrier pipe without sagging. Install spacers sized to raise the carrier pipe bells above the encasement pipe invert.

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Seal ends of casing with concrete, brick or other approved materials. Ensure drainage of encasement by leaving a 25 mm diameter weep hole in the seal of the lower end of the encasement.

(F) Casing Pipe Fill

Pump or place flowable fill into the annular void between the carrier pipe and casing pipes 900 mm or larger.

1540-4 MEASUREMENT AND PAYMENT

Encasement Pipe will be measured from end to end and paid for at the contract unit price per linear meter for each size.

Payment will be made under:

Pay Item	Pay Unit
__mm Encasement Pipe	Linear Meter

SECTION 1550 TRENCHLESS INSTALLATION OF UTILITIES

1550-1 DESCRIPTION

Install pipe using a trenchless method. Pipe refers to the specified pipe, which may be the primary carrier pipe or an encasement pipe. Shoring means the earth support system used for installing the pipe. The terms for encasement, casing, encasement pipe and casing pipe are interchangeable. Casing is considered shoring except where specified.

A Professional Engineer shall design the method and certify the work will not damage the roadway above or endanger the roadway user.

1550-2 MATERIAL

Refer to Division 10.

Item	Section
Encasement Pipe	1540
Treated Timber	1082-2
Grout	1040-9
Flowable Fill	340
Structural Timber	1082
Structural Steel	1072
Concrete	1000

Use pipe joints that are modified to suit the installation method. Provide engineering calculations for piping and shoring. Submit material certifications and obtain approval from the Department's Engineer prior to installation.

Use steel or concrete liner plates. Steel tunnel liner plates shall meet the requirements of AASHTO Section 16 and Section 25 *Standard Specifications for Highway Bridges*. Concrete liner plates shall meet AASHTO specifications.

Drilling fluids consist of water, bentonite and polymer additives.

Other materials will be considered with adequate design and quality control.

1550-3 CONSTRUCTION REQUIREMENTS

(A) General

Apply all the requirements in Section 1505 for excavation, trenching, pipe laying, and backfill.

Install the pipe to the lines and grades shown on the plans. Use workers that are skilled in the method of construction. Construct with good workmanship by skilled workers along with proper safety precautions.

Locate ends of trenchless construction and pits beyond the vehicle recovery area of the roadway. The vehicle recovery area may be reduced using acceptable traffic control methods.

(B) Design

Assess soil conditions expected during trenchless operations.

Use a trenchless method appropriate for the field conditions and for the specified pipe. Design the method to insure no settlement of the pipe or the completed roadway section. Use methods of construction and installation that will not disturb the soils outside of the immediate vicinity of the pipeline or pits.

Before construction, provide detailed plans for the method of installation certified by a Professional Engineer. Provide certified calculations demonstrating the method of installation as safe and of minimal risk. Provide certified calculations of the structural adequacy of all materials. The design shall meet the applicable requirements of *AASHTO Standard Specifications for Highway Bridges*. A Professional Engineer shall certify changes or modifications to the designed method as needed for actual field conditions.

(C) Water control

Provide groundwater control and removal as appropriate for the method of excavation and installation. Remove the groundwater using an engineered dewatering system. Keep surface waters out of the excavation and pits.

(D) Shoring

Maintain continuous and active support (shoring) to the soils surrounding both the pit and the trenchless excavation. Provide temporary or permanent shoring, as needed. Provide temporary shoring to maintain the hole or pit excavation for the duration of the work. Casing pipe 900 mm and larger, tunnel liner, pit and trench shoring, and shoring that is not certified for permanent use is considered temporary. Provide permanent shoring when desired or specified to maintain the open hole for an indefinite time. Permanent shoring requires certification of durability and a design life of 100+ years.

Fill all voids around the excavation and shoring with structural fill material as work progresses. Fill the annular space between the specified pipe and temporary shoring.

Either work continuously (24 hours/day and 7 days/week) on the operations from the time the excavation begins through the filling of voids or use an engineered system for shoring the excavation during work stoppage.

(E) Pre-Construction Meeting

The Contractor shall conduct a pre-construction meeting with the Department's Engineer to review the proposed method for installation of the pipe. Conduct the meeting at least 48 hours before beginning installation. The meeting shall consist of, but is not limited to:

- (1) Presentation of the construction methods for understanding by all involved.
- (2) Presentation of methods for filling any potential voids around the pipe.
- (3) Advising the Department's Engineer of any work to be observed for *Not In Soil* classification.
- (4) Demonstrating that appropriate equipment and materials are on site.
- (5) Providing a progress schedule.
- (6) Demonstrating ability to react to failures or roadway settlement.

1550-4 TRENCHLESS METHODS

(A) Bore and Jack

For bore holes up to 150 mm diameter in stable ground, the hole may be augured and the pipe pushed or jacked through the cleaned out hole. For bore holes greater than 150 mm, provide continuous support of the hole by simultaneously jacking the pipe or casing into the hole.

Use equipment suitably sized and designed to simultaneously bore or drill the soil or rock while pushing or jacking piping on a controlled grade. Position the cutter head within one diameter of the leading edge of the piping. In cohesive, dense, and dry soils and rock, position the cutter head in front of the leading edge. In non-cohesive or loose soils, position the cutter head inside the piping.

Dry bore only, do not use jetting or wet boring methods. Use drilling fluids only on the outside of piping for lubrication or hole stabilization.

Minimize over bore, match cutter diameter to the outside diameter of the encasement pipe. Limit overbore to 5% of bore diameter or 50 mm, whichever is less.

Provide steering controls as necessary to maintain line and grade.

(B) Directional Drilling

For drilled holes up to 150 mm diameter in stable ground, the hole may be drilled and reamed followed by pulling the pipe into the hole within 8 hours. For drilled holes greater than 150 mm, simultaneously pull the pipe or casing into the hole as reaming occurs. Multi-pass reaming larger than 150 mm requires certification by the Contractor’s Engineer that the soils are self-supporting of the dead and live loads.

When under pavement or within a 1 horizontal to 1 vertical distance from pavement, maintain the following depth of cover:

Drilled hole diameter	Single pass reaming minimum depth of cover	Multi-pass reaming minimum depth of cover
50 to 150 mm	1.22 m	1.22 m
> 150 mm to 560 mm	8 times the hole diameter	12 times the hole diameter
> 560 mm to 810 mm	4.57 m	7.62 m

Begin bores at locations that allow transitioning the bore to meet the above depths.

Use drilling fluids as appropriate for the type soils. Pump drilling fluids only while drilling or reaming. Monitor flow rates to match the amount leaving the bore hole. Do not increase pressure or flow to free stuck drillheads, reamers or piping.

Limit drilled or reamed holes to 50 mm larger than the pipe.

(C) Tunneling

Tunnel using hand mining or mechanical excavation. Use tunnel shields or fore-poling along with benched excavation and breast boarding as appropriate for the field conditions. Alternatively, the Contractor’s Engineer may certify that the soils are self-supporting of the dead and live loads and design tunneling methods as appropriate.

Provide active support to the tunnel walls. Shore tunnel walls using liner plates, steel ribs with lagging, or other engineered method or by jacking piping into place.

Limit over excavation to 25 mm larger than the liner or shield. Grout the external voids as work progresses and as specified by the Contractor’s Engineer.

(D) Pipe Ramming

Use pipe ramming only where soils are homogeneous and free of rock, boulders, stumps and debris. Do not use in the vicinity of quick or liquefiable soils.

Steel bands 12 mm thick are allowed on the outside of the leading edge of the pipe or casing to oversize the hole to reduce friction. Also, steel bands 12 mm thick may be used on the inside to compact the spoil and to prevent plugging.

Install at the following minimum depth of cover.

Pipe or casing diameter	Minimum depth of cover
50 mm to 150 mm	1.22 m
>150 mm to 350 mm	6 pipe diameters
>350 mm to 600 mm	2.44 m

Contain spoil within the casing during ramming. After completion, use compressed air or augers to remove the spoil. Clean the interior using a pig. Provide appropriate safety devices. Limit air pressure to less than the rating of the pipe or casing.

Use lubricants and surfactants as needed.

(E) Other methods

Other methods will be considered on a case by case basis when thoroughly engineered.

(F) Lubrication and drilling fluids

Use drilling fluids for lubrication as needed at low pressure, low flow, and low volume. Do not use water alone. Low pressure is less than the weight of the soil above the excavation. Low flow is less than 3.8 liters per minute. Low volume is less than the calculated annular space between the piping and excavated hole.

1550-5 QUALITY CONTROL

The Contractor at no cost to the Department shall replace or repair damaged or defective installations. The method to be used shall be designed by the Contractor's Engineer and approved by the Department's Engineer.

(A) Ground movement

Before excavation, establish control points for measuring settlement of the road at 3 m intervals along the centerline and 1.0 m each side of the pipeline. A licensed Land Surveyor shall monitor these points daily until construction is complete.

Cease trenchless operations when measured settlement exceeds 6 mm. Determine cause of settlement and repair as necessary. Modify trenchless methods as needed.

(B) Line and Grade

Abandon and grout all pipes that are not at required alignment and grade in conformance with Section 1530.

Trenchless installation of proposed water main may not vary more than 2% of total length from required horizontal alignment, one meter from vertical alignment, and shall maintain minimum cover.

Trenchless installations for grade and alignment dependent pipes such as sewers may not vary.

(C) Leakage

Control leakage through tunnel walls to minor seepage. Seal all leaks in pipes, casing, or other permanent shoring.

(D) Roundness

Provide permanent shoring with at least 95% of nominal diameter in all directions.

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(E) External voids

Fill all external voids greater than 50 mm high or wide. Fill with compacted class II or III select material, flowable fill, or grout.

1550-6 MEASUREMENT AND PAYMENT

Trenchless Installation of _____ in Soil will be measured and paid per linear meter. Measurement will be made horizontally to the nearest tenth of a linear meter.

Trenchless installation of _____ Not in Soil will be measured and paid per linear meter. Measurement will be made horizontally to the nearest tenth of a linear meter.

Trenchless installations will be considered *In Soil* unless classified as *Not In Soil* by observation of the Engineer. *Not In Soil* is all material other than soil as determined and observed by the Department's Engineer. It is the Contractor's responsibility to request and obtain the Department's Engineer's observation for installations *Not In Soil*.

Measurement will be made along utility pipes with required trenchless installation. Payment for trenchless installation will be made as additional compensation for utility piping with contract pay items of the various sizes. No additional payment will be made for access pits or shoring. No payment will be made for abandoning defective installations.

Payment will be made under:

Pay Item	Pay Unit
<i>Trenchless Installation of _____ in Soil</i>	Linear Meter
<i>Trenchless installation of _____ Not in Soil</i>	Linear Meter