

08030 Water Main Construction

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08030-1 Scope

The General Conditions, Specific Conditions and Material Specifications form an integral part of these Specifications and shall be read in conjunction herewith.

This Section shall include Water Connections Construction not regulated by Section 08025 wherein water service connections are greater than 50mm in diameter.

The Contractor shall supply all material, labour, equipment, plant and tools necessary to construct the water mains complete with hydrants, valves and fittings within and/or under the jurisdiction of the City of Saskatoon.

1.1 Existing Infrastructure - Requirements and Fees

Certain fees for inspection, tapping mains, pavement and concrete repair, detouring services and public liability insurance shall be charged by the City to the Contractor on completion of the work.

The contractor shall obtain the conditions of work and fee rates by contacting the Water & Sewer Connections Desk at 975-2461 before estimating or commencing any particular project. The Water & Sewer Connections Desk will outline the requirements and fees so that the Contractor shall know in advance and the safety of the water and sewer system remains intact.

Before any work within the City Right-of-Way is performed, the Contractor shall have an approved permit "Use of Right-of-Way Permit". This permit shall be obtained by contacting the Transportation Right of Way Group at 975-2460. There may be restrictions on times and dates that portions of Right-of-Way may be available and this will be outlined in the Use of Right-of-Way permit.

08030-2 Existing Utilities and Structures

The location and elevation of existing underground utilities is compiled from records but is not guaranteed. Notwithstanding any other provision, the Contractor shall be responsible for determining at his expense the actual location and elevation of all sewer, water and gas lines, power, telephone or telecommunications conduits, or other such structures or utilities whether or not shown on the plans. The Contractor shall be responsible for notifying the respective utility at least 48 hours in advance of his

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intention to carry out operations in the vicinity of the said utility and if required shall pay for any services supplied for locating these utilities.

When in the course of the work, existing utilities must, for reasonable cause, be temporarily disconnected, the Contractor shall be wholly responsible for notifying all persons affected, at least 48 hours in advance of the outage. The Contractor shall contact the utility owner who may disconnect the utility himself or supervise the Contractor during disconnection. In no case shall the Contractor operate any utility without the approval of the owner.

When a utility is exposed during construction, the Contractor shall immediately inform the owner of the utility, who may inspect the utility prior to backfilling.

Any accidental damage such as severing a cable, scraping the coating on an underground pipe or rupturing the pipe must be reported immediately through the appropriate emergency number.

Where existing utilities or other street improvements are found to be within the lines of the work the Engineer shall be notified. The Contractor shall then proceed as directed by the Engineer or the respective utility corporation.

All costs incurred for the disruption of service and for the repair of surface and/or underground utilities damaged by the Contractor's operation shall be the Contractor's responsibility.

Existing sidewalks and curbs, mains, service connections, catch basin leads and structures removed or damaged by the Contractor shall be repaired or replaced by the Contractor at his own expense.

Maintenance of existing utilities and structures which were disturbed or repaired by the Contractor, shall be the responsibility of the Contractor for the duration of the maintenance period.

08030-3 Excavation

3.1 General

Excavation shall be taken to mean the removal from the trench of all material of whatever kind encountered, for the construction therein of all water mains and
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appurtenances. All excavations shall be made to the lines and grades as shown on the plans or as established in the field by the Engineer.

3.2 Trenching

At no time will the length of trench that is not backfilled to finished grade exceed 100 meters. The walls of the trench shall be sloped or shored up to prevent caving, in accordance with the requirements of the Occupational Health and Safety Regulations. All water encountered in the trench shall be pumped out before saturation of the pipe bedding material occurs. The discharge from the trench dewatering pumps shall be conducted away from the site of the work and into natural drainage channels, drains or storm sewers.

The trench shall be excavated so as to provide a uniform and continuous support for the pipe and fittings on solid undisturbed ground. Any over-excavation by the Contractor below the required grade shall be backfilled at his expense with compacted bedding material.

The earth taken from the trench shall be neatly deposited at the sides, in such manner as to obstruct the street or lane as little as possible. Where it is impracticable in the opinion of the Engineer to place the earth at the side of the trench, it shall be removed and deposited as designated by the Engineer.

The Contractor shall repair all walls, crib work, culverts, drains, ditches and embankments which it may be necessary to remove or to pass through in laying the pipes.

The Contractor shall provide for all surface water courses and drainage systems interrupted during the progress of the work, and replace them in as good condition as originally encountered.

The Contractor shall remove all pavement from the surface of any area to be excavated prior to starting the excavation.

The edges of the areas to be removed shall be precut in straight lines for the full depth of the pavement.

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The Contractor shall then remove the pavement and transport it to the storage site designated by the Engineer.

3.3 Trench Width

The minimum trench width below the crown of the pipe shall be whichever is greater between the outside diameter of the pipe plus 450 mm, or 1.25 multiplied by the outside diameter plus 300mm.

The maximum trench width below the crown of the pipe, for pipes with a nominal diameter of 300 mm or less, shall be 1050 mm.

3.4 Rock Excavation

Rock excavation is defined as boulders, pieces of concrete, or masonry equal to or exceeding 1 cubic metre in volume.

The Contractor shall, use methods other than explosives such as drilling and wedging to split very large boulders prior to removing them from the trench.

Where the excavation is made in rock or in another material which cannot provide an even, uniform surface, all of the projections of such material shall be removed to provide a clear space around the pipe and fittings. The minimum dimension for this clear space shall be 150 mm for pipe having an outside diameter less than or equal to 600 mm and 225 mm for pipe having an outside diameter greater than 600 mm.

The subgrade shall then be made by backfilling with bedding material compacted in 150 mm layers to provide a uniform and continuous support for the pipe.

3.5 Unstable Subgrade

Where, in the opinion of the Engineer, the bottom of the trench at the subgrade below the pipe bedding is found to be unstable or to contain organic or other deleterious material which would not provide a sound foundation for the pipe, the Contractor shall remove such materials to the width and depth ordered by the Engineer and shall replace it with crushed rock, compacted in 150 mm layers. Prior to placing the crushed rock, geotextile fabric shall be installed flat on the trench bottom. The fabric shall extend up the trench walls to accommodate a minimum seam overlap of 900mm or

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equivalent to the trench width. The top surface of the crushed rock shall be covered with geotextile fabric before any pipe bedding aggregate is placed.

Where, in the opinion of the Engineer, additional support is required for the pipe, the Contractor shall supply all materials and shall construct such additional support in accordance with the plans and specifications which will be provided to him by the Engineer.

08030-4 Temporary Protective Structures

The Contractor shall protect excavations, trenches, shafts and tunnels from cave-ins, collapse, sliding or rolling materials by cutting back the walls and/or supplying and installing Temporary Protective Structures as required by the Occupational Health and Safety Regulations and as may be necessary to protect adjacent property and the work.

The Contractor shall install Temporary Protective Structures to prevent movement in the sides of the excavations. All material required, as well as the labour required for the installation, shall be furnished by the Contractor as part of this Contract.

The Contractor shall ensure that, where required by the Occupational Health and Safety Regulations, a professional engineer certifies that the Temporary Protective Structure, if constructed as drawn, and installed and used as instructed, will provide adequate protection to any worker constructing, installing or using the Temporary Protective Structure. The Contractor shall, prior to commencing construction, provide the Engineer with a copy of this certification for each Temporary Protective Structure which will be used on the project.

The right of the Engineer to order sheeting, bracing, underpinning or any other form of brace or support shall not be construed as creating any obligation on his part to issue such orders and his failure to exercise his right to do so shall not relieve the Contractor from his responsibility for damages to persons or property arising from or upon the work of construction occasioned by negligence or otherwise growing out of a failure on the part of the Contractor to leave in place in the trench sufficient sheeting and bracing to prevent any caving or moving of the ground adjacent to the sides of the trench, or for failure to construct and maintain proper support of all kinds whatsoever in the first instance.

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Sheeting and bracing ordered left in place must be cut off and removed for a depth of 900 mm below the established street grade or the existing surface of the street, whichever is lower.

08030-5 Preparation of Trench Bottom

The Contractor shall remove any water which has accumulated in the excavation by pumping before any bedding is placed. The previously installed pipe shall not be used to drain the trench. Loose material shall be removed from the surface and the subgrade shall be thoroughly compacted.

08030-6 Pipe Bedding

6.1 General

The type of bedding to be used with each size and class of pipe shall be as shown on the Tender Form and in the Specific Conditions. The following various classes of bedding are detailed on the current City of Saskatoon Standard Drawing as posted on the City's Internet web site.

6.2 Bedding

The pipe shall be bedded on a layer of approved fine granular material as defined in Section 08000-7.1 shaped to fit the lowest part of the pipe exterior. The required minimum depth of the granular material under the pipe shall be as outlined on the current City of Saskatoon Standard Drawing as posted on the City's Internet web site for various pipe diameters and shall extend up the sides of the pipe to a height equal to one-half (1/2) of the outside diameter of the pipe. Care shall be taken to completely fill all voids under the pipe. The bedding material shall be placed in 150 mm layers and shall be compacted to 98% of Standard Proctor Density using mechanical compaction equipment.

08030-7 Pipe Laying and Jointing

7.1 General

The pipe shall be protected against impact shocks and free fall during handling and shall be kept clean at all times. All pipe to be used for water main distribution shall be sealed before leaving the production plant and shall remain sealed throughout
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transportation and storage onsite until installed. Each pipe shall be carefully inspected prior to being lowered into the trench and those not meeting specifications shall be rejected and shall be removed from the site of the work. The individual lengths of pipe shall be installed so that the spigot end can be inserted into the bell of the previously installed pipe. The Contractor shall excavate the trench deeper at the location of each joint to facilitate making the joint and so that the pipe will not rest on the bell when it is installed. Each pipe shall be installed so that the bedding material will support it evenly throughout its entire length. The interior of the pipe and the bell must be cleared of all foreign material before the joint is made.

The Contractor shall supply a watertight cap or plug which shall be installed on the end of the pipe while excavation is in progress and when the Contractor leaves the site of the work.

7.2 Alignment and Grade

Water mains shall be installed according to the lines and grades shown on the plans or as staked in the field by the Engineer. The Contractor shall transfer the line and grade to the water main by means of an approved batter board and boning rod system, laser beam system, or other system approved by the Engineer.

7.3 Polyvinyl Chloride (PVC) Pipe

Polyvinyl Chloride (PVC) shall be installed as per AWWA C605 unless specified otherwise.

PVC pipe shall be jointed as follows. The bell, spigot and rubber gasket shall be cleaned with a clean cloth, removing all traces of dirt, grit or plastic cuttings. A thin film (equivalent to a brushed coating) of an edible, vegetable based lubricant manufactured for this purpose shall be applied uniformly to the bell and spigot areas as indicated by the pipe manufacturer's published recommendations. With the assistance of a lever pressing on a wooden cushion block which has been placed against the bell end of the pipe, a uniform force shall be applied until the pipe has been inserted to the reference mark.

The Contractor shall use a fine tooth hand saw or a power cut-off saw to cut the pipe where this is required. The ends shall be cut square and shall be bevelled at 15 degrees through one-half of the wall thickness using a grinding disc or a flat file. The jointing

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reference mark shall be re-established using a factory marked pipe of the same size as a guide.

7.4 Polyethylene Pipe

Polyethylene pipe which is being used for main construction shall be joined by butt fusing the ends of the pipes. The Contractor shall use the specially designed joining machines complete with alignment jigs, trimmers and heating plate which can be obtained from the pipe manufacturer. The Contractor shall provide personnel who have been trained to perform this procedure and shall ensure that the joints are made in accordance with the manufacturer's specifications.

Connections to valves and fittings shall bolted and shall be made using flange assembly consisting of a polyethylene stub-end which must be butt-fused to the end of the pipe and a special metal slip-on flange.

08030-8 Reaction Blocking

Reaction blocking shall be constructed at all hydrants, tees, bends, reducers, caps and plugs. Detailed methods of anchoring and blocking the fittings are shown on the current City of Saskatoon Standard Drawing as posted on the City's Internet web site.

Concrete shall have a minimum strength of 20 MPa at 28 days. Blocking shall be placed between solid ground and the fittings to be anchored. The area of bearing on the ground in each instance shall be as shown on the current City of Saskatoon Standard Drawing as posted on the City's Internet web site. The blocking shall be so placed that the pipe and fitting joints will be accessible for repair. 6 Mil polyethylene sheeting shall be placed between the reaction blocking and the pipe or fittings.

Where metal harness tie rods or clamps form an integral part of the reaction blocking they shall be galvanized or rust proofed by methods approved by the Engineer.

In scenarios where primary water mains (pipe diameter >400mm) are designed with pipe restraints, reaction blocking is not required unless specified.

08030-9 Valves

Valves shall be set accurately at the positions shown on the plans and properly jointed into the main. A guide plate shall be installed below the valve operating nut. The valve
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bonnet shall be set plumb over the guide plate. The valve box shall be set plumb over the valve bonnet. The bottom nut of the extension rod shall be securely fitted on the valve operating nut. On paved streets, the top of the valve box on main and hydrant valves shall be set flush with the finished paved surface. On gravelled streets and lanes, the top of the valve box on main and hydrant valves shall be set 150 mm below the finished gravelled surface. The two bolts in the top section shall be tightened, and a locking ring shall be clamped to the middle section of the valve box to support the top section. The top of the extension rod shall not be more than 600 mm or less than 300 mm below the top of the valve box.

The Contractor shall mark the location of each valve with a 38 mm x 89 mm x 750 mm stake with letters M.V. painted in red on a white background.

08030-10 Hydrants

The Contractor shall install hydrants at the locations as shown on the plans or as directed by the Engineer.

All hydrants shall be installed in accordance with the current City of Saskatoon Standard Drawing as posted on the City's Internet web site.

The hydrant shall stand plumb. The hose nozzles shall be parallel with the curb and the pumper nozzle shall face the street.

The hydrant shall be set so that the ground flange is at an elevation of 100mm +/- 50 mm above finished grade.

08030-11 Cathodic Protection

The Contractor shall supply and install sacrificial zinc anodes to provide cathodic protection for all valves, hydrants and cast iron fittings installed.

The Contractor shall connect a 24 lb. anode to each hydrant and each valve. Where the anode is connected to a valve, the anode wire shall also be connected to the valve box.

The Contractor shall connect a 12 lb. anode to each cast iron fitting, each bolted sleeve-type coupling and to each copper water service line where the existing service lines are being reconnected into the new water main.

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The Contractor shall install the anodes one metre away from the fitting/valve at water main depth and shall connect the anode wire to the cast iron using the "Cadweld" method. The Contractor shall provide experienced personnel who shall make these connections in accordance with the manufacturer's recommendations.

Following welding, the Contractor shall remove all slag from the weld, file off all sharp edges and coat all exposed cast iron surfaces, steel surfaces and "Cadweld" locations with corrosion prevention paste and tape.

When the installation is complete, the Contractor shall pour 10 litres of water over the anode and backfill uniformly around the anode.

08030-12 Backfill

12.1 Initial Backfill in Pipe Zone

The Contractor shall hand place select excavated material which is free from lumps and stones in 150 mm lifts above the granular bedding on both sides of the pipe and to a point 300 mm above the crown of the pipe over the full width of the trench. The Contractor shall compact each lift to 98% of Standard Proctor Density using mechanical compaction equipment.

12.2 Backfill above Pipe Zone

12.2.1 Class I Backfill

Approved granular material with a maximum aggregate size of 75 mm, shall be placed in 300 mm lifts over the whole width of the trench. Each lift shall be compacted to 98% of Standard Proctor Density, using mechanical compaction equipment.

12.2.2 Class II Backfill

Approved excavated material shall be placed in 300 mm lifts over the whole width of the trench. Each lift shall be compacted to 98% of Standard Proctor Density, using mechanical compaction equipment.

This backfill may contain coarse materials but shall be free from brush, frozen or other objectionable material that would prevent proper consolidation or that might cause subsequent settlement.

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Rocks or stones not exceeding 10 kilograms in weight may be placed in this portion of the backfill but must be placed by hand.

The Contractor shall be responsible for controlling the moisture content of the backfill material so that the moisture content **shall be within 2% of the optimum moisture content as determined by the Standard Proctor Compaction Test**. The Contractor shall add water to the material if the moisture content is too low or if the moisture content is too high, the Contractor shall move the material to an approved stockpile area, dry the material and then move the material back to the site of the work. **Any test results over 103%, using any testing method, will be considered suspect and may be discarded at the discretion of the City.**

12.2.3 Class III Backfill

Class III backfill shall consist of approved excavated material free from brush and rocks or stones over 10 kilograms and other objectionable material. Backfill material shall be pushed down a ramp or slope of existing backfill and not directly onto the newly bedded pipe.

The backfill material shall be placed in 750 mm lifts over the whole width of the trench. Each lift shall be compacted to a density which is equal to the density of the adjacent soil.

12.2.4 Backfill around Valves & Hydrants

The Contractor shall carefully select, place and compact backfill material in 150 mm lifts for a distance of 600 mm around each valve and hydrant. The contractor shall compact each lift to a minimum of 98% of the Standard Proctor Density.

12.3 Street Surfaces

12.3.1 General

The Contractor shall use a rubber tired motor grader to spread surface granular materials during compaction and to level earth streets after the backfilling has been completed.

The Contractor shall be responsible for filling trench settlements and repairing street surfaces which settle along the lines of his work during the maintenance period.

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12.3.2 Paved Streets

Where excavation has been carried out on a paved street or on a street which has been based and is ready for pavement, the Contractor shall backfill the excavation up to 300 mm below the level of the original street surface. The Contractor shall then place 300 mm of base gravel to the gradation as specified in Section 08000-7.2 flush with the original street surface and shall compact it to 100% of Standard Proctor Density. Prices tendered for laying pipe, shall include the supply and placing of this gravel unless specified otherwise.

12.3.3 Gravel Streets

Where the excavation has been carried out on a gravel street, the Contractor shall backfill the excavation up to 100 mm below the level of the original street surface.

The Contractor shall then place 100 mm of base gravel to the gradation as specified in Section 08000-7.2 flush with the original street surface and shall compact it to 100% of Standard Proctor Density. Prices tendered for laying pipe, shall include the supply and placing of this gravel unless specified otherwise.

12.3.4 Earth Streets

Where excavation has been carried out on a graded earth street, the Contractor shall backfill the excavation up to the level of the original street surface.

Where the surface of the street has not previously been cut to grade, the Contractor shall spread and level any surplus excavated material over the top of the excavation.

12.3.5 Surplus Excavated Material

Where excavation has been carried out on a paved street, gravelled street or graded earth street all of the excavated material may not be required for backfilling. The Contractor shall load and haul this surplus excavated material to the nearest earth dumping site or to the location as specified in the Specific Conditions. The costs of disposing of this material shall be included in the Contractor's unit prices for constructing water main.

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08030-13 Field Pressure Testing

Hydrostatic pressure testing of PVC water mains up to 350mm in diameter shall conform to AWWA C605 unless specified otherwise.

All water mains installed shall be subject to a hydrostatic pressure test in the presence of the Engineer after backfilling has been completed and the mains have been flushed with potable water prior to chlorination.

The Contractor shall furnish all labour and equipment necessary to make the tests including the costs of tapping the pipe if required. Water for the test shall be supplied to the Contractor without charge.

The Contractor shall subject each section of water main to a test pressure of 1034kPa for a period of 2 hours. Additional water shall be added from a measured container as required to maintain this pressure during the test.

The test section will not be accepted if the leakage in litres measured by the above method exceeds the quantity determined by the following formula:

$$L_{PVC} = \frac{NxDx(P)^{0.5}}{130,400}$$

Equation 1: Maximum Allowable Leakage

where:

- L_{PVC} = Allowable leakage in litres per hour.
- N = Number of joints in the test section (including all associated appurtenances).
- D = Nominal diameter of the pipe in millimetres.
- P = Average Test Pressure in kilopascals (kPa).

Note: Hydrostatic pressure testing procedures for pipe types other than C900 CL150 PVC, shall be done in accordance with current AWWA and ASTM standards, the pipe manufacturer's published recommendations and at the Engineer's discretion.

If the leakage exceeds the allowable, the Contractor shall locate and repair leaks and defects and repeat the tests until the leakage does not exceed the allowable.

08030-14 Disinfection

No extra payment will be made for disinfection.

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14.1 Backflow Protection

The new water main shall be kept isolated from the active distribution system using an approved physical separation, backflow protection, until the disinfection water has been flushed out and satisfactory testing has been completed.

14.2 Chlorinating

Hydrants shall not be used for chlorine injection.

The method chosen to disinfect the water mains shall conform to AWWA C651 Standards, and utilize liquid chlorine solutions as described in AWWA B301 Standards. Deviations from either of the aforementioned Standards, including the initial liquid chlorine concentration, must be approved by the Engineer.

If a deviated method has been agreed upon, if at any time during the process the free chlorine residual drops below 50% of the initial chlorine concentration, then the chlorine concentration shall be restored to the approved initial concentration and the exposure time shall be restarted.

14.2.1 Modified-Slug Method of Chlorinating

The City has approved a modified-slug method of chlorinating. This method consists of completely filling the main with water dosed with chlorine to a concentration of not less than 100 mg/L. All parts of the main and its appurtenances will be exposed to the highly chlorinated water for a period of not less than three (3) hours.

The free chlorine residual shall be measured in the main. If at any time the free chlorine residual drops below 100 mg/L the chlorine concentration shall be restored to the initial concentration, and the exposure time shall be restarted.

Table 1: Chlorine Concentration Requirements for Modified-Slug Method

Chlorine Concentration Measurements	Minimum Free Chlorine Concentration (mg/L)	Maximum Free Chlorine Concentration (mg/L)
Initial Concentration	100	200
Post Exposure Concentration	100	n/a*

* Post exposure only requires the minimum free chlorine concentration requirement to be met

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14.3 Dechlorinating

The method to dechlorinate the water mains shall conform to AWWA C655 standards, including the dechlorinating plans and procedures.

Solid debris will not be allowed to enter the sanitary or storm sewer systems and must be removed to an approved disposal site.

08030-15 Field Sampling for Bacteriological Tests

The City shall conduct all sampling.

Water sample collection for bacteriological testing shall be as per AWWA C651 Standards. Ambiguities, if any, in the AWWA C651 Standard shall be clarified by the Engineer prior to sampling.

The Contractor shall provide a sampling port, free from interior threads and able to be throttled, so that samples can be collected by City staff.

The City water field sampling requirements are as follows:

Table 2: Field Water Sampling Requirements

Description of Measurement	Measurement
Min. Total Chlorine (mg/L)	0.7
Min. Typical Total Chlorine (mg/L)	1.0
Max. Typical Total Chlorine (mg/L)	2.2
Max. Total Chlorine (mg/L)	3.0
Max. Turbidity (NTU)	1.0

Water samples for bacteriological testing shall be taken when total chlorine measurement results are within the typical range unless otherwise endorsed by the City of Saskatoon Water Laboratory.

08030-16 Bacteriological Tests

The City shall conduct all bacteriological testing.

The City water bacteriological test result requirements are as follows:

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Table 3: Bacteriological Test Result Requirements

Bacteria Test Type	HPC (ct/mL)	TC (ct/100mL)	NC (ct/mL)
Max. Allowable Limit	50.0	0.0	50.0

Bacteriological test result requirements must be fulfilled prior to the water main being placed into service.

08030-17 Clean Up

The Contractor shall clean up the site as the work progresses.

The Contractor shall remove all of his equipment, plant, tools and surplus material from the site of the finished work and shall repair and restore all drainage facilities which have been blocked or damaged as a result of the Contractor's operations.

End of Specification 08030

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