

EXCAVATING, TRENCHING AND BACKFILLING

1. GENERAL

1.1 Scope of Work

- .1 This Section outlines the requirements for excavation, backfilling, and compaction for works related to trenching of buried underground works only. Excavation, backfilling, and compaction requirements for works related to pavement structures are specified in other section of this Document.

1.2 Definitions

- .1 Solid Rock: material excavated from solid masses of igneous, sedimentary, or metamorphic rock which, prior to its removal, was integral with its parent mass and boulders or rock fragments or concrete having individual volume in excess of 1 m³. Frozen material is not classified as rock.
- .2 Common Material: materials of whatever nature, which are not included under the definition of solid rock, including dense tills, hardpan, frozen materials, and partially cemented materials which can be ripped and excavated with heavy construction equipment.
- .3 Top Soil: material capable of supporting good vegetation growth and suitable for use in top dressing, landscaping, and seeding.
- .4 Trenchless Installation: any method of installing pipe inside a hole that has been made between shafts by coring, boring, horizontal directional drilling, jacking, tunneling, and extraction of existing pipe or similar methods with minimal excavation and surface disruptions.

1.3 Protection

- .1 Existing Buried Utilities:
 - .1 Size, depth, and location of existing utilities as indicated are for guidance only; completeness and accuracy are not guaranteed.
 - .2 Prior to commencing any excavation work, notify applicable utility authorities, establish location and state of use of buried services. Clearly mark such locations to prevent disturbance during work.
 - .3 Confirm locations of buried utilities by careful test excavations and according to applicable utility guidelines.
 - .4 Maintain and protect from damage, water, sewer, gas, electric, telephone, and other utilities encountered.
 - .5 Obtain direction of owner of utility and Contract Administrator before moving or otherwise disturbing utility. Repair any damage to utilities in accordance to the direction of the Utility owner at no cost to the City.
 - .6 Remove abandoned utility service lines encountered from areas of construction. Cap, plug, or seal such lines and identify at grade with markers.

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- .7 Accurately locate and record abandoned and active utility lines re-routed or extended on Record Drawings.
- .8 Be responsible to arrange and pay for site inspector or other personnel from the respective utility as required by the respective utility during crossing operations.
- .2 Existing Surface Features:
 - .1 Protect existing buildings, trees and other plants, lawns, fencing, poles, wires, sidewalks, curbs, bench marks and monuments, paving, and other surface features located within right-of-way or adjoining properties from damage while work is in progress and repair damage resulting from work as an incidental. Excavations are not to encroach on normal 45° bearing support under any foundation.
 - .2 Avoid disturbing roots of trees shown to remain. If excavation through roots is required, excavate by hand and cut roots cleanly.
 - .3 Avoid disturbing trees shown to remain. If pruning is necessary, make cuts clean, smooth, and slanted. Apply tree paint on all wounds.
 - .4 Maintain unobstructed access to fire and police appurtenances, telephone, electric, water, sewer, gas and other public utilities, and private properties.
 - .5 Make good all damage occurring as a result of inadequate, unauthorized or defective methods of protection.
 - .6 Protect open excavation against flooding and damage from surface water run-off.

1.4 Measurement and Payment

- .1 Work performed under this section shall be incidental to work performed in other sections.
- .2 Where excavation is made below depth shown through error, fill to required depth with Type 2 granular backfill at no additional cost to City. Compact to 95% of Standard Proctor Dry Density.
- .3 Any material excavated from trench which is suitable for backfill but in excess of requirements for that trench backfill shall be available for use in backfilling or replacing any unsuitable materials in other trenches. No extra payment shall be made for moving this site material from one location to another.
- .4 Any excess material from trench excavations shall be removed and disposed of at a location approved by the City as an incidental to the works.
- .5 Granular Backfill:
 - .1 Granular backfill to replace unsuitable material in utility trenches shall be paid for, when ordered by the Contract Administrator in writing, at the Contract Unit Price per cubic metre of the material which shall be full compensation for supplying, placing, compaction of gravel. Measurement of each class of granular backfill shall be based on the number (volume) of cubic metres supplied, placed and compacted for each class.

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- .2 Payment under this clause shall be made only when the Contract Administrator has ordered imported gravel in writing. If in the opinion of the Contract Administrator excess site material is available at the time that it is required, from elsewhere in the Contract, the Contract Administrator will have the right to instruct the Contractor to haul that excess material to replace unsuitable material in trenches without any additional compensation. No payment will be made under this Clause for fill material required to replace excavated rock. The rock excavation price is to include replacement fill. No compensation will be allowed when these conditions have resulted from acts, neglects, or delays on the part of the Contractor or from the presence of ground or surface water.
- .6 When in the opinion of the Contract Administrator over excavation is required due to the natural existence of unsatisfactory soil conditions. The Contract Administrator will have the right to order granular backfill material and compensation will be made accordingly.
- .7 Locating Existing Utilities: No measurement shall be taken for "Locating Existing Utilities". Payment for "Locating Existing Utilities" paid at the Contract Lump sum unit price. All works including equipment mobilization, saw cutting of pavement, hydrovac excavations, backfilling of holes, measurement of elevations and alignments, and all other work necessary or incidental to the work for which no prices or provisions are included in the Contract.

2. PRODUCTS

2.1 Bedding and Backfill

- .1 Type 1 material shall be well graded pit run conforming to the gradation as per Table 1 following.
- .2 Type 2 and Type 3 material shall be sound, hard, crushed rock or crushed gravel free from shale, clay, and organic matter which would disintegrate through decay or weathering conforming to the grading requirements outlined in Table 1 below.

Table 1

Canadian Metric Sieve Size	Percent of Total Dry Weight Passing Each Sieve		
	Type 1 Material	Type 2 Material	Type 3 Material
75,000	90 – 100		
28,000	80 – 100		100
20,000		100	
5,000	40 – 80	40 – 70	0 – 5
2,500		25 – 60	
315	10 – 35	8 – 25	
80	5 – 30	6 – 17	
Abrasion Loss	Maximum 35%	Maximum 35%	

- .3 Materials passing the 315 micrometre sieve is to have a liquid limit not greater than 25 and a plasticity index not greater than six.
- .4 Abrasion testing to be in accordance with Grading B of ASTM C131.
- .5 Type 2 material to have a 100% crush count and be well graded throughout.
- .6 Sand shall be clean, and free running, conforming to the grading requirements outlined below. Under freezing conditions, dry sand shall be used.

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Cdn. Metric Sieve Size	Per Cent Total Dry Weight
10,000	100
5,000	90 – 100
630	25 – 60
80	0 – 3

- .7 Common Backfill Material: Approved material selected from trench excavation or other source, unfrozen and free from cinders, ashes, sod, refuse or other deleterious materials.
- .8 Cement Stabilized Fill: Cement stabilized fill shall be a blend of Type 10 normal cement, aggregates, and water materials. The material shall develop a 28 day compressive strength of 0.3 MPa to 0.7 MPa utilizing a maximum aggregate size of 20 mm.
- .9 Flowable Cement Stabilized Fill: Flowable cement stabilized fill shall be a blend of Type 10 normal cement, aggregates, and water materials to provide a minimum 200 mm slump and develop a 28 day compressive strength of 0.3 MPa to 0.7 MPa. The maximum aggregate size utilized in the mix shall be 5 mm. Air content to be a minimum of 20%.

3. EXECUTION

3.1 Site Preparation

- .1 Remove trees, shrubs, vegetation, fences and other obstructions, ice and snow, from surfaces to be excavated within limits indicated.
- .2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface will break evenly and cleanly.

3.2 Alignment

- .1 Do not deviate from the centre line alignment by more than 100 mm.
- .2 Where elevations are given on the stakes or a proposed pipeline profile is provided, install piping within 25 mm of the required elevations unless otherwise approved by the Contract Administrator. When the pipe installation is a gravity sewermain the pipe shall be installed within 12 mm of the required elevations.
- .3 Replace any piping installed which deviates from the limits stated above.
- .4 In cases where no profile of the proposed pipeline is provided, the plans or specifications shall specify a minimum depth of cover for the pipeline. The minimum pipe depth shall be 2.5 m from the top of the pipe to existing ground surface prior to construction unless otherwise approved by Contract Administrator.
- .5 Utilize laser equipment for grade control on all gravity mains.

3.3 Stockpiling

- .1 Stockpile fill materials in areas designated. Stockpile granular materials in manner to prevent segregation.
- .2 Protect fill materials from contamination.

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- .3 Do not damage existing roadways or surface features with stockpiled material.

3.4 Shoring, Bracing and Underpinning

- .1 Provide shoring, bracing, and underpinning in accordance with all applicable safety regulations, provide safe access and egress to the area and permit placing, and tamping of bedding material under and around piping.
- .2 Shoring to be in accordance with the Province of Manitoba "W210, The Workplace Safety and Health Act" and "Guidelines for Excavation Work".
- .3 Use suitable type of shoring for soil conditions.
- .4 Shoring, Bracing and Underpinning: Whenever underpinning, shoring, sheeting, timbering and bracing of excavations is required, engage services of a Professional Engineer to design and assume responsibility for adequacy of shoring, bracing, and underpinning. Professional Engineer shall be registered in province or territory in which work is to be carried out.
- .5 Prefabricated cages or shields may be used to supplement or replace conventional shoring, provided they comply with all applicable safety regulations and permit placing, and tamping of bedding material under and around utility piping.
- .6 When requested, submit for review drawings and calculations signed and stamped by Professional Engineer responsible for their preparation.
- .7 Shoring, bracing, and underpinning shall be inspected by the Professional Engineer responsible for their preparation.
- .8 Underpin and support structures, service lines and piping which may be damaged by excavation work.
- .9 Shoring shall be designed and constructed to prevent adjacent soil from entering excavation and to prevent any damage to pipes and structures being constructed, and to existing underground and surface features.
- .10 Use type and method of shoring that will not disturb the compacted foundation and bedding during removal of shoring.
- .11 Unless otherwise indicated or directed from Contract Administrator, remove sheeting and shoring from excavations.
- .12 Do not remove bracing until backfilling has reached respective levels of such bracing.
- .13 When shoring is required to remain in place, cut off tops at elevations indicated or directed by Contract Administrator.

3.5 Site Drainage and Excavation Dewatering

- .1 Maintain existing site drainage around excavations in such a manner as to prevent surface run-off from entering excavation.
- .2 Control grading in and adjacent to excavations to prevent water running into excavated areas or onto adjacent properties or public thoroughfares.

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- .3 Keep excavations free of water while work is in progress.
- .4 Protect open excavations against flooding and damage due to rainfall and surface run-off.
- .5 Dewater trenches as required to permit progress of work. Provide temporary drainage and pumping as necessary. Dispose of water in a manner not detrimental to public health, environment, public and private property, or any portion of work completed or under construction.
- .6 Provide flocculation tanks, settling basins, or other treatment facilities and sediment control measures to remove suspended solids or other materials before discharging to storm sewers, water courses, or drainage areas. Do not permit soil laden run-off and silt to affect ditches or watercourses.
- .7 Submit details of proposed dewatering methods for Contract Administrator's review.
- .8 Do not discharge drainage water lines into municipal sewers without municipal approval. Ensure water discharge does not contain silt held in suspension.

3.6 Excavation

- .1 Perform excavation works in accordance with Province of Manitoba "*W210, The Workplace Safety and Health Act*" and "*Guidelines for Excavation Work*".
- .2 Excavate to lines, grades, elevations, and dimensions indicated or as directed.
- .3 Remove unsuitable material, rubble, and other obstructions encountered during excavation. Do not use these materials in backfill.
- .4 Minimum trench width to be 300 mm greater than outside pipe diameter.
- .5 Maximum trench width at top of pipe to be not greater than outside pipe diameter plus 900 mm plus allowance for timbering or prefabricated cage.
- .6 If maximum trench width is exceeded through error, provide a better class of bedding to Contract Administrator's approval at no additional cost to City.
- .7 Excavation must not interfere with normal 45° display of bearing from bottom of any footing.
- .8 Remove boulders and large stones to provide 150 mm minimum clearance under and on side of pipe.
- .9 Notify Contract Administrator when soil at proposed elevation of trench bottom appears unsuitable for foundation of installation. Remove unsuitable material from trench bottom to extent and depth directed by Contract Administrator.
- .10 Unless otherwise authorized by Contract Administrator in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.
- .11 Dispose of surplus and unsuitable excavated material in approved location.
- .12 Stockpile suitable excavated materials required for trench backfill in approved location.

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- .13 Do not obstruct flow of surface drainage or natural watercourses.

3.7 Trench Bottom Preparation

- .1 Ensure the bottom of excavation is undisturbed soil, level, free from depressions, soft organic matter, lumps, and protruding objects.
- .2 Hand trim, make firm and remove loose material and debris from excavations. Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.
- .3 Where required due to removal of unsuitable material or unauthorized over-excavation, bring bottom of excavation to design grade with Type 2 granular backfill material. Compact material to a minimum of 95% standard Proctor Dry Density.

3.8 Pre-installation Inspection

- .1 Excavations require inspection and approval prior to commencement of installation operations.

3.9 Foundation and Pipe Bedding

- .1 Ensure trenches are free from debris, snow, ice and water, and that ground surfaces are not in a frozen condition.
- .2 Do not proceed with bedding operations until Contract Administrator has reviewed installations.
- .3 Classes of bedding are as follows:
 - .1 Class A Bedding (Concrete Pipe Only) – 20 MPa non-reinforced concrete cradle in accordance with details as outlined on the Construction drawings. Utilize specified compacted sand, Type 2 or Type 3 bedding for the remainder of the bedding and initial backfill to a minimum height of 200 mm above the pipe.
 - .2 Class B Bedding – Specified compacted sand, Type 2 or Type 3 bedding and initial backfill from a minimum depth of 150 mm below the pipe to a minimum height of 200 mm above the pipe.
 - .3 Bedding material shall be placed in the trench such that the pipe is supported along its entire length (and under bells and flanges) at the thickness specified. Additional bedding material shall be placed and compacted around and 200 mm above the pipe for the entire width of the trench. Place and compact layers uniformly and simultaneously on each side of pipe to prevent lateral displacement of pipe.
- .4 Use Class B bedding unless otherwise specified.
- .5 Bedding to include material that supports the pipe and extends up to an elevation of 200 mm above the pipe. Ensure bedding of pipes and utilities to 200 mm above top of pipes and utilities (or as specified in other Sections) is satisfactorily completed prior to installing backfill.

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3.10 Classes of Backfill

- .1 Backfilling to include the material 200 mm above the pipe to the ground surface. Following are classes of backfilling:
 - .1 Class 1 – Backfill utilizing Type 1 material compacted to a density of at least 95% Standard Proctor Dry Density to within 1.0 metres of underside of pavement. Fill the remainder of the excavation with cement stabilized fill to required depth below finished pavement as indicated on the drawings or as directed by the Contract Administrator.
 - .2 Class 2 – Backfill utilizing Type 1 material in maximum 300 mm thick lifts to grades as indicated on the drawings or as directed by the Contract Administrator. Compact each layer to a density of at least 95% Standard Proctor Dry Density. Place and compact layers uniformly and simultaneously on each side of pipe to prevent lateral displacement of pipe. Obtain Contract Administrator's approval prior to proceeding with the next lift.
 - .3 Class 3 – Backfill utilizing Type 1 material to grades as indicated on the drawings or as directed by the Contract Administrator. Compact backfill material by jetting, flooding, and tamping in accordance with specifications outlined below in item 3.11.
 - .4 Class 4 – Backfill utilizing suitable excavated material in maximum 600 mm thick layers to ground surface as directed by the Contract Administrator. Compact each layer to a density equivalent to that of the surrounding unexcavated material. Place and compact layers uniformly and simultaneously on each side of pipe to prevent lateral displacement of pipe. Obtain Contract Administrator's approval prior to proceeding with the next layer.
 - .5 Class 5 – Backfill utilizing suitable excavated material in maximum 600 mm thick layers to ground surface as directed by the Contract Administrator. Compact backfill material by jetting, flooding, or tamping in accordance with specifications outlined below in item 3.11.

3.11 Jetting, Flooding, and Tamping of Backfill

- .1 Use a minimum 25 millimetre diameter rigid pipe of suitable length for jetting excavations. Jetting nozzles to be insert along the centerline of the trench at maximum 1,500 mm spacing between jetting nozzles.
- .2 Insert the jetting pipe into the backfill to within 1 metre of the top of pipe. Allow water from jetting action to determine rate at which jetting pipe is worked through backfill.
- .3 Continue jetting until water migrates to top surface of the backfill and begins to pond.
- .4 Tamp backfill with backhoe mounted vibratory compactor after sufficient drying of surface has occurred.
- .5 Place and compact additional backfill as required to bring backfill surface to desired grade.

3.12 Backfilling

- .1 Do not proceed with trench backfilling operations until Contract Administrator has reviewed and approved installations.

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- .2 Areas to be backfilled to be free from debris, snow, ice, water, and frozen ground.
- .3 Do not use backfill material which is frozen or contains ice, snow, or debris.
- .4 Backfill excavations as per the following:
 - .1 Trenches and excavations located within existing paved areas and areas proposed to be paved: Utilize Class 1, Class 2, or Class 3 backfill as indicated on the drawings and specifications or as directed by the Contract Administrator.
 - .2 Trenches and excavations within 1 metre of a paved area: Utilize Class 3 backfill.
 - .3 Trenches and excavations located within boulevards and grassed areas: Utilize Class 4, or Class 5 backfill as indicated on the drawings and specifications or as directed by the Contract Administrator.
- .5 Do not backfill around or over cast-in-place concrete within 24 hours after placing.
- .6 Place layers simultaneously on both sides of installed work to equalize loading.
- .7 Dumping material directly on installations will not be permitted. Place material in maximum 150 mm lifts under, around and over installations until 600 mm of cover is provided.
- .8 Compact using approved mechanical tamping devices, or by hand tamping to achieve specified compaction.
- .9 When a prefabricated cage or shield is used in the trench, special care shall be taken to ensure that there is no lateral or longitudinal movement of the pipe when the cage is moved.

3.13 Existing Pipe Crossings

- .1 Where new pipes are being installed in a trench crossing above an existing pipe, and within a vertical distance of 600 mm; excavate and expose existing piping to a trench width of 600 mm plus the existing pipe diameter. Backfill to underside of bedding required for the new pipe with Type 2 granular material. When trenchless installation is specified, verify the alignment and depth of the existing piping prior to commencing boring, tunneling or coring operations to ensure trenchless works do not damage existing piping.
- .2 Where new pipes are being installed in a trench crossing below an existing pipe, duct, or conduit; support or remove existing pipe, duct, or conduit as directed by the Contract Administrator to permit installation of new pipe. Backfill to underside of bedding required for the existing pipe, duct, or conduit with Type 2 granular material. When trenchless installation is specified, verify the alignment and depth of the existing piping prior to commencing boring, tunneling or coring operations to ensure trenchless works do not damage existing piping.
- .3 Where two utilities cross the minimum vertical separation between the mains shall be 300 mm for pipes 400 mm diameter and smaller. Clearances for pipes 400 mm diameter and larger shall be as indicated on the drawings or as directed by the Contract Administrator. Center length of new pipe on existing utility being crossed.
- .4 Where two mainlines cross and one is a water line and one is a sewer line the vertical distance between the mainlines should be maximized (minimum 200 mm). The sewer and water main pipe shall be laid so that the crossing is in the centre of each length of pipe.

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3.14 Parallel Pipes

- .1 When excavating or trenching adjacent to existing pipes and excavation of lower pipe will disturb existing higher pipe; take all necessary precautions to support and protect existing higher pipe.
- .2 Backfill trenches to invert of existing higher pipe with Type 1 granular backfill compacted to 95% Standard Proctor Dry Density unless otherwise indicated or directed by the Contract Administrator.

3.15 Clean-Up and Restoration

- .1 As backfilling proceeds, keep roads, streets, and sidewalks clean of dirt and excavated material.
- .2 Upon completion of work, remove surplus materials and debris, trim slopes, and correct defects noted by Contract Administrator. Clean and reinstate areas affected by work as directed.
- .3 Clean up any material dropped or spilled during trenching and hauling operations to the satisfaction of the Contract Administrator.
- .4 Haul any excavated and unnecessary material from site and dispose in a manner acceptable to the Contract Administrator. Disposal location as approved by the City.
- .5 Replace topsoil as indicated or directed by Contract Administrator.
- .6 Reinstall ditches to conditions and elevations which existed before trenching.
 - .1 Replace concrete pavement slabs, miscellaneous concrete slabs, curbs and asphaltic pavement in accordance with City of Winnipeg Standard Construction Specification CW3230, CW3235, CW3240, CW3410 and as directed by the Contract Administrator. For concrete repair of existing roadways use "early opening" concrete (24 hours after placement) in accordance with City of Winnipeg Standard Construction Specification CW3310.
 - .2 Restore gravel surfaces in accordance with City of Winnipeg Standard Construction Specification CW3150.
- .7 Complete restoration works as indicated elsewhere in the Specification.

3.16 Settlement

- .1 Promptly repair any settlement of backfill which occurs prior to the end of the warranty period.
- .2 Recompress defective areas and place and compact additional backfill up to grade. Use material matching adjacent surface and compact to specified density.
- .3 Repair damages to other work caused by such settlement as an incidental to the works.

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3.17 Communication / Electrical Underground Cables

- .1 Buried NavCan / communication / electrical cable systems exist which will require crossing during the installation of mainline works. Verify utility locations utilizing HydroVac Excavation prior to commencement of construction to mitigate potential conflicts with locations of proposed underground piping.
- .2 Size, depth and location of existing utilities and structures if indicated are for guidance only. Completeness and accuracy is not guaranteed.
- .3 Notify the utility to locate all cable, complete construction alongside or across utilities in accordance with the regulations set out by the Utility Company. Obtain Utility Company approval of construction procedures.
- .4 Without foregoing any of the Utility requirements some of the requirements include the following:
 - .1 To avoid damage to existing underground cables and services, use HydroVac Excavation method unless otherwise approved by the Utility Company. HydroVac Excavation shall include the following:
 - .1 Use pressurized water and vacuum system to remove soil cover and expose existing underground cables and services.
 - .2 Contain resulting water and earth slurry in truck mounted containment vessel. Dispose of slurry on site at location designated by Contract Administrator.
 - .2 Ensure cable is exposed and visible prior to open cut crossing. Verify utility locations to ensure satisfactory clearance when boring or jacking under utility.
 - .3 For open cut locations, provide pressure treated wood planking as required under cables as support to minimize future sag from settlement.
 - .4 Backfill trenches within 300 mm of exposed cable with sand.
- .5 Repair any damage to utilities in accordance to the direction of the Utility owner at no cost to the City.

END OF SECTION