

DIVISION 02 -CITY OF NORTH BATTLEFORD SPECIFICATIONS

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SPECIFICATION 01100 – SITE CLEARING AND GRUBBING

1 GENERAL

1.1 WORK INCLUDED

- .1 This section refers to general site clearing, which includes:
- .2 Pulling down and disposing of obstructions such as:
 - Fences;
 - Clearing and grubbing consisting of the cutting of trees, brush and shrubs;
 - Removal, piling and disposal of trees (except trees to be preserved), brush, stumps, roots and logs from areas required to facilitate the works.
- .3 Breakout and disposal of existing pavement and concrete.

1.2 REGULATIONS

- .1 Abide by the laws of the Province, Territory and/or Municipality in which the work is located, particularly with regard to fire regulations and public safety.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

- Section 01210 - Stripping and Respreading

2 PRODUCTS

Not applicable.

3 EXECUTION

3.1 CLEARING

- .1 Cut, pile or remove, and dispose of all obstructions such as old fences, signs, trees, brush, shrubs, stumps, roots, logs and rubbish as required for the execution of the work under this contract; except such trees, shrubs etc. as may be designated for preservation by the Engineer.
- .2 Complete site clearing work before commencing earth work.
- .3 The Contractor shall be responsible for locating and protecting all existing underground and surface structures, utility pipelines, overhead lines and poles, fences, water, and sewer mains, building services, cables, culverts, side walks and any other works. All damage incurred shall be repaired by the Contractor at his expense.

END OF SPECIFICATION

SPECIFICATION 01210 – STRIPPING AND RESREADING

1 GENERAL

1.1 WORK INCLUDED

This section refers to stripping of topsoil and organic material, and includes:

- .1 Stripping and stockpiling for re-use.
- .2 Stripping and hauling to disposal.
- .3 Stripping and resreading on completed area inclusive of side slopes.
- .4 Excavating from stockpile and resreading.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

- Section 01223 – Trenching
- Section 01224 – Grading
- Section 01240 – Backfilling

1.3 REGULATIONS

Abide by the by-laws and regulations of the province, territory or municipality in which the work is located, with regard to stream crossings, diversions or alterations to drainage patterns.

1.4 LIMITS

- .1 Strip only those areas shown on the drawings to be stripped, or those areas specified or ordered in writing by the Engineer.
- .2 Strip all roadways, utility lots, lanes, easements and rights-of-way.
- .3 Strip all borrow areas.

2 PRODUCTS

Not applicable.

3 EXECUTION

3.1 STRIPPING AND STOCKPILING

- .1 Strip to depth ordered by Engineer.
- .2 Load, haul and pace in stockpiles in the designated areas.
- .3 Stockpile in a manner that will not endanger persons, the work, or adjacent property.
- .4 Do not mix loam with unsuitable material. The Engineer may require that the Contractor provide a separate stockpile for topsoil contaminated with common material.
- .5 Stockpile topsoil in the designated areas.

3.2 STRIPPING AND DISPOSAL

- .1 Strip organic material that will not be re-used, and strip material which is unsuitable to the Engineer.

- .2 Strip to the depth ordered by the Engineer.
- .3 Load, haul, and dispose of stripped material off the site.

3.3 DISPOSAL AREAS

- .1 Disposal areas shall be shown on the drawings marked in the field by the Engineer.
- .2 Grade the disposal areas to provide adequate drainage, as directed by the Engineer.

3.4 SEPARATE OPERATION

Carry out stripping as a separate operation from the excavation of suitable material.

3.5 Stripping and resreading

- .1 Strip to the depth ordered by the Engineer.
- .2 Load, haul and resread on boulevards, reserve areas, park site areas or as so indicated to the depth shown on the drawings or ordered by the Engineer.
- .3 Timing of resreading of loam from stockpile will not necessarily coincide with grading operations.

END OF SPECIFICATION

SPECIFICATION 01223 - TRENCHING

1 GENERAL

1.1 WORK INCLUDED

.1 This section refers to excavation, maintenance and backfill of trenches for underground pipes including:

- Removal of surface materials and structures.
- Excavation from the trench of all materials of whatever kind encountered so that pipes and structures can be laid to alignment and depth required.
- Support of the adjoining ground or structures.
- Stockpiling and disposal of excess excavated material.
- Control of surface and subsurface water in trenches.
- Temporary railings, coverings and enclosures to excavations.
- Removal and replacement of unsuitable material.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

- Section 01100 – Clearing and Grubbing
- Section 01210 - Stripping and Respreading
- Section 01240 – Backfilling
- Section 06600 - Pressure Pipe
- Section 06720 – Sewer/Gravity Pipe
- Section 06722 – Manholes, Vaults and Catch Basins

2 PRODUCTS

2.1 GRAVEL

.1 Pit-run gravel for stabilization of trench bottoms, as requested by the Engineer, 75mm minus graded to comply with the following sieve analysis:

Passing 25mm - 80% maximum

Passing 5mm - 60% maximum

Passing 80µm - 10% maximum

.2 Base gravel for stabilization of trench bottoms, as requested by the Engineer - maximum size 50 mm crushed rock or gravel.

.3 Screened rock for stabilization of trench bottoms, as requested by the Engineer - maximum size 25mm.

2.2 COMMON BACKFILL

.1 Suitable Material shall be used as common backfill, which is defined as selected material obtained from trench, common or borrow excavations that is free of organic, wet or frozen materials, that is suitable for compacted backfill construction.

- .2 Backfill to be moisture conditioned to +/- 2% of the optimum moisture content as determined by ASTM D698.

2.3 PIPE BEDDING MATERIALS

2.3.1 Granular Materials, General

- .1 Gradation shall be within specified limits when tested to ASTM C136-81 and ASTM C117-80 (AASHTO T11-78 and T2k7-78) and giving a smooth curve without sharp breaks when plotted on a semi-log grading chart.
- .2 Bedding Gravel - crushed gravel to following grading requirements:

Sieve Size	Percent Passing (%)
25 mm	100
20 mm	95-100
10 mm	60-80
5 mm	40-60
1.25 mm	20-40
0.630 mm	9-22
0.080 mm	4-10

- .3 Bedding Sand - sand to following grading requirements (CSA A23.1):

Sieve Size	Percent Passing (%)
10 mm	100
5 mm	95-100
2.5 mm	80-100
1.25 mm	50-90
0.630 mm	25-65
0.315 mm	10-35
0.160 mm	2-10
0.080 mm	0-1

- .4 Screened Rock

Sieve Size	Percent Passing (%)
40 mm	100
20 mm	45-90
5 mm	10-40
2 mm	0-10

2.4 IMPORTED FILL

- .1 Imported backfill material for trenches - free from organic material or any perishable or objectionable material that would prevent proper consolidation. Maximum rock size 100mm.

3 EXECUTION

3.1 INSPECTION OF MATERIALS

- .1 All material supplied is subject to inspection and testing at the discretion of the Engineer.
- .2 Furnish the Engineer a list of sources of materials and furnish without charge sufficient samples, tests and reports as may be required for preliminary approval of the material.

3.2 PROTECTION

3.2.1 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 utilities; clearly mark such locations to prevent disturbance during work.
- .3 Maintain and protect from damage all utilities encountered.
- .4 Obtain authorization from utility owner and Engineer prior to moving or otherwise disturbing utility infrastructure.

3.2.2 Existing Surface Features

- .1 Protect from damage existing buildings, trees and other plants, lawns, fencing, service poles, paving and other surface features located within adjoining properties while work is in progress and repair damage resulting from work.
- .2 Where excavation necessitates root or branch cutting, do so only as approved by the Engineer.

3.2.3 Shoring and Bracing

- .1 Whenever shoring, sheeting, timbering, and bracing of excavations is required engage the services of a professional engineer registered in the province where the work is being completed to design and assume responsibility for the adequacy of shoring and bracing.
- .2 When requested, submit for review drawings and documentation signed and stamped by a professional engineer.
- .3 Shoring and bracing shall be inspected by the professional engineer responsible for their preparation.

.4 Close sheeting, when required, shall be designed and constructed to prevent adjacent soil from entering the excavation and to control water infiltration.

3.2.4 Protect open excavation against flooding and damage from surface water run-off.

3.2.5 Protect the public at all times by securing access to open excavation sites. Secure all open excavations when daily construction activities cease.

3.3 PREPARATION

3.3.1 Site Clearing

.1 Clear the surface of the ground or road within the working area.

.2 Dispose of refuse in a manner satisfactory to the Engineer.

3.3.2 Gravel and Topsoil Removal

Windrow reusable gravel and topsoil, and keep separate from the remainder of the excavated material so that they can be replaced when the backfilling operation has been completed.

3.3.3 Pre-cutting Paved Surfaces

.1 Cut pavement in straight lines parallel to the trench centre line.

.2 Cut width of pavement shall exceed the specified maximum trench width at the ground surface by 0.5m.

.3 Dispose of cut pavement.

3.3.4 Frost Removal

.1 Frost removal is required when frost has penetrated the ground to a depth of 450 mm or more.

3.4 EXCAVATION

3.4.1 General

.1 Excavate to lines, grades, elevations and dimensions indicated on the drawings. For pipe trenches, comply with the Pipe Trench Width Schedule.

.2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

.3 Notify Engineer when soil at proposed elevation of trench bottom appears unsuitable for foundation of installation.

.4 Remove unsuitable material from trench bottom to extent and depth directed by Engineer.

.5 Unless otherwise authorized by Engineer 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.

.6 Stockpile suitable excavated materials required for trench backfill in approved location.

- .7 Dispose of surplus and unsuitable excavated material in approved location.
- .8 Do not obstruct flow of surface drainage or natural water courses.
- .9 Secure all open trenches at the end of daily operations.
- .10 Limit the length of open trench to 50 meters or less and the work zone to 100 meters or less at any location.

3.4.2 Water

- .1 The expense of removing water from trenches, regardless of origin, is the responsibility of the Contractor.
- .1 Divert surface water away from trenches by means of permanent or temporary drainage structures.
- .2 Remove water by acceptable means to allow installation of pipe without detrimental effect on pipes, trench bottom or adjacent property.
- .3 Direct discharge of surface water, pumps or well points away from the work to an acceptable location without damage to the construction or to other property structures or persons.
- .4 Existing sanitary sewers cannot be used to carry away water. Silt or sand laden water cannot be discharged into existing storm sewers.

3.4.3 Rock Excavation

- .1 Rock is defined as:
 - any material that will require for its removal drilling, blasting or breaking up with power operated hand tools;
 - a single boulder(s), or pieces of concrete or masonry with a volume in excess of 0.5 m³.
- .1 No extra payment will be considered, and is incidental to the Work, when soft or disintegrated rock can be removed with a hand pick; or loose and/or previously blasted rock or broken stone which may fall into the excavation occurs.
- .2 Measurements for rock excavation are taken from the top of the rock to 150mm below the pipeline invert at a trench width of the outside diameter of the pipeline plus 300mm.
- .3 Approval by the Engineer must be obtained before blasting can be undertaken. Obtain permits to blast; take precautions to protect persons and property and blast only at times permitted by the Engineer. Observe all the requirements of the Workers Compensation Board respecting explosives and their use.

3.4.4 Unsuitable Material

- .1 Unsuitable material is material in the trench at sub-grade that is unstable or found to contain ashes, cinders, organic material, and large pieces of inorganic material which in the judgement of the Engineer should be removed.
- .2 Excavate and remove unsuitable material to a width and depth ordered by the Engineer. Backfill the sub-grade with an approved material compacted in 150mm lifts to provide a continuous bearing for pipes.
- .3 Compact the backfilled material for the trench bottom to a density at least equal to the density of adjacent surrounding soil.
- .4 Material that becomes unstable or unsuitable through the Contractor's failure to divert surface water or control ground water in the trench shall be excavated, removed, and replaced with approved material compacted in 150 mm lifts at the expense of the Contractor.

3.4.5 Trench Bottom Preparation

- .1 Where required due to removal of unsuitable material or unauthorized over-excavation, bring bottom of excavation to design grade with approved material.
- .2 Compact trench bottom to density at least equal to density of adjacent surrounding soil.
- .3 Grade and shape pipe trench to give uniform and even bearing for each length of pipe.

3.4.6 Pipe Trench Width

- .1 Except as otherwise specified, minimum and maximum trench widths, up to a point 300 mm above top of pipe, shall be as specified in Pipe Trench Width Schedule.
- .2 Maximum trench widths indicated in Pipe Trench Width Schedule exclude an allowance for shoring.
- .3 Trench width at any point shall not be less than trench width at any depth below such point.

3.4.7 Pipe Trench Width Schedule – For Flexible and Rigid Pipe

Pipe Size (Outside Diameter)	Minimum Trench Width	Maximum Trench Width
850 mm diameter or less	300 mm greater than external pipe diameter	600 mm greater than external pipe diameter or 750 mm total trench width, whichever is greater
Greater than 850 mm diameter	300 mm greater than external pipe diameter	600 mm greater than external pipe diameter

3.4.8 Trench Crossings

- .1 Railways - Methods of crossing railway property are subject to the approval of the railway company and "Standards Regulations Regarding Pipe Crossing Under Railways" - The Board of Transport Commissioners for Canada - General Order No. E.10.
- .2 Pipe Lines - Methods of crossing existing pipelines are subject to the conditions of General Order No. 2 - National Energy Board.

3.4.9 Temporary Protective Structures

- .1 Temporary protective structures, bracing, shoring and sheeting are the responsibility of the Contractor.
- .2 Observe safety regulations of the Workers' Compensation Board with regard to protection of the Work, property, structures adjacent to the work and maintenance of the trench widths.
- .3 When close sheeting is required it shall be installed such that adjacent soil cannot enter the trench either below or through sheeting.
- .4 Increase trench widths as necessary to allow placing of supports, sheeting and bracing.
- .5 When damages to adjacent structures will not result, remove temporary protective structures and backfill as specified for the pipe zone and the trench.

3.4.10 Hand Trenching, Tunnelling, Boring

- .1 Employ hand trenching, tunnelling or boring methods where specified on the drawings or ordered by the Engineer.
- .2 Tunnelling, boring or hand trenching may be used if it is to the advantage of the Contractor to use such methods in lieu of machine trenching.
- .3 Observe safety regulations of the Workers' Compensation Board with respect to tunnelling and submit an outline of the proposed methods to the Engineer for approval.

3.4.11 Interfering Services

- .1 Provide for the uninterrupted flow of all watercourses, sewers and drains encountered during the work.
- .2 Support existing water mains, sewer pipes, gas lines, and other pipes to protect them from damage (subject to approval of bracing structures by the utility provider).
- .3 Repair and make good at no extra cost to the Owner any damage which may occur to any waterman, sewer pipe, gas line or other pipe and to any electrical conductor, cable, sidewalk, or curb or structure.
- .4 Determine the locations of all structures, pipes, manholes, valves by examination of drawings and by excavation. If necessary explore and excavate for such purposes.

3.5 CLEAN UP

- .1 Clean up and dispose of all excess material, trash, rocks, boulders and debris as work progresses.

3.6 RESTORATION

- .1 Restore or replace all sidewalks, curb, gutter, shrubs, fences, poles or other property and surface structures damaged or removed during the course of the work to a condition equal to that before the work began; furnishing all labour and materials at no extra cost to the Owner.
- .2 Restore the trench surface to the original grade and condition after backfilling.
- .3 Restore other working areas that were affected by the construction operation by regrading, regravelling and pavement repair as necessary to restore these surfaces to the original grade and condition.

3.7 PIPE PROTECTION

In all cases it will be the responsibility of the Contractor to protect the installations from damage. Any pipe, fitting, structure, etc. found damaged prior to final acceptance of the work will be replaced by the Contractor at his cost.

END OF SPECIFICATION

SPECIFICATION 01224 - GRADING

1 GENERAL

1.1 WORK INCLUDED

This section refers to earthwork, sub-grade preparation, and general site grading.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

- Section 01100 - Site Clearing and Grubbing
- Section 01210 - Stripping and Respreading
- Section 01223 – Trenching
- Section 01230 – Sub-grade Preparation
- Section 01240 – Backfilling
- Section 02200 – Granular Base and Sub Base
- Section 04210 – Sidewalk Construction
- Section 04225 – Extruded Concrete

1.3 REGULATIONS

- .1 Abide by the by-laws and regulations of the province, territory or municipality in which the work is located with regard to stream crossing diversions or alterations to drainage patterns.
- .2 Obtain permission from the Local or Highway Authority for haul routes, and abide by the regulations with respect to their maintenance.

1.4 TESTING

1.4.1 Density Testing by the Owner

- .1 The Owner may engage a CSA certified testing company to confirm the compliance to the specifications.
- .2 The Contractor shall allow access and provide material for all tests by the Owners testing agency.
- .3 The testing company is only authorized to report results of the tests and is not authorized to approve the construction.
- .4 Testing frequency will be a minimum of one test for every 400m² of surface area.

1.4.2 Re-testing of Failed Areas

Re-testing due to failure to meet density requirements will be the responsibility of the Contractor and the Owner will deduct the costs of re-tests from monies owed to the Contractor.

1.4.3 Reworking of Failed Areas

Reworking of failed areas shall be in accordance with this section. Any reworking of failed areas is considered incidental work. No additional claim will be paid by the Owner for reworking of failed areas.

2 PRODUCTS

2.1 COMMON EXCAVATION

- .1 Common excavation shall be approved material from site grading, or material from approved borrow pits.
- .2 The Contractor shall strip the overburden from any borrow pit.
- .3 Borrow pits shall be left in a neat and uniform condition, to the grades set by the Engineer.

2.2 ROCK EXCAVATION

- .1 Rock is defined as:
 - any material that will require for its removal drilling, blasting or breaking up with power operated hand tools;
 - a single boulder(s), or pieces of concrete or masonry with a volume in excess of 0.5 m³.

3 EXECUTION

3.1 INSPECTION OF MATERIALS

- .1 Obtain Engineer's approval prior to use of any embankment material in the field.
- .2 Preliminary approval of material does not constitute general acceptance.
- .3 Final acceptance of embankment material shall depend on field test results and performance in place.
- .4 Remove any rejected material off site at no cost to Owner.

3.2 PREPARATION OF SITE

Stripping of top soil and site clearing work must be complete before commencement of any grading.

3.3 GRADING PROCEDURES

3.3.1 Excavation

- .1 Excavate excess materials to the required grade, elevations and cross-sections as shown on the drawings or as directed by the Engineer.
- .2 Load, haul or dump approved selected excavated materials to areas where embankments are to be constructed.
- .3 Load, haul dump and grade excavated material unsuitable for embankment construction in disposal/stockpile areas as per the Contractor's Waste Management Plan or as directed by the Engineer.
- .4 Maintain the roadway crown adequate for drainage during grading.

3.3.2 Embankments

- .1 Areas to be filled shall be scarified to a depth of 150mm before fill is placed.

- .2 Use one of the following to construct embankments and for replacing unsuitable materials in the sub-grade and in utility trenches or as instructed by the Engineer in the field:
 - common excavation
 - common borrow
- .3 Schedule work to utilize the common excavation material completely.
- .4 Obtain the Engineer's approval with respect to the existing ground prior to constructing embankments.
- .5 Provide, deposit, shape and compact accepted approved material to embankment.
- .6 Where embankments are to be made on hill sides, or where a new fill is to be applied upon an existing embankment, the slopes of the original ground or embankment (except rock embankment) shall be terraced or stepped by approved means before filling is commenced.
- .7 Spread fill material in 200mm lifts (uncompacted) over the width of the trench, each lift compacted to a minimum of 98% of the Standard Proctor maximum dry density and moisture conditioned to between $\pm 2\%$ of optimum moisture content as determined by ASTM D698, Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures.
- .8 In the event that the embankment material is too wet to obtain specified density, thoroughly work the material until the optimum moisture content is reached uniformly throughout.
- .9 Shape, trim and roll to grade, elevations and cross-sections as shown on the drawings.

3.3.3 Finishing

- .1 Final surfaces shall be reasonably smooth and uniform, free from lumps, loose earth, stones and debris.
- .2 Grades shall be within 150mm of design grades.

3.3.4 Utilities and Appurtenances

- .1 Locate, protect and adequately mark all utilities and appurtenances including manholes, catch basins, valves and hydrants.
- .2 Manholes, catch basins and valves shall be accurately adjusted to 10mm - 15mm below the finished grade line and elevation of the finished road surface or ground design grade.

END OF SPECIFICATION

SPECIFICATION 01230 – SUB-GRADE PREPARATION

1 GENERAL

1.1 DESCRIPTION

- .1 This section refers to the sub-grade construction of the roadways.
- .2 Sub-grade construction shall include scarifying, moisture conditioning, compacting and fine grading.
- .3 All the above to be carried out in accordance with these specification and the lines, grades and dimensions shown on the drawings.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

- Section 02200 – Granular Base/Sub Base Preparation.

1.3 DEFINITIONS

- .1 Sub-grade elevation: elevation immediately below the granular sub base structure.

2 PRODUCTS

2.1 MATERIALS

- .1 Fill materials require approval by the Engineer.
- .2 Fill Material – fill materials, where required, shall be free of stones larger than 150mm, clods, sticks, roots, concrete, any toxic materials (e.g. salt, oil, etc.) and other objects, extraneous matter and debris. These materials shall be removed from the site and disposed of. Disposal locations for fill containing any of the above materials shall be approved by the Engineer.
- .3 Imported granular material shall be well graded, select, pit-run or crushed gravel and shall contain no organic or other deleterious substances. It shall be graded as per Clause 2.1 of Section 02200.
- .4 The synthetic filter fabric shall consist of durable, permeable, woven, polypropylene fabric composed of continuous synthetic filaments with typical properties as follows:

Puncture Strength	420 N
Tensile Grab Strength	890 N
Trapezoidal Tear Strength	400 N
Mullen Burst Strength	2,900 kPa

3 EXECUTION

3.1 EQUIPMENT

- .1 All proposed routes for hauling equipment must be approved by the appropriate road authority prior to commencement of the work. Rubber tired motor scrapers shall not be used to haul over improved streets. When any travelled roadway is being entered or crossed by hauling equipment, traffic must be controlled as per Section 01.111.00.

- .2 Trucks must be loaded in such a manner that no spillage occurs, and care must be taken to prevent dragging construction materials onto improved streets.
- .3 Trucks must follow applicable cargo securement requirements as per the Highway Traffic Act.
- .4 Haul routes must be kept clear and free from dust by grading and sprinkling with moisture whenever, in the opinion of the Engineer, conditions warrant this treatment.
- .5 All excavating and hauling equipment must be equipped with suitable muffling systems.

3.2 RESERVATION OF MATERIAL

- .1 Whenever gravel, sand, topsoil, or any other material suitable for special use is encountered, it shall be deemed to be the property of the Owner and shall be used as fill or any special purpose, or otherwise disposed of as directed by the Engineer.
- .2 Where layers of gravel, or gravely mixtures are encountered they shall be excavated separately from other excavation, and shall be stockpiled, or incorporated into the work as base or subbase material, or otherwise disposed of as directed by the Engineer.

3.3 UNSTABLE SUB-GRADE

- .1 Where the sub-grade is un-stable, or where it contains materials such as ashes, cinders, refuse, vegetable or organic material, the Contractor shall excavate such material to the width, depth (minimum 300 mm) and length ordered by the Engineer and dispose of the material as directed. The sub-grade shall then be made by backfilling with approved native material or imported granular material as per Section 02200 clause 2.1. Material shall be placed in successive layers as directed by the Engineer and compacted to a minimum of 98% Standard Proctor maximum dry density at $\pm 2\%$ of the optimum moisture content as determined by ASTM D698.

3.4 SUB-GRADE PREPARATION

- .1 The sub-grade shall be scarified to a depth of 150 mm and compacted to a minimum of 98% Standard Proctor maximum dry density at $\pm 2\%$ of the optimum moisture content as determined by ASTM D698, over the full width of the cross-section. The material shall be worked to ensure as much uniformity as possible.
- .2 Shape and roll alternately to obtain a smooth, even and uniformly compacted sub-grade.
- .3 Apply water as necessary during compacting to obtain specified density. If the material is excessively moist, aerate by scarifying with suitable equipment until moisture content is correct.
- .4 In areas not accessible to rolling equipment, compact to the specified density with approved mechanical tampers.

3.5 ALLOWABLE TOLERANCES

- .1 The finished sub-grade shall be within 30 mm vertically and 150 mm horizontally, but not uniformly high or low.
- .2 Correct surface irregularities by loosening and adding or removing material until the surface is within the specified tolerances.

3.6 TESTING

- .1 The Owner may engage a CSA certified testing company to confirm the compliance to the specifications.
- .2 The Contractor shall allow access and provide material for all tests by the Owners testing agency.
- .3 The testing company is only authorized to report results of the tests and is not authorized to approve the construction.
- .4 Density Tests shall be performed at a minimum frequency of 1 Test per 400 square meters.
- .5 When required by the Engineer the Contractor shall supply and operate a loaded test vehicle with a minimum of 18,200 Kg. (gross vehicle weight) to test the sub-grade for rutting, weaving and soft spots. Where proof rolling indicates areas that are defective, the Contractor shall remove and replace the material with suitable compacted material. Proof rolling shall be considered incidental to the sub-grade construction.
- .6 Construction or material not meeting the specifications will not be accepted.

3.7 MAINTENANCE

- .1 Maintain finished sub-grade in a condition conforming to this section until succeeding material is applied or until acceptance.

END OF SPECIFICATION

SPECIFICATION 01240 - BACKFILLING

1 GENERAL

1.1 DESCRIPTION

- .1 The following specifications apply to compaction of all water, sewer (storm and domestic) service cuts, repairs, replacements, main breaks, extensions, etc. and all shallow utility cuts by utility companies.
- .2 A trench cut is defined as that portion of any excavation extending from within 300 mm below the pipe to the finished sub-grade surface.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

- Section 01100 - Clearing and Grubbing
- Section 01210 - Stripping and Respreading
- Section 01223 – Trenching
- Section 06600 - Pressure Pipe
- Section 06720 – Sewer-Gravity Pipe
- Section 06722 – Manholes, Vaults and Catch Basins

1.3 REGULATIONS

- .1 Abide by the by-laws and regulations of the Province, Territory or Municipality in which the work is located, and abide by the laws and regulations with regard to stream crossings, fire regulations and public safety.
- .2 Perform work under observation of Safety Regulations of the Occupational Health and Safety Act.

2 PRODUCTS

2.1 BACKFILL MATERIALS

2.1.1 NATIVE BACKFILL

- .1 Selected material from excavation approved by the Engineer for the intended use, unfrozen and free from rocks larger than 75 mm, cinders, ashes, sods, refuse or other deleterious materials.

2.1.2 NON SHRINK BACKFILL

- .1 Low strength concrete (fillcrete):
 - Compressive Strength of 0.2 MPa to 0.5 MPa.
 - Maximum compressive strength shall not exceed 0.5 MPa in 56 days.
- .2 Slump Requirements:
 - Minimum Slump – 75 mm
 - Maximum Slump – 125 mm

.3 Admixtures:

- .1 Calcium Chloride may be used.
- .2 Air entrainment 4 – 7 %.

.4 Aggregate Gradation:

Sieve Size	Percent Passing
10 mm	100
5 mm	95 – 100
2.5 mm	80 – 100
1.25 mm	50 – 100
630 um	25 – 65
315 um	10 – 35
160 um	2 – 5
80 um	0 - 10

2.1.3 GRANULAR BACKFILL

- .1 Gradation to be within the following limits when tested to ASTM C-117 with sieve sizes to CAN/CGSBD 8-GP-2M rather than ASTM E11, and to have a smooth curve without sharp breaks when plotted on a semi-log grading chart.

Sieve Size (microns)	Percent Passing By Weight
20 000	100
16 000	84 - 94
10 000	63 – 86
5 000	40 – 67
1 250	20 – 43
630	14 – 34
315	9 – 26
160	5 – 18
80	2 - 10

3 EXECUTION

3.1 GENERAL

- .1 Requirements apply to the full width of the right-of-way with the exception of the boundary area from the property line up to one (1) meter from the constructed or designed surface installation.

3.2 SITE PREPARATION

- .1 The Contractor at his own expense shall clear and broom clean the surface of the pavement as may be necessary for full width and length of the work area and shall dispose of all refuse in a manner satisfactory to the Engineer.

3.3 BACKFILL AND COMPACTING

- .1 Do not proceed with backfilling operations until Engineer has inspected and approved installations.
- .2 Prior to backfilling, the excavation shall be completely free of debris, ponding water or drifted snow.
- .3 Place suitable backfill material in uniform layers not exceeding 300mm uncompacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
- .4 Fill materials shall be moisture conditioned, by drying or by adding water, to obtain an in-place moisture content $\pm 2\%$ of the optimum moisture content.
- .5 Compact each lift throughout its entirety to the following:
 - Pipe or Cable Zone - 300 mm below to 300 mm above the pipe or cable zone to a minimum of 95% of Standard Proctor maximum dry density.
 - Avoid contact between the pipe and the compaction equipment.
 - Compaction in the haunch area is to be obtained by use of mechanical tampers or tamping bars.
 - Mechanical tampers shall not be used directly above the pipe until a minimum of 300 mm of backfill material is in place above the top of the pipe.
 - Roller compacting equipment is not to be used until a minimum of 500 mm of backfill material is in place above the top of the pipe.
 - A hydro-hammer is not to be used until a minimum of 1000 mm of backfill material is in place above the top of the pipe.
 - Above Pipe or Cable Zone to the finished elevation – to a minimum of 98% of Standard Proctor maximum dry density.
- .6 Backfilling around installations:
 - Place bedding and surround material as specified.
 - Do not backfill around or over cast in place concrete within 24 hours of placing.
 - Place layers simultaneously on all sides of installed work to equalize loading.

- .7 When soils removed from any trench appear unsuitable for replacement in the trench due to excessive moisture content, or for any other reason and suitable material is not available on site, the trench shall be backfilled with granular material or non-shrinkable backfill with prior written approval by the Engineer. Under no circumstances shall frozen material be used for backfill.
- .8 In landscaped areas place native backfill to 300mm below the finished grade to allow for topsoil placement.
- .9 On existing paved streets and lanes, or existing graveled streets and lanes native backfill shall be brought up to the existing sub-grade only. The final 150 mm depth of the sub-grade shall be compacted and moisture conditioned in accordance with Section 01230.
- .10 On existing paved streets and lanes, or existing graveled streets and lanes the base structures shall be rebuilt with specified granular sub base and base materials shall be in accordance with Section 02200. Compaction of the base granular base structures shall be in accordance with Section 02200.
- .11 On existing paved streets and paved lanes, asphalt shall be replaced in accordance with Section 03140 Asphalt Concrete.

3.4 WINTER COMPACTION

- .1 Winter compaction is permitted only if agreed to in writing by the Engineer.
- .2 During these portions of the year, when specified densities cannot be obtained due to cold weather, a minimum of 95% of Standard Proctor maximum dry density above the pipe zone will be acceptable.
- .3 If a minimum of 95% of Standard Proctor maximum dry density above the pipe zone is unobtainable, non shrink backfill is an approved alternate and recommended during winter backfill operations versus the use of native and granular materials.
- .4 Cold mix asphalt shall be used for the final surfacing of roadways during the winter months. The cold mix shall be removed and replaced with the specified hot mix asphalt in early spring. All settlements related to winter backfill operations must be repaired by the Contractor prior to placing hot mix asphalt.
- .5 Winter compaction is approved only for emergency excavation situations.

3.5 NON SHRINK BACKFILL PLACEMENT

- .1 Non shrink backfill delivered in cold weather shall conform to the requirements specified in Section 18 of CSA Standard a23.1-M04.
- .2 Non shrink backfill shall be rodded or vibrated to eliminate voids, rough areas, honeycombing and to ensure contact with the sides of the excavation.
- .3 Place materials using methods which do not lead to segregation.
- .4 Pumping of material is permitted with the approval of the Engineer.
- .5 In landscaped areas place non shrink backfill to 300 mm below the finished sub-grade to allow for topsoil placement.

- .6 Temporary plating or other means of supporting traffic loads shall be used to provide safe driving surface for traffic until pavement materials are replaced.
- .7 Protect freshly placed material from heavy rain to prevent washout.
- .8 Protect freshly placed non shrink backfill from freezing.
- .9 Allow material to cure for a period of 48 hours to ensure adequate strength.

3.6 TESTING

- .1 The Owner may engage a CSA certified testing company to confirm the compliance to the specifications.
- .2 The Contractor shall allow access and provide material for all tests by the Owners testing agency.
- .3 The testing company is only authorized to report results of the tests and is not authorized to approve the construction.
- .4 Density tests shall be representative of the entire length, width and depth of the trench backfill including around catch basins, manholes, valves and service connections.
- .5 The following is the minimum testing frequency:
 - Trenches more than 15 meters in length shall require a minimum of 3 density tests per 500 mm of trench depth per 75 m of trench length.
 - Trenches less than 15 m in length shall require a minimum of 2 density tests evenly distributed throughout the length of the trench, per 500 mm of trench depth.
 - Maintenance excavations less than 6 square meters in area shall require 1 density test per 500 mm of depth.
 - Backfill adjacent to valves, manholes, catch basins and other structures shall require a minimum of 2 density tests for every 500 mm of trench depth.
 - All sewer and water main installations within the City right-of-way are subject to continuous testing and inspection to verify compliance with current backfill and compaction specifications.
 - Inspection and testing of non shrink fill will be carried out by a CSA certified testing agency designated by the Engineer. Tests for compressive strength, slump and air entrainment shall be performed for each 50 m³ of non shrink fill placed.
 - The Engineer may determine additional testing as necessary.

3.7 PIPE PROTECTION

In all cases it will be the responsibility of the Contractor to protect the installations from damage. Any pipe, fitting, structure, etc. found damaged prior to final acceptance of the work will be replaced by the Contractor at his cost.

4 MAINTENANCE AND WARRANTY

4.1 GENERAL

- .6 The Contractor will be responsible for the rehabilitation costs of failures due to settlement of the backfill during the maintenance and warranty period. If any obvious major settlement occurs, the Engineer may require the trench to be re-compacted for its full depth and length.

END OF SPECIFICATION

SPECIFICATION 02200 – GRANULAR BASE / SUB BASE PREPARATION

1 GENERAL

1.1 DESCRIPTION

- .1 This section specifies requirements for supply, producing, hauling, placing and compacting processed gravel or quarried stone as a granular base or sub base to lines, grade and typical cross-sections, or as otherwise directed.
- .2 Granular sub base is defined as the initial layer of granular material placed upon prepared sub-grade to form an integral part of the total pavement structure.
- .3 Granular base is defined as the layer of granular material placed upon the compacted granular sub base or prepared sub-grade to form an integral part of the total pavement structure.

1.2 RELATED SECTIONS

- Section 01230 - Sub-grade Preparation

1.3 SAMPLES

- .1 At least fourteen (14) calendar days prior to commencing work, inform the Engineer of proposed source of aggregates and provide access for sampling.

1.4 MATERIALS CERTIFICATION

- .1 Aggregates: At least fourteen (14) calendar days prior to commencing work provide:
 - .1 Test data reports representing granular base and/or granular sub base processed into stockpile. Submit one complete aggregate gradation analysis report for every 1000 tonnes of each material required for the project, or one complete analysis for each production day when production rate is less than 1000 tonnes. Include percentage of crushed coarse aggregate particles in granular base reports.
 - .2 Certification that the physical properties of the aggregates meet the requirement of this section.
 - .1 Reports and certification shall be provided by an independent testing consultant under the signature and professional seal of a qualified materials engineer.
 - .2 At least fourteen (14) calendar days prior to contemplated change in source of aggregates, provide written notification to the Engineer and provide new materials certification in accordance with the requirements of this section.

1.5 SUBMISSIONS

- .1 Granular sub base and base sources and test results shall be submitted to the Engineer for review and approval before being used.
- .2 Preliminary review of the material as represented by the test results shall not constitute general acceptance of all the material in the deposit or source of

supply. Materials may be considered unsuitable even though particle sizes are within the limits of gradation sizes required, if particle shapes are thin or elongated or any other characteristic precludes satisfactory compaction, or if the material fails to provide a roadway suitable for traffic. Rejected material will not be paid for. The Engineer has the right to request additional testing if there are any concerns with the proposed aggregate.

1.6 DELIVERY AND STORAGE

- .1 Deliver and stockpile aggregates in accordance with the requirements of this section.
- .2 Stockpile minimum of fifty (50%) percent of each type of base material required before commencing to haul products to the project site.
- .3 Handle and transport products to avoid segregation, contamination and degradation.
- .4 Stockpile products in sufficient quantities to meet project schedules. When adding new products to the stockpile after removal to the project site has commenced, do not deposit material against working face of stockpile.
- .5 Separate product stockpiles by substantial dividers or stockpile far enough apart to prevent intermixing.
- .6 Reject intermixed or contaminated materials. Remove and dispose of rejected materials as directed by the Engineer within 48 hours of rejection.
- .7 Construct stockpiles in uniform lifts using trucks or rubber-tired loading equipment, being careful to avoid spillage of materials over the ends of previously place lifts. Do not use conveyors or tracked equipment in stockpile construction.
- .8 Provide a previously stabilized stockpile base or provide a compacted sand base not less than 300 mm in depth to prevent contamination. Alternatively, stockpile aggregates on the ground but do not incorporate bottom 300 m of pile into the work.

2 PRODUCTS

2.1 GRANULAR SUB BASE

- .1 Crushed stone or gravel consisting of hard, durable particles free from clay lumps, cementation, organic material, frozen material and other deleterious material.

.2 Physical properties of aggregates:

Los Angeles Abrasion, Loss, %	50 max.
Liquid Limit, %	25 max.
Plasticity Index, %	6 max.
Lightweight particles, %	5 max.
California Bearing Ratio when compacted to 100 % of ASTM D698	20 min.
Crushed Particles (1 face, plus 5 000 sieve fraction) , %	50 min.

.3 Gradation to be within the following limits when tested to ASTM C-136 and ASTM C-117 with sieve sizes to CAN/CGSBD 8-GP-2M rather than ASTM E11, and to have a smooth curve without sharp breaks when plotted on a semi-log grading chart.

Sieve Size (microns)	Percent Passing By Weight
50 000	100
25 000	66 – 90
16 000	54 – 81
10 000	45 – 73
5 000	35 – 63
1 250	22 – 45
630	17 – 38
315	13 – 30
160	9 – 20
80	4 – 10

2.2 GRANULAR BASE

.1 Crushed stone or gravel consisting of hard, durable, angular particles, free from clay lumps, cementation, organic material, frozen material and other deleterious materials.

.2 Physical properties of aggregates:

% Fracture, by weight (2 faces)	60 min.
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Los Angeles Abrasion, loss, %	45 max.
Liquid Limit, %	25 max.
Plasticity Index, %	6 max.
Lightweight particles, %	5 max.
California Bearing Ratio, when compacted to 100% of ASTM D698	80 min.

- .3 Gradation to be within the following limits when tested to ASTM C-117 with sieve sizes to CAN/CGSBD 8-GP-2M rather than ASTM E11, and to have a smooth curve without sharp breaks when plotted on a semi-log grading chart.

Sieve Size (microns)	Percent Passing By Weight
20 000	100
16 000	84 - 94
10 000	63 – 86
5 000	40 – 67
1 250	20 – 43
630	14 – 34
315	9 – 26
160	5 – 18
80	2 - 10

3 EXECUTION

3.1 GENERAL

- .1 The sub-grade shall be prepared according to the requirements of Section 01230 and to cross-sections shown on the Drawings. The Contractor shall maintain the sub-grade to the specified section, free from ruts, waves and undulations until granular sub base material is placed. The sub-grade shall be in a firm dry condition and must be approved by the Engineer before gravel is placed. The depositing of granular base or sub base on a soft, muddy or rutted sub-grade will not be permitted.

3.2 PLACING

- .1 Place material only on a clean unfrozen surface, properly shaped and compacted and free from snow and ice.
- .2 Place using methods which do not lead to segregation or degradation of aggregate. Use approved methods to create uniform windrow of material along a crown line or high side of a one-way slope.
- .3 Place material to full width in layers not exceeding 150 mm in compacted thickness.
- .4 Shape each layer to a smooth contour and compact to the specified density before a succeeding layer is placed.
- .5 Apply water as necessary during compacting to obtain specified density. If the material is excessively moist, aerate by scarifying with suitable equipment until moisture content is correct.
- .6 Remove and replace any portion of a layer in which material becomes segregated during compaction.

3.3 COMPACTING

- .1 The granular base and sub base layers shall each be compacted to a density not less than 100% of Standard Proctor maximum dry density at $\pm 2\%$ of the optimum moisture content as determined by ASTM D698 (Method C) over the full width of the cross-section.
- .2 Shape and compact alternately to obtain a smooth, even and uniformly compacted base and sub base.
- .3 Apply water as necessary during compacting to obtain specified density. If the material is excessively moist, aerate by scarifying with suitable equipment until moisture content is correct.
- .4 In areas not accessible to rolling equipment, compact to specified density with approved mechanical tampers.

3.4 ALLOWABLE TOLERANCES

- .1 Finished sub base and base surfaces shall be within ± 10 mm of established grade, but not uniformly high or low.
- .2 Correct surface irregularities by loosening and adding or removing materials until surface is within the specified tolerances.

3.5 TESTING

- .1 The Owner may engage a CSA certified testing company to confirm the compliance to the specifications.
- .2 The Contractor shall allow access and provide material for all tests by the Owners testing agency.
- .3 The testing company is only authorized to report results of the tests and is not authorized to approve the construction.

- .4 Density Tests shall be generally performed at a minimum frequency of 1 Test per 400 square meters.
- .5 When required by the Engineer the Contractor shall supply and operate a loaded test vehicle with a minimum of 18,200 Kg. (gross vehicle weight) to test the granular materials for rutting, weaving and soft spots. Where proof rolling indicates areas that are defective, the Contractor shall remove and replace the material with suitable compacted material. Proof rolling shall be considered incidental to the sub base and base construction.
- .6 Construction or material not meeting the specifications will not be accepted.

3.6 MAINTENANCE

- .1 Maintain finished sub base and base surfaces in a condition conforming to this section until succeeding material is applied or until Substantial Completion.

END OF SPECIFICATION

SPECIFICATION 03200 - CONCRETE AND ASPHALT REMOVAL, DISPOSAL AND SALVAGE

1 GENERAL

1.1 PROTECTION

- .1 Protect existing items designated to remain. In the event of damage to such item, immediately replace or make repairs to approval of the Engineer at no cost to the Owner.

2 EXECUTION

2.1 EQUIPMENT

- .1 All proposed routes for hauling equipment must be approved by the appropriate road authority prior to commencement of the work.
- .2 Trucks must be loaded in such a manner that no spillage occurs, and care must be taken to prevent dragging construction materials onto improved streets.
- .3 Haul routes must be kept clear and free from dust by grading and sprinkling with moisture whenever, if in the opinion of the Engineer, conditions warrant this treatment.
- .4 All excavating and hauling equipment must be equipped with suitable muffling systems.

2.2 PREPARATION

- .1 Inspect the site and verify with the Engineer, items designated for removal and items to remain.
- .2 Locate and protect utility lines. Preserve in operating condition active utilities traversing the site.

2.3 REMOVAL OF EXISTING CONCRETE

- .1 Remove existing curbs, gutters, and sidewalks and other structures shown on the drawings or as directed by the Engineer.
- .2 Cut existing concrete neatly, and load and haul debris to a designated disposal area or approved facility.
- .3 Avoid damage to adjacent concrete surfaces not scheduled for removal. Damages will be the responsibility of the Contractor.
- .4 Properly sign and barricade areas of removed concrete areas.
- .5 Deter the public from access to the removed concrete areas until the new concrete has been replaced and hardened.

2.4 REMOVAL OF EXISTING ASPHALT

- .1 Remove existing pavement structure as indicated on the drawings or as identified by the Engineer.
- .2 Do not disturb adjacent items designated to remain in place.

.3 In removal of pavement:

1. Square up adjacent surfaces to remain in place by saw cutting or other methods approved by the Engineer.
2. Protect adjacent joints and load transfer devices.
3. Protect and stockpile underlying granular materials for re-use as directed by the Engineer.

2.5 DISPOSAL

- .1 Recycle removed concrete and asphalt in a suitable manner.
- .2 If recycling is not available, removed concrete and asphalt shall be separated and disposed of at an Engineer approved facility.

2.6 RESTORATION

- .1 Upon completion of the work, remove debris, trim surfaces and leave work site clean.
- .2 Reinstate areas and existing works to original or better condition.

END OF SPECIFICATION

SPECIFICATION 06600 – PRESSURE PIPE

1 GENERAL

1.1 WORK INCLUDED

This section refers to the supply and installation of water main and accessories, and sewage force mains and accessories.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

- Section 01223 – Trenching
- Section 06722 – Manholes, Vaults and Catch Basins
- Section 01240– Backfilling

1.3 REGULATIONS

- .1 Saskatchewan Environment Standards and Guidelines for Waterworks, Wastewater, and Storm Drainage Systems.
- .2 Saskatchewan Environment Storm Water Management Guidelines.
- .3 The Public Water Supply Regulations, Environment Protection, Environment Canada shall apply to the work of this section.

1.4 MATERIALS TESTING

- .1 Materials supplied shall be in accordance with AWWA, ASTM and CSA Standards.
- .2 The Engineer may at any time require the Contractor to produce certification by an independent testing agency that materials used conform to the specified standards.
- .3 The Engineer may reject the material that in the opinion of the Engineer is unsuitable for the intended application.
- .4 Areas of backfill failing to meet density requirements will be reworked in accordance with this section, Section 01223, and Section 01240.

1.5 HANDLING OF PIPES AND ACCESSORIES

- .1 Pipe and accessory materials shall be unloaded and stored at the site by the Contractor with care to prevent damage.
- .2 Store materials so that they are kept clean and in accordance with the manufacturer's recommendations.
- .3 Drain valves and hydrants of water to eliminate damage due to freezing of trapped water.

2 PRODUCTS

2.1 PIPE

2.1.1 PVC

- .1 DR18 Pipe to AWWA C-900, CSA B137.3-M; 100mm-300mm size; pressure class 150.

- .2 DR18 Pipe to AWWA C-905, CSA B137.3-M; 350mm-900mm size; pressure rating 235.
- .3 All products shall comply with NSF/ANSI 61 "Drinking Water System Components – Health Effects".

2.1.2 Rubber Gasket Joint Fittings

- .1 Polyvinylchloride molded fittings to AWWA. C907, SDR 18, Class 150, ASTM cell classification 12454B, with rubber gasket joints and outside diameter conforming to cast iron fitting, bell ends, c/w 1 MPa elastomeric gasket push-on joint
- .2 Ductile iron and cast iron fittings to ANSI/AWWA C110 or ANSI/AWWA C152, pressure class 150 minimum. Exterior and interior fittings to be factory Fusion Bonded Epoxy Coated according to ANSI/AWWA C116 and NSF/ANSI 61 "Drinking Water System Components-Health Effects". Joints shall be to the latest revision ANSI/AWWA C111, "Tyton Joint" or approved equal.

2.1.3 Pipe Lubricants

- .1 Only Manufacturer's recommended organic, non-toxic, water soluble gasket lubricant to be used.
- .2 Pipe gasket lubricants shall comply with NSF/ANSI 61 "Drinking Water System Components-Health Effects".

2.2 COUPLINGS AND REPAIR CLAMPS

2.2.1 Repair Clamps

- .1 Designed for joining plain end pipes of equal outside diameter. To be flexible, all stainless steel construction. All welded stainless steel to be "passivated" after welding to eliminate sensitizing of the stainless steel.
- .2 Shell, Sidebars, Nuts, and Bolts to be Type 304 fully passivated stainless steel. Gasket to be continuous ringed S.B.R. rubber conforming to latest revision AWWA C-111 / ANSI A21.11.
- .3 Approved Products:
 - Robar 1606 Style 2
 - Robar 5606, 5616, 5626 and 5636
 - Smith Blair 267 and 268
 - EZMAX plus 4000
 - Cambridge Brass (Stainless Steel) Series 425, 435, 825 & 835

2.2.2 Epoxy Coated Couplings

- .1 All products to be to ANSI/AWWA C116/A21.16 (American National Standard for Protective Fusion-Bonded Epoxy Coatings for the interior and exterior surfaces of ductile iron and gray-iron fittings for Water Supply Service).
- .2 Epoxy Coated couplings are supplied in the three following configurations:

- Standard Couplings: designed for joining plain end pipes of equal outside diameter
 - Transition Couplings: designed for connecting pipes of the same nominal size, which have great differences in outside diameter, transition to be made by "stepped-down" center ring, c/w special end plate
 - Reducing Couplings: designed for connecting pipes of different nominal sizes, reduction to be made by "stepped-down" center ring, c/w special end plate
- .3 Centre ring to be cast ductile iron to latest revision ASTM A536, factory coated with fusion bonded epoxy. Coating thickness to be 0.30 mm (12 mils) minimum, 0.50 mm (20 mils) maximum.
- .4 End plates to be heat-treated cast ductile iron to latest revision ASTM A536, factory coated with fusion bonded epoxy. Coating thickness to be 0.30 mm (12 mils) minimum, 0.50 mm (20 mils) maximum. End plates shall be provided with one 6 mm (1/4") SAE J429 Grade 5, NC cadmium plated setscrew to provide electrical conductivity between the end plates and the sleeves and wrapped with petrolatum tape.
- .5 Gasket to be S.B.R. rubber conforming to latest revision AWWA C- 111 / ANSI A21.11.
- .6 Bolts to be 15.875 mm (5/8") NC track head, c/w heavy-duty hex nuts. Material to be low alloy steel conforming to latest revision AWWA C-111 / ANSI A21.11. All bolts (except threaded area) to be factory coated with fusion bonded epoxy. Coating thickness to be 0.30 mm (12 mils) minimum, 0.50 mm (20 mils) maximum.
- .7 Coupling components to be marked as follows:
- Centre Ring: Nominal size and manufacturers' name
 - End-Plate: O.D. range and manufacturers' name
 - Gaskets: O.D. range and manufacturers' name
- .8 Approved Coupling Products:
- Robar 1506 or approved "Smith-Blair" or "Dresser" equivalent
 - Romac 501 or approved "Smith-Blair" or "Dresser" equivalent
 - Hymax coupling and flanged adapter
 - Romac Macro 2 bolt coupler
 - Robar Vantage Coupling 1596/1598
 - Robar Mega Coupling Series 3800

2.3 TAPPING SLEEVES

- .1 Shall be full circle type designed to allow tightening of the sleeve bolts from the opposite side of the flange outlet. Install according to manufacturer's specifications and torque ratings. With specific approval from the Environmental Utilities Department only, a non-full circle sleeve may be used where the branch tap is a

- minimum of two nominal diameters smaller than the tapped main. Taps on asbestos-cement pipe always require special consideration.
- .2 To be constructed of stainless steel or corrosion protected mild steel material. Corrosion protected sleeves shall be epoxy coated and lined. All welded stainless steel to be "passivated" after welding to eliminate sensitizing of the stainless steel.
 - .3 Sleeves to include a 19 mm (3/4") NPT test plug for pressure testing of sleeve and installed tapping valve. Test plug shall be at the 12 o'clock position after installation. Manufacturer's working pressure ratings to be approved by Engineer.
 - .4 Sleeves to have permanent identification marking to identify the manufacturer's name, nominal size, and O.D. range. All sleeves to be packaged and delivered as a complete unit (i.e. sleeves, gaskets, nuts, and bolts).
 - .5 Sleeves to have Class D flanges conforming to the latest revision of AWWA C207, 150 lb. drilling. Flanges to be fixed, not floating.
 - .6 Flange materials for stainless steel tapping sleeves to be stainless steel. Flange materials for fusion bonded epoxy tapping sleeves to be cast ductile iron.
 - .7 Gasket materials as follows:
 - Flange - Virgin SBR compounded for water service use
 - Ring Seal - Buna N, or virgin SBR compounded for water service use
 - Liner - 3.18 mm (1/8") Neoprene, or virgin SBR compounded for water service use
 - .8 Bolts to be 16 mm (5/8") NC stainless steel c/w heavy hex nuts and washers, factory treated to prevent galling.
 - .9 Tapping sleeve to be wrapped in 6 mil polyethylene when thrust block required.
 - .10 Approved Products:
 - Robar 6606
 - Romac "SST"
 - Ford FAST
 - Smith Blair 663
 - PowerSeal (Stainless Steel) Series 3480 & 3490

2.4 TRACER WIRE

- .1 Type 14/1B MDPE Tracer Wire
- .2 Tracer wire to be 14 gauge single conductor copper wire, un-stranded, color of insulation: white. Wire coating must be made for direct bury.
- .3 When joining tracer wire use underground waterproof splice kit.
- .4 Approved Products:
 - 3- M DBR or DBY splice kit or equivalent

2.5 VALVES AND VALVE BOXES

2.5.1 Resilient Wedge Gate Valves

- .1 Valves sized 100 mm to 300 mm diameter shall be resilient wedge gate valves, conforming to latest revision AWWA C509, c/w fully rubber encapsulated solid wedge, non-rising stem, suitable for direct bury.
- .2 Valves to open counter clockwise (turn left to open).
- .3 Valve body to be constructed of cast iron, in accordance with ASTM A126, Class "B". All nuts, bolts, and washers shall be stainless steel.
- .4 Interior and exterior of valve to be fusion bonded epoxy coated, as per latest revision AWWA C550.
- .5 Bronze valve stem to be operated by a 50 mm x 50 mm square operating nut. The valve stem (stuffing box) shall contain a double "O" ring seal.
- .6 Valve ends to be push-on "Tyton Joint" conforming to latest revision of AWWA C111 / ANSI A21.11.
- .7 Approved Products:
 - Mueller Resilient Wedge Gate Valve
 - Or equivalent approved by the Engineer.

2.5.2 Resilient Wedge Tapping Gate Valves

- .1 Valves sized 100 mm to 300mm diameter shall be resilient wedge gate valves, conforming to latest revision AWWA C509, c/w fully rubber encapsulated solid wedge, non-rising stem, suitable for direct bury.
- .2 Valves to open counter clockwise (turn left to open).
- .3 Valve body to be constructed of cast iron, in accordance with ASTM A126, Class "B". All nuts, bolts, and washers shall be stainless steel.
- .4 Interior and exterior of valve to be fusion bonded epoxy coated, as per latest revision AWWA C550.
- .5 Bronze valve stem to be operated by a 50 mm x 50 mm square operating nut. The valve stem (stuffing box) shall contain a double "O" ring seal.
- .6 Valve ends to be push-on "Tyton Joint" by flange. Push-on joints shall conform to latest revision of AWWA C111/ ANSI A21.11. Flanged valve ends shall meet the requirements of ANSI B16.1, Class 125. Bolts, nuts, washers to be stainless steel.
- .7 Approved Products:
 - Clow F-6113 Resilient Wedge Tapping Gate Valve flange x push- on for sizes 100 to 300 mm diameter
 - Mueller A-2360-41 Resilient Wedge Tapping Gate Valve flange x push-on for sizes 100 mm to 300 mm diameter
 - Bibby-Ste-Croix Resilient Wedge Tapping Gate Valve flange x push-on for sizes 100 mm to 300 mm diameter
 - Or equivalent approved by the Engineer.

2.5.3 Butterfly Valves

- .1 Valves sized 350 mm to 900 mm diameter shall be butterfly valves conforming to latest revision AWWA C504. They shall be short body design, Class 150B, c/w adjustable rubber seats, suitable for direct bury. All nuts, bolts, and washers shall be stainless steel.
- .2 Valves to open counter clockwise (turn left to open).
- .3 Valve must be rated at 1034 kPa (150 psi) working pressure and must be able to pass a hydrostatic test at 2068 kPa (300 psi) with the valve partially open.
- .4 Valve to be operated by 50 mm x 50 mm square operating nut connected to a totally enclosed gear actuator.
- .5 Orientate valve as per manufacturer's design for flow direction. Where flow could be in either direction (looped) then place valve so that actuator is away from other utilities.
- .6 Valve ends to conform to the following patterns:
 - Mechanical Joint: shall meet the requirements of the latest revision AWWA C111/ ANSI A21.11, bolts to be stainless steel
 - Flanged End: shall meet the requirements of ANSI B16.1
 - Class 125 bolts to be stainless steel.
- .7 Interior and exterior of valve to be fusion bonded epoxy coated, as per latest revision AWWA C550.
- .8 Approved Products:
 - Pratt
 - Mueller Linesal III 3211
 - Or equivalent approved by the Engineer.

2.5.4 Automatic Control Valves (Pilot Controlled PRV's, PSV's, and Check Valves)

- .1 Control valves to be fusion bonded epoxy coated and lined with stainless steel seats, brass position indicator rod, copper tubing, brass fittings and pilots.
- .2 PRV's and PSV's must fail in open position and Check Valves must fail in closed position.
- .3 Must be designed for minimum and maximum flows. ACV's 200 mm and larger require a secondary, smaller ACV installed in parallel to handle low flows. Minimum size for secondary ACV is 100 mm (flows to be confirmed by Engineer).
- .4 Each ACV to have an NRS, hand wheel operated, resiliently seated isolation valve bolted to each end. Valves to be fusion bonded epoxy coated and lined complete with stainless steel bolts.
- .5 Piping to be schedule 40 with 150 # ANSI flanges and fusion bonded epoxy coated/lined. Pipe must extend through vault wall and span open excavation. Installation to include 2-1/2" pressure indicators with 1/2" ball valves. Low pressure side to have 0-100 psi gauge and high pressure side to have 0-200 psi gauge.

- .6 Watertight, concrete vault to fit equipment complete with lifting lugs and cored or formed holes. Minimum height to be 2 m with MSU steps or ladder. If main ACV is larger than 400 mm in size, vault must have access hatch directly over ACV for removal.

2.5.5 Cast Iron Valve Boxes

- .1 To be completely fusion bonded epoxy coated sliding type, adjustable over a minimum of 450 mm. Bottom casing diameter to be compatible to size of valve. All castings shall clearly have the manufacturer's identification cast on them.
- .2 Depth of bury to be 1.83 m (6') to 2.75 m (9').
- .3 Valve operating extension spindle to be 25 mm x 25 mm square. Spindle length shall be such that the operating nut will not be more than 300 mm below the cover when set on the valve operating nut.
- .4 Bottom of spindle to fit 50 mm x 50 mm square valve operating nut and shall be riveted to spindle.
- .5 Top of spindle shall have removable 50 mm x 50 mm square operating nut c/w stone catcher flange.
- .6 Top casing to fit over 120 mm outside diameter casing. Pipe set screws shall be removed to allow top casing to slide up and down.
- .7 Lid to be marked "V".
- .8 Approved Products:
 - Norwood "Type C"
 - Trojan Industries "Type C"
 - Sovereign Castings Ltd. "Type C"
 - East Jordan Iron Works
 - Westview "Type C"

2.6 HYDRANTS

- .1 Post type hydrants according to AWWA C502 and ULC S520 listed. Designed for a working pressure of 1724 kPa and tested at 3447 kPa.
- .2 Hydrant shall include two AMA-AWO 65 mm threaded hose outlets and 100 mm N pumper port to be located 460 mm above the ground flange; 150 mm riser barrel and 25 mm bottom valve.
- .3 Hydrant inlet to be 150 mm diameter push-on "Tyton Joint" c/w elastomeric gasket conforming to the latest revision of AWWA. C111/ANSI A21.11; and 150 mm connection for main.
- .4 Hydrants to open counterclockwise. Threads to W.C.U.S., 6 threads per inch, 123 mm (4.84") outside dia. and 120 mm (4.742") pitch dia.
- .5 Standard depth of bury 2.75 m for new development. Depth of water mains must be confirmed by the Contractor prior to ordering each hydrant for installation.
- .6 Provide key operated gate valve to isolate hydrant from water main as detailed.

- .7 Hydrant body to be red in color with silver caps. If considered high pressure, hydrant body to be yellow.
- .8 Operating nut to be pentagon configuration, 22 mm (7/8") flats, 35 mm (1 3/8") flat to point.
- .9 Hydrants to be constructed with a breakaway flange complete with a safety stem (spindle). Bottom of breakaway flange set a minimum of 0.05 m (2") above finished grade. Bottom of breakaway flange cannot exceed 0.20 m (8") above finished grade.
- .10 All nuts, bolts, and washers to be stainless steel.
- .11 Approved Products:
 - Canada Valve Century Hydrant with Western Canada Threads
 - Or equivalent approved by the Engineer

2.7 CATHODIC PROTECTION

2.7.1 General

- .1 Prior to backfilling, arrange for the Engineer to witness the installation of the sacrificial anode, wires, cadwelding, etc., and the necessary continuity check. Location of anode packs to be determined by the Engineer.
- .2 Use sacrificial zinc anodes only if specified.

2.7.2 Metallic Pipe and Valves

- .1 Sacrificial zinc anodes shall conform to ASTM B418 Type II and are to be supplied and installed by the Contractor on each buried steel pipe and adapter.
- .2 Zinc anodes to be supplied and installed by the Contractor shall consist of an alloy of the following chemical composition:
 - Al - 0.005% maximum
 - Cd - 0.003%
 - Fe - 0.0014% maximum
 - Zinc - Remainder
- .3 The anode lead wires shall be 3 meters (10-feet) in length and shall consist of #13 solid copper wire with Type TW insulation. The lead wire shall be connected to the core with silver solder. The entire connection shall be insulated by filling the recess with an electrical potting compound.
- .4 The anode shall be packaged in a permeable cloth bag containing a backfill mixture of the following composition:

• Ground Hydrated Gypsum	75%
• Powdered Wyoming Bentonite	20%
• Anhydrous Sodium Sulphate	5%

- .5 Backfill shall have a grain size so that 100% is capable of passing through a 20 mesh screen and 50% will be retained by a 100 mesh screen. The mixture shall be firmly packaged around the zinc within the cloth bag by means of adequate vibration.

2.8 PIPE DISINFECTION

- .1 Sodium hypochlorite to AWWA B300 to disinfect water mains.

2.9 CORROSION PROTECTIVE TAPES AND WRAPS

- .1 Field installed corrosion protective coatings to be two part paste & tape systems.

.2 Approved Products:

- Polyken 900 system:
 - No. 930 Joint Wrap Tape
 - No. 931 Filler Tape
- Denso of Canada Ltd:
 - Denso Paste
 - Denso Tape
- Corexco Inc.:
 - Petro Primer Paste
 - Petro 40 Tape
 - Petro Overwrap Tape
- Polyguard Products Inc.:
 - Polyguard 600 Primer
 - Polyguard 600 Series Coating Tape
 - Polyguard 606 Filler System
- The Trenton Corporation:
 - Trenton Tec-Tape Primer
 - Trenton Tec-Tape Wrapper
 - Trenton Glas-Wrap
 - Trenton Fill-Putty

2.10 THRUST BLOCKING

2.10.1 Concrete

- .1 Concrete mix shall satisfy the requirements of Exposure Classification C-2 of Table 8, CAN/CSA A23.1, and shall be in accordance with the following minimum requirements unless shown in the drawings:

- 28 day compressive strength – 25 MPa
- Maximum nominal size of course aggregate – 25 mm
- Slump – 40 mm to 75 mm
- Maximum water cementing materials ratio – 0.45
- Portland Cement – Type 50, Sulfate Resistant

- Minimum cement content – 300 kg/m³
- Fly Ash Content – 20% max.

2.10.2 Plastic

- .1 6 mil polyethylene to be placed between all fittings, valve, pipe and the concrete.

2.10.3 Mechanical Restraint

- .1 Product used and method of mechanical restraint to be approved by Engineer.

3 EXECUTION

3.1 TRENCH INSPECTION

- .1 Check trench bottom for stability and ensure that pipes can be properly laid to design grade. Notify the Engineer if conditions prevent successful pipe installation.
- .2 Remove unstable soil and replace with compacted pit run gravel or washed rock, if directed by the Engineer.

3.2 INSPECTION OF PIPE AND ACCESSORIES

- .1 Inspect for defects immediately before lowering into trench. Promptly remove and replace defective material.
- .2 Clean pipes, fittings, valves before installation.

3.3 TRENCING AND BACKFILL

- .1 Complete trenching and backfill work as specified.
- .2 Trench depth to provide minimum cover over pipe of 2.6 m from finished grade.
- .3 Where minimum cover is less than 2.6 m from finished grade, use an approved insulation method to prevent frost penetration.
- .4 Depth of cover shall not exceed 4.0 m without approval of the Engineer.

3.4 GRANULAR BEDDING

- .1 Place granular bedding materials in accordance with details.
- .2 Shape bed true to grade to provide continuous uniform bearing surface for pipe exterior. Do not use blocks when bedding pipe.
- .3 Shape transverse depressions in bedding as required to accommodate pipe bell or other non-uniform pipe components. Care must be taken so as not to create unfilled voids in the bedding that would cause pipe “bridging”.
- .4 Compact full width of bed to at least 95% Standard Proctor ASTM D698, Method D.
- .5 Fill any excavation below level of bottom of specified bedding with approved granular bedding material as directed.

3.5 PIPE INSTALLATION

- .1 Installation and handling of pipe shall be to manufacturer's standard instructions and specifications, and applicable AWWA Specification for the type of pipe selected or as specified herein.
- .2 Join pipes in accordance with manufacturer's recommendations.
- .3 Handle pipe by approved methods. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends. Lift pipe by means of slings and lower into the trench by hand or mechanical equipment. **Do not roll or drop pipe into the trench.** If the Contractor elects to use a narrow trench, the method of lowering the pipe into the trench shall be such that no rocks or lumps of earth fall into the trench beneath the pipe. Lumps of earth and rock greater than 25 mm will not be permitted beneath the pipe and must be removed prior to pipe replacement.
- .4 Lay pipes on prepared bed, true to line and grade. Ensure the barrel of each pipe is in contact with shaped bed throughout its full length. Provide bell or coupling holes and support the pipe uniformly and continuously throughout its length.
- .5 Replace defective pipe.
- .6 Face socket ends of pipe in direction of laying. For mains on a grade of 2% or greater, face socket ends up-grade.
- .7 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.
- .8 Keep jointing materials and installed pipe free of dirt and water and other foreign materials. Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .9 Position and join pipes with approved equipment. Do not use excavating equipment to force pipe sections together.
- .10 Cut pipes, as required, for special fittings or closure pieces, in a neat manner, as recommended by pipe manufacturer, without damaging pipe or its coating and to leave a smooth end at right angles to axis of pipe. Cut pipes squarely and accurately.
- .11 Align pipes carefully before jointing.
- .12 Install gaskets to manufacturer's recommendations. Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
- .13 Avoid displacing gasket or contaminating with dirt or other foreign material. Gaskets so disturbed or contaminated shall be removed, cleaned, lubricated and replaced before jointing is attempted again.
- .14 Use only Manufacturer's approved gasket lubricant for potable water lines.
- .15 Complete each joint before laying next length of pipe.
- .16 Minimize deflection after joint has been made.
- .17 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.

- .18 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by the Engineer.
- .19 When stoppage of work occurs, backfill and compact trench in an approved manner to prevent the pipe shifting during down time. Cap and mark at construction stage interfaces. Where existing pipe is cut in one stage but is to remain operational through the next stage, cap and seal by method approved by the Engineer.
- .20 Do not lay pipe on frozen bedding.
- .21 Protect hydrants, valves and appurtenances from freezing.
- .22 Install couplings, fittings and repair couplings to Manufacturers specifications and torque ratings.
- .23 Install tracer wire along top of pipe using duct tape to secure wire from movement during backfill procedure; secure every 3 m. Wire to be continuous and terminate with three wraps around fire hydrant. Start new run of tracer at same hydrant as termination hydrant. Start run of tracer wire with three wraps around fire hydrant. Where hydrants are not available, tracer wire will be terminated at ground level inside an approved enclosure such as an irrigation box or fink post. When tying onto existing water mains (that have tracer wire), use an approved water proof splice kit. Continuity will be checked prior to Substantial Completion.
- .24 Aquifer and non-potable waterlines to be clearly labeled to distinguish from potable waterlines.
- .25 Upon completion of pipe laying and after Engineer has inspected work in place, surround and cover pipes with approved granular material placed to dimensions indicated or directed.
- .26 Hand place select native granular material in uniform layers not exceeding 300 mm thick to minimum 300 mm over top of pipe. Dumping of material directly on top of pipe is not permitted.
- .27 Place layers uniformly and simultaneously on each side of pipe to prevent lateral displacement of pipe.
- .28 Compact each layer in the pipe zone to at least 95% of Standard Proctor maximum dry density at $\pm 2\%$ of optimum moisture content as determined by ASTM D698, Method C.
- .29 Backfill only after hydrostatic and leakage test results are acceptable to the Engineer.
- .30 Notify the Environmental Utilities Department if there is water supply service interruption to any hydrants.
- .31 Maintain constructed grade to within ± 50 mm from the lines, grades and elevations shown in the Contract Documents. Where departures occur, return to established grade gradually over a distance of not less than 25 m.

3.6 VALVE INSTALLATION

- .1 Install valves to manufacturer's recommendations and applicable AWWA Specifications.

- .2 Support valves 300 mm and larger by means of concrete located between valve and solid ground as detailed. Bedding to be the same as adjacent pipe. Minimum length of pipe on each end of valve shall be 1 m. Valves are not to be supported by the pipe.
- .3 When replacing a valve on an existing water main, ensure any portion of a valve that comes into contact with the pipe, is swabbed with 1% hypochlorite solution. Flush line to remove excess chlorine residual.
- .4 Set the valve accurately in position and place the valve box carefully over the bonnet with the valve casing perpendicular to the axis of the pipe, and adjust the top box to the grades specified. Remove bolts from slider before backfilling.
- .5 Securely set the extension rods on the valve nut.
- .6 Install wooden markers as directed by the Engineer.
- .7 Valves and valve boxes shall have approved granular backfill (Class B).
- .8 Main valve placement, whenever possible, should not be less than 3 m from other fittings and a minimum of 5 m from thrust blocks.
- .9 At future stubs or dead-ends a boundary valve must be provided. For 200 mm diameter and smaller, a minimum of 12 m of pipe must be installed past the boundary valve to a plug with a thrust block. For 250 mm and larger diameter water mains, a minimum of 18 m is required. At the approval of the Engineer, mechanical restraint may be considered as an alternative.
- .10 When paving roads, avoid spraying oil on valve lids and remove excess asphalt on lid.
- .11 Top of valve lid to be set flush or slightly below top of asphalt or finished grade.

3.7 TAPPING VALVE INSTALLATION

- .1 Install valves to manufacturer's recommendations and applicable AWWA Specifications.
- .2 When connecting to an existing main that is in service an approved tapping valve and sleeve shall be used, provided the size of the existing main is at least one size larger than the connecting main. All bolts to be torqued to manufacturer's specifications. Municipal forces may tap sizes 100 mm to 250 mm.
- .3 Ensure any portion of a tapping sleeve that comes into contact with the pipe is swabbed with 1% hypochlorite solution.
- .4 Set the valve accurately in position and place the valve box carefully over the bonnet with the valve casing perpendicular to the axis of the pipe, and adjust the top box to the grades specified. Remove bolts from slider before backfilling.
- .5 Securely set the extension rods on the valve nut. Install wooden markers as directed by the Engineer.
- .6 Provide thrust block and concrete support for valve.
- .7 Fittings and pipe must be wrapped with 6 mil polyethylene to keep joints and couplings free of concrete.
- .8 Valves and valve boxes shall have approved granular backfill (Class B).

3.8 HYDRANT INSTALLATION

- .1 Install hydrants in accordance with manufacturer's recommendations and AWWA Manual of Practice M-17.
- .2 Install 150 mm gate valve and cast iron valve box on hydrant service leads as indicated. Valve to be positioned in asphalt roadway a minimum of 3.0m from thrust blocks where ever possible. A minimum of 1.0 m may be accepted if valve is mechanically restrained to tee. Remove bolts from slider before backfilling.
- .3 Set hydrants plumb with hose outlets parallel with edge of pavement or curb line, pumper connection facing roadway with underside of body flange set at elevation between 50 mm and 200 mm above final grade. Where the hydrant barrel needs to be lengthened to achieve the specified flange elevation, no more than one barrel extension per hydrant will be permitted.
- .4 Place concrete thrust blocks as indicated and specified ensuring that drain holes are unobstructed.
- .5 Install deep bury hydrants with valve and drain holes at 2.75m deep if water main depths exceed standard cover.
- .6 To provide proper draining for each hydrant, excavate a pit measuring not less than 1 m x 1 m x 0.5 m deep and back-fill with coarse gravel or crushed stone to a level 150 mm above drain holes.
- .7 Place appropriate sign on installed hydrants indicating whether or not they are in service during construction.
- .8 Hydrants shall have approved granular backfill (Class B).
- .9 In high water table plug drain holes from the inside as per manufacturer's recommendation.

3.9 THRUST BLOCKS

- .1 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as indicated or as directed by the Engineer.
- .2 Thrust-blocking material shall be purchased from a Redi-Mix concrete supplier and will not be manufactured on site.
- .3 Thrust blocking shall be placed between undisturbed ground and the fitting to be anchored with a minimum bearing area between the pipe and the ground in each instance shall be in accordance with. The blocking shall be so placed that the pipe and fitting joints will be accessible for repair. Bearing areas shall be inspected by the Engineer prior to placing concrete.
- .4 Keep joints and couplings free of concrete by wrapping with 6 mil polyethylene.
- .5 Do not backfill or compact over concrete within 24 hours after placing.
- .6 Mechanical restraint may be used as an alternative if approved by the Engineer. All mechanical restraints must be sealed from moisture with an approved paste and tape product.

3.10 CATHODIC PROTECTION

3.10.1 Factory Applied Fusion-Bonded Epoxy Coatings

- .1 Fittings that are factory fusion-bonded epoxy coated do not require cathodic protection unless specifically requested by Engineer.
- .2 Fittings that have damaged or deficient coatings may be rejected. An approved coating repair product may be allowed to cover small coating defects and/or anodes may be required at the discretion of Engineer.

3.10.2 Corrosion Protective Coatings

- .1 Install as per manufacturer's recommendations.
- .2 Ensure steel to be coated is clean so that coating adheres to the surface.
- .3 Allow any cadwelds to cool before placing coating over cadweld.
- .4 All coatings to comply with NSF/ANSI 61 "Drinking Water System Components-Health Effects".

3.10.3 Sacrificial Anodes

- .1 Remove the plastic bag from the anodes, leaving the cloth bag intact.
- .2 Place the anodes a minimum distance of 915 mm (3-feet) from the main in a horizontal position at approximately the same elevation and parallel to the main.
- .3 Ensure that soil is packed uniformly around the anodes to eliminate voids or air pockets adjacent to the anodes.
- .4 Zinc anodes shall be cadwelded onto each length of buried steel pipe and each metal adapter.
- .5 Coordinates of anodes to be recorded and marked on Record Drawings.

3.10.4 Cadwelding

- .1 Remove a small portion of coating on the pipe or fitting if a coating exists.
- .2 Thoroughly clean area to be cadwelded and file metal until a shiny, roughened surface is obtained approximately 75 mm (3-inches) square.
- .3 Crimp a copper sleeve onto the bared end of the wire to be cadwelded.
- .4 Use a cadweld mold M108 or equal and powder CA-15 or equal.
- .5 Knock any slag off of the completed cadweld and file smooth any sharp edges.
- .6 Thoroughly coat the cadweld and any area adjacent that has had the coating removed with a molded plastic patch.

3.11 CLEAN TIE-INS AND REPAIRS

- .1 All in-service valves and appurtenances shall be operated by the municipality. Contractor is responsible for arranging all locates and for site safety.
- .2 Contractor is responsible for notifying the public and businesses affected by a shutdown as specified in the contract documents.

- .3 Contractor to have all necessary, approved parts onsite to perform the task including valves, hydrants, fittings, trash pumps and hoses and/or vac trucks. All ditch water must have sediments removed by a suitable filtration method when pumping into storm and sanitary manholes to prevent silt deposits/sand/gravel from entering storm drainage or sanitary systems.
- .4 Whenever possible, laterals should be connected by hot taps instead of cut-ins. Hot taps are performed with the line left under pressure. In a situation where there may be some risk involved because of high pressure, high volume, pipe material or location, proximity valves will be closed by the municipality and the line will be fed from one direction.
- .5 Prior to cut-ins and water shutdown, turbidity and chlorine residual levels may be taken by the municipality as a reference to indicate the levels to be obtained after the work has been completed.
- .6 Excavate below pipe to allow for a rock sump. Maintain ditch water levels below the bottom of the pipe to avoid contamination. Positive pressure must be maintained until water level is safely below the bottom of the pipe. If water, soil or other contaminants from the ditch enters the open pipe, uni-directional flush the line from all directions to flush out the line.
- .7 If positive pressure is lost, the line must be isolated and bacteriological samples are to be taken. Results must be confirmed negative before line is returned into service.
- .8 For valve, hydrant, fitting or pipe repair, swab all parts with a minimum 1% hypochlorite solution. Prevent contamination by sealing parts with poly prior to assembling and use clean disposable gloves when handling and making connections.
- .9 All fittings to be installed and torqued to manufacturer's specifications.
- .10 A static pressure test or a visual inspection by the Engineer will be required prior to completing the backfill. Once repair is made, backfill pipe as specified.
- .11 When the pipe has sufficient backfill weight on it, the waterline may be safely loaded by the municipality. All air and excess chlorine residual to be expelled utilizing the closest existing hydrants or flush points. Chlorinated water must be discharged to sanitary sewer or dechlorinated before being directed to storm drainage. Contractor required to supply all fittings, hoses and manpower.
- .12 Turbidity and chlorine residual will be monitored until they return to their original readings. Once that is accomplished the municipality will return all valves to normal position.

3.12 PLUGGING OF DEAD ENDS

- .1 Insert standard plugs into the bell ends of fittings or pipe bells. Place caps over spigot ends of fittings and pipes.
- .2 Construct concrete thrust blocks for all plugs and caps or ties to fittings using approved mechanical restraints.

3.13 TEMPORARY FLUSHING AND CHLORING INJECTION POINTS

- .1 Size and location of injection and flushing points as shown on the drawings or as determined by Engineer.
- .2 Curb stops to be stop and drain type.
- .3 Removal and abandonment of connections to be witnessed and approved by Engineer.
- .4 An approved cap or saddle to be installed on closed main stop to prevent future leaks.
- .5 Flush points that are located in roadways or temporary graveled turnarounds where vehicle traffic could damage the flush point shall be protected by enclosing curb stop and pigtail in a vault or manhole.
- .6 Flush points in undeveloped roadways or easements shall have marker posts to prevent damage to the curb stop.

3.14 TEMPORARY WATER SERVICES

- .1 Notify the Engineer at least one (1) business day prior to installation, removal, or relocation temporary water service.
- .2 If the temporary service line is for domestic use, the following procedures must be adhered to.
- .3 The Contractor will string out the temp water line and necessary laterals using new or clean pipe approved by the Engineer. Valves to be installed at each lateral and at the end of the line.
- .4 The municipality will supply water for initial leak testing and a pre-flush of the main line and laterals of the temporary water supply system.
- .5 The temporary system including all laterals are to be disinfected and bacteriological tested as outlined in this section. The line is to be isolated until bacteriological results come back negative.
- .6 Water used for flushing and super-chlorination must be disposed of in the sanitary sewer system or a water truck with an approved air gap.
- .7 Once bacteriological tests have passed, Contractor will have to arrange for the municipality to charge the temporary line.
- .8 Contractor must arrange to ensure the residence's internal meter shut-off valve is accessible and in good working condition. Outside hose bibs that are used must allow water to flow into the home. Frost-free hose bibs may have to be modified if used as a connection. Direct connection to the existing water service or other proposed service methods may be allowed as an alternative only with specific approval from the Engineer.
- .9 Contractor is responsible to coordinate appointments with individual homeowners for hook-ups to the temporary water service system. The shut-off valve at meter is to be closed and confirmed to hold before temporary water is hooked up to the building. Using clean disposable gloves and a 1% hypochlorite solution, spray connections.

- Flush and make all the necessary connections. Homeowners or their designate to be present at all times.
- .10 Each residence or business will be additionally isolated by the municipality to eliminate reverse flow when testing the new water main.
 - .11 Once the new water main has been put into service, the Contractor will again have to make arrangements with the municipality and individual homeowners to disconnect the temporary service and restore permanent water service.
 - .12 Temporary water must be disconnected first and meter valve opened. The municipality will then open up the curb stop and the Contractor shall flush the house service through the outside hose bib until water flows clear and air is expelled.
 - .13 Once all residences have been converted over to the permanent water line, the temporary water service is to be removed and hydrant will be put back into normal service by the municipality.

4 FIELD TESTING

4.1 LEAKAGE AND PRESSURE TESTING

4.1.1 General

- .1 Provide labour, equipment and materials required to perform leakage tests hereinafter described. Equipment shall include a pump, pipe connections, pressure gauges with adequate pressure range, and all other necessary equipment.
- .2 Test is to be completed after services are installed.
- .3 Notify Engineer at least one (1) business day in advance of all proposed tests. Perform tests in presence of Engineer.
- .4 Where any section of system is provided with concrete thrust blocks, do not conduct tests until at least 5 days after placing concrete or 2 days if high early strength concrete is used.
- .5 Before testing, bed and cover pipe to prevent movement or snaking of pipe line when pressure test is applied.
- .6 Backfill, mechanically restrain or strut and brace all caps, bends, tees and valves to prevent movement when pressure test is applied.
- .7 In coordination with the municipality, open all valves necessary to test section of pipe.
- .8 Expel air at services and hydrants by slowly filling main with potable water. Install temporary taps wherever necessary to expel air, remove and cap after completion.
- .9 Thoroughly examine exposed parts and correct for leakage as necessary.
- .10 Locate and repair defects if leakage is greater than amount specified. Any leaks, breaks, failures, or blockages, which are a result of faulty material and/or workmanship, are the sole responsibility of the Contractor to correct at his expense.
- .11 Repeat test until leakage is within specified allowance for full length of water main.

4.1.2 Procedure

- .1 After completing the installation of the Pipeline or a section of the line including water services the lines shall be hydrostatically pressure tested. The completed line shall be tested at a pressure equal to one and one-half times the maximum operating pressure or 1,000 kPa whichever is greater, but not in excess of the Manufacturer's recommended operating pressure measured at the lowest point in the test section.
- .2 Apply test pressure by means of a test pump with a measurable volume container, acceptable to the Engineer, supplied by the Contractor.
- .3 To compensate for initial pipe stretch and to expel all entrapped air, the pipe shall be pressurized until pressure is maintained before the test period is started.
- .4 After completion of the initial expansion phase, the pressure shall be at the specified level and the test period shall commence. The test period shall be for a period of 2 hours and shall only commence prior to 2:00 p.m.
- .5 During the test if the pressure drops more than 35 kPa (5 psi) then attempt to expel air and retest.
- .6 After the test period, a measured amount of "make-up" water shall be added to return the pipe to the test pressure. The amount of "make-up" water shall not exceed the allowance given in AWWA C-605.
- .7 The formulas for make-up for PVC pipe per hour are as follows :
 - Where Q_m is the quantity of make-up water per hour in liters, L is the length of the testing section in meters, D is the diameter of the pipe in mm, and P is the testing pressure in kPa.
 - Or Q_m is the quantity of make-up water per hour in liters, N is the number of joints in the testing section, D is the diameter of the pipe in mm, and P is the testing pressure in kPa.

$$Q_m = \frac{L \times D \sqrt{P}}{795,000} \quad \text{OR} \quad Q_m = \frac{N \times D \sqrt{P}}{130,400}$$

- .8 For pressure testing HDPE pipe, the test pressure shall be 50% greater than the rated pressure of the pipe or specified by Engineer. The testing pressure shall be based on the lowest elevation of the test section and if there are pipes with different pressure ratings, they shall be tested separately.
- .9 Testing procedures and allowable losses to be determined by Engineer.

4.2 FLUSHING AND DISINFECTING

- .1 Flushing and disinfecting operations shall be witnessed by Engineer. Notify Engineer at least two (2) business days in advance of proposed date when disinfecting operations will commence.

- .2 Flush water mains through available outlets with a sufficient flow in accordance with AWWA Standards to clean the pipe. If velocities cannot be achieved then an approved foam pig may be used to scour the pipe.
- .3 Open and close valves, hydrants, and service connections using a uni-directional flushing method to ensure thorough cleaning.
- .4 Boundary valves shall be operated by the municipality and the Contractor must ensure a positive flow during the flushing procedure at all times.
- .5 Ensure that all water flushed from the main is de-chlorinated and properly discharged to an approved disposal point. Testing and sampling to be witnessed by the Engineer.
- .6 When flushing has been completed to satisfaction of Engineer, introduce a strong solution of chlorine into water main and ensure that it is distributed throughout entire system using a continuous feed method.
- .7 Disinfect water mains to AWWA C651 under the supervision of the Engineer and the municipality.
- .8 Provide connections and pumps as required.
- .9 Install any necessary chlorination points along the pipeline route in order to properly inject the disinfectant. Connections made shall be appropriately marked and abandoned to the satisfaction of the Engineer.
- .10 Take water test samples at hydrants and service connections in suitable sequence to test for chlorine residual.
- .11 When a free chlorine residual not less than 50 ppm has been obtained, leave system charged with chlorine solution for 24 hrs. After 24 hours of contact time; test samples shall be taken to ensure that there is no less than 10 ppm of chlorine residual remaining throughout system.
- .12 Flush system to remove excess chlorine. Abide by all local and provincial regulations relative to the discharge of super-chlorinated water. Test samples at all hydrants and flush points are then taken to confirm that free chlorine residuals are between 0.1ppm and 1ppm.
- .13 As early as the following day after flushing, samples may be obtained in approved sample bottles provided by Saskatchewan Disease Control Laboratory for analysis. Under supervision of the Engineer, one sample shall be taken and submitted for every 360 m of water main installed, at all dead ends, and end points of pipe. Additional sampling may be required at the discretion of the Engineer. Samples are to be delivered to the Environmental Public Health Office for transfer to the Provincial Lab.
- .14 A second water sample shall be taken at the same locations a minimum of 24 hours after the first samples were taken and submitted for bacterial analysis.
- .15 Submit all bacterial sample results to the Engineer. Two consecutive negative results must be attained at each test location before the water main can be turned-in by the municipality and become part of the water distribution system.

- .16 If test results indicate a positive result, an additional sample must be taken at that location. If that sample comes back positive for pathogens again the water main is to be re-flushed, chlorinated, and sampled again.
- .17 All new valves and hydrants will be only operated by the municipality once the water main is accepted and turned into the system. If any further work is required the municipality shall be notified.

4.3 OPERATION

- .1 Check the operation of all valves and hydrants in the presence of the Engineer.
- .2 Mark locations of valves and other underground appurtenances with 50mm x 100mm stakes 1m long, driven 0.6m into the ground at the property line opposite the valve. Marker stakes shall be painted blue.
- .3 Valves shall only be operated by their respective owners.

END OF SPECIFICATION

SPECIFICATION 06800 – ADJUSTMENT OF APPURTENANCES

1 GENERAL

1.1 DESCRIPTION

This section refers to the adjustment of valves and manholes within the roadways to be paved.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

- Section 03140 – Asphalt Concrete

2 PRODUCTS

2.1 VALVE BOX RISERS

.1 Valve box extensions shall be 75, 100 or 150 mm cast iron conforming to ASTM A48 Class 25 and are to be completely coated with an asphaltic type varnish to prevent corrosion.

2.2 GAS VALVES

.1 Contact the gas utility for arranging adjustments to gas valves.

2.3 MANHOLE GRADE RINGS AND BLOCK

- .1 Precast grade rings and blocks for manhole grade adjustment shall conform to ASTM C478 and C139, respectively.
- .2 Infra-Riser Rubber adjustment rings.

2.4 MORTAR

.1 Mortar shall be Sulphate resistant ASTM Type 50 producing a minimum strength of 10 MPa.

3 EXECUTION

3.1 GENERAL

- .1 For asphalt base course, adjustments to valves and manholes shall be made to the asphalt base course elevation.
- .2 For asphalt surface course, adjustments to valves and manholes shall be made to the asphalt surface course elevation.
- .3 Where top/final lift of asphalt is not placed in the same year as the base lift, manhole frames/covers and other surface appurtenances shall be set to the interim asphalt grade.
- .4 Where top lift of asphalt is to be placed in the same year as the base lift, manhole frames/covers and other surface appurtenances shall be set to the final asphalt grade. Projecting manholes and valves shall be ramped at 1:40 prior to placing final asphalt lift.

- .5 Final adjustments shall be made to the final Asphalt Surface Course elevation using adjustment rings only prior to the placement of the final asphalt lift.

3.2 VALVE BOXES

- .1 The Contractor shall shorten or lengthen the boxes and stems as required and block the boxes to prevent any settlement. The adjustments shall be so made that the valves operate effectively.
- .2 If the top box fails to move, risers can be used to bring it to grade.
- .3 The Contractor shall replace any valve top box that becomes broken during adjustment at his expense.

3.3 MANHOLES

- .1 Manholes shall be adjusted so that the cover conforms to the required elevation. All adjustments are to be made with grade rings firmly set in position. All bearing loads of the manhole frame to the manhole slab top shall be evenly distributed.
- .2 Raise existing manholes frames and covers and catch basin frames and grates to final design elevation, using adjusting rings.
- .3 If adjustment exceeds more than 0.3 m the adjustment shall be made using a new manhole barrel c/w ladder rung.
- .4 The final 0.025 m shall be adjusted utilizing a composite rubber adjustment ring directly beneath the frame and cover assembly. Sloped composite rubber adjustment rings shall be used to match the roadway profile.
- .5 Wood or metal shims shall not be used to level the adjustment rings or frames.
- .6 Depth from top of manhole covers to first ladder rung shall not exceed 0.75 m. Install additional ladder rungs as necessary or as directed by the Engineer.

3.4 BACKFILL

- .1 Should any backfill be required around the valve box or manhole below the elevation of the road base course surface, mortar or granular base shall be used and properly compacted in place.

END OF SPECIFICATION

SPECIFICATION 08050 – TEMPORARY FENCING

1 GENERAL

1.1 DESCRIPTION

This section specifies requirements for temporary security fencing around excavation areas, working areas, environmental reserve areas, and protected areas.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

- Section 01223- Trenching

1.3 TEMPORARY FENCING

- .1 Temporary fencing around excavations shall be polyethylene safety fence or approved alternate.
- .2 Temporary fencing around environmental reserve and protected areas shall be polyethylene safety fence or approved alternate.

2 PRODUCTS

2.1 MATERIALS

2.1.1 Polyethylene Safety Fence

High density polyethylene fencing material with; 33mm x 33mm square or diamond shaped mesh, minimum height of 1200mm, orange color. Tensar Safety Grid-GS as manufactured by Nilex Inc. or approved alternate.

2.1.2 Posts

- .1 Studded Steel T-Posts - Minimum length – 900mm longer than the fabric width.
- .2 Portable Posts - The Contractor shall submit details for approval.

2.1.3 Gates

The Contractor shall submit details for approval for gates for access to working area.

3 EXECUTION

3.1 GRADING

Remove debris and grade between posts to provide ground clearance between 40mm and 100mm.

3.2 POST SPACING

Space T-posts at 3.0m centre to centre, if portable posts are used, reduce spacing to suit.

3.3 POST-SETTING – T-POSTS

- .1 Drive T-posts into the ground, at specified spacing.

- .2 Set posts in line and plumb so that the fence forms a straight line between corner posts.
- .3 Install straining posts where required.

3.4 FABRIC INSTALLATION

- .1 Set braces for gates and corners.
- .2 Install fabric in accordance with the manufacturer's instructions.
- .3 Fasten fabric to posts and bracing wire with nylon ties.
- .4 Stretch fabric and secure using steel bars in accordance with the manufacturer's instructions.

3.5 CLEAN-UP

Clean up debris and trim all areas disturbed.

END OF SPECIFICATION

SPECIFICATION 08100 – ROADWAY SIGNS

1 GENERAL

1.1 DESCRIPTION

- .1 This section specifies the supply and installation of Regulatory Roadway Signs for the normal use of roadways.

1.2 DESIGN REQUIREMENTS

- .1 Sign supports and appurtenances to be capable of withstanding summation of the following loads:
 - .1 Wind and ice loading specified to be consistent with anticipated loads in the City of North Battleford. Refer to the National Building Code of Canada and/or Provincial Building Code.
 - .2 Dead load of signboards, sign supports and appurtenances.
 - .3 Ice load on one face of signboards and around surface of all structural members and appurtenances.
- .2 Structural deflections and vibration in accordance with American Association of State Highway and Transportation Officials (AASHTO), “Specification for the Design and Construction of Structural Supports for Highway Signs”.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings for signage structures indicating product data and design.

2 PRODUCTS

2.1 SIGN SUPPORTS

- .1 Steel posts:
 - .1 To CAN-G40.21, (4) m long, flanged “U” shaped in cross section, measuring (65) mm wide by (30) mm deep.
 - .2 Metal thickness: (4.5) mm.
 - .3 Hot dipped galvanized: to CAN/CSA-G164.
 - .4 Standard tubular supports for small signs: to ASTM B210M.
- .2 Base plates:
 - .1 To ASTM B209M.
- .3 Fasteners:
 - .1 Bolts, nuts, washers and other hardware for roadside signs to be cast aluminum alloy, or galvanized steel.

2.2 SIGN BOARDS

- .1 Aluminum sheet to ASTM B209M, pre-cut to required dimensions. Minimum thickness shall be 1.6 mm for signboards up to 750 mm wide. Minimum thickness for signboards 750 3 1200 mm wide shall be 2.0 mm.
- .2 Connecting straps and bracket to ASTM B209M.
- .3 3M HI-Intensity Scotchlite or equal approved by the Engineer.

2.3 FABRICATION

.1 Signboards

- .1 Aluminum blanks shall be degreased, etched and bonderized with chemical conversion coating. Clean surfaces with xylene thinner. Aluminum signboards shall be painted prior to installation. Spray and back face of signboards with two coats of enamel in accordance with CAN/CGSB-1.104.

3 EXECUTION

3.1 GENERAL

- .1 The Engineer will provide plan layout information in the form of a base line for the installation of permanent signs. The Contractor shall establish the height and elevation of the sign and install it in accordance with the plans or as directed by the Engineer.
- .2 The Contractor shall have all utilities located prior to digging holes for sign posts. Any adjustments to the location of the signs will be subject to the approval of the Engineer.
- .3 Signs shall be mounted to the posts in accordance to Standard Drawing MW 200.
- .4 The installed sign shall be clean and not bent or twisted. The reflectorized surface shall be free of scratches, dents and marks and must be securely fastened to the post.
- .5 The disturbed area around all installations shall be restored to the original contours or as directed by the Engineer.

3.2 INSTALLATION OF BREAKAWAY STEEL POSTS

- .1 Breakaway steel posts shall be installed to within 1.5 degrees of vertical and as indicated on the drawings.
- .2 Breakaway steel posts are to be driven to the required depth without damage to the posts. If rock or concrete is encountered, auger the post holes to the required depth and backfill the post with material free of organics. All backfill shall be placed in 150 mm thick lifts and thoroughly compacted for the full depth.
- .3 Damage to galvanized surfaces shall be repaired by treating the damaged areas with zinc rich paint conforming to MIL SPEC DOD-P-21035.

3.3 INSTALLATION OF WOODEN POSTS

- .1 Wooded posts shall be installed to within 1.5 degrees of vertical and as indicated on the drawing.
- .2 Wooden posts shall be set in augured holes to the required depth. The wooden post shall be backfilled with material free of organics. Backfill shall be placed in 150 mm thick lifts and thoroughly compacted for the full depth.

3.4 INSTALLATION OF CONCRETE BASES

- .1 Concrete bases shall be installed as shown on the drawings. The Contractor shall excavate hole to a minimum of 300 mm larger than the base and the base shall be installed in the center of the excavation. The concrete base shall be backfilled with material free of organics. Backfill shall be placed in 150 mm thick lifts and thoroughly compacted for the full depth.

END OF SPECIFICATION