Part 1 General

1.1 REFERENCES

.1 American Society for Testing and Materials (ASTM)

.1 ASTM D4791-99, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.

1.2 SAMPLES

.1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

.2 Allow continual sampling by Departmental Representative during production.

.3 Provide Departmental Representative with access to source and processed material for sampling.

.4 Pay cost of sampling and testing of aggregates which fail to meet specified requirements.

Part 2 Products

2.1 MATERIALS

.1 Type 1 fill (Washed Rock):

.1 Clean, hard, durable, gravel or stone free from clay lumps, cementation, shale, organic material, frozen material and other deleterious materials.

.2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117 giving a smooth curve without sharp breaks when plotted on semi-log charts.

Sieve Designation (um)	% Passing
50 000	100
25 000	80 – 100
20 000	20 – 100
5 000	0 - 10

.2 Type 2 fill (Granular Sub-Cut):

.1 Crushed, pit run or screened stone, gravel or sand.

.2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1 or CAN/CGSB-8.2.

.1 Gradation Method # 1 to:

Sieve Designation	% Passing
80 mm	100
50 mm	55-100
40 mm	-
25 mm	38-100
16 mm	32-85
12.5 mm	-
10 mm	-
5.00 mm	20-65
2.00 mm	-
0.315 mm	6-30
0.160 mm	-
0.080 mm	2-10

.3 Other Properties as follows:

.1 Plasticity Index: to ASTM D4318, Maximum 8.

.2 Los Angeles degradation: N/A

.3 Native Backfill:

.1 Selected material from excavation or other sources, approved by Departmental Representative for use intended, unfrozen and free from rocks larger than 500 mm, cinders, ashes, sods, organics, refuse or other deleterious materials.

.2 Submit a complete sieve analysis of two samples of imported backfill material to the Departmental Representative for approval, prior to delivery on site.

.3 The sieve analysis must be performed by a qualified materials testing laboratory.

.4 Pipe Zone Material:

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

.2 Graduations to be within limits specified when tested to ASTM C136 and ASTM C117 and to have a smooth curve without sharp breaks when plotted on semi-log charts.

Sieve Designation (um)	% Passing
10 000	100
5 000	95 – 100
2 500	80 – 100
1 250	50 – 85
630	30 - 65
315	10 – 30
160	2 – 10

.5 Aggregate quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, or other substances that would act in deleterious manner for use intended.

.6 Flat and elongated particles of coarse aggregate: to ASTM D4791.

.1 Greatest dimension to exceed five times least dimension.

.7 Fine aggregates satisfying requirements of applicable section to be one, or blend of following:

.1 Natural sand.

.2 Manufactured sand.

.3 Screenings produced in crushing of quarried rock, boulders, gravel or slag.

.8 Coarse aggregates satisfying requirements of applicable section to be one of or blend of following:

.1 Crushed rock.

.2 Gravel and crushed gravel composed of naturally formed particles of stone.

.3 Light weight aggregate, including slag and expanded shale.

.9 Granular Sub-base

.1 Crushed, pit run or screened stone, gravel or sand.

.2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1 or CAN/CGSB-8.2.

.1 Gradation Method # 1 to:

Sieve Designation	% Passing
80 mm	100
50 mm	55-100
40 mm	-
25 mm	38-100
16 mm	32-85
12.5 mm	-
10 mm	-
5.00 mm	20-65
2.00 mm	-
0.315 mm	6-30
0.160 mm	-
0.080 mm	2-10

.3 Other Properties as follows:

.1 Plasticity Index: to ASTM D4318, Maximum 8.

.2 Los Angeles degradation: N/A

.4 Refer to section 32 11 16.01 Granular Sub-base.

.10 Granular Base

.1 Crushed stone or gravel.

.2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1 or CAN/CGSB-8.2.

.1 Gradation Method # 1 to:

Sieve Designation	% Passing
25 mm	-
20 mm	100
16 mm	84-94
12.5 mm	
10 mm	63-86
5 mm	40-67
1.25 mm	20-43
0.630 mm	14-34
0.315 mm	9-26
0.160 mm	5-18
0.080 mm	2-10

.2 Liquid limit: to ASTM D4318, maximum 25

.3 Plasticity index: to ASTM D4318, maximum 6

.4 Los Angeles degradation: to ASTM C131. Max. % loss by weight: 50

.5 Crushed particles: at least 60% of particles by mass within each of following sieve designation ranges to have at least 2 freshly fractured face. Material to be divided into ranges using methods of ASTM C136.

.3 Refer to Section 32 11 23: Aggregate Base Course.

.11 Submit a complete sieve analysis of two samples of granular sub-base material to the Departmental Representative for approval, prior to delivery on site.

.12 The sieve analysis must be performed by a qualified materials testing laboratory.

.13 The aggregate must be crushed and have a minimum CBR of 60.

.14 The coarse fraction of the aggregate must have a percent wear by the Los Angeles abrasion test of not more than 50.

.15 The material passing the 0.4 mm sieve must have a plasticity index of 6 or less.

.16 The material retained on the 5 mm sieve must have a minimum 60 percent by dry mass with at least two fractured faces.

.17 Granular sub-base must be placed in lifts not exceeding 200 mm in compacted thickness with each lift being uniformly compacted to a minimum of 98% of Standard Proctor maximum dry density (ASTM D698).

2.2 SOURCE QUALITY CONTROL

.1 Inform Departmental Representative of proposed source of aggregates and provide samples at least 4 weeks prior to commencing production.

.2 If, in opinion of Departmental Representative materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate an alternative source or demonstrate that material from source in question can be processed to meet specified requirements.

.3 Advise Departmental Representative 4 weeks in advance of proposed change of material source.

.4 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

Part 3 Execution

3.1 PREPARATION

.1 Aggregate source preparation

.1 Prior to excavating materials for aggregate production, clear and grub area to be worked, and strip unsuitable surface materials. Dispose of cleared, grubbed and unsuitable materials as directed by authority having jurisdiction.

.2 Where clearing is required, leave screen of trees between cleared area and roadways as directed.

.3 Clear, grub and strip area ahead of quarrying or excavating operation sufficient to prevent contamination of aggregate by deleterious materials.

.4 When excavation is completed dress sides of excavation to nominal 2:1 slope, and provide drains or ditches as required to prevent surface standing water.

.5 Trim off and dress slopes of waste material piles and leave site in neat condition.

.2 Processing

.1 Process aggregate uniformly using methods that prevent contamination, segregation and degradation.

.2 Blend aggregates, if required, to obtain gradation requirements, percentage of crushed particles, or particle shapes, as specified. Use methods and equipment approved by Departmental Representative.

.3 Wash aggregates, if required to meet specifications. Use only equipment approved by Departmental Representative.

.4 When operating in stratified deposits use excavation equipment and methods that produce uniform, homogeneous aggregate.

.3 Handling

.1 Handle and transport aggregates to avoid segregation, contamination and degradation.

.4 Stockpiling

.1 Stockpile aggregates on site in locations as indicated unless directed otherwise by Departmental Representative. Do not stockpile on completed pavement surfaces.

.2 Stockpile aggregates in sufficient quantities to meet Project schedules.

.3 Stockpiling sites to be level, well drained, and of adequate bearing capacity and stability to support stockpiled materials and handling equipment.

.4 Except where stockpiled on acceptably stabilized areas, provide compacted sand base not less than 300 mm in depth to prevent contamination of

aggregate. Stockpile aggregates on ground but do not incorporate bottom 300 mm of pile into Work.

.5 Separate different aggregates by strong, full depth bulkheads, or stockpile far enough apart to prevent intermixing.

.6 Do not use intermixed or contaminated materials. Remove and dispose of rejected materials as directed by Departmental Representative within 48 h of rejection.

.7 Stockpile materials in uniform layers of thickness as follows:

.1 Max 1.5 m for coarse aggregate and base course materials.

.2 Max 1.5 m for fine aggregate and sub-base materials.

.3 Max 1.5 m for other materials.

.8 Uniformly spot-dump aggregates delivered to stockpile in trucks and build up stockpile as specified.

.9 Do not cone piles or spill material over edges of piles.

.10 Do not use conveying stackers.

.11 During winter operations, prevent ice and snow from becoming mixed into stockpile or in material being removed from stockpile.

3.2 CLEANING

.1 Leave aggregate stockpile site in tidy, well drained condition, free of standing surface water.

.2 Leave any unused aggregates in neat compact stockpiles as directed by Departmental Representative.

.3 For temporary or permanent abandonment of aggregate source, restore source to condition meeting requirements of authority having jurisdiction.

3.3 QUALITY ASSURANCE

.1 Supply copies of the following sieve analyses to ASTM C136 and other tests to ensure that aggregates being produced and supplied meet specified requirements. Contractor to provide a daily estimate of production tonnage to the Departmental Representative.

.2 Grading of aggregate for stockpile

.1 A minimum of one sieve analysis per 500 tonnes of aggregate will be performed. Aggregate placed in stockpiles prior to acceptance by the Departmental Representative may be rejected, all or in part.

.2 Evaluation of tests: the average grading of the first 8 consecutive sieve tests shall conform to the specified grading band.

.3 Grading of aggregate shipped direct from the crusher to jobsite

.1 A minimum of one sieve analysis per 300 tonnes of aggregate will be performed.

.2 Do not strip aggregate to jobsite until the applicable test results have been accepted by the Departmental Representative.

3.4 FILL TYPES AND COMPACTION

.1 Unless otherwise specified, compact to the following densities at Optimum Moisture Content:

.1 Type 1 fill (Washed Rock): 95% Standard Proctor Density.

.2 Type 4 fill (Granular Sub-Cut): 100% Standard Proctor Density

.3 Compacted Native Backfill.

.1 100% Standard Proctor Density in final 300 mm beneath roadway in paved/gravelled areas, and walking trails.

.2 95% Standard Proctor Density in landscaped or natural areas.

.3 90% Standard Proctor Density in areas designated as Environmental.

.4 Pipe zone material: 95% Standard Proctor Density.

.5 Granular Sub-Base course: 100% Standard Proctor Density

.6 Granular Base course: 100% Standard Proctor Density.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

.1 Excavation classes: two classes of excavation will be recognized; common excavation and rock excavation.

.1 Rock: solid material in excess of 1cubic metre; and which cannot be removed by means of heavy duty mechanical excavating equipment. Frozen material not classified as rock.

.2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.

.2 Unclassified excavation: excavation of deposits of whatever character encountered in Work.

.3 Topsoil:

.1 Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

.2 Material reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and free from cobbles, stumps, roots, and other objectionable material larger than 25 millimeters in any dimension.

.4 Waste material: excavated material unsuitable for use in Work or surplus to requirements.

.5 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.

.6 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.

.7 Unsuitable materials:

.1 Weak, chemically unstable, and compressible materials.

.2 Frost susceptible materials under excavated areas.

.8 Unshrinkable fill: very weak mixture of cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

.9 Native Backfill: Material excavated from the trench from which all Boulders, roots, stumps or other debris which would prevent consolidation of bckfill have been removed.

.10 Pipe Zone: the portion of the trench between the bottom of the pipe bedding and a minimum 300 mm above the top of the installed pipe.

1.2 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Samples:

.1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

.2 Inform Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of fill unshrinkable fill materials and provide access for sampling.

.3 Submit 10 kg samples of type of fill specified including representative samples of excavated material.

.4 Ship samples to Departmental Representative in tightly closed containers to prevent contamination and exposure to elements.

1.3 QUALITY ASSURANCE

.1 Health and Safety Requirements:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 EXISTING CONDITIONS

.1 Buried services:

.1 Before commencing work verify location of buried services on and adjacent to site.

.2 Hand expose or hydrovac buried utilities within 1.0 m of work.

.3 Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.

.4 Remove obsolete buried services within 2 m of foundations: cap cut-offs.

.5 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.

.6 Prior to beginning excavation Work, notify applicable authorities having jurisdiction establish location and state of use of buried utilities and structures. Authorities having jurisdiction to clearly mark such locations to prevent disturbance during Work.

.7 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered as indicated.

.8 Where utility lines or structures exist in area of excavation, obtain direction of Departmental Representative before removing or re-routing. Costs for such Work to be paid by Departmental Representative.

.9 Record location of maintained, re-routed and abandoned underground lines.

.10 Confirm locations of recent excavations adjacent to area of excavation.

.2 Existing buildings and surface features:

.1 Conduct, with Departmental Representative, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey bench marks and monuments which may be affected by Work.

.2 Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately make repair as directed by Departmental Representative.

.3 Where required for excavation, cut roots or branches as directed by Departmental Representative.

Part 2 Products

2.1 MATERIALS

.1 Native Backfill: to Section 31 05 16 - Aggregate Matierals.

.2 Pipe Zone Material: to Section 31 05 16 - Aggregate Materials.

.3 Type 1 and Type 2 fill: properties to Section 31 05 16 - Aggregate Materials:

.4 Unshrinkable fill: proportioned and mixed to provide:

.1 Maximum compressive strength of 0.4 MPa at 28 days.

.2 Maximum cement content of 25 kg/m^3 with 40% fly ash replacement: to CSA-A3001, Type 10.

.3 Minimum strength of 0.07 MPa at 24 h.

.4 Concrete aggregates: to CSA-A23.1/A23.2.

.5 Cement: Type 10.

.6 Slump: 160 to 200 mm.

Part 3 Execution

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

.1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.

.2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

.3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 SITE PREPARATION

.1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.

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

3.3 PREPARATION/PROTECTION

.1 Keep excavations clean, free of standing water, and loose soil.

.2 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Departmental Representative approval.

.3 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.

.4 Protect buried services that are required to remain undisturbed.

3.4 STOCKPILING

.1 Stockpile fill materials in areas designated by Departmental Representative.

.1 Stockpile granular materials in manner to prevent segregation.

.2 Cover stockpile with polyethylene sheeting or tarps.

.2 Protect fill materials from contamination.

.3 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

3.5 COFFERDAMS, SHORING, BRACING AND UNDERPINNING

.1 Maintain sides and slopes of excavations in safe condition by appropriate methods and in accordance with Section 01 35 29.06 - Health and Safety Requirements.

.1 Where conditions are unstable, Departmental Representative to verify and advise methods.

.2 Obtain permit from authority having jurisdiction for temporary diversion of water course.

.3 Upon completion of substructure construction:

.1 Remove cofferdams, shoring and bracing.

.2 Remove excess materials from site and restore watercourses as directed by Departmental Representative.

3.6 DEWATERING AND HEAVE PREVENTION

.1 Keep excavations free of water while Work is in progress.

.2 Dewatering is defined as removal of water from the trench by means of a submersible pump.

.3 Provide for Departmental Representative review of proposed dewatering or heave prevention methods, including dikes, well points, and sheet pile cut-offs.

.4 Avoid excavation below groundwater table if quick condition or heave is likely to occur.

.1 Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.

.5 Protect open excavations against flooding and damage due to surface run-off.

.6 Dispose of water in accordance with Section 01 35 43 - Environmental Procedures to approved collection and runoff areas in a manner not detrimental to public and private property, or portion of Work completed or under construction.

.1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.

.7 Provide flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, watercourses or drainage areas.

3.7 STRIPPING OF TOPSOIL

.1 Do topsoil and finish grading in accordance with Section 32 91 19.13 - Topsoil Placement and Grading.

.2 Commence topsoil stripping of areas as directed by Departmental Representative after brush, weeds, and grasses have been removed from these areas.

.3 Strip topsoil to depths as directed by Departmental Representative. Do not mix topsoil with subsoil.

.4 Stockpile in locations as directed by Departmental Representative. Stockpile height not to exceed 2 m.

.5 Stockpile topsoil on geotextile material, tarps or plywood.

.6 Dispose of unused topsoil off site as directed by Departmental Representative.

.7 Remove clearing and grubbing debris from stripping.

.8 Spread organic stripping, on completion of excavation and embankment construction, on slopes and trim or remove from site if quantity exceeds ability to grade on site.

3.8 EXCAVATION

.1 Advise Departmental Representative at least 7 days in advance of excavation operations for initial cross sections to be taken.

.2 Excavate to lines, grades, elevations and dimensions as indicated.

.3 Remove concrete, masonry, paving, walks, demolished foundations and rubble and other obstructions encountered during excavation.

.4 Excavation must not interfere with bearing capacity of adjacent foundations.

.5 Stockpile spoil material on geotextile material, tarps or plywood. Stockpiles which are to remain in excess of 24 hrs to be covered with polyethylene sheeting or tarps.

.6 Do not disturb soil within branch spread of trees or shrubs that are to remain.

.1 If excavating through roots, excavate by hand and cut roots with sharp axe or saw.

.7 For trench excavation, unless otherwise authorized by Departmental Representative in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 10 m at end of day's operation.

.1 All open excavation left overnight or during non-construction periods to be fenced with minimum 1.8 m high chainlink fence.

.8 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by Departmental Representative.

.9 Restrict vehicle operations directly adjacent to open trenches.

.10 Dispose of surplus and unsuitable excavated material in approved location off site.

.11 Do not obstruct flow of surface drainage or natural watercourses.

.12 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.

.13 Notify Departmental Representative when bottom of excavation is reached.

.14 Obtain Departmental Representative approval of completed excavation.

.15 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by Departmental Representative.

.16 Correct unauthorized over-excavation as follows:

.1 Fill under other areas with Type 1 fill compacted to not less than 95 % in accordance with Section 31 05 16 - Aggregate Materials.

.17 Hand trim, make firm and remove loose material and debris from excavations.

.1 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.

.2 Clean out rock seams and fill with concrete mortar or grout to approval of Departmental Representative.

.18 Transport and relocate boulders and rock to a location approved by Departmental Representative and within 10.0 km of site.

3.9 PIPE ZONE MATERIAL

.1 Place pipe zone materials in accordance with details as directed by Departmental Representative.

.2 Shape bed true to grade and to provide continuous, uniform bearing surface for barrel of pipe. Do not use blocks when bedding pipe.

.3 Shape transverse depressions as required to receive bell, if bell and spigot pipe is used.

.4 Compact full width of bed to 95% Standard Proctor Density.

.5 Pipe Zone material to be a minimum 300 mm above pipe.

.6 Fill excavation below bottom of specified pipe zone adjacent to manholes or structures with Type 1 Fill.

3.10 BACKFILLING

.1 Do not proceed with backfilling operations until completion of following:

.1 Departmental Representative has inspected and approved installations.

.2 Departmental Representative has inspected and approved of construction below finish grade.

.3 Inspection, testing, approval, and recording location of underground utilities.

.4 Removal of concrete formwork.

.5 Removal of shoring and bracing; backfilling of voids with satisfactory soil material.

.2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.

.3 Do not use backfill material which is frozen or contains ice, snow or debris.

.4 Place backfill material in uniform layers not exceeding 300 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.

.5 Backfilling around installations:

.1 Place bedding and surround material as specified elsewhere.

.2 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.

.3 Place layers simultaneously on both sides of installed Work to equalize loading.

.6 Place unshrinkable fill in areas as indicated.

.7 Consolidate and level unshrinkable fill with internal vibrators.

.8 Install drainage system in backfill as directed by Departmental Representative.

3.11 RESTORATION

.1 Upon completion of Work, remove waste materials and debris, trim slopes, and correct defects as directed by Departmental Representative.

.2 Replace topsoil.

.3 Reinstate lawns to elevation which existed before excavation.

.4 Seed landscaped or natural areas.

.5 Reinstate pavements and sidewalks disturbed by excavation to thickness, structure and elevation which existed before excavation.

.6 Clean and reinstate areas affected by Work as directed by Departmental Representative.

.7 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.

.8 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society for Testing and Materials International, (ASTM).

.1 ASTM D698-00a, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,000 ft-lbf/ft^3) (600 kN-m/m^3).

1.2 DEFINITIONS

.1 Rock Excavation: refer to Section 31 23 33 .01: Excavating, trenching and Backfill:

.1 Boulder or rock fragments measuring in volume one (1) cubic metre or more.

.2 Common Excavation: excavation of materials that are not Rock Excavation or Stripping.

.3 Stripping: excavation of organic material covering original ground.

.4 Embankment: material derived from usable excavation and placed above original ground or stripped surface up to top of subgrade.

.5 Waste Material: material unsuitable for embankment, embankment foundation or material surplus to requirements.

.6 Borrow Material: material obtained from areas outside right-of-way and required for construction of embankments or for other portions of work.

.7 Topsoil: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

Part 2 Products

2.1 MATERIALS

.1 Embankment materials require approval by Departmental Representative.

.2 Material used for embankment not to contain more than 3% organic matter by mass, frozen lumps, weeds, sod, roots, logs, stumps or other unsuitable material.

.3 Borrow material:

.1 Obtain from borrow pit approved by Departmental Representative.

Part 3 Execution

3.1 COMPACTION EQUIPMENT

.1 Compaction equipment must equivalent of one 12 tonne vibratory packer capable of obtaining required densities in materials on project. Equipment that does not achieve specified densities must be replaced or supplemented.

.2 Operate minimum equivalent of one 12 tonne vibratory packer continuously in each embankment when placing material.

3.2 WATER DISTRIBUTORS

.1 Apply water with equipment capable of uniform distribution.

3.3 STRIPPING OF TOPSOIL

.1 Do topsoil and finish grading in accordance with Section 32 91 19.13 - Topsoil Placement and Grading.

.2 Commence topsoil stripping of areas as directed by Departmental Representative after brush, weeds, and grasses have been removed from these areas.

.3 Strip topsoil to depths as directed by Departmental Representative. Do not mix topsoil with subsoil.

.4 Stockpile in locations as directed by Departmental Representative. Stockpile height not to exceed 2 m.

.5 Stockpile topsoil on geotextile material, tarps or plywood.

.6 Dispose of unused topsoil off site as directed by Departmental Representative.

.7 Remove clearing and grubbing debris from stripping.

.8 Spread organic stripping, on completion of excavation and embankment construction, on slopes and trim or remove from site if quantity exceeds ability to grade on site.

3.4 EXCAVATING

.1 General:

.1 Notify Departmental Representative when waste materials are encountered and remove to depth and extent directed.

.2 Subcut 600 mm below subgrade in cut sections unless otherwise directed. Replace with approved granular sub-base fill material and compact.

.3 Treat ground slopes, where subgrade is on transition from excavation to embankment, at grade points as directed by Departmental Representative.

.2 Drainage:

.1 Maintain profiles, crowns and cross slopes to provide good surface drainage.

.2 Provide ditches as work progresses to provide drainage.

.3 Construct interceptor ditches as indicated or as directed before excavating or placing embankment in adjacent area.

.3 Borrow Excavation:

.1 Completely use in embankments, suitable materials removed from right-of-way excavations before taking material from borrow areas.

.2 Obtain embankment materials, in excess of what is available from cut areas, from designated borrow areas.

.1 Departmental Representative to designate extent of borrow areas and allowable depth of excavation.

.2 Remove waste and stripping material from borrow pits to designated locations.

.3 Trim and leave borrow pits in condition to permit accurate measurement of material removed.

3.5 EMBANKMENTS

.1 Scarify or bench existing slopes in side hill or sloping sections to ensure proper bond between new materials and existing surfaces. Method used to be subject to prior approval of Departmental Representative.

.2 Break up or scarify existing road surface prior to placing embankment material.

.3 Do not place material which is frozen nor place material on frozen surfaces except in areas authorized.

.4 Maintain crowned surface during construction to ensure ready run-off of surface water.

.5 Drain low areas before placing materials.

.1 Place and compact to full width in layers not exceeding 200 mm loose thickness. Departmental Representative may authorize thicker lifts if specified compaction can be achieved and if material contains more than 25% by volume stone and rock fragments larger than 100 mm.

3.6 SUBGRADE COMPACTION

.1 Break material down to sizes suitable for compaction and mix for uniform moisture to full depth of layer.

.2 Compact each layer to minimum 98% maximum dry density, ASTM D698 (AASHTO T99) except top 300 mm of subgrade. Compact top 300 mm to 100% maximum dry density.

.3 If subgrade preparation and compaction cannot be achieved to requirement in a single layer, temporarily remove upper portion to depth necessary to achieve requirement. Remove, replace, and compact such materials at no extra cost to the Owner.

.4 Add water or dry as required to bring moisture content of materials to level required to achieve specified compaction.

3.7 FINISHING

.1 Shape entire roadbed to within 25 mm of design elevations.

.2 Finish slopes, ditch bottoms and borrow pits true to lines, grades and drawings where applicable. Scale slope by removing loose fragments, for cut slopes in bedrock steeper than 1:1.

.3 Remove rocks over 150 mm in dimension from slopes and ditch bottoms.

.4 Hand finish slopes that cannot be finished satisfactorily by machine.

.5 Round top of backslope 1.5 m both sides of top of slope.

.6 Trim between constructed slopes and edge of clearing to provide drainage and free of humps, sags and ruts.

3.8 PROTECTION

.1 Maintain finished surfaces in condition conforming to this section until acceptance by Departmental Representative.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation of polymeric geotextiles used in revetments, breakwaters, retaining wall structures, filtration, drainage structures, roadbeds and railroad beds purpose of which is to:

.1 Separate and prevent mixing of granular materials of different grading.

.2 Act as hydraulic filters permitting passage of water while retaining soil strength of granular structure.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 31 23 33.01 - Excavating, Trenching and Backfilling.

.3 Section 31 24 13 - Roadway Embankments.

1.3 MEASUREMENT PROCEDURES

.1 Measure geotextiles in square metres of surface covered by material. No allowance will be made for seams and overlaps.

1.4 REFERENCES

.1 American Society for Testing and Materials International, (ASTM)

.1 ASTM D4491-[99a], Standard Test Methods for Water Permeability of Geotextiles by Permittivity.

.2 ASTM D4595-[86(2001)], Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-4.2 No. 11.2-[M89(April 1997)], Textile Test Methods - Bursting Strength - Ball Burst Test (Extension of September 1989).

.2 CAN/CGSB-148.1, Methods of Testing Geotextiles and Complete Geomembranes.

.1 No.2-M85, Methods of Testing Geosynthetics - Mass per Unit Area.

.2 No.3-M85, Methods of Testing Geosynthetics - Thickness of Geotextiles.

.3 No.6.1-93, Methods of Testing Geotextiles and Geomembranes - Bursting Strength of Geotextiles Under No Compressive Load.

.4 No.7.3-92, Methods of Testing Geotextiles and Geomembranes - Grab Tensile Test for Geotextiles.

.5 No. 10-94, Methods of Testing Geosynthetics - Geotextiles - Filtration Opening Size.

1.5 SUBMITTALS

.1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit to Departmental Representative 2 copies of mill test data and certificate at least 1 week prior to start of Work, and in accordance with Section 01 33 00 - Submittal Procedures.

1.6 DELIVERY, STORAGE AND HANDLING

.1 During delivery and storage, protect geotextiles from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris and rodents.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.2 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 MATERIAL

.1 Geotextile: woven synthetic fibre fabric, supplied in rolls.

.1 Width: 5.33 m minimum.

.2 Length: 78.6 m minimum.

.3 Roll Area: 418 m^2

.2 Physical properties:

.1 Grab tensile strength and elongation: to ASTM D4632.

.1 Grab Tensile Strength: 1110 N.

.2 Grab Elongation: 12%.

.2 CBR Puncture: to ASTM D - 3786, 3335 N.

.3 Mullen Bursting strength: to ASTM D-3786, 3447 kPa, wet condition.

.3 Hydraulic properties:

.1 Apparent opening size (AOS): to ASTM D4751, 40 mm.

.2 Water Flow Rate: to ASTM D4491, 160 1/min/m^2.

.3 Permitivity: to ASTM D4491, 0.05 sec^{-1}.

.4 Securing pins and washers: to CAN/CSA-G40.21, Grade 300W, hot-dipped galvanized with minimum zinc coating of 600 g/m^2 to CAN/CSA G164.

Part 3 Execution

3.1 INSTALLATION

.1 Place geotextile material by unrolling onto graded surface in orientation, manner and locations indicated.

.2 Place geotextile material smooth and free of tension stress, folds, wrinkles and creases.

.3 Place geotextile material on sloping surfaces in one continuous length from toe of slope to upper extent of geotextile.

.4 Overlap each successive strip of geotextile 600 mm over previously laid strip.

.5 Pin successive strips of geotextile as per manufacturer's recommendation.

.6 Protect installed geotextile material from displacement, damage or deterioration before, during and after placement of material layers.

.7 After installation, cover with overlying layer within 4h of placement.

.8 Replace damaged or deteriorated geotextile to approval of Departmental Representative.

.9 Place and compact soil layers in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling

3.2 CLEANING

.1 Remove construction debris from Project site and dispose of debris in an environmentally responsible and legal manner.

3.3 PROTECTION

.1 Vehicular traffic not permitted directly on geotextile.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 31 32 19.01 - Geotextiles.

.2 Section 32 42 13 - Pipe Culverts.

Part 2 Products

2.1 STONE

.1 Hard, durable quarry stone, free from seams, cracks or other structural defects, to meet following size distribution for use intended:

.1 Random rip-rap:

.1 Nominal Mass 40 kg or Nominal Diameter 300 mm.

.2 None heavier than 130 kg or 450 mm.

.3 No less than 20 % or more than 50 % heavier than 70 kg or 350 mm.

.4 No less than 50 % or more than 80 % heavier than 40 kg or 300 mm.

.5 Supply rock spalls or cobbles to fill open joints

2.2 GEOTEXTILE FILTER

.1 Geotextile: in accordance with Section 31 32 19.01 - Geotextiles.

Part 3 Execution

3.1 PLACING

.1 Where rip-rap is to be placed on slopes, excavate trench at toe of slope to dimensions as indicated.

.2 Fine grade area to be rip-rapped to uniform, even surface. Fill depressions with suitable material and compact to provide firm bed.

.3 Place geotextile on prepared surface in accordance with Section 31 32 19.01-Geotextiles and as indicated. Avoid puncturing geotextile. Vehicular traffic over geotextile not permitted.

.4 Place rip-rap to thickness and details as indicated.

.5 Place stones in manner approved by Departmental Representative to secure surface and create a stable mass. Place larger stones at bottom of slopes.

.6 Hand placing:

.1 Use larger stones for lower courses and as headers for subsequent courses.

.2 Stagger vertical joints and fill voids with rock spalls or cobbles.

.3 Finish surface evenly, free of large openings and neat in appearance.

END OF SECTION