

TENDER DOCUMENTS

SUBSECTION 6.87 EARTHWORKS

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SUBSECTION 6.87 EARTHWORKS

6.87.1 GENERAL

6.87.1.1 This subsection describes the requirements relating to the earthworks covered by this Contract. This work includes, without limitation the following:

- 6.87.1.1.1 deforestation, felling, stump removal, stripping and removal of topsoil, stumps and all other plant debris;
- 6.87.1.1.2 construction of exploratory wells at the request of the Engineer;
- 6.87.1.1.3 placement of geogrid and geotextile for the reinforcement of the road infrastructure;
- 6.87.1.1.4 placement of watertight geomembrane for ditch waterproofing;
- 6.87.1.1.5 placement of geotextiles;
- 6.87.1.1.6 work related to Class 1 and Class 2 excavations;
- 6.87.1.1.7 backfill, base, sub-base and compaction of granular materials works;
- 6.87.1.1.8 placement of stones and riprap protective cover;
- 6.87.1.1.9 construction of ditches.

6.87.1.2 Any specific requirements pertaining to the earthworks covered by this Contract are set out on the plans and in Section 4 *Special Technical Conditions*.

6.87.2 MEASUREMENT UNITS

6.87.2.1 The measurement units and respective symbols thereof used in this subsection are described as follows:

Measurement Unit	Designation	Symbol
length	meter	m
length	millimeter	mm
length	micrometer	μm
area	square meter	m^2
volume	cubic meter	m^3
mass	gram	g
force	newton	N
force	kilonewton	kN
temperature	Celsius degree	$^{\circ}\text{C}$

6.87.3 REFERENCE STANDARDS

6.87.3.1 The Contractor shall carry out all earthworks in accordance with the requirements of the following standards and documents to which the provisions of this Contract are added:

6.87.3.2 (ASTM) ASTM International:

- ASTM D6938 *Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)*.

6.87.3.3 (BNQ) Bureau de normalisation du Québec:

- BNQ 2560-114 *Travaux de génie civil – Granulats, Partie II: Fondation, sous-fondation, couche de roulement et accotement*;
- BNQ 2560-600/2002 *Travaux de génie civil – Granulats », Matériaux recyclés fabriqués à partir de résidus de béton, d'enrobés bitumineux et de briques – Classification et caractéristiques*;
- CAN/BNQ 2501–255 *Sols – Détermination de la relation teneur en eau-masse volumique – Essai avec énergie de compactage modifiée (2 700 kN • m/m³)*.

6.87.3.4 (MDDELCC) Ministry of Sustainable Development, Environment, and Fight Against Climate Change:

- *Guidelines for the management of concrete, brick and asphalt from construction and demolition work and tailings of the freestone sector.*

6.87.3.5 (MTQ) Ministère des Transports du Québec:

- MTQ – *Cahier des charges et devis généraux (CCDG)*;
- MTQ – *Normes – Ouvrages routiers – Tome II – Construction routière*;
- MTQ – *Normes – Ouvrages routiers – Tome VII – Matériaux*.

6.87.4 MATERIALS

6.87.4.1 GEOTEXTILES

6.87.4.1.1 In addition to meeting the requirements of MTQ standard 13101, the geotextiles shall be made of polypropylene and shall be non-woven needle-punched.

6.87.4.1.2 The Contractor shall provide the Engineer, at least seven (7) days before the start of placement of geotextile and for each delivery, with the certificates of conformity attesting that the geotextiles have, for each use, the following physical and mechanical properties, without however being limited thereto:

6.87.4.1.2.1 Geotextile for bottom of excavations:

6.87.4.1.2.1.1 minimum tensile strength of 400 N;

6.87.4.1.2.1.2 minimum elongation of 15 %;

6.87.4.1.2.1.3 maximum filtration opening "FOS" size of 150 µm;

6.87.4.1.2.2 Geotextile for ditch waterproofing:

6.87.4.1.2.2.1 minimum tensile strength of 1,400 N;

6.87.4.1.2.2.2 minimum elongation of 70 %;

6.87.4.1.2.2.3 maximum filtration opening size "FOS" of 110 µm;

6.87.4.1.2.2.4 minimum thickness of 3.5 mm;

6.87.4.1.2.3 Type V geotextile for the construction of banks and ditches:

6.87.4.1.2.3.1 minimum tensile strength of 1,000 N;

6.87.4.1.2.3.2 minimum elongation of 15 %;

6.87.4.1.2.3.3 maximum filtration opening size "FOS" of 150 µm;

6.87.4.1.2.3.4 minimum surface density of 250 g/m².

6.87.4.2 GEOGRID

6.87.4.2.1 The geogrid shall be model BX 1200 from Tensar or model TBX 2500 from Terrafix or an equivalent approved by the Engineer and shall be polymer-based consisting of a regular open network of tensioned elements in two (2) directions.

6.87.4.3 WATERPROOF GEOMEMBRANE

6.87.4.3.1 In addition to meeting the requirements of MTQ standard 13201, the geomembrane shall, for ditch waterproofing, meet the following requirements, without however being limited thereto:

6.87.4.3.1.1 high-density polyethylene geomembrane (HDPE);

6.87.4.3.1.2 tensile strength at the elastic limit of 15 kN/m;

6.87.4.3.1.3 puncture resistance of 350 N;

6.87.4.3.1.4 minimum weld shear strength of 14 kN/m;

6.87.4.3.1.5 minimum weld peel strength of 10 kN/m;

6.87.4.3.1.6 low temperature resistance of $\leq -30^{\circ}\text{C}$.

6.87.5 EXECUTION OF WORK

6.87.5.1 DEFORESTATION

6.87.5.1.1 General

6.87.5.1.1.1 The deforestation work, which shall be necessary for the execution of the works, consists in the entire removal of the trees of all sizes, whether isolated or not, of shrubs, branches, brush and dead wood located within the limits of the work areas, and indicated on the plans.

6.87.5.1.1.2 The removal of stumps below the existing natural ground level and the removal of the organic soil are part of Class 2 excavations.

6.87.5.1.1.3 The burning of the deforestation products on site is prohibited. The Contractor may proceed by mechanical shredding in order to obtain fragments of the maximum size allowed for incorporation into the topsoil or for any other use.

6.87.5.1.1.4 The Contractor shall dispose of the materials and debris from the deforestation, cut at ground level, felling and stump removal.

6.87.5.1.1.5 The wood of commercial value cut within the site limits is the property of the Contractor. It is forbidden to burn, bury or destroy this wood on the worksite.

6.87.5.1.2 Cutting at ground level

6.87.5.1.2.1 When cutting at ground level, the stumps shall be left in place in the following locations:

6.87.5.1.2.1.1 in fill areas, the stumps and all other vegetation shall be cut to a maximum height of 150 mm above the existing ground at the location of embankments of 1 m or more in thickness, measured under the subgrade;

6.87.5.1.2.1.2 at the edge of a preserved woodlot or at the limits of earthworks, the Contractor shall maintain, in that edge, the condition of the non-arborescent plant cover as well as the existing soil;

6.87.5.1.2.1.3 in any other location indicated by the Engineer.

6.87.5.1.2.2 Any traffic of heavy equipment is prohibited in the zones described in the above paragraphs 6.87.5.1.2.1.1 to 6.87.5.1.2.1.3.

- 6.87.5.1.3 Isolated trees
- 6.87.5.1.3.1 The trees to be felled shall be selected and marked by the Engineer. The Contractor shall obtain the approval of the Engineer prior to proceeding with the felling.
- 6.87.5.1.4 Stump removal
- 6.87.5.1.4.1 The stump removal consists in removing the stumps to a minimum depth of 300 mm below the surface. The Contractor shall avoid damaging the lands or areas of rooting of the preserved trees and shrubs and shall restore the damaged surface.
- 6.87.5.2 GEOTEXTILES
- 6.87.5.2.1 The surface to be covered with a geotextile shall be clean, free of organic and foreign materials and leveled to the required profiles. Any roughness or depression greater than 100 mm/m² shall be eliminated.
- 6.87.5.2.2 The geotextile shall be placed loosely on the surface to be covered so that it follows the relief thereof without being turned in on itself. For the rip-rap embankments, it shall extend up to the top of the embankment as well as to the base thereof, over a minimum distance of 1.5 m. The overlap between two (2) adjacent layers shall be at least 300 mm.
- 6.87.5.2.3 All measures shall be taken to protect the geotextile from adverse weather conditions and to prevent puncture thereof. No equipment shall circulate directly on the geotextile.
- 6.87.5.2.4 In the upper portion of the embankment, the geotextile shall be turned in on itself over at least 300 mm and fixing rods shall then be inserted in the center of this length at one-meter intervals. The fixing rods shall be pushed down until the thrust washer rests against the geotextile and holds it firmly against the surface. The geotextile shall then be rolled down the slope and held in place temporarily.
- 6.87.5.2.5 The assembly of layers shall be carried out through overlapping. The Contractor shall distinguish between the transversal joint, according to the slope, and the longitudinal joint, across the slope. In the first case, the overlapping joint shall have a minimum width of 500 mm and shall be pinned every meter with 150 mm long steel nails. In the second case, the longitudinal joint shall be made as follows: a first layer shall first be unrolled in the lower part of the embankment; subsequently, a second layer shall be unrolled on the first one so as to place the upper edges of the layers at the same height. The upper edge of the two layers shall then be folded down on a width of 300 mm and fixing rods shall be inserted every meter in the center of that width. Finally, the upper layer free end shall be rolled out towards the top of the embankment, maintaining the 300 mm width of the joint.
- 6.87.5.2.6 The geotextile final cover shall be carried out so as to avoid any movement or puncture thereof.

6.87.5.3 GEOGRID

- 6.87.5.3.1 The placement, fixing and assembly of the geogrids shall be carried out in accordance with the plans and with the manufacturer's recommendations.
- 6.87.5.3.2 The bottom of excavation shall be free of debris and roughnesses. The Contractor shall strip the topsoil on 100 mm prior to placing the geogrid.
- 6.87.5.3.3 The geogrid rolls shall be unrolled in the projected direction of traffic. The Contractor shall take the necessary measures to eliminate the waves and hold the geogrid in place during placement.
- 6.87.5.3.4 The Contractor shall cut the geogrid locally to follow the shape of the manholes and other drainage elements and to adapt to the horizontal curves of the road.
- 6.87.5.3.5 The Contractor shall provide for a minimum overlap of 800 mm between the rolls, both laterally and at the end thereof. The overlap shall be made in the direction of the spreading of the granular materials in order to avoid any uplifting and separation of the geogrid layers.
- 6.87.5.3.6 Where required, the Contractor may attach the rolls together with tie wraps every 5 m.
- 6.87.5.3.7 The crawler equipment movement on the geogrid is prohibited.
- 6.87.5.3.8 The Contractor shall place a 600 mm layer of granular material to allow the movement of heavy equipment, including the crawler equipment.
- 6.87.5.3.9 The backfill material shall be compacted.

6.87.5.4 WATERPROOF GEOMEMBRANE

- 6.87.5.4.1 The surface to be covered with a waterproof geomembrane shall be clean, free of organic and foreign materials and leveled to the required profiles. Any roughness or depression greater than 100 mm/m² shall be eliminated.
- 6.87.5.4.2 The Contractor shall ensure that the geomembrane is protected between two (2) geotextiles for the ditch waterproofing as indicated on the plans.
- 6.87.5.4.3 The placement, fixing and assembly of the layers shall be carried out in accordance with the plans and the manufacturer's recommendations.
- 6.87.5.4.4 In the locations indicated on the plans or by the Engineer, the Contractor shall connect the geomembrane to the culvert end pieces. As indicated on the plans, the geomembrane shall be folded back on the faces of the end pieces and fixed, all around, with anchors spaced from each other by 300 mm. A sealant shall then be applied to ensure the tightness of the ditch.
- 6.87.5.4.5 The geomembrane shall be placed loosely on the surface to be covered so that it follows the relief thereof without being turned in on itself. The overlap between two (2) adjacent layers shall be at least 300 mm.

6.87.5.4.6 The Contractor shall take all necessary measures to protect the material from adverse weather conditions and to prevent puncture thereof. No equipment shall drive directly on the geomembrane. Any damaged material shall be replaced by the Contractor at its expense.

6.87.5.5 EXCAVATIONS

6.87.5.5.1 General

6.87.5.5.1.1 Class 1 and Class 2 excavations designate the part of the earthworks comprising the total terrain sections to be carried out within the site limits, according to the plans. These excavation works shall include the following, without however being limited thereto:

6.87.5.5.1.1.1 removal of the stumps and organic soil;

6.87.5.5.1.1.2 construction of the lateral and transversal ditches within the site limits indicated on the plans;

6.87.5.5.1.1.3 construction of the transitions;

6.87.5.5.1.1.4 stockpiling of materials for future use;

6.87.5.5.1.1.5 excavation of soils with low bearing capacity.

6.87.5.5.1.2 The Contractor shall consider that all excavations carried out in the course of the work under this Contract shall be executed according to subsection 6.13 *Environmental Protection*.

6.87.5.5.1.3 Class 1 excavations

6.87.5.5.1.3.1 Class 1 excavations include the solid rock as well as, when they have a volume greater than 1 m³, the blocks of rock and massive concrete, stone or cemented masonry structures, that can only be fragmented to the required size by means of percussive equipment. The frozen soils and densely agglomerated stony soils are excluded from this class even if the extraction thereof cannot be properly carried out by means of an excavator.

6.87.5.5.1.4 Class 2 excavations

6.87.5.5.1.4.1 Class 2 excavations include all excavations that are not described as Class 1 excavations. They specifically include debris from old asphalt pavement, concrete debris having a volume of less than 1 m³, riprap, stripping of topsoil as well as usable and unusable materials, unless they are included in a separate pay item in the *Price Table*.

- 6.87.5.5.1.4.2 All usable materials, with the exception of the asphalt pavements and concrete debris from Class 2 excavations, shall be used for the construction of the embankments as indicated on the plans and according to the instructions from the Engineer. If usable materials are lost through the fault of the Contractor, the latter shall replace them, at its own expense, by an equivalent volume of materials compliant with the indications on the plans.
- 6.87.5.5.1.4.3 If excavated materials cannot be used, the Contractor shall dispose thereof according to subsection 6.13 *Environmental Protection*.
- 6.87.5.5.1.5 Stripping of the topsoil
- 6.87.5.5.1.5.1 Unless otherwise indicated on the plans, the topsoil layer shall be removed wherever the existing natural ground surface is located both within 1 m of the subgrade and within the area comprised between 1V:1H slopes drawn from the outer limit of the shoulders, at the pavement level. This excavation, even if it shall be done separately, is part of Class 2 excavations.
- 6.87.5.5.1.5.2 The Contractor shall stockpile the topsoil necessary for its work. It shall, at its own expense, recover the topsoil and stockpile it close to the worksite area.
- 6.87.5.5.1.5.3 If usable materials are lost through the fault of the Contractor, it shall replace them, at its own expense, by an equivalent volume of usable materials.
- 6.87.5.5.1.5.4 During stockpiling, the topsoil stockpile height shall not exceed 3 m and the Contractor shall not drive onto the stockpiles.
- 6.87.5.5.1.6 The excavations shall be carried out according to the longitudinal and transversal profiles indicated on the plans. The excavations shall be carried out with equipment equipped with blade buckets, without teeth.
- 6.87.5.5.1.7 The bottom of the excavations shall continuously be kept in good drainage condition and the embankments shall be leveled to obtain an even and uniform surface. The bottom of the excavations shall be dry and kept dry during the time required to carry out the earthworks. The stones protruding on the surface of the embankments and likely to become loose shall be removed and the holes shall be filled. The elevation tolerances, bottom course and ditches, are limited to 30 mm and the width tolerances, outer embankments, to 100 mm.
- 6.87.5.5.1.8 If, at the bottom of a course, the soil contains stone blocks over 200 mm in diameter within the area comprised between 1V:1H slopes drawn from the outer limit of the shoulders, at the pavement level, the Engineer may require that all blocks of 200 mm and larger be removed by scarification to a depth of 300 mm.

6.87.5.6 EMBANKMENTS

6.87.5.6.1 General

6.87.5.6.1.1 The embankments shall be constructed with materials from Class 1 or Class 2 excavation, excavations for engineering structures or borrow materials.

6.87.5.6.1.2 A portion of the materials that are less frost sensitive, such as soils containing less than 30 % of fine particles, shall be stockpiled to close the embankment, up to the last meter located under the subgrade. The material placed in that last meter shall be homogeneous so as not to cause differential behaviors. For the last 300 mm layer for the closure of the embankment, located just under the subgrade, the material shall contain less than 20 % of fine particles.

6.87.5.6.2 Preparation before backfilling

6.87.5.6.2.1 Before backfilling, the depressions and cavities, whether natural or caused by the removal of an obstacle, shall be filled to the surrounding ground level, with materials of the same type. The ground surface shall be free of snow, ice, mud and frozen materials.

6.87.5.6.3 Soil backfilling

6.87.5.6.3.1 All materials constituting the soil backfilling shall be deposited and spread in uniform layers of a maximum thickness of 300 mm after compaction, over the full width required by the theoretical slope of the embankments. The pebble diameter shall not exceed the layer thickness, except for the last 300 mm under the subgrade, where the stone size shall be less than 100 mm. The stones larger than those mentioned above shall be pushed to the side of the embankment, outside the area comprised between 1V:1H slopes drawn from the outer limit of the shoulders, at pavement level. All compactable soils compliant with MTQ standard 1101 may be used, except organic soils and soils containing frozen clumps. The contaminated soils may be reused, provided that they meet the specifications of the material they replace, and comply with subsection 6.13 *Environmental Protection*. The maximum organic matter content allowed in the soils and backfill material is 3.0 %, determined from analysis method MA. 1010-PAF 1.0 "*Détermination de la matière organique par incinération : méthode de perte au feu (PAF)*" of the *Centre d'expertise en analyse environnementale du Québec*.

6.87.5.6.3.2 Each backfill layer shall be densified separately to the compactness degree required for the compaction of soil backfills. It is forbidden to unload materials on the edges of an embankment and let them slide down the slope.

6.87.5.6.4 Widening of embankments and roadways

6.87.5.6.4.1 The widening of existing embankments and roadways shall be carried out in tiers according to Tome II of MTQ and as indicated on the plans. This work is part of the implementation of the embankments.

6.87.5.6.5 Drainage of the embankments

6.87.5.6.5.1 During the construction of the embankments, the surface of each layer shall be completely drained at all times and free from ice, snow and frozen materials before the placement of a new layer. The surfaces shall have a minimum cross slope of 2 % towards the drains or ditches. In curves, the slope shall be that of the slope.

6.87.6 QUALITY CONTROL

6.87.6.1 GEOTEXTILES

6.87.6.1.1 The geotextiles delivered to the worksite shall be manufactured by a manufacturer whose plant holds a compliance certificate issued by the BNQ in accordance with certification protocol BNQ 7009-910 "*Géotextiles – Qualité des géotextiles utilisés en génie routier*".

6.87.6.1.2 A copy of the certificate of compliance, together with the appendix presenting the types of geotextiles covered by the certification, shall be submitted to the Engineer for each type of geotextile used.

6.87.6.1.3 Delivery control

6.87.6.1.3.1 When a delivery control is conducted by the Engineer, the sampling will consist of one (1) piece of 1 m x 2 m per production batch.

6.87.6.2 GEOGRID

6.87.6.2.1 At least seven (7) days prior to use of geogrid and for each delivery, the Contractor shall, for each production batch, provide the Engineer with a certificate of conformity containing the following information, without however being limited thereto:

6.87.6.2.1.1 name and address of the manufacturer;

6.87.6.2.1.2 trade name;

6.87.6.2.1.3 type of polymer used;

6.87.6.2.1.4 manufacturing process;

6.87.6.2.1.5 dimensions of the rolls;

6.87.6.2.1.6 production batch number, which shall be easily identifiable on the delivery order and on the rolls;

6.87.6.2.1.7 results of the following tests:

6.87.6.2.1.7.1 tensile strength;

6.87.6.2.1.7.2 UV resistance;

- 6.87.6.2.1.7.3 hydrocarbon resistance.
- 6.87.6.2.1.8 name of the laboratory member of the *Association des firmes de genie-conseils – Québec* (AFG), responsible for conducting these analysis and tests.
- 6.87.6.2.2 A production batch consists of one or more rolls of geogrid of the same type, same kind, having the same properties and manufactured by continuous process with the same machine and the same batch of raw materials. Furthermore, the maximum surface area of a batch is limited to 3,000 m².
- 6.87.6.3 GEOMEMBRANE
 - 6.87.6.3.1 At least seven (7) days prior to use of the geomembrane and for each delivery, the Contractor shall, for each production batch, provide the Engineer with a certificate of conformity containing the following information, without however being limited thereto:
 - 6.87.6.3.1.1 name of the manufacturer;
 - 6.87.6.3.1.2 type of geomembrane;
 - 6.87.6.3.1.3 trade name;
 - 6.87.6.3.1.4 production batch number;
 - 6.87.6.3.1.5 identification numbers of the rolls;
 - 6.87.6.3.1.6 geomembrane thickness;
 - 6.87.6.3.1.7 results of the following tests:
 - 6.87.6.3.1.7.1 tensile strength;
 - 6.87.6.3.1.7.2 puncture resistance;
 - 6.87.6.3.1.7.3 hydraulic properties;
 - 6.87.6.3.1.7.4 hydrocarbon resistance;
 - 6.87.6.3.1.7.5 carbon black content;
 - 6.87.6.3.1.7.6 low temperature resistance.
 - 6.87.6.3.2 A production batch consists of one (1) or more rolls of geomembrane having the same properties and manufactured by continuous process with the same machine. Furthermore, the maximum surface area of a batch is limited to 10,000 m².
 - 6.87.6.3.3 The production batch number shall be easily identifiable on the delivery order and on the roll.

6.87.6.3.4 Delivery control

6.87.6.3.4.1 When a delivery control is conducted by the Engineer, the sampling consists of one (1) one-meter long piece over the full width of a roll per production batch.

END OF SUBSECTION