

YORK REGION DESIGNED SOIL MIX SPECIFICATION

ENVIRONMENTAL SERVICES DEPARTMENT | NATURAL HERITAGE AND FORESTRY SERVICES

Supply and Installation of Region Designed Soil

The Contractor shall supply and install Region designed soil. It is the Contractor's responsibility to ensure that the designed soil placed is in accordance with the requirements specified below.

Supply and installation of designed soil includes, but is not limited to, the following:

1. Blending of topsoil, sand, organic matter and other amendments to create designed soil.
2. Testing of designed soil and their component parts.
3. Installation of designed soil.
4. Compaction and grading of designed soil.

References

This Specification refers to the following standards, specifications, and publications:

1. ASTM International (formerly American Society of Testing Materials):
 - a. ASTM D422 (hydrometer test)
 - b. ASTM F1632 (pipette test)
2. Agriculture and Agri-Food Canada:
 - a. The Canadian System of Soil Classification, 3rd edition, 1998
 - b. The Canadian System of Soil Classification - Soil Classification Working Group, Research Branch, Agriculture and Agri-Food Canada, Publication 1646.

Submission of Product/Component Samples and Testing Requirements

The Contractor shall complete Product and mix testing and submit Product samples and testing results in accordance with the following:

1. Where required in this Specification, submit samples and testing results of all designed soil components to the Region for approval a minimum of 10 Working Days prior to the planned installation of the designed soil.
2. Samples shall be clearly labelled with relevant identifying characteristics including, but not limited to, the type of material, source and stockpile location, and manufacturer contact information. Samples shall be reviewed by the Region for appearance only. The Contractor is solely responsible for ensuring that materials comply with all other specifications and requirements. Designed soil samples shall be labelled with the percentage of each component material.
3. Manufacturer Product data and literature describing all designed soil components, and certificates indicating that the materials meet the specification requirements, shall accompany all sample submissions and shall be submitted to the Region for review a minimum of 10 Working Days prior to the planned installation of designed soil.
4. Designed soil shall not be prepared prior to the approval of all designed soil components by the Region. Prepared designed soils and written laboratory test results shall be submitted to the Region for approval within 5 Working Days of approval of designed soil components.
5. All samples of designed soil components shall be submitted for review and acceptance at the same time.

6. The Region may reject any or all designed soil components or designed soil mixes at its sole discretion. No rejected materials shall be installed or used in the manufacture of designed soils. Delivered materials shall match the samples provided to, and approved by, the Region.
7. Topsoil and designed soil mixes shall be submitted for testing to a testing laboratory accredited by the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA).
8. The topsoil test analysis report shall provide, at a minimum, the following information:
 - a. pH
 - b. Percentage of organic matter by dry weight
 - c. Chemical levels of the following, in ppm, at a minimum:
 - i. Nitrate
 - ii. Ammonium
 - iii. Phosphorus (P)
 - iv. Potassium (K)
 - v. Calcium (Ca)
 - vi. Sulfur (S)
 - vii. Magnesium (Mg)
 - viii. Manganese (Mn)
 - ix. Chlorine (Cl)
 - x. Copper (Cu)
 - xi. Iron (Fe)
 - xii. Nickel (Ni)
 - xiii. Zinc (Zn)
 - xiv. Boron (B)
 - d. Particle size analysis compared to United States Department of Agriculture (USDA) Soil Classification System per ASTM D422 (hydrometer test) or ASTM F1632 (pipette test), and tested by passing the topsoil through a ¼ inch sieve to enable the passage of larger organic matter materials
 - e. Soluble salt by electrical conductivity of a 1:2 soil water sample measured in milliohms per centimetre
 - f. Cation Exchange Capacity (CEC)
 - g. Recommendations to improve fertility and ability to promote growth of engineered soil material, if required.
9. The designed soil test analysis report shall provide, at a minimum, the following information:
 - a. pH
 - b. Percentage of organic matter by dry weight
 - c. Chemical levels of the following, in ppm, at a minimum:
 - i. Nitrate
 - ii. Ammonium
 - iii. Phosphorus (P)
 - iv. Potassium (K)
 - v. Calcium (Ca)

- vi. Sulfur (S)
 - vii. Magnesium (Mg)
 - viii. Manganese (Mn)
 - ix. Chlorine (Cl)
 - x. Copper (Cu)
 - xi. Iron (Fe)
 - xii. Nickel (Ni)
 - xiii. Zinc (Zn)
 - xiv. Boron (B)
- d. Particle size analysis compared to United States Department of Agriculture (USDA) Soil Classification System per ASTM D422 (hydrometer test) or ASTM F1632 (pipette test), and tested by passing the designed soil mix through a ¼ inch sieve to enable the passage of larger organic matter materials
 - e. Soluble salt by electrical conductivity of a 1:2 soil water sample measured in milliohms per centimetre
 - f. Cation Exchange Capacity (CEC)
 - g. Recommendations to improve fertility and ability to promote growth of designed soil material, if required.
 - h. Physical analysis of designed soil shall provide bulk density and water permeability with the sample compacted to 80% and 85% maximum dry density (Proctor).
10. Sand manufacturer's particle size analysis, including Fineness Modulus Index (FM) and/or gradation index, of sand component shall be submitted.
11. Organic matter and high-lignin organic matter manufacturer's data shall be submitted. At a minimum, the analysis shall include:
- a. pH
 - b. Salinity
 - c. Total organic nitrogen
 - d. Carbon: Nitrogen (C:N) ratio
 - e. Solvita® Compost Maturity Index
 - f. Moisture
 - g. Sodium (Na)
 - h. Phosphorus (P)
 - i. Potassium (K)
 - j. Calcium (Ca)
 - k. Magnesium (Mg)
- Organic matter analysis reports from samples older than four months from the date of sample submission will not be accepted.
12. The Region may require additional testing of designed soil components or designed soil mixes at any time that such samples are deemed necessary to verify conformance to specification requirements.
13. All testing shall be at the expense of the Contractor.

Designed Soil Components

The Contractor shall only use those components specified in this Specification to manufacture the designed soil.

Topsoil (imported)

Topsoil used to manufacture the designed soil mixture shall conform to the following:

1. Topsoil used in the designed soil shall be high-quality, naturally-occurring fertile sandy loam, loam or sandy clay loam, as described in The Canadian System of Soil Classification.
2. Topsoil shall consist of 7% to 20% clay, 3% to 7% organic matter (by weight) and 8% combined stone and gravel content. Local topsoil with clay content between 21% and 25% may be substituted if the following conditions are met:
 - a. The soil must be amended with sand specified within this Contract; and
 - b. Once amended with sand the topsoil shall consist of 3% to 7% organic matter (by weight) and less than 8% combined stone and gravel content.
 - c. Total sand content of the topsoil shall not exceed 60%
3. Topsoil pH shall range between 6.0 and 7.8.
4. Topsoil salinity shall not exceed 3.0 mmhos/cm at 25°C.
5. Topsoil shall be entirely free of all contaminants and deleterious materials such as litter, construction materials, stones greater than 50 mm in diameter, wood materials greater than 25 mm in diameter, plant or soil pests, subsoil, or any other contaminants that may damage or otherwise impair plants or plant growth.
6. Plant material including noxious weeds and/or their seeds, tubers, rhizomes, sod, crabgrass, couchgrass, or roots shall not be acceptable in the planting soils.
7. A mix of sand, fertilizers, organic matter and/or other component parts assembled to meet the structural, chemical and other requirements of topsoil shall not be substituted for naturally-occurring topsoil that has developed through weathering, decomposition and/or other natural soil building processes.
8. Topsoil shall maintain a naturally-occurring heterogeneous structure including loose soil, soil peds (clods or clumps) and void space.
9. Topsoil shall not be screened to avoid excessively homogenizing soil structure.
10. Topsoil source location shall be submitted to the Region for approval, along with an outline of all crops grown on the topsoil and all herbicides and pesticides applied within the previous three years.

Two duplicate, 4 litre samples of topsoil comprised of random samples from each topsoil source shall be submitted for laboratory testing within 5 Working Days of field sampling.

Two duplicate, 4 litre samples of topsoil comprised of random samples from each topsoil source and the soil laboratory test results shall be submitted to the Region a minimum of 10 Working Days prior to the planned installation of the planting soil.

Coarse Sand

Coarse sand used to manufacture the designed soil mixture shall conform to the following:

1. Sand used in the designed soil mix shall be clean, sharp, coarse grade silica sand with a Fineness Modulus Index (FM) of 2.8 to 3.2, and/or a D90/D10 gradation index of less than 8.
2. The presence of limestone, shale and/or slate particles in the sand mixture will result in the rejection of the sand.
3. Sand shall consist of less than 0.5% organic matter (by dry weight).
4. pH of sand shall be less than 7.0.

Two duplicate, 4 litre samples of sand with manufacturer's literature and material testing certification stating that the sand meets the Contract requirements shall be provided to the Region a minimum of 10 Working Days prior to the planned installation of the planting soil.

High-lignin Organic Matter

High-lignin organic matter used to manufacture the designed soil mixture shall conform to the following:

1. High-lignin organic matter shall consist of composted pine, spruce, fir or other conifer bark with a dark brown colour. Rice hulls, coconut husks or other plant materials with hard fibrous structures are also acceptable.
2. High-lignin organic matter shall have 95% of the total volume consisting of particle sizes less than 15mm, 50% of the total volume consisting of particle sizes less than 5mm, and a maximum of 10% of the total volume consisting of particle sizes less than 1mm.
3. pH shall range between 4.5 and 6.5.
4. Wood fibre content shall not exceed 10%. The remainder shall consist of bark or other specified materials.

Two duplicate, 4 litre samples of high-lignin organic matter with manufacturer's literature and material testing certification stating that the high-lignin organic matter meets the Contract requirements shall be provided to the Region a minimum of 10 Working Days prior to the planned installation of the designed soil.

Organic Matter (compost)

Organic matter (compost) used to manufacture, or as a surface amendment for, the designed soil mixture shall conform to the following:

1. Blended organic material composted for a minimum of 6 months, and free of toxic and non-organic matter, in a stable, humus-like state and produced from aerobic decomposition.
2. Except as specified herein, compost shall conform to standards of Category 'A' compost as outlined in the Canadian Council of Ministers of the Environment Guidelines for Compost Quality, PN1340 (2005) and Guideline for the Production Compost in Ontario (2012).
3. Acceptable organic matter shall exhibit a dark brown colour. Light brown organic matter shall be rejected.
4. Organic matter shall have a strong aerobic (sweet) odour. Organic matter with an anaerobic (sour) odour shall be rejected.

5. Organic matter shall not be over- or under-composted, and shall have a Solvita® Compost Maturity Index of 7 or 8.
6. Organic matter pH shall range between 5.0 and 8.0.

Two duplicate, 4 litre samples of organic matter with manufacturer's literature and material testing certification stating that the organic matter meets the Contract requirements shall be provided to the Region a minimum of 10 Working Days prior to the planned installation of the designed soil.

Preparation of Designed Soil Mixture

Designed Soil Mixture

The designed soil mixture shall be prepared using the following proportions of the designed soil components **by volume**:

1. High-lignin organic matter – 10% +/-2%
2. Coarse sand – 45% +/-10%
3. Topsoil (imported) 45% +/- 10%

The designed soil mixture shall also contain the following designed soil component:

1. Organic matter (compost) – shall be tilled in after the planting soil mixture installation.

The component mixture of sand and topsoil shall be adjusted such that the planting mix drains at a rate of 50-75 mm per hour when installed and compacted to 80% of maximum dry density (Proctor).

The designed soil mix pH and nutrient levels shall be adjusted in accordance with the results and recommendations of the soil test. The pH of the designed soil mixture shall range between 6.0 and 7.5.

Two, 4-litre samples of the designed soil mixture and written laboratory test results shall be provided to the Region no more than 5 Working Days after acceptance of component materials.

Designed Soil Manufacture

The designed soil shall be manufactured and stored in accordance with the following:

1. Designed soil components shall not be blended until all individual components are approved by the Region.
2. Designed soil shall be mixed with a front end loader bucket. Soil blending machines shall not be used and assembled planting soil shall not be screened.
3. Sand and required organic materials shall be mixed prior to the addition of topsoil. The mixture of sand and organic matter shall be spread on 300 mm of topsoil and the two materials shall be loosely mixed together. Care shall be taken to avoid over-mixing and disturbing soil peds and homogenizing soil structure.
4. While soil peds are a critical component of good soil structure, an excessive amount of soil peds and massive soil clumps shall not be permitted. The maximum soil ped inclusion in the designed soils shall be:
 - a. Unlimited for soil peds less than 25 mm in diameter;
 - b. 15% of the total soil mix for soil peds 25 mm to 75 mm in diameter;

- c. 5% for soil peds 75 mm to 150 mm in diameter, and;
 - d. Less than 2% for soil peds greater than 150 mm in diameter.
5. The final designed soil mix shall not be stockpiled higher than 1.8 metres. Designed soil stockpiles shall be loosely covered with filter cloth material and protected from becoming saturated. Stockpiles shall not be covered with plastic or similar materials.

Chemical Additives

1. Chemical additives to modify soil fertility shall not be used in the construction of the designed soil.
2. Hydrated lime shall not be used to stabilize designed soils or promote soil aggregation. Soils treated this way shall not be used for planting trees. If designed soils are treated with hydrated lime they shall be removed and replaced with suitable unlimed soils.
3. Due to the difficulty of permanently altering soil pH levels, chemical additives to alter pH shall only be used if approved, in advance, by the Region.

Installation of Designed Soil

Site Preparation and Grading

The Contractor shall verify that all existing grades and elevations are correct and in accordance with the Specifications. If any deficiencies occur, the Region shall be notified and the deficiencies shall be rectified as required prior to installation of the designed soil mix.

Placement of Designed Soil Mixture

Designed soil shall only be installed during periods when mix and subgrade soils are friable.

Designed soil shall not be installed when saturated, frozen or excessively dry. Designed soil shall be installed as soon as the subgrade preparation is completed.

Tracked or large-tired equipment shall be used to install soils, and repeated passes over areas of soil installation shall be avoided to the greatest extent possible. Where possible, cranes or conveyors shall be used to deliver soil from stockpiles to the installation area. Soil blowers and soil pumps shall not be used to install the planting soil.

Designed soil shall be installed in lifts as specified below:

1. Finished subgrade soil shall be tilled by roto-tiller or Region-approved equivalent equipment to a depth of 25mm - 50 mm prior to installation of the first lift of the designed soil. Tilling will improve the transition between soil types, facilitate movement of water and nutrients, and improve root penetration into lower soil profiles.
2. The first lift of designed soil shall be placed to a depth of 25 mm - 50 mm. The first lift shall be tilled into subgrade soil by rototiller or other Region-approved equivalent equipment in order to provide a gradual transition between the planting soil and subgrade soil.
3. Remaining designed soil shall be installed in multiple lifts of 150 mm to 300 mm.
4. Lifts and compaction shall be repeated until the soil depth, including any organic material which has been added, meets the requirements of the final grading.

The designed soil shall be compacted to between 75% and 80% of maximum dry density (Proctor).

Installation of the designed soil mix shall be suspended if the mix becomes overly saturated, overly dry, or frozen. Designed soil mix shall not be placed on a wet or frozen subgrade.

Addition of Organic Matter

Till an additional 40 mm of organic matter (compost) into the top layer of the installed designed soil to a depth of 60 mm - 90 mm.

Fine Grading

The designed soil shall be fine graded to eliminate rough spots or low areas and to ensure positive drainage. Trenches shall be prepared by means of cultivation and subsequent raking. Finished surfaces shall be 50mm - 75 mm higher than the surrounding boulevard to allow for settlement in the first year.

All finished grades shall be smooth, uniform and firm against deep foot printing.