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Subject: Executive summary - Geotechnical and environmental investigation for the construction of a bioreactor, Sherbrooke, Quebec

Ref.: 161-01346-04

Sir,

Please find below our final comments and recommendations related to the subject mentionned.

Context

PSPC is planning to build a bioreactor south of 2000 College Street in Sherbrooke, Quebec. According to the information obtained, the bioreactor will be composed of the following three main buildings:

- To the south, a circular digester founded on a freestanding slab on grade. Estimated building dimensions are 7.7 m diameter and 10 m high;
- North of the digester, a square-shaped control building, including various mechanical equipment. Estimated building footprint is 54 m^2;
- Adjacent to the control building to the east, a circular mixing pit. Estimated building dimensions are 5.6 m diameter and 3 m deep, below ground.

Currently, the location of the planned buildings is occupied by herbaceous vegetation and trees (mainly conifers and a few hardwoods). A manure pit is adjacent to the proposed bioreactor to the west and a look for the pit drains is located south of the studied area.

Field Work

Two stratigraphic boreholes, identified as F1-18 and F2-18, were carried out on the site to meet the different objectives of the study. The drilling was completed on June 7, 2018. The supervision of the work was carried out by a technical member of the WSP staff.

Borehole F1-18 was located in the mixing pit area and the control building, while F2-18 was located south of the proposed digester. A discrepancy between the initially desired location and the site location for borehole F2-18 was subsequently observed after the completion of the drilling. This discrepancy would have been caused by the use of preliminary non-georeferenced plans for the borehole location.

Nonetheless, the borehole F1-18 was still retained for the control building and the mixing pit and the F2-18 was used for the digester in terms of soil representativeness.

Boreholes F1-18 and F2-18 reached depth of 6.74 m and 8.23 m respectively. Rock was not reached in any of the holes. A Casagrande piezometer was installed at the bottom of borehole F1-18 in a permeable zone. The Casagrande porous / permeable zone was isolated from the upper level with bentonite, as well as the tube at the surface.

Stratigraphy

On the surface, backfill materials were encountered down to 1.83 m below actual surface, followed by native soil composed of silt and sand deposit. Below the silt and sand deposit, a silt deposit was encountered (F1-18) at 3.81 m while a gravelly and sandy till was encountered (F2-18) at 6.10 m.

Geotechnical Results

To respect the required frost protection, a minimum of 1.4 m depth below the finished grade will be required for the foundation elements for a heated structure, while a depth of 1.7 m will have to be used for an unheated structure.

Temporary excavation slopes of 2.0H: 1.0V may be considered for the installation of the foundations. Excavations must be carried out in compliance with the requirements of « Loi sur la santé et sécurité du travail du Code de sécurité pour les travaux de construction ». If necessary, a temporary shoring system could be used. To carry out the required excavations, an appropriate pumping and dewatering system must be provided to allow the water level to be lowered and maintained during the work duration to a depth of at least 0.5 m below any excavation.

A raft foundation will have to be used for the digester. Prior to foundation installation, all backfill materials must be excavated down to native soils. If necessary, the site could be raised within the structure footprint using non-freezing compacted granular materials. A value of 100 kPa can be used for the service limit state (SLS): the total settlement should be less than 50 mm. The ultimate limit state should be calculated by the designer using equation 10.1 of the Canadian Foundation Engineering Manual.

Superficial foundations can be used for the control building. All existing backfill materials should be excavated down to native soils prior to the installation of the foundation. If required, the site could be raised within the building footprint using compacted non-freezing granular material. A value of 125 kPa could be used for the service limit state (SLS): the total settlement should be less than 25 mm. The ultimate limit state should be calculated by designer using the equation 10.1 of the Canadian Foundation Engineering Manual. A slab-on-grade can be placed over a densified granular foundation of crushed stone of 300 mm thickness. The materials will have to be DB certified (NQ 2560-510).

A raft foundation should be used for the mixing pit. All backfill materials should be excavated down to native soils prior to the installation of the foundation. A value of 200 kPa could be used for the service limit state (SLS): the total settlement should be less than 50 mm. The ultimate limit state should be calculated by the designer using the equation 10.1 of the Canadian Foundation Engineering Manual. Backfilling around the perimeter walls should be done using clean, well-draining granular material. A long-term drainage system should be installed.

According to Table 4.1.8.4.A of the National Building Code of Canada (2010), and based on the results obtained in the boreholes, a site category **D** could be considered for this site.

Environmental Results for Nickel / Cadmium

Analytical results indicate metal (nickel and / or cadmium) concentrations above federal agricultural criteria for agricultural use in surface fill (from 0.61 to 1.83 m) at drill hole F2-18 (CF-2 and CF-3 samples), as well as in the native soils at the F1-18 / CF-5 sample.

Otherwise, concentrations below laboratory detection limits were measured for C_{10} to C_{50} petroleum hydrocarbons and polycyclic aromatic hydrocarbons.

For nickel, the federal agricultural criteria is based on the Soil Quality Guidelines for Environmental Protection (SQGEP) and Human Health (SQGHH). The federal agricultural criteria is based on the lowest value (soil contact) among several values calculated to protect human health (skin contact, soil and food intake, cancer risk) and the environment (ingestion soil and food by wildlife, nutrient cycle and energy).

The area to be worked on for the construction of the bioreactor is not and will not be used for cultivation purposes, although it is located in an agricultural zone.

Therefore, we believe it would be acceptable to re-use the excavated soil as part of the work, which has nickel concentrations above the federal agricultural criteria, as long as these soils are confined to minimize contact with the surrounding plants and invertebrates.

The F2-18 / CF-3 fill sample, collected between depths of 1.22 and 1.83 m has a concentration slightly higher than the 1.4 mg / kg federal agricultural criteria for cadmium.

The federal agricultural criteria is based on the Soil Quality Guidelines for Environmental Protection (SQGSP) and Human Health (SQGHH). The federal agricultural criteria is based on the lowest value (soil ingestion by humans) among other SQGs available values (soil contact, soil ingestion and food consumption by wildlife, cycle of nutrients and energy).

The risk of soil ingestion by humans when soils are confined is considered nil. Thus, the concentration of 1.6 mg / kg measured at the F2-18 / CF-3 sample is below the lowest SQGEP associated with the ingestion of soil and food by wildlife, which is 3.8 mg / kg.

Therefore, there would be no restriction associated with measured concentrations of cadmium in soils, as these are not used for the cultivation of plants which will be ingested by humans.

Environmental Conclusions and Recommendations

Soils with concentrations below the federal agricultural criteria can be managed without restriction at the site, ie, soils associated with F1-18 / CF-1 and CF-3 samples (0 to 1.83 m), as well as the surface fill associated with sample F2-18 / CF-1 (0 to 0.61 m);

Soils with concentrations greater than the federal agricultural criteria, ie natural soils associated with the F1-18 / CF-5 sample (1.83 to 3.05 m), as well as soil backfills. surface areas associated with F2-18 / CF-2 and CF-3 (0.61 to 1.83 m) if excavated; could be reused on the site provided that the following conditions are followed:

- When excavated, these soils should be manipulated as little as possible to limit the generation of dust.
- Mitigation measures to reduce worker exposure to soils are also possible. It would be desirable that soil excavation be carried out during periods of low wind and that any work downstream of the excavation be limited.
- These soils must not be mixed with other soils on the site. In order to reduce the contact for plants and invertebrates, we recommend that these soils be reused for leveling the

land but that these remain buried at a depth of one meter below the final level of the planned work, such as as proposed in the Government of Quebec's Soil Protection and Land Reclamation Policy in 1998. The objective of this measure is to limit contact with biota, of which more than 90% live in the first meter of soil. This measure, combined with the seeding of the area affected by soil containment, will eliminate the risk associated with wind and soil erosion.

- No crops should be grown on these confined soils.

If no soil reuse is planned for the project, only soils with concentrations above the provincial criterion A (F2-18 / CF-2 and CF-3 samples) should be eliminated in authorized MDDELCC landfill sites as AB-grade soils or be eliminated on a site where the nickel and cadmium concentrations are greater than or equal to the disposed soils.

Soils with concentrations below criterion A could be eliminated anywhere in Quebec without restrictions as long as it is not on federal land.

Hoping that our study and this summary is to your satisfaction,

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N.b.: The final report written in French (August 3, 2018) prevails on this summary written in English in the event of any ambiguities or translation errors

cc: Joël Mathieu, Eng.