December 22, 2011 Reference No. 046254

RESPONSES TO DECEMBER 16, 2011 COMMENTS FROM MOE REGARDING CRA'S HYDROGEOLOGICAL ASSESSMENT, DATED DECEMBER 8, 2011 WOOLWICH BIO-EN INC. FACILITY ELMIRA, ONTARIO

HYDROGEOLOGICAL ASSESSMENT COMMENTS

Comment 1:

Section 4.5 indicated the first 15 m of the overburden are characterized as the Surficial Aquitard, which corresponds to the Tavistock Till comprised of primarily silt, and clayey silt deposits. However, the classification of the first 15 m of the overburden as an aquitard does not consider the presence of a sand to gravely sand layer at boreholes 1, 2, 3, 4, 8 and 9 within the first 15 m nor does it consider the regional hydrogeologic context (Cross-sections A-A', E-E', and F-F'), which suggests that the Surficial Aquitard (Tavistock Till), Upper Aquifer (Upper Elmira Moraine Stratified Deposits), and Upper Aquitard (Maryhill/Catfish Creek Till) should have been encountered in the upper 15 m of the overburden. The sand layer appears to be consistent with the Upper Aquifer identified regionally. Additional justification is required to support the identification of the upper 15 m of the overburden as the Tavistock Till and the Surficial Aquitard.

Response 1:

The sand layer identified at the ground surface of the Site is not part of the Upper Aquifer. The Site-specific geologic cross-sections presented on Figures 8a, 8b, and 8c, show that the "Sand/Sandy Silt" layer is present between elevations of approximately 365 and 357 m AMSL above a thick layer of fine-grained material ("Silt" and "Clayey Silt") and ranges in thickness, where present, between 0 m (BH-10) and 6 m (BH-1/BH-2) at the geotechnical boreholes completed in 2011 during geotechnical and hydrogeological investigation activities. Furthermore the "Sand/Sandy Silt" layer is for the most part dry.

Based on the regional geologic/hydrogeologic cross-sections presented on Figures 3a, and 3b, the Upper Aquifer within the vicinity of the Site (indicated as "Woolwich Bio-En Facility" on the associated Figures) would be present between elevations of approximately 340 and 345 m AMSL. In fact, on Figure 3c, the Upper Aquifer would not be present beneath the Site at all, suggesting the Upper Aquifer is discontinuous.

Therefore, based on the elevations from the regional and Site-specific cross-sections, the regional Upper Aquifer is 13-25 m lower than the Site-specific "Sand/Sandy Silt" layer, thus clearly showing that the Sand/Sandy Silt layer is not part of the Upper Aquifer hydrostratigraphic unit.

Also, given that the "Sandy/Sandy Silt" layer at the Site appears to be a surficial layer of local nature, then it is reasonable for the "Silt" and "Clayey Silt" units to be considered part of the Surficial Aquitard, based on similar Site-specific and regional characteristics and elevations.

The "Silt" and "Clayey Silt" units at the Site are part of the Surficial Aquitard, with a minimum conservatively estimated thickness ranging between 2 m (BH-1/BH-8) and 13 m (BH-3) of fine grained glacial deposits with at least 15% clay.

The thickness of fine-grained material are very conservatively estimated at 2 m because boreholes BH-1 and BH-8 were terminated at depths of 8.2 and 6.6 m below ground surface (bgs) corresponding to elevations of 357.1 and 358.8 m AMSL, respectively.

The nearest well to the Site of significant depth is MOE Well No. 6506864 shown on Figure 5. This well is located approximately 95 m southwest of the Site with a ground surface elevation of 353.1 and a total depth of 33.8 m bgs corresponding to an elevation of 319.3 m AMSL. At MOE Well No. 6506864 there are 20.7 m of clay below a thin layer of fill of 0.9 m. The elevation of the bottom of the clay is 331.5 m AMSL indicating that the thickness of fine-grained material in the vicinity of the Site is very significant and based on comparable elevation data is in fact at least 25 m and not 2 m as conservatively estimated with the aid of the site-specific geotechnical and hydrogeologic data.

Therefore, the thickness of fine-grained material at the Site based on Site-specific data and stratigraphic data from the closest well to the Site is very significant and certainly 15 m or greater.

Comment 2:

Geologic and Hydrogeologic cross-sections should be prepared incorporating the geotechnical boreholes advanced on the Site with the boreholes advanced as part of the Elmira/St. Jacobs Water Supply Project (CH2M Hill Engineering Ltd., 1991). The source of the regional geologic/hydrogeologic cross-sections provided in the report was the Elmira/St. Jacobs Water Supply Project.

Response 2:

The Elmira/St. Jacobs Water Supply Project regional geologic and hydrogeologic presented on Figures 3a, 3b, and 3c were included in the Hydrogeologic Assessment only to depict the regional geologic and hydrogeologic framework in the general area of the Site. These cross-sections are offset at significant distances (400 to 1,000 m) from the Site. It would not be prudent to combine the Site-specific geotechnical and hydrogeologic data with the borehole data used to construct the regional Elmira/St. Jacobs Water Supply Project, given the significant offset distances and the significant differences in ground surface elevations between the Site and the these regional geologic and hydrogeologic cross-sections The stratigraphic data from geotechnical boreholes were employed to generate Site-specific geologic and hydrogeologic cross-sections to focus on the geological and hydrogeological details directly beneath the Site.

Comment 3:

Section 4.4 indicated the SAT is present and ranges in thickness from 10 m to upwards of 14 m. As boreholes BH-1, BH-6, BH-7, BH-8, BH-9, and BH-10 were terminated at depths of less than

10 m, it is unclear how the minimum thickness of the SAT is known to be 10 m. Additional justification should be provided.

Response 3:

See response to Comment No. 1.

Comment 4:

If the Upper Aquifer (UA) is present beneath the SAT, it is unclear why Section 4.4 indicates the UA is an unconfined aquifer. Clarification should be provided.

Response 4:

The Upper Aquifer (UA) is generally present beneath the Surficial Aquitard (SAT), as shown on the schematic conceptual hydrogeologic model on Figure 4 and is known to be under unconfined conditions.

Comment 5:

The rationale for stating that the Upper Aquifer has no hydrogeologic significance should be provided. It is worth noting that Section 3.5 of the hydrogeological assessment indicates "generally in the Elmira area, most of the domestic wells obtain water from the upper 15 m of the overburden".

Response 5:

The UA at the Site is hydro geologically insignificant because is not present. The Site is underlain by fine-grained material.

In the Elmira area the UA is highly variable and discontinuous. Shallow domestic wells used for water supply are generally found in rural areas at significant distances from the Site. These domestic wells obtain their water supply from areas where the UA is found at shallow depths within generally topographically high areas, such as those shown on the eastern portion of regional geologic/hydrogeologic cross-section F-F′ shown on Figure 3c.

Comment 6:

Section 4.4 of the hydrogeological assessment indicated the Upper Aquitard is a continuous and effective confining unit which separates the UA from the municipal aquifer system. It is worth noting that the Elmira Well Field was shutdown in response to contamination in the municipal aquifer system; thus, the Upper Aquitard may not be continuous and/or an effective confining unit.

Response 6:

The Elmira Well Field shutdown occurred in an area where Canagagigue Creek is a more prominent hydrologic feature causing significant changes to the hydrogeologic framework of the area.

The Upper Aquitard in the area of the Site is a continuous and effective confining layer of significant thickness which protects the municipal aquifer system from potential shallow sources of impact.

Comment 7:

As location 6509809 did not encounter a fine-grained sediment at ground surface, the minimum Surficial Aquitard thickness in the vicinity of the Site is 0. It is unclear why location 6509809 was not considered in the stratigraphic framework presented in Table 2. It is difficult to correlate the thicknesses of the hydrostratigraphic units provided in Table 2 with the soil descriptions provided on the MOE Well Record Report in Attachment A. The consultant should clearly indicate the hydrostratigraphic unit contacts for the boreholes included in Table 2.

Response 7:

The thicknesses presented in Table 2 were from a selected number of MOE well record reports that were close in proximity to the Site. The location 6509809 is approximately 280 m west of the Site and is shallow (4.3 m). All of the MOE well record report locations reviewed and considered for the assignment of representative thicknesses of stratigraphic units presented on Table 2 were selected based on the proximity to the Site and the completion depths of greater than 30 m.

Comment 8:

Additional justification is necessary to support the statement that the fine-grained glacial deposits with at least 15% clay are adequate to restrict the downward migration of any potential contamination. It is also worth noting that it is questionable whether the upper 15 m of overburden are in fact the Surficial Aquitard. The sand layer identified at the Site appears to be consistent with the upper aquifer identified regionally.

Response 8:

The fine-grained glacial deposits are composed primarily of silt and clay. These glacial deposits have a combined silt and clay content on the order of 97% and a minimum clay content of 15%. These percentages of fine-grained material essentially are representative of an aquitard and are more than adequate to restrict the downward migration of any potential contamination.

As explained in the Response to Comment No. 1 the sand layer identified at the ground surface of the Site is not part of the Upper Aquifer. The Site-specific geologic cross-sections presented

on Figures 8a, 8b, and 8c, show that the "Sand/Sandy Silt" layer is present between elevations of approximately 365 and 357 m AMSL above a thick layer of fine-grained material ("Silt" and "Clayey Silt") and ranges in thickness, where present, between 0 m (BH-10) and 6 m (BH-1/BH-2) at the geotechnical boreholes completed in 2011 during geotechnical and hydrogeological investigation activities. Furthermore the "Sand/Sandy Silt" layer is for the most part dry.

Also, given that the "Sandy/Sandy Silt" layer at the Site appears to be a surficial layer of local nature, then it is reasonable for the "Silt" and "Clayey Silt" units to be considered part of the Surficial Aquitard, based on similar Site-specific and regional characteristics and elevations.

GEOTECHNICAL INVESTIGATION (DECEMBER 2011) COMMENTS:

Comment 9:

CRA advanced boreholes in the vicinity of the original boreholes advanced by CVD and used the same nomenclature (i.e., BH-3, BH-4, and BH-5); however, the locations of the CRA boreholes were not provided on a figure. The location of the boreholes advanced by CRA should be provided on a figure.

Response 9:

The locations of the boreholes (BH-3, BH-4, and BH-5) advanced by CRA on October 6, 2011 were completed immediately adjacent to the CVD boreholes of the same nomenclature. The purpose of the CRA boreholes was to collect soil samples for additional geotechnical parameters (grain size distribution including hydrometer, and permeability testing). Soil samples had been collected by CVD for total silt and clay content without the hydrometer component to differentiate between the silt and clay content.

Specific CRA borehole location identifiers were not generated since the boreholes were completed directly adjacent to the corresponding previously completed borehole by CVD. Notwithstanding this, all CRA borehole locations references will be amended with an "A" (e.g., "BH-5A") to indicate they were completed at a different, although very close proximity locations.

Figures and references are revised to show the location nomenclature (e.g., "BH-5/BH-5A") to indicate both CVD and CRA boreholes were completed at this location. These figures are provided in Attachment 1 and are included in the revised Geotechnical Report.

Comment 10:

Logs for the boreholes advanced by CRA should be provided.

Response 10:

The locations of the boreholes (BH-3, BH-4, and BH-5) advanced by CRA on October 6, 2011 were completed immediately adjacent to the CVD boreholes of the same nomenclature. The purpose of the CRA boreholes was to collect soil samples for additional geotechnical parameters (grain size distribution, and permeability testing).

Notwithstanding this, borehole logs for boreholes BH-3A, BH-4A, and BH-5A, completed immediately adjacent to boreholes BH-3, BH-4, and BH5 are provided in Attachment 1 and in the revised Geotechnical Report.

Comment 11:

The depths of the samples collected by CRA for grain-size analyses should be provided.

Response 11:

The depths of the soil samples collected by CRA for grain-size distribution analyses, including hydrometer are as follow:

- BH-3A: 3.0-3.6 m
- BH-4A: 4.0-4.6 m
- BH-5A: 2.5-3.1 m

Table 2 of the revised Geotechnical Report has been revised to include the depths shown above. These sample depths are also shown on the corresponding stratigraphic logs for BH-3A, BH-4A, and BH-5A, provided in Attachment 1 and the revised Geotechnical Report..

Comment 12:

Page 4 indicated the Shelby tubes were collected at approximately 360 m AMSL, which corresponds to depths of 2.5 m, 3.5 m, and 2.0 m at locations BH-3, BH-4, and BH-5, respectively. All of the permeability test result forms indicate that the Shelby tubes were collected from a Sandy SILT material; however, this does not correspond with the soil descriptions on the CVD borehole logs. This inconsistency should be explained.

Response 12:

The permeability test result forms, included in Appendix C, were not relied upon for a soil classification. The permeability tests were completed (October 7-14, 2011), prior to conducting grain size distribution tests (October 18, 2011), therefore a preliminary and unofficial "Type of Material" classification was used on the permeability test result forms by the laboratory technician. The material is classified as Silt with some clay according to the grain-size distribution.

The permeability test "Type of Material" classification on each of the result forms has been revised to more accurately reflect the grain size distribution results. The revised permeability test result forms are included in Attachment 1 and are also included in the revised Geotechnical Report.

Comment 13:

Section 5.0 indicated "therefore, the upper 15 m of the Site-Specific geology and hydrogeology is characterized as the Surficial Aquitard (SAT) which corresponds to the Tavistock Till comprised primarily silt, and clayey silt deposits with an average clay content of 15% or greater. The average combined silt and clay content of the SAT beneath the Site is 97%". As the soil descriptions within the first 15 m vary considerably, with the shallowest soils being described as Sandy SILT, some clay to SAND, trace silt and no grain-size analysis samples were collected from these units, it is not accurate to indicate that the grain size analysis results are representative of the upper 15 m at the Site. According to the particle size distribution plots, an adjective (e.g., sandy) descriptive modifier indicates 21 to 35%; thus, the Sandy SILT, some clay material would contain at least 21% sand and the SAND, trace silt would contain approximately 90% sand, as trace indicates less than 10% silt. The combined thickness of the Sandy SILT, some clay and SAND, trace silt varies from approximately 0 to 7 m at the Site, with an average thickness where present of approximately 3.5 m.

Response 13:

Grain size analyses were not collected from the "Sand/Sandy Silt" unit at the Site since these shallow soils will be excavated and removed prior to construction. The "Sand/Sandy Silt" unit at the Site will be excavated to an elevation of approximately 360 m AMSL prior to building the proposed tanks, which will remove the deposits almost entirely in the vicinity of the proposed storage tanks. Any areas where the "Sand/Sandy Silt" is still present beneath the 360 m AMSL, will be dealt with in accordance with Section 6.0 of the Geotechnical Investigation to adequately grade and ensure compaction requirements are fulfilled.

The Surficial Aquitard Unit ("Silt" and "Clayey Silt" units) comprised primarily of silt and clay had numerous grain size distribution tests completed to verify the sand, silt and clay contents within the specified boreholes, as summarized in Table 2 and provided in Appendix B of the Geotechnical Report.

Based on the three grain size distribution results obtained by CRA from depths below 360 m AMSL (base of proposed storage tanks) from the October 6, 2011 sampling event (BH-3A, BH-4A, and BH-5A), the sand content ranged from 0 to 2%, the silt content ranged from 17 to 92%, and the clay content ranged from 8 to 20%. The average combined silt and clay content of the SAT beneath the proposed elevations for the storage tanks is 99% and the average clay is 15%. The overall silt and clay content from all seven grain-size distribution analyses (four samples collected by CVD and three samples collected by CRA) is about 97%.

Comment 14:

Section 5.1 of the geotechnical report stated "based upon the water levels measured and the moisture contents of the various soil samples secured during field investigation procedures, groundwater is found within the SAT under stagnant conditions, since this unit is an aquitard comprised primarily of fine-grained materials". It is unclear what is meant by this statement. Clarification should be provided.

Response 14:

The statement in Section 5.1 refers to the fact that the measured water levels in BH-3 and BH-6 are reflective of water present within the fine-grained material of the SAT. Water in fine-grained glacial deposits is known and well-documented to be considered to be stagnant or to move very slowly. The fine-grained glacial deposits form an aquitard.

Comment 15:

Page 8, 2nd last paragraph states "The groundwater conditions encountered at the boreholes do not constitute the in situ soil deposits as being the uppermost identified aquifer as defined in Part VIII of Ontario Regulation 267/03 pertaining to the Nutrient Management Act, 2002 (Ministry of Agriculture Food &Rural Affairs)." The statement is unclear considering that O. Reg. 267/03 defines "aquifer" and not the "uppermost aquifer". Please explain what is meant by this statement.

Response 15:

The statement in Section 5.1 refers to the fact that measured water levels in BH-3 and BH-6 are reflective of water present within the fine-grained material of the SAT. Water in fine-grained glacial deposits is known and well-documented to be considered to be stagnant or to move very slowly. The fine-grained glacial deposits form an aquitard and not an aquifer.

Comment 16:

Based on the cross-sections provided and the proposed base elevation of 360 m AMSL for the Main Digestor Tanks and Secondary Digestor Tanks, it appears that the sandy silt and/or sand to gravely sand unit will be removed during Site re-grading near some of the borehole locations, including BH-3, BH-4, and BH-5. However, the borehole log for BH-6 suggests that at an elevation of 360 m AMSL, the Secondary Digestor & Repository Tank will be underlain by a thin sand, some silt layer. As the SAT and Upper Aquifer thicknesses are extremely variable in the vicinity of the Site, it is possible that portions of the tank may not be underlain by at least 1.0 m of soil with a clay content of at least 10%.

Response 16

As detailed in the Geotechnical Investigation in Section 6.1 Site Grading and Engineered Fill Construction:

"The engineered fill should be constructed in accordance with the following procedures in order to support building foundations, floor slabs, and pavement areas:

1. All topsoil, organic and deleterious materials should be stripped from building, tank and pavement areas.
2. The exposed subgrade surface is to be thoroughly re-compacted by large heavy compaction equipment (10-tonne compactor is recommended) and inspected by qualified geotechnical personnel. Any loose or soft areas identified should be excavated to the level of competent soil.
3. The required grades can then be achieved by placing OPSS Granular B Type I or on-Site fine to gravelly sand deposits in maximum 0.3-m thick loose lifts and compacting to a minimum of 100% Standard Proctor maximum dry density (SPMDD) in areas to support building foundation, floor slab and various tank structures. On-Site fine grained fill soil can be used beneath asphalt surfaced main entrance, access roads and parking areas. It can be placed in maximum 0.3-m thick loose lifts and compacted to at least 98% SPMDD. The moisture content of the fill materials must be within 3% of the optimum content in order to achieve the specified degree of compaction.
4. Engineered fill used to support future building foundations and tank structures (compacted to at least 100% SPMDD) must be placed such that the fill pad extends horizontally outwards from all footings at least the same distance as how thick the engineered fill pad will exist between the underside of future footings and the approved native earth subgrade.
5. Compaction above building footing foundations to the floor subgrade level (for the support of the floor slabs) and within pavement areas may be reduced to no less than 98% SPMDD.
6. All fill placement and compaction operations must be supervised on a full-time basis by qualified geotechnical personnel to approve fill material and ensure the specified degrees of compaction have been achieved."

A reference in the text (Section 6.2.1) was mistakenly directed at BH-4, when it should have been focused on conditions at BH-6. The specific situation encountered at BH-6 will be clarified in the revised text for Section 6.2.1:

> "It is noted that the competent footing founding level is expected to be lower in the area of BH-6 due to the presence of very loose sand."

Although the SAT thickness is variable at the Site, the construction of the tanks will be underlain by at least 1.0 m of soil with a clay content of at least 10%. It should be emphasized that the Upper Aquifer was not encountered within the uppermost 15 m at beneath the Site.

The revised Geotechnical report will include the changes noted above.

OTHER COMMENTS

Comment 17:

The May 2010 version of the hydrogeological assessment indicated the thickness of the Surficial Aquitard is "extremely variable and ranges from less than 1 m to 12 m. The SAT is characterized as primarily silt and clay, with trace to little sand and little gravel…The SAT pinches out laterally and is not present in the vicinity of the Site." The source of this information should be provided.

Response 17:

The statement from the May 2010 version of the hydrogeological assessment was based on data extrapolated from a regional study (Elmira/St. Jacobs Water Supply Project) and not from Site-specific data. Site-specific data were collected in 2011 and the Site specific conceptual model was refined. The statement has been removed from the hydrogeological assessment as it is no longer relevant.

The original statement was from:

> CH2M Hill Engineering Ltd. 1991. *Elmira/St. Jacobs Water Supply Project – Volume I, Hydrogeological Evaluation of the Elmira Aquifer System*. Prepared for the Regional Municipality of Waterloo.

Comment 18:

In the CRA response letter dated December 9, 2011, Response 1 indicates the "Silt layer is underlain by a Clayey Silt layer. Together these two layers form the Undifferentiated Surficial and Upper Aquitard". This hydrogeologic conceptual model is inconsistent with the model presented in the hydrogeological assessment, as Section 4.5 of the hydrogeological assessment indicates the upper 15 m of overburden is characterized as the Surficial Aquitard. There is no indication in the hydrogeological assessment that the Upper Aquitard was encountered in the geotechnical boreholes advanced on Site. The hydrogeological assessment suggests that the Upper Aquifer is present beneath the Surficial Aquitard on the Site, suggesting that the Surficial Aquitard and Upper Aquitard are separated by the Upper Aquifer at the Site and do not form a single undifferentiated aquitard. Furthermore, Response 1 suggests that only the Silt and Clayey Silt layers form the Undifferentiated Surficial and Upper Aquitard, which does not consider the sandy silt and/or sand to gravely sand units located above the Silt layer. As the Silt layer does not extend to ground surface, it is unclear how the Silt layer forms the uppermost portion of the Surficial Aquitard (i.e., it is not located at the surface). These discrepancies in the hydrogeologic conceptual model should be addressed.

Response 18:

As detailed in the Response to Comment No. 1, the sand layer identified at the ground surface of the Site is not part of the Upper Aquifer. The Site-specific geologic cross-sections presented on Figures 8a, 8b, and 8c, show that the "Sand/Sandy Silt" layer is present between elevations of

approximately 365 and 357 m AMSL above a thick layer of fine-grained material ("Silt" and "Clayey Silt") and ranges in thickness, where present, between 0 m (BH-10) and 6 m (BH-1/BH-2) at the geotechnical boreholes completed in 2011 during geotechnical and hydrogeological investigation activities. Furthermore the "Sand/Sandy Silt" layer is for the most part dry.

Based on the regional geologic/hydrogeologic cross-sections presented on Figures 3a, and 3b, the Upper Aquifer within the vicinity of the Site (indicated as "Woolwich Bio-En Facility" on the associated Figures) would be present between elevations of approximately 340 and 345 m AMSL. In fact, on Figure 3c, the Upper Aquifer would not be present beneath the Site at all, suggesting the Upper Aquifer is discontinuous.

Therefore, based on the elevations from the regional and Site-specific cross-sections, the regional Upper Aquifer is 13-25 m lower than the Site-specific "Sand/Sandy Silt" layer, thus clearly showing that the Sand/Sandy Silt layer is not part of the Upper Aquifer hydrostratigraphic unit.

Also, given that the "Sandy/Sandy Silt" layer at the Site appears to be a surficial layer of local nature, then it is reasonable for the "Silt" and "Clayey Silt" units to be considered part of the Surficial Aquitard, based on similar Site-specific and regional characteristics and elevations.

The "Silt" and "Clayey Silt" units at the Site are part of the Surficial Aquitard, with a minimum conservatively estimated thickness ranging between 2 m (BH-1/BH-8) and 13 m (BH-3) of fine grained glacial deposits with at least 15% clay.

The thickness of fine-grained material are very conservatively estimated at 2 m because boreholes BH-1 and BH-8 were terminated at depths of 8.2 and 6.6 m below ground surface (bgs) corresponding to elevations of 357.1 and 358.8 m AMSL, respectively.

The nearest well to the Site of significant depth is MOE Well No. 6506864 shown on Figure 5. This well is located approximately 95 m southwest of the Site with a ground surface elevation of 353.1 and a total depth of 33.8 m bgs corresponding to an elevation of 319.3 m AMSL. At MOE Well No. 6506864 there are 20.7 m of clay below a thin layer of fill of 0.9 m. The elevation of the bottom of the clay is 331.5 m AMSL indicating that the thickness of fine-grained material in the vicinity of the Site is very significant and based on comparable elevation data is in fact at least 25 m and not 2 m as conservatively estimated with the aid of the site-specific geotechnical and hydrogeologic data.

Therefore, the thickness of fine-grained material at the Site based on Site-specific data and stratigraphic data from the closest well to the Site is very significant and certainly 15 m or greater.

It is possible that the UA is not present in the vicinity of the Site at all. As noted above, the closest commercial water supply well (MOE well record number 6506864) is located south-southwest and approximately 95 m southwest of the Site. The approximate ground surface is 353.1 m AMSL. The stratigraphy indicates a very thin fill layer (ground surface to 352.2 m AMSL), underlain by a clay unit (352.2 to 331.5 m AMSL), and underlain by a sandy

clay and stony gravel approximately 8.8 m in thickness in turn underlain by gravel and coarse sand units (324.5 to 319.3 m AMSL). Based on the water well record, the elevations 352.22 to 324.48 m AMSL are comprised of fine grained deposits (primarily clay) and form an aquitard.

A comparison of the elevations from the 6506864 commercial water supply well with the Site and with regional cross-sections indicates that no UA is identified at the 6506864 location. Based on these data and Figure 3c, which indicates UA is not present beneath the facility and is identified as "undifferentiated surficial and upper aquitard", it is reasonable to anticipate the UA is not present at the Site.

Comment 19:

There are several comments related to Response 35 in Attachment 2 of the CRA response letter dated December 9, 2011, including a) Response 35 indicates the Upper Aquifer is the uppermost hydrostratigraphic unit under unconfined conditions in the vicinity of the Site; however, this hydrogeologic conceptual model is inconsistent with the model presented in the December 8, 2011 version of the hydrogeological assessment, as the most recent version suggests that the Upper Aquifer is not the uppermost hydrostratigraphic unit; b) The response also indicates "Given its heterogeneous nature inherent of stratified glacial deposits this unit [Upper Aquifer] very likely has silty material within the vadose zone. The less permeable finer grained material within these stratified deposits would slow down the rate of vertical migration of liquids before the reach the more permeable portions of the Upper Aquifer". There are no data to support the statement that finer grained materials were encountered within the Upper Aquifer or that they would be adequate to slow down the vertical migration of liquids before they reach the more permeable portions of the Upper Aquifer; c) The most recent version of the hydrogeological assessment does not indicate that portions of the Upper Aquifer are more permeable; d) It is also unclear what is meant by "the slower rate of migration of the liquids would enhance natural biodegradation processes if sufficient microbes and oxygen are present". The potentially slower migration of any liquids released would not enhance microbial activity. Clarification should be provided for all of these issues.

Response 19:

As discussed in the Response to Comment No. 1, hydrostratigraphic unit present at the Site within the uppermost 15 m is the SAT.

The sand layer identified at the ground surface of the Site is not part of the Upper Aquifer. The Site-specific geologic cross-sections presented on Figures 8a, 8b, and 8c, show that the "Sand/Sandy Silt" layer is present between elevations of approximately 365 and 357 m AMSL above a thick layer of fine-grained material ("Silt" and "Clayey Silt") and ranges in thickness, where present, between 0 m (BH-10) and 6 m (BH-1/BH-2) at the geotechnical boreholes completed in 2011 during geotechnical and hydrogeological investigation activities. Furthermore the "Sand/Sandy Silt" layer is for the most part dry.

Based on the regional geologic/hydrogeologic cross-sections presented on Figures 3a, and 3b, the Upper Aquifer within the vicinity of the Site (indicated as "Woolwich Bio-En Facility" on the associated Figures) would be present between elevations of approximately 340 and

345 m AMSL. In fact, on Figure 3c, the Upper Aquifer would not be present beneath the Site at all, suggesting the Upper Aquifer is discontinuous.

Therefore, based on the elevations from the regional and Site-specific cross-sections, the regional Upper Aquifer is 13-25 m lower than the Site-specific "Sand/Sandy Silt" layer, thus clearly showing that the Sand/Sandy Silt layer is not part of the Upper Aquifer hydrostratigraphic unit.

Also, given that the "Sandy/Sandy Silt" layer at the Site appears to be a surficial layer of local nature, then it is reasonable for the "Silt" and "Clayey Silt" units to be considered part of the Surficial Aquitard, based on similar Site-specific and regional characteristics and elevations.

The "Silt" and "Clayey Silt" units at the Site are part of the Surficial Aquitard, with a minimum conservatively estimated thickness ranging between 2 m (BH-1/BH-8) and 13 m (BH-3) of fine grained glacial deposits with at least 15% clay.

The thickness of fine-grained material are very conservatively estimated at 2 m because boreholes BH-1 and BH-8 were terminated at depths of 8.2 and 6.6 m below ground surface (bgs) corresponding to elevations of 357.1 and 358.8 m AMSL, respectively.

The nearest well to the Site of significant depth is MOE Well No. 6506864 shown on Figure 5. This well is located approximately 95 m southwest of the Site with a ground surface elevation of 353.1 and a total depth of 33.8 m bgs corresponding to an elevation of 319.3 m AMSL. At MOE Well No. 6506864 there are 20.7 m of clay below a thin layer of fill of 0.9 m. The elevation of the bottom of the clay is 331.5 m AMSL indicating that the thickness of fine-grained material in the vicinity of the Site is very significant and based on comparable elevation data is in fact at least 25 m and not 2 m as conservatively estimated with the aid of the site-specific geotechnical and hydrogeologic data.

Therefore, the thickness of fine-grained material at the Site based on Site-specific data and stratigraphic data from the closest well to the Site is very significant and certainly 15 m or greater.

The fine grained glacial deposits determined to be present within the upper 15 m at the Site, would prevent any potential contamination to migrate laterally or vertically The 97% combined silt and clay content of these deposits would provide a barrier since because these deposits form an aquitard. The UA was not encountered during the geotechnical investigation. Based on the data available from location 65068064 a permeable layer is found at an elevation of about 324.5 m AMSL which is in excess of 30 m below the existing ground surface.

DECEMBER 20, 2011 COMMENTS:

Comment 20:

Page 32, under Sections 64 and 65 of O. Reg. 267/03 – 1st paragraph.

The report states that soil samples were collected immediately adjacent to boreholes BH-3, BH-4, and BH-5 immediately below the proposed base elevation of the tanks of 360 m AMSL.

i. ***Location of the new boreholes has not been identified in any of the diagrams provided with either D&O report or the Geotechnical Investigation report. Please provide a diagram that shows the location of these boreholes and also provide their borehole logs.***

ii. ***Since the proposed tanks will be made of reinforced concrete, section 65(1) (a) of O. Reg. 267/03 requires that a site characterization study that consists of a stage one hydrogeologic or geotechnical investigation of the site of the proposed facility should be carried out to identify the soil types and the presence of any aquifer or bedrock, all to a depth of at least 1.5 metres below the lowest elevation of the excavation required for a structure made of concrete. However, according to both the D&O report and Geotechnical Investigation report, soil samples were collected immediately below the proposed elevation of the tanks of 360 m AMSL. Please confirm if samples collected meet section the requirements of 65(1)(a) of O. Reg. 267/03 as identified above.***

Response 20:

i. The locations of the boreholes (BH-3, BH-4, and BH-5) advanced by CRA on October 6, 2011 were completed immediately adjacent to the CVD boreholes of the same nomenclature. The purpose of the CRA boreholes was to collect soil samples for additional geotechnical parameters (grain size distribution including hydrometer, and permeability testing). Soil samples had been collected by CVD for total silt and clay content without the hydrometer component to differentiate between the silt and clay content.

Specific CRA borehole location identifiers were not generated since the boreholes were completed directly adjacent to the corresponding previously completed borehole by CVD.

Notwithstanding this, all CRA borehole locations references will be amended with an "A" (e.g., "BH-5A") to indicate they were completed at a different, although very close proximity locations.

Figures and references are revised to show the location nomenclature (e.g., "BH-5/BH-5A") to indicate both CVD and CRA boreholes were completed at this location. These figures are provided in Attachment 1 and are included in the revised Geotechnical Report.

Borehole logs for boreholes BH-3A, BH-4A, and BH-5A, completed immediately adjacent to boreholes BH-3, BH-4, and BH5 are provided in Attachment 1 and in the revised Geotechnical Report.

ii. Boreholes BH-3A, BH-4A, and BH-5A were completed immediately adjacent to boreholes BH-3, BH-4, and BH-5 for the sole purpose of collecting the additional geotechnical data, namely the Shelby tubes and hydrometer (clay) portion of the grain-size distribution data. Boreholes BH-3, BH-4, and BH-5 provide site

characterization data to depths of 12.1 m, 9.4 m and 9.7 m below the lowest elevation of the excavation required for a structure made of concrete.

One Shelby tube sample was collected from each location, BH-3A, BH-4A, and BH-5A at depths of 2.5 m, 3.5 m, 2.0 m, respectively. One soil sample was also collected in a split-spoon sampler at depths below the Shelby tube at each of the borehole locations BH-3A (3.0-3.6 m), BH-4A (4.0-4.6 m), and BH-5A (2.5-3.1 m) and analyzed for grain size distribution including hydrometer to separate and quantify the amount silt and clay.

At BH-3/BH-3A the characterization study extended to a minimum depth of 12.1 m below the lowest elevation (360 m AMSL) of the excavation required for a structure made of concrete. No underlying aquifer or bedrock were encountered to a depth of at least 12.1 m below the lowest elevation of the excavation required for a structure made of concrete. All the material encountered at BH-3 to its depth of completion of 12.1 m were fine-grained glacial deposits of the Surficial Aquitard.

At BH-4/BH-4A the characterization study extended to a minimum depth of 9.4 m below the lowest elevation (360 m AMSL) of the excavation required for a structure made of concrete. No underlying aquifer or bedrock were encountered to a depth of at least 9.4 m below the lowest elevation of the excavation required for a structure made of concrete. All the material encountered at BH-4 to its depth of completion of 9.4 m were fine-grained glacial deposits of the Surficial Aquitard.

At BH-5/BH-5A the characterization study extended to a minimum depth of 9.7 m below the lowest elevation (360 m AMSL) of the excavation required for a structure made of concrete. No underlying aquifer or bedrock were encountered to a depth of at least 9.7 m below the lowest elevation of the excavation required for a structure made of concrete. All the material encountered at BH-5 to its depth of completion of 9.7 m were fine-grained glacial deposits of the Surficial Aquitard.

All the samples collected meet the requirements of 65(1)(a) of O. Reg. 267/03.

Comment 21:

Page 4 – top of the page [Geotechnical Investigation Report] – As identified in item 2 above, section 65(1) (a) of O. Reg. 267/03 requires that a site characterization study should be carried out to identify the soil types and the presence of any aquifer or bedrock, all to a depth of at least 1.5 metres below the lowest elevation of the excavation required for a structure made of concrete. However, the depths of samples collected from BH-3, BH4, and BH-5, corresponding to 360 metres AMSL is from 2.5 m, 3.5 m, and 2.0 m below surface grade, respectively. Please confirm if samples collected meet section the requirements of 65(1)(a) of O. Reg. 267/03 as identified above.

Response 21:

As noted in the Response to Comment No. 20, boreholes BH-3A, BH-4A, and BH-5A were completed immediately adjacent to boreholes BH-3, BH-4, and BH-5 for the sole purpose of collecting the additional geotechnical data, namely the Shelby tubes and hydrometer (clay) portion of the grain-size distribution data. Boreholes BH-3, BH-4, and BH-5 provide site characterization data to depths of 12.1 m, 9.4 m and 9.7 m below the lowest elevation of the excavation required for a structure made of concrete.

One Shelby tube sample was collected from each location, BH-3A, BH-4A, and BH-5A at depths of 2.5 m, 3.5 m, 2.0 m, respectively. One soil sample was also collected in a split-spoon sampler at depths below the Shelby tube at each of the borehole locations BH-3A (3.0-3.6 m), BH-4A (4.0-4.6 m), and BH-5A (2.5-3.1 m) and analyzed for grain size distribution including hydrometer to separate and quantify the amount silt and clay.

At BH-3/BH-3A the characterization study extended to a minimum depth of 12.1 m below the lowest elevation (360 m AMSL) of the excavation required for a structure made of concrete. No underlying aquifer or bedrock were encountered to a depth of at least 12.1 m below the lowest elevation of the excavation required for a structure made of concrete.

At BH-4/BH-4A the characterization study extended to a minimum depth of 9.4 m below the lowest elevation (360 m AMSL) of the excavation required for a structure made of concrete. No underlying aquifer or bedrock were encountered to a depth of at least 9.4 m below the lowest elevation of the excavation required for a structure made of concrete.

At BH-5/BH-5A the characterization study extended to a minimum depth of 9.7 m below the lowest elevation (360 m AMSL) of the excavation required for a structure made of concrete. No underlying aquifer or bedrock were encountered to a depth of at least 9.7 m below the lowest elevation of the excavation required for a structure made of concrete.

All the samples collected meet the requirements of 65(1)(a) of O. Reg. 267/03.

ATTACHMENT 1

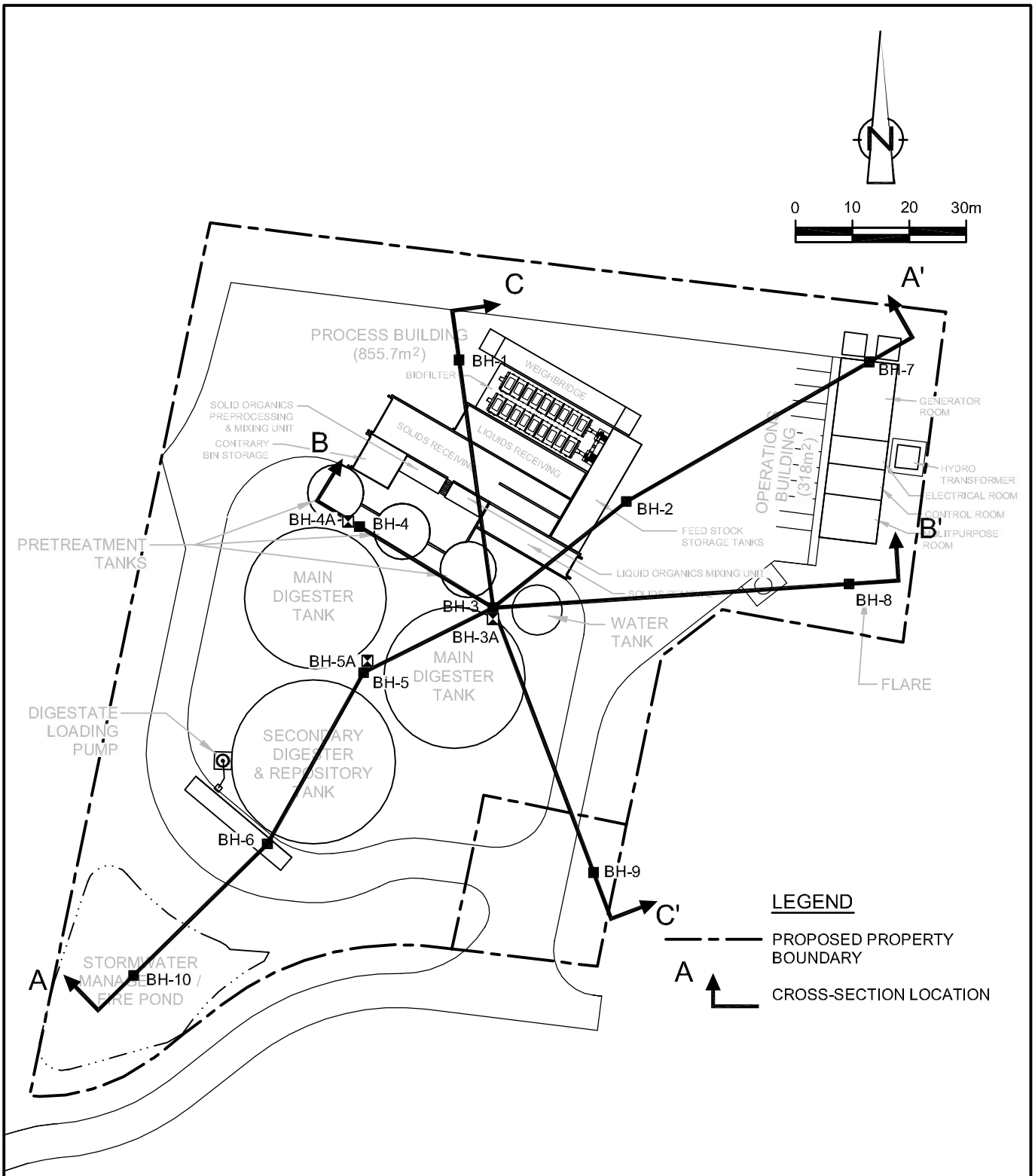
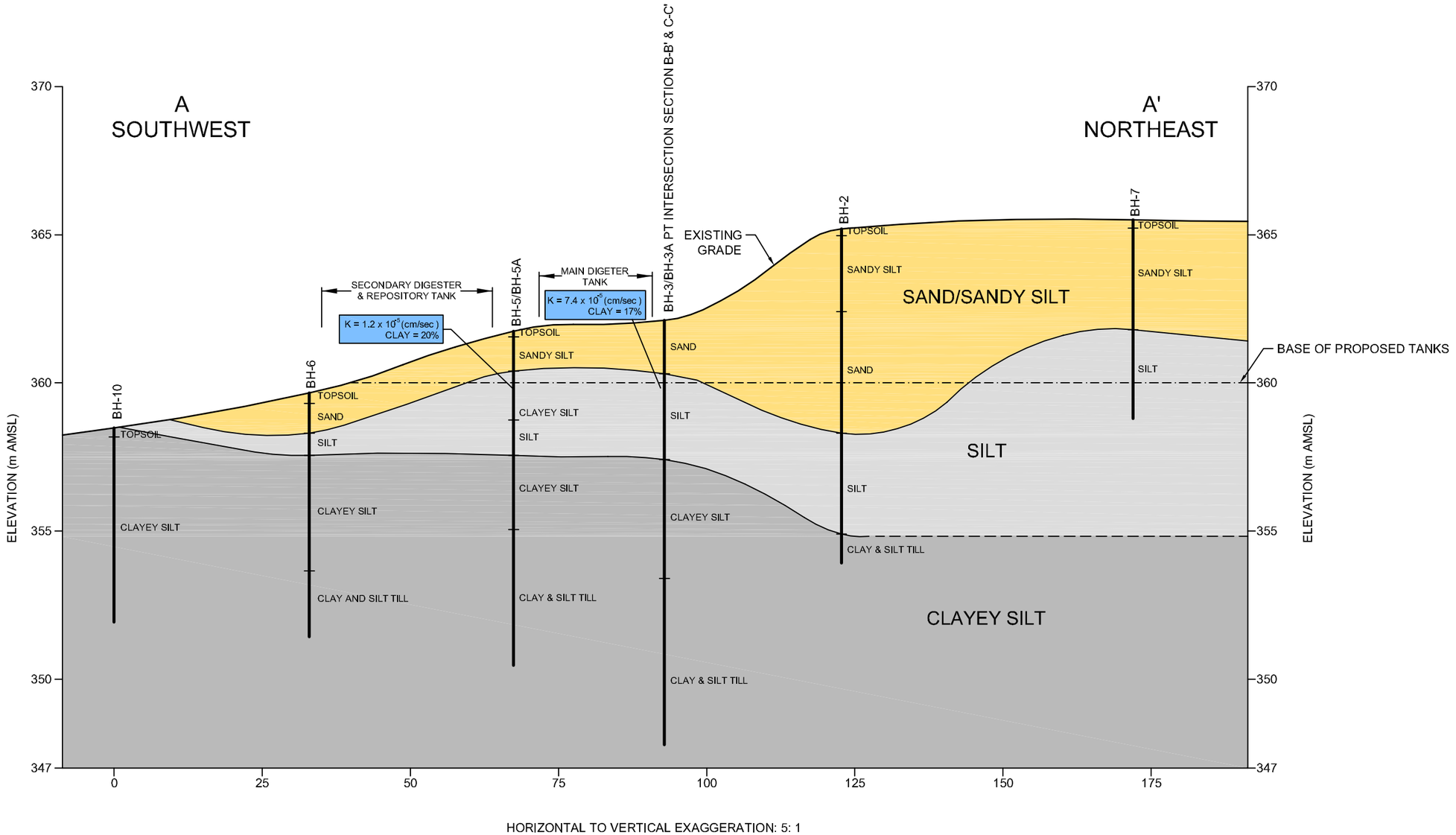


figure 1

GEOLOGIC CROSS-SECTION LOCATIONS
WOOLWICH BIO-EN FACILITY
Elmira, Ontario

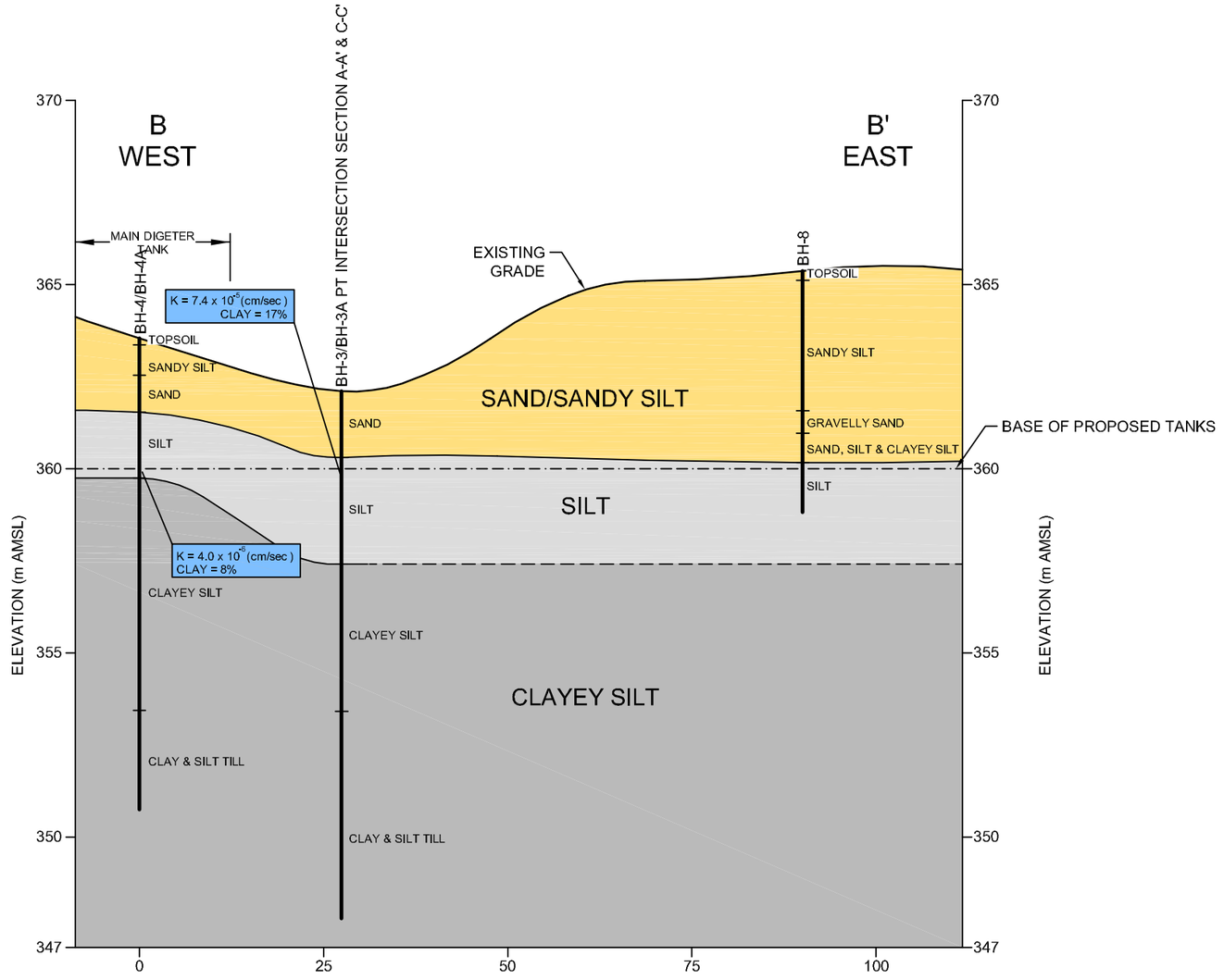
46254-07(012)GN-WA001 DEC 22/2011



HORIZONTAL TO VERTICAL EXAGGERATION: 5: 1

figure 2

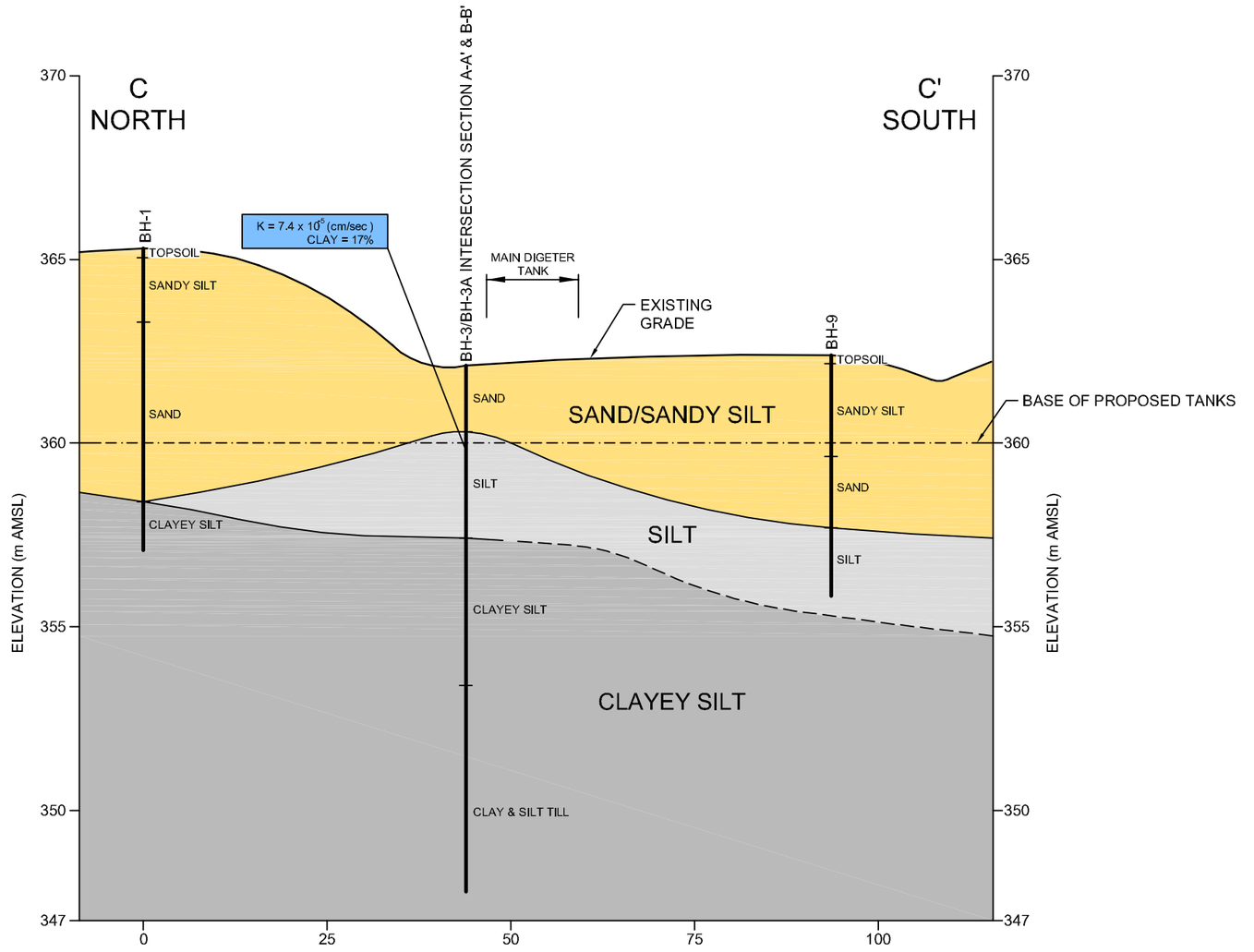
GEOLOGIC CROSS-SECTION A-A'
WOOLWHICH BIO-EN FACILITY
Elmira, Ontario



HORIZONTAL TO VERTICAL EXAGGERATION: 5: 1

figure 3

GEOLOGIC CROSS-SECTION B-B'
WOOLWICH BIO-EN FACILITY
Elmira, Ontario



HORIZONTAL TO VERTICAL EXAGGERATION: 5: 1

figure 4

GEOLOGIC CROSS-SECTION C-C'
WOOLWICH BIO-EN FACILITY
Elmira, Ontario

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: BIO-EN Inc. Facility
PROJECT NUMBER: 046254
CLIENT: BIO-EN Inc. Facility
LOCATION: Elmira, Ontario

HOLE DESIGNATION: BH-3A
DATE COMPLETED: October 6, 2011
DRILLING METHOD: Geoprobe
FIELD PERSONNEL: R. Waller

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Borehole	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	GROUND SURFACE	362.10					
0.5	SP-SAND, fine to medium grained, compact, brown - trace silt, occasional gravel and cobbles at 0.50m BGS			1			
1.0				2			
1.5	- damp to saturated at 1.50m BGS			3			
2.0	ML-SILT, compact, brown to grey	360.30	Bentonite	4			
2.5	- occasional sand and clayey lenses at 2.50m BGS			5			
3.0				6			
3.5	END OF BOREHOLE @ 3.60m BGS	358.50		7			
4.0							
4.5							
5.0							
5.5							
6.0							
6.5							
7.0							
7.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GEOTECHNICAL ANALYSIS (6) GRAIN SIZE ANALYSIS (7)

OVERBURDEN LOG 46254 - BH3, BH4, BH5.GPJ CRA_CORP.GDT 12/21/11

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: BIO-EN Inc. Facility
PROJECT NUMBER: 046254
CLIENT: BIO-EN Inc. Facility
LOCATION: Elmira, Ontario

HOLE DESIGNATION: BH-4A
DATE COMPLETED: October 6, 2011
DRILLING METHOD: Geoprobe
FIELD PERSONNEL: R. Waller

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Borehole	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	GROUND SURFACE	363.50					
0	TOPSOIL	363.32		1			
0.5	SANDY SILT, loose, brown - some clay, trace gravel at 0.75m BGS - moist at 0.90m BGS						
1.0	SP-SAND, very loose, brown	362.50		2			
1.5	- trace silt at 1.70m BGS - damp to moist at 1.90m BGS			3			
2.0	ML-SILT, compact, brown	361.50		4			
2.5	- occasional clayey lenses at 2.50m BGS		Bentonite	5			
3.0				6			
3.5	- moist to wet at 3.60m BGS			7			
4.0	CL-ML-CLAYEY SILT, stiff, grey	359.70		8			
4.5	- occasional sand and silt lenses at 4.50m BGS						
	END OF BOREHOLE @ 4.60m BGS	358.90					
5.0							
5.5							
6.0							
6.5							
7.0							
7.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GEOTECHNICAL ANALYSIS (7) GRAIN SIZE ANALYSIS (8)

OVERBURDEN LOG 46254 - BH3, BH4, BH5.GPJ CRA_CORP.GDT 12/21/11

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: BIO-EN Inc. Facility
PROJECT NUMBER: 046254
CLIENT: BIO-EN Inc. Facility
LOCATION: Elmira, Ontario

HOLE DESIGNATION: BH-5A
DATE COMPLETED: October 6, 2011
DRILLING METHOD: Geoprobe
FIELD PERSONNEL: R. Waller

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	Borehole	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	GROUND SURFACE	361.80					
0	TOPSOIL						
	MLS-SANDY SILT, very loose, brown	361.60		1			
0.5	- some clay, trace gravel at 0.65m BGS						
1.0	- moist to wet at 1.00m BGS			2			
	CL-ML-CLAYEY SILT, stiff, brown	360.45	Bentonite	3			
1.5	- occasional silt lenses at 1.75m BGS						
2.0	- moist to very moist at 2.00m BGS			4			
2.5	- grey, wet at 2.50m BGS			5			
				6			
3.0	ML-SILT, compact, brown	358.80					
	END OF BOREHOLE @ 3.10m BGS	358.70					
3.5							
4.0							
4.5							
5.0							
5.5							
6.0							
6.5							
7.0							
7.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GEOTECHNICAL ANALYSIS (5) GRAIN SIZE ANALYSIS (6)

OVERBURDEN LOG 46254 - BH3, BH4, BH5.GPJ CRA_CORP.GDT 12/21/11

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Measurement of Hydraulic Conductivity of Saturated Porous Material Using a Flexible Wall Permeameter

Falling Head Raising Tail (Method C)
(ASTM D-5084)

Project Name:	**CRA Lab Testing Services**
Project No.:	**T050123-B1 (CRA # 046254)**
Project Location:	**15 Martins Lane, Elmira, Ontario (Woolwich Bio-En Inc.)**
Client:	**Conestoga Rovers & Associates**

Sample Location and Type	**BH 3 Shelby Tube**
Date Sampled	**6-Oct-11**
Date Tested	**10/7/2011-10/14/2011**
Lab #	**WLA 0072-1**

Type of material	**SILT**

Sample Parameters	Initial	Final
Diameter, cm	5.0	
Length, cm	4.9	
Dry Density, kg/m^3	1788	
Moisture, %	19.9	20.6

Permeation Condition		
Cell pressure	kPa	*300.0*
Head pressure	kPa	*288.6*
Back pressure	kPa	*284.5*
Volume under steady flow	cm^3	*4.86*
Hydraulic gradient, I	-	*8.5*

Hydraulic Conductivity:	***cm/s***	***7.4E-05***

REPORTED BY: Michael Braverman **DATE:** October 19, 2011
VERIFIED BY: Ali Nasseri-Moghaddam, Ph.D., P.Eng. **DATE:** October 19, 2011

INSPEC•SOL
ENGINEERING SOLUTIONS

Measurement of Hydraulic Conductivity of Saturated Porous Material Using a Flexible Wall Permeameter

Falling Head Raising Tail (Method C)
(ASTM D-5084)

Project Name:	**CRA Lab Testing Services**
Project No.:	**T050123-B1 (CRA # 046254)**
Project Location:	**15 Martins Lane, Elmira, Ontario (Woolwich Bio-En Inc.)**
Client:	**Conestoga Rovers & Associates**

Sample Location and Type	**BH 4 Shelby Tube**
Date Sampled	**6-Oct-11**
Date Tested	**10/7/2011-10/14/2011**
Lab #	**WLA 0072-2**

Type of material	**SILT**

Sample Parameters	Initial	Final
Diameter, cm	5.0	
Length, cm	5.0	
Dry Density, kg/m^3	1627	
Moisture, %	21.1	17.6

Permeation Condition		
Cell pressure	kPa	*300*
Head pressure	kPa	*287.8*
Back pressure	kPa	*281.8*
Volume under steady flow	cm^3	*6.01*
Hydraulic gradient, I	-	*12.2*

Hydraulic Conductivity:	***cm/s***	***4.0E-06***

REPORTED BY: Michael Braverman **DATE:** October 19, 2011
VERIFIED BY: Ali Nasseri-Moghaddam, Ph.D., P.Eng. **DATE:** October 19, 2011

INSPEC•SOL
ENGINEERING SOLUTIONS

Measurement of Hydraulic Conductivity of Saturated Porous Material Using a Flexible Wall Permeameter

Falling Head Raising Tail (Method C)
(ASTM D-5084)

Project Name:	**CRA Lab Testing Services**
Project No.:	**T050123-B1 (CRA # 046254)**
Project Location:	**15 Martins Lane, Elmira, Ontario (Woolwich Bio-En Inc.)**
Client:	**Conestoga Rovers & Associates**

Sample Location and Type	**BH 5 Shelby Tube**
Date Sampled	**6-Oct-11**
Date Tested	**10/7/2011-10/14/2011**
Lab #	**WLA 0072-3**

Type of material	**SILT**

Sample Parameters	Initial	Final
Diameter, cm	5.0	
Length, cm	5.2	
Dry Density, kg/m^3	1803	
Moisture, %	22.5	17.1

Permeation Condition		
Cell pressure	kPa	*300*
Head pressure	kPa	*288.0*
Back pressure	kPa	*281.0*
Volume under steady flow	cm^3	*8.28*
Hydraulic gradient, I	-	*13.7*

Hydraulic Conductivity:	***cm/s***	***1.2E-05***

REPORTED BY: Michael Braverman **DATE:** October 19, 2011
VERIFIED BY: Ali Nasseri-Moghaddam, Ph.D., P.Eng. **DATE:** October 19, 2011