

Appendix I

Simplified Stratigraphic Model Approach



TECHNICAL MEMORANDUM

TO: Ian Richardson REF. NO.: 007843

BT

FROM: Brad Trytten, Mike Mateyk/kf/58 DATE: November 7, 2012

CC: Kristen Todtz, Indre Chimoutite

RE: **Proposed Simplified Stratigraphic Model Approach
Occidental Chemical Corporation - Tacoma, Washington**

INTRODUCTION

During the October 15, 2012 Technical Team meeting, the concept of simplifying the stratigraphic model for the Site was discussed. It was noted that Weston Solutions had lumped stratigraphic units by their hydraulic properties to present hydrogeologic units in their data evaluation. The Technical Team believed it may have merit to consider some hydrogeologic variability in the numerical groundwater flow and contaminant transport models rather than continue with the uniform hydraulic conductivity approach. The lumping of stratigraphic units by their textural properties (a surrogate for hydraulic conductivity) and ignoring the depositional environment may be an appropriate approach for the modeling efforts.

Since the October 15, 2012 meeting, Conestoga-Rovers & Associates (CRA) reviewed the current stratigraphic model and the Comprehensive Site Investigation (CSI) borehole logs and developed a simplifying approach for the Technical Team's consideration.

CURRENT STRATIGRAPHIC MODEL

The current stratigraphic model includes 9 soil codes to classify the soil types found at the Site. There were also letter codes for non-described fill, concrete, asphalt, and other materials utilized in the classification. These 9 soil codes were based on the texture (i.e., relative hydraulic conductivity) and depositional environment. Five soil codes (0 through 4, inclusive) were developed for post-glacial fluvial/deltaic sediments, and four soil codes (5 through 8, inclusive) for glacially-derived sediments. The soil codes and related descriptions were defined the Stratigraphic Pick Details table from December 2009. The current soil codes and descriptions are summarized in the table below, along with estimated initial hydraulic conductivity from the July 2010 Draft Model Calibration Report.

<i>Soil Code</i>	<i>Soil Description</i>	<i>Estimated Hydraulic Conductivity (cm/sec)</i>
0	Clayey Silt (CL-ML)	2.96×10^{-5}
1	Sandy Silt (ML)	2.04×10^{-4}
2	Silty Sand (SM)	1.12×10^{-3}
3	Sand (SP or SW)	5.31×10^{-3}
4	Gravel (GP or GW)	5.00×10^{-2}
5	Low Permeability Glacial-Derived Material "Low_K_Glacial" [same as the Silty Gravel (GM) in the original approach]	5.00×10^{-5}
6	Medium Permeability Glacial-Derived Material "Med_K_Glacial" (SP/SM or GP/GW described as high density, some silt, and/or low moisture content, and corresponding to an elevation horizon where glacial-derived material was observed in adjacent boreholes)	5.00×10^{-4}
7	High Permeability Glacial-Derived Material "High_K_Glacial" (SP/GP described as loose, absent silt, and/or high moisture content, and corresponding to an elevation horizon where glacial-derived material was observed in adjacent boreholes)	5.00×10^{-3}
8	ML corresponding to an elevation horizon where glacial-derived material was observed in adjacent boreholes "ML_in_Glacial"	2.04×10^{-4}

CSI FINDINGS

The CSI investigative drilling included a number of boreholes that extended into glacial-derived materials. In some cases, glacial-derived materials were not encountered; however, lower permeability zones were observed. In addition, due to the use of the rotosonic drilling method, the quality of the stratigraphic logging was improved. In reviewing the stratigraphic logs, a number of soil descriptions from the glacial-related materials were noted that do not exactly match the abbreviated descriptions used to develop the current stratigraphic model (e.g., variations on the GM, GP, SP/GP described above). The glacially-derived soils identified in the CSI were classified using the current stratigraphic model, as follows. All clayey gravelly type materials were included in soil code 5 (lowest hydraulic conductivity), and non-clayey but silty gravelly materials as soil code 6 (low to intermediate hydraulic conductivity). Silt materials with only trace amounts of gravel, were classified under soil code 8.

The following table provides all the different glacial-related soil descriptions taken from CSI stratigraphic logs, showing the grouping of similar material types in soil codes 5 through 8.

<i>Soil Code</i>	<i>Glacial-Derived Soil Descriptions and Groupings</i>
5	GC-Clayey Sandy Gravel; CL-Silty Gravelly Clay, trace sand; CL-Silty Sandy Clay, trace gravel; CL-Sandy Gravelly Clay; CL-Silty Clay, with gravel, trace sand; SC-Clayey Sand trace silt; GP-Clayey Gravel; GC-Silty Sandy Clayey Gravel; GC-Sandy Clayey Gravel, trace silt; GC-Silty Clayey Gravel, trace sand; GM/GC-Gravel, with silt and clay, trace sand; SC-Clayey Sand, with gravel; GC-Clayey Gravel, trace sand; SC-Silty Sandy Clay, trace gravel; GC-Clayey Silty Gravel, trace sand; SC-Clayey Sand, trace gravel; CL-Silty Clay, with gravel; CL-Silty Sandy Clay, with gravel; CL-Clay, with sand, trace gravel, trace silt; CL-Silty Clay; CL-Clay, trace silt; CL/ML-Silty Clay trace sand, trace gravel

<i>Soil Code</i>	<i>Glacial-Derived Soil Descriptions and Groupings</i>
6	SM-Sand with Silt, trace gravel; GM-Silty Gravel with sand; SM/GM-Silty Gravel and Sand; SP-Gravelly Sand with silt; GM-Silty Sandy Gravel; SM/ML-Gravelly Sandy Silt; SM/GM-Silty Gravelly Sand; SP-Silty Sand, trace gravel; GM-Silty Sandy Gravel, trace clay; SW/GW-Sand and Gravel, with silt; ML-Gravelly Sandy Silt, trace clay; GM-Silty Gravel, trace sand; SM-Silty Sand, trace clay; SW-Sand, with silt; SM-Silty Gravelly Sand, trace clay; SM/GM-Sand and Gravel, with silt; SM-Sand, with silt; SM/GM-Silty Sand and Gravel; SM-Silty Sand, trace gravel; SM/GM-Silty Sandy Gravel, trace clay; SM/GM-Sand and Gravel, with silt, trace clay; GM-Sandy Silty Gravel, trace clay; GM-Sandy Gravel, with silt; SM-Silty Sand, trace clay, trace gravel; GM-Gravel, with silt, trace sand; SW/GW-Silty Sand and Gravel; SM-Silty Sand, with gravel; SM/GM-Silty Sand and Gravel, trace clay; SP-Sand, with silt with gravel, trace clay; SP-Sand, with silt, with gravel; GM-Gravel, with silt; GM-Gravel, with sand, with silt; SP-Sand, with gravel, little silt; SW-Sand, with silt, trace gravel
7	SP-Sand, trace silt; SW-Sand, trace silt, trace gravel; GW-Sandy Gravel, trace silt; GW-Gravel, with sand, trace silt; SW/GW-Sand and Gravel, trace silt; SW-Sand, trace silt; SW-Gravelly Sand, trace silt, trace clay; SM-Sand, with gravel, trace silt; SW/GW-Gravel and Sand, trace silt; GM-Gravel, with sand, trace silt; SP/GM-Sand, with gravel, trace silt; GP-Gravel, with sand, trace silt; SP-Sand, with gravel, trace silt; GP-Gravel, trace sand, trace silt
8	ML-Silt with gravel, trace sand; SM/ML-Sand and Silt, trace gravel; ML-Sandy Silt, trace clay, trace gravel; ML-Silt, trace gravel, trace clay

PROPOSED SIMPLIFIED STRATIGRAPHIC MODEL

Based on the above, the proposed simplified stratigraphic model is presented in the table below:

<i>Proposed Soil Code</i>	<i>Description</i>	<i>Estimated Hydraulic Conductivity (cm/sec)</i>
0	Clayey Silt, Silty Clay, Clay, Sandy Clay, and similar clayey materials (corresponds to soil codes 0 and 5 in the original classification)	Unit 0, K = 2.96 × 10 ⁻⁵ Unit 5, K = 5.00 × 10 ⁻⁵
1	Sandy Silt, Silt, and very silty similar materials (corresponds to current soil codes 1 and 8)	Unit 1, K = 2.04 × 10 ⁻⁴ Unit 8, K = 2.04 × 10 ⁻⁴
2	Silty Sand, Silty Gravels (trace to no clay) and similar materials (corresponds to current soil codes 2 and 6)	Unit 2, K = 1.12 × 10 ⁻³ Unit 6, K = 5.00 × 10 ⁻⁴
3	Sand, Sand and Gravel, Gravel, and similar materials (corresponds to current soil codes 3, 4, and 7)	Unit 3, K = 5.31 × 10 ⁻³ Unit 4, K = 5.00 × 10 ⁻² Unit 7, K = 5.00 × 10 ⁻³

This simplified stratigraphic model may be more appropriate for use in the groundwater flow and contaminant transport models to be developed for the Site. It is still CRA's intent to use the current 9 soil code approach for geologic characterization in the Site Characterization Report.