patersongroup **memorandum**

consulting engineers

re: **Response to City Comments - Hydrogeological Review of Groundwater Conditions**
Proposed Residential Development – Barrhaven Conservancy
Borrisokane Road - Ottawa – Ontario

to: Caivan Communities – **Hugo Lalonde –** Hugo.Lalonde@Caivan.com

date: June 8, 2021

file: PG5036-MEMO.12

Further to your request, Paterson Group (Paterson) reviewed the Rideau Valley Conservation Authority (RVCA) Technical Review Memorandum dated May 13, 2021 for the City of Ottawa (City) File: D07-16-20-0021 for the aforementioned site. This memo will provide a summary of the comments that are to be addressed within this memo followed by a consolidated response to comments. A further consolidation for the future submission may be necessary as requested by the City of Ottawa.

Rideau Valley Conservation Comment Summary

The comments to be addressed within this memo are related to the groundwater elevation and the assertion that the proposed stormwater solution will negatively impact the groundwater table.

The RVCA comments were provided in a commentary fashion and will be referenced based on the page number and section.

Comments

- ❏ Page 3 of 8 – Section A - Sump pumps appear to be necessary around all foundations to continually drain the water table to the storm sewer (not just seasonally high water).

- ❏ Page 3 of 8 – Section A - A buried perforated pipe system is to be installed throughout. Given that the water table is high, it seems that the system is designed to drain the existing and future groundwater table (and recharging water) and maintain the groundwater at the elevation of the pipe's bottom.

- ❏ Page 4 of 8 – Section B.a - To this point, RVCA does not agree with the geotechnical report conclusions that the water table would be two to three metres below ground. The setting, the soil types and the numerous data points (presented in the report) indicate that the water table is at or very near to the original ground surface. RVCA would point out that following filling and grading, a new water table will establish itself within the fill, the elevation of which will depend on the properties of the fill (i.e. washed gravel or silty clay) and the final grading. If there is other monitoring data to indicate all of the original data is suspect, this should be provided.

> Reference to soil mottling depth, etc. is not enough to refute so much data and common understanding of water tables in low lying clay plains.

Paterson Consolidated Response

Paterson has reviewed the RVCA comments and has the following information / comments.

Sump Pit

The sump pump installations are necessary at all foundations in compliance with the City of Ottawa Technical Bulletin ISTB-2018-04 – Sewer, Second Edition, October 2012. In the forthcoming Paterson Hydrogeological Report in support of the use of sump pumps for the ongoing phases (previously approved for Phase 1), greater detail will be provided on the requirements listed within the Technical Bulletin.

The sump pump installations are anticipated to have recommendations to place low permeability fill material as backfill around the foundations to further reduce low potential inflows from the native silty clay materials. The sump will be used to direct minor groundwater ingress, that reaches the sump pit, away from the foundation.

Using the proposed elevations of the centreline of roads from preliminary grading completed by David Schaeffer Engineering Limited (DSEL), the underside of footing (USF) values can be estimated. For this development, a 1.8 m reduction in elevation is the estimated elevation that the USF values will be placed. The USF values coincide with the original ground surface elevation or higher, which is considered to be approximately 1.8 to 3.2 m separation to the existing groundwater table.

Groundwater Levels

The groundwater levels on the site were shown to range from 1.8 to 3.2 m based on the desiccated silty clay crust observed within the geotechnical boreholes completed by others. The silty clay crust ranged from 2.3 to 3.7 m depth at the borehole locations. The soil parameters observed would consist of the colour and consistency of the samples. The measured parameters would consist of the moisture content levels of the samples and the apparent shear strength from the Standard Penetration Resistance (SPT) values.

Colour

Soils that are fully saturated are typically a grey colour. The surficial portion of the silty clay deposit is exposed to oxygen and drying occurs. The exposure to the oxygen rich atmosphere allows for oxidation-reduction reactions to occur within the soils. The brown colour of the clay

on site is evidence that a chemical change has occurred within the soil. Dependent upon the constituent minerals in the silty clay, various colour formations can occur.

Consistency

The physical consistency of a desiccated silty clay shows significantly higher stiffness than a fully saturated grey silty clay sample. The consistency is a tactile observation of the strength of the SPT samples.

Moisture Content Measurements

The measured water content values within the brown silty clay crust was measured by others. The East portion of the development ranged from 22 to 50% moisture content for the samples and from 27 to 59% for the West portion of the site based on the lab measurements completed by others. These values are indicative of a silty clay that has undergone historical desiccation. The saturated grey silty clay underlies the brown silty clay crust and will typically exhibit moisture contents in the range of 70 to 100+%. The moisture content of a soil sample can exceed 100% as the equation is based on the ratio of the weight of water contained within the soil pores to the weight of the soil solids. Materials with large numbers of voids have the ability to retain higher moisture contents. If the material has an exposed surface that allows for the loss of water to evapotranspiration, the silty clay will consolidate as the water content is reduced and creates a stiff desiccated crust at ground surface.

Shear Strength

The silty clay soils are sampled through the use of a SPT for stiffer materials. The sampler allows for retrieval of a subsurface sample during geotechnical field programs and provides a correlated strength of the soils based on the recorded blow count of a specific weight to drive the sampler a specific distance. When weaker saturated grey silty clays are encountered, a shear vane is used to determine the strength of the materials, as the SPT will typically sink under its own weight.

The geotechnical program for the East portion of the site by others observed undrained shear strengths of 46 to 96 kPa within the lower weathered crust and 19 to 49 kPa within the grey silty clay. The SPT values within the weathered crust ranged from the weight of the hammer to 10 blows per 0.3 m penetration, while the underlying silty grey clay had measurements of weight of hammer to 1 blow per 0.3 m penetration. A similar trend was observed within the data for the West portion of the site.

Quantitative and Qualitative Review

The shear strength, oxidation, moisture content and physical consistency of the onsite silty clays provide significant evidence of historical desiccation of the upper silty clay deposit. The multiple lines of evidence indicate that the many physical parameters that were measured point toward a groundwater elevation that is consistent with the reported depth of 2 to 3 m below the original ground surface.

Groundwater Monitoring Program

A groundwater monitoring program, to be completed under separate cover, was carried out at the available monitoring wells within the east and west phases of the subject site from April 2020 to April 2021. Each monitoring well was outfitted with an electronic data logger that recorded measurements at 12 hour intervals. The data shows a general trend for the majority of the wells that rain events cause a quick spike in the water levels measured in the monitoring wells within a 12 hour period subsequent to the event. These spikes are inconsistent with well known properties of the silty clay crust and may be indicative of a surficial connection to the well screen. A mark-up of the monitoring data for BH17-38s has been attached to depict the materials and trends. Additionally, winter conditions may direct ponded water to the base of the well due to radiant heat transfer from the sun to the coloured well casing that will in turn melt the surrounding snow/ice. Surficial sheet flow is likely to occur during the spring freshet with the majority of the site containing a shallow frost layer within the silty clay crust that would increase the impermeability of the brown silty clay crust.

The monitoring results have been consistent with similar developments serviced with sump pumps per the City guidelines that are within the surrounding areas. No ongoing issues related to continuous sump pump discharge have been reported to Paterson's knowledge.

Etobicoke System

The Etobicoke System is proposed to be constructed within the ROW of all streets within the proposed subdivision. The vertical alignment of the proposed systems was reviewed based on sanitary and storm trunk profiles provided by DSEL. The base of the Etobicoke System granular material, that provides the filtration, extends to approximately 0.15 m below the base of the storm sewer. The base of the Etobicoke System is considered to be encompassed entirely within the native brown silty clay layer as shown in Figure 1 attached.

The subgrade below the granular filtration material will consist of the native brown silty clay crust that was observed and measured to have physical and mechanical properties that exhibit behaviour associated with a material that is generally found in an unsaturated state. As the material has consistent properties associated with unsaturated materials, the

Etobicoke System is considered to have a construction elevation that would remain above the groundwater table.

Summary

The qualitative and quantitative parameters of the silty clay clearly indicate that the brown silty clay crust has undergone physical changes that are consistent with silty clay that is in a unsaturated condition (ie. Exists above the groundwater table). Based on the observations and measurements completed during the geotechnical field/laboratory and hydrogeological review, the groundwater table is expected to vary from 2 to 3 m below original ground surface. The groundwater elevation will be dependent on the soils encountered at each borehole and will exhibit minor variability.

The review provides multiple lines of evidence that the groundwater is below the original ground surface and the groundwater table will not be intersected by the proposed sump pits / weeping tiles or Etobicoke System

We trust that the current submission meets your immediate requirements.

Best Regards,

Paterson Group Inc.

Michael S. Killam, P.Eng.

Attachments:

- BH17-38s – Groundwater Monitoring Levels vs Precipitation Data
- Figure 1 – Paterson Mark-up of DSEL Storm Trunk 9 Profile

Caivan Communities
Barrhaven Conservancy
Groundwater Monitoring Wells

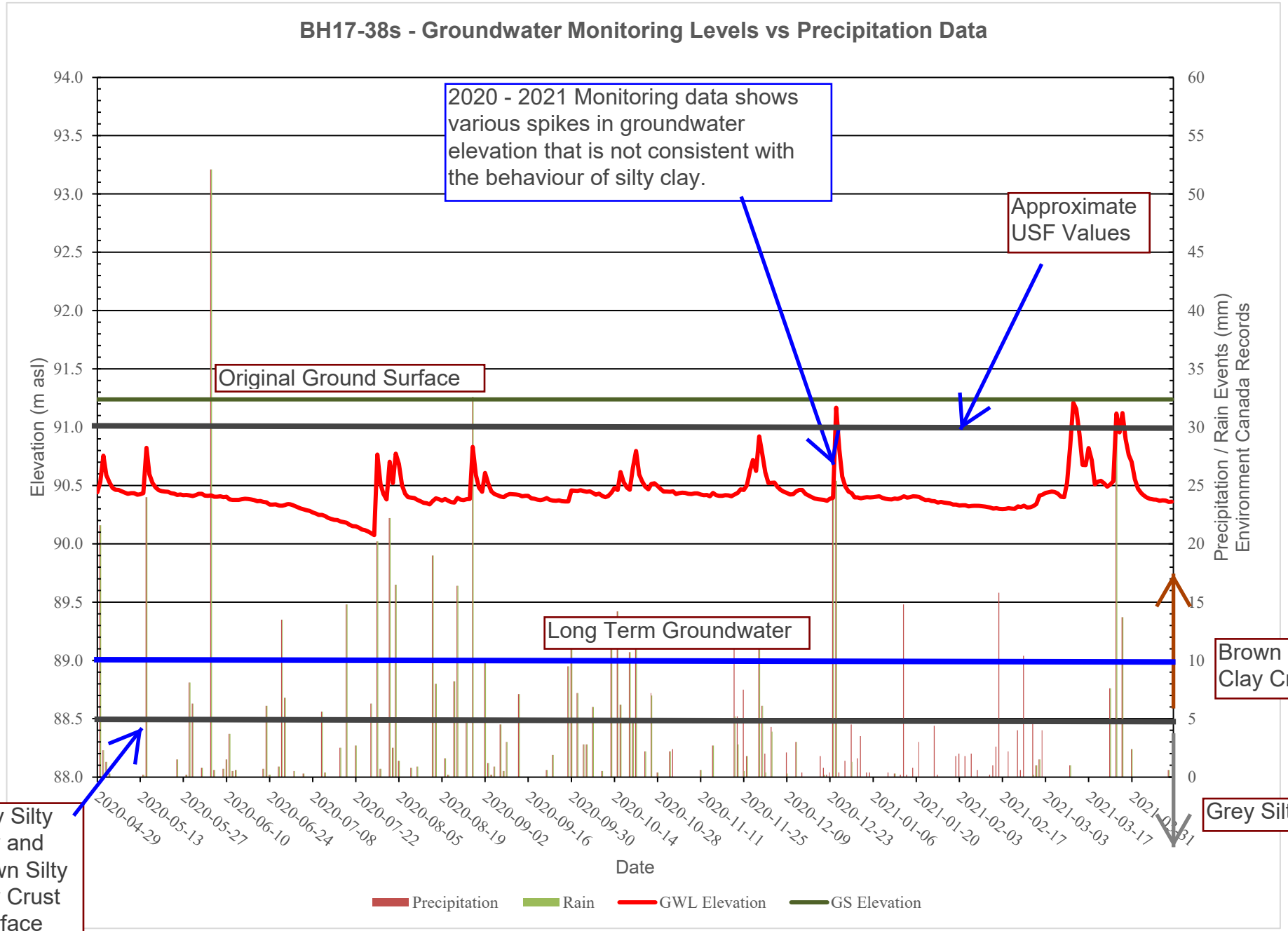
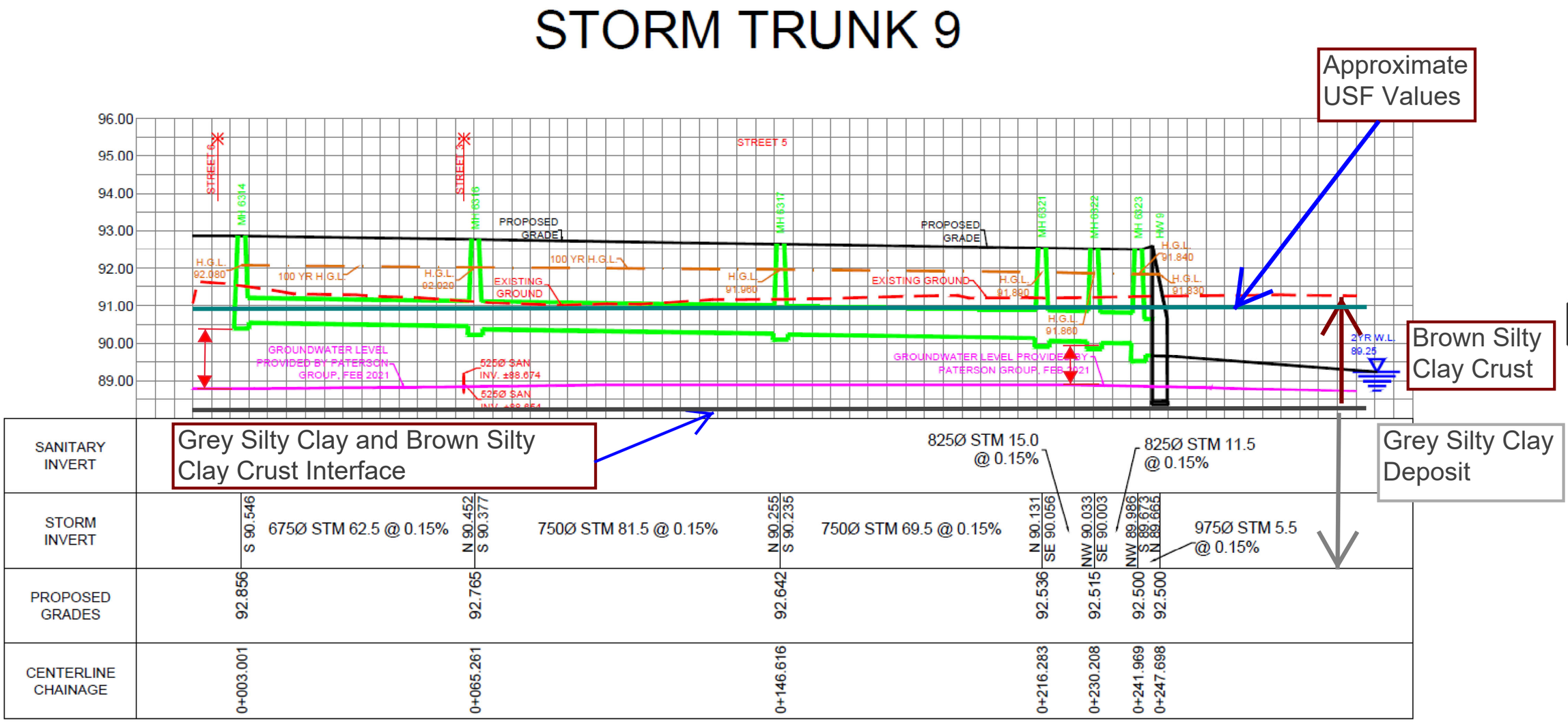


Figure 1: Paterson Mark-up of DSEL Storm Trunk 9 Profile - Located in Proximity to BH17-38



- Etobicoke System is above the long term groundwater elevation.
- Etobicoke System granular layer is approximately 0.15 m below the base of the proposed storm sewer.
- Brown silty clay crust extends approximately 2.3 to 3.7 m below original ground surface across the site.
- Storm Trunk 9 has approximately 0.5 to 1.5 m of separation to the Long Term Groundwater Level.