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Cascadia Green Development
106 – 252 Esplanade West
North Vancouver, BC
V7M 0E9

July 14, 2026
File: 23967
R1

Attention: Jaraad Marani

Re: Hydrogeological Investigation Report – Proposed Mixed-Use Development
835 - 845 W 15th Street, North Vancouver, BC

1.0 INTRODUCTION

We understand that Cascadia Green Development is considering the above referenced property for a new proposed mixed-use development. Architectural drawings provided by Shape Architecture, dated April 29th, 2026, indicate that the proposed development will include a 5-storey boutique medical building over two levels of parkade. The lowest P2 top-of-slab elevation is shown at approximately 5.3 m geodetic, though the majority of the P2 top-of-slab elevation is shown at 5.57 m geodetic.

The report presents the findings of our hydrogeological investigation and presents recommendations pertaining to groundwater management for the proposed development and temporary excavations based on on-site groundwater and test hole data and our experience in the immediate area. This report has been prepared exclusively for our client, for their use, and the use of others in their design team as well as for the City of North Vancouver for use in the development and permitting.

2.0 SITE DESCRIPTION

The proposed development site is bounded by existing commercial properties to the east and west, Marine Drive to the southwest, West 15th Street to the north, and an existing municipal laneway to the south. The site comprises the two civic addresses 835 and 845 West 15th Street, North Vancouver, BC. The western property (845 West 15th Street) is improved with a 2-storey commercial building with at-grade parking / loading areas to the north and south. The adjoining eastern property (835 West 15th Street) is unimproved, with grass cover and metal fencing.

The site slopes gently from an elevation of 13.0 m geodetic at the northeast to an elevation of approximately 11.7 m geodetic at the southwest, representing a vertical fall of 1.3 m over a horizontal distance of 46.0 m. The site has a measured area of 975.96 m^2 (Shape Architecture, 2025).

The location of the site is shown on the attached Drawing, No. 23967-01, following the text of this report.

3.0 FIELD INVESTIGATION

3.1 Drill Investigation

GeoPacific conducted a geotechnical investigation of the site on the 19th of April 2024. At that time, a total of 2 test holes were advanced to depths of 18.3 m and 21.3 m. The drilling was completed using a sonic drill that was supplied and operated by Blue Max Drilling of Surrey, BC. The test holes were completed as groundwater monitoring wells, including one nested installation at MW24-02, for a total of three wells (MW24-01, MW24-02S and MW24-02D), to facilitate characterization of the groundwater regime at the site.

All monitoring wells were installed with a 10/20 sand pack surrounding the screened interval and backfilled with bentonite chips to grade. All monitoring wells were completed with cemented flush mount covers. The test holes were supervised and logged by a member of our geotechnical staff. Prior to drilling, a BC One Call was placed and a utility and service locate was conducted at proposed drilling locations.

The approximate locations of the test holes and wells are shown on Drawing No. 23967-01, following the text of this report. Elevations reported on drill logs are inferred from CityMap of North Vancouver (2024).

4.0 SUBSURFACE CONDITIONS

According to the Geological Survey of Canada Surficial Geology Map 1484A, the site is underlain by Lowland and Mountain Stream Marine Deltaic deposits, mainly consisting of medium to coarse gravel and minor sand up to 15 m or more. A general description of the subsurface materials encountered in our field investigation is given below.

ASPHALT/ TOPSOIL

Asphalt was observed at MW24-01 and was approximately 50 mm thick and topsoil was encountered at MW24-02 with a thickness of 600mm.

Silty SAND, SAND to Gravelly SAND (FILL)

Silty sand fill was observed at MW24-01 and noted to extend to 2.4 m below ground level (bgl). Sand to gravelly sand fill was encountered at MW24-02 that was noted to extend to 0.9 m bgl. DCPT blow counts ranging from 4 to 13 counts inferred the soil to be loose/ firm to compact/ stiff with orange to brown in colour and moist with traces of cobbles <8cm.

SAND to Gravelly SAND to SAND and GRAVEL (OVERBANK AND DELTAIC DEPOSITS)

Underlying the fill were natural soils comprising sand to gravelly sand to sandy gravel that we infer to be overbank and marine deltaic deposits. The overbank deposits were encountered at both locations to depths of between 13.4 m bgl (MW24-02) to 14.6 m bgl (MW24-01). In general, this layer was noted to consist of medium to coarse grained sand that is described as tan in colour, moist to wet and with some cobbles (<10cm) throughout. The DCPT blow counts within this stratum range from 4 to >50 which infers that the soil is of variable density.

At MW24-02, below a depth of 10.4 m, the soil is noted to grade to a silty sandy to sandy silt. The finer grained soils then grade to a fine to medium grained sand between 12.2 and 13.4 m bgl.

Interbedded SILT, Sandy SILT, fine SAND and Gravelly SAND (OVERBANK AND DELTAIC DEPOSITS)

Below the overlying predominantly sandy soils, the soil grades to a silt or sandy silt that is interbedded with sand to gravelly sand. These interbedded soil layers were noted to extend to depths of between 16.8 m (MW24-01) and 18 m (MW24-02) and were between 2.2 m and 4.6 m in thickness.

The silt to sandy silt was noted to be dark grey in colour, moist to damp with traces of fine-grained sand. The sand to gravelly sand was noted to consist of medium to coarse grained sand, tan in colour, very dense, moist with trace cobbles.

GRAVELLY AND SILTY SAND (GLACIAL TILL)

The fluvial deposits are underlain by a layer of very dense glacial till soils comprising variable gravel, silt and sand. This soil was observed to extend to at least the maximum depth of investigation (*i.e.,* greater than 21.3 m). The glacial till soils were noted to be grey in colour, very dense, moist, with fine to medium grained sand and fine sized gravel.

Test holes logs and detailed well diagrams are presented in Appendix ‘A’, following the text of this report.

5.0 GROUNDWATER CONDITIONS

5.1 Groundwater Conceptualisation

With reference to the British Columbia Water Resources Atlas, the site is not situated within the mapped extent of any known groundwater aquifer. However, the mapped boundary of the Capilano River Aquifer (designated by the BC Ministry as Aquifer No.66) is shown at less than 15 m from the southwest corner of the site. The overbank and deltaic deposits, described above in Section 4.0, are thus considered to be representative of the Capilano River Aquifer. Aquifer No. 66 is described as a predominantly unconfined aquifer and limited information is available on the transmissivity of the formation, though based on our experience in the area, groundwater seepage rates are anticipated to be significant for any portion of the proposed excavation that extends below the static groundwater level.

Mosquito Creek is located approximately 145 m east of the site, and Mackay Creek is located approximately 350 m west of the site. Groundwater below the site is likely hydraulically connected to surface water courses in the area, though the degree of connectivity is not certain.

Given that the proposed development will extend 2 levels below grade, we anticipate that static groundwater will be encountered. The following sections describe our groundwater monitoring program, hydraulic conductivity testing, and seepage analysis, and provides recommendations pertaining to groundwater management for the design and construction of the proposed development.

5.2 Hydrogeological Units

The following are the hydrogeological units encountered during the drilling investigation, based on the soils described in Section 4.0 above.

The first hydrogeological unit encountered is the upper granular overbank and deltaic deposits. These soils are representative of Aquifer No. 66 and are saturated at around 5 to 6 m below site grades. Groundwater seepage resulting from excavation into these soils, and below the level of static groundwater, is anticipated to be both heavy and persistent. Groundwater management in the form of active dewatering (such as well points or deep wells) would be required to facilitate construction, which will be discussed further in Section 5.8

The second hydrogeological unit is the lower silty sand to sandy silt to silt soils, present below the upper granular layers, that are also inferred to be overbank and deltaic deposits. This soil unit is anticipated to be orders of magnitude less permeable than the overlying sand to sand and gravel layer. This layer is located below the proposed excavation depth, and as such direct seepage from this layer will not occur. We anticipate that this layer is representative of an aquitard, which is a unit of soil which slows the vertical and horizontal movement of groundwater in the subsurface.

The third hydrogeological unit is the glacial till soils, present near the base of our drill holes below the upper overbank and deltaic deposits. The glacial tills are located far below the proposed excavation depth and as such direct seepage from this layer will not occur. Similar to the fine-grained overbank and deltaic deposits described above, the glacial till is expected to also behave as an aquitard. Based on our experience in the area, the hydraulic conductivity of the glacial till is expected to be very low.

5.3 Groundwater Monitoring Well Summary

Groundwater monitoring wells were installed at the site, to facilitate monitoring of groundwater levels and hydraulic conductivity testing. These wells are summarised on the following table (Table 1).

Table 1 – Summary of Groundwater Monitoring Wells

Well No.	Well Elevation (m geo)*	Screened Formation	Screened Depth	
			m bgs	m geo
MW24-01	11.9	Sandy to gravelly sand (Overbank and Deltaic Deposits)	10.7 to 12.2	-0.3 to 1.2
MW24-02D	12.8	Gravelly and silty sand (Glacial Till)	17.7 to 19.2	-6.4 to -4.9
MW24-02S	12.8	Sand to gravelly sand (Overbank and Deltaic Deposits)	4.6 to 6.1	6.7 to 8.2

***Well elevations are approximate and estimated from CityMap of North Vancouver elevation contours (2024)**

After installation of the above wells, they were subsequently developed using a bailer that was used to remove a minimum of three well volumes from each of the wells, or until the well ran dry. MW24-02S was effectively dry at the time of development, and as such no development could be completed. At MW24-01, the groundwater level recharge was near instantaneous. At MW24-02 the groundwater level lowered by approximately 4 m after removing 3 well volumes of groundwater.

5.4 Manual Groundwater Level Measurements

The following table is a summary of manual water level measurements obtained using a water level monitoring probe (Table 2).

Table 2 – Manual Groundwater Level Measurements

Well No.	24th Apr, 2024		30th Oct, 2025		3rd Nov, 2025		26th Nov, 2025		9th July, 2026	
	m bgs	m geo	m bgs	m geo	m bgs	m geo	m bgs	m geo	m bgs	m geo
MW24-01	5.32	6.58	5.80	6.10	5.72	6.18	5.65	6.25	5.86	6.04
MW24-02D	4.94	7.86	5.60	7.20	5.51	7.29	5.44	7.36	5.58	7.22
MW24-02S	5.40	7.40	Dry		Dry		Dry		Dry	

5.5 Automated Groundwater Level Measurements

Groundwater levels have been monitored at all wells using automated pressure transducers for the period between November 2025 and July 2026 and are presented on the following graph (Figure 1).

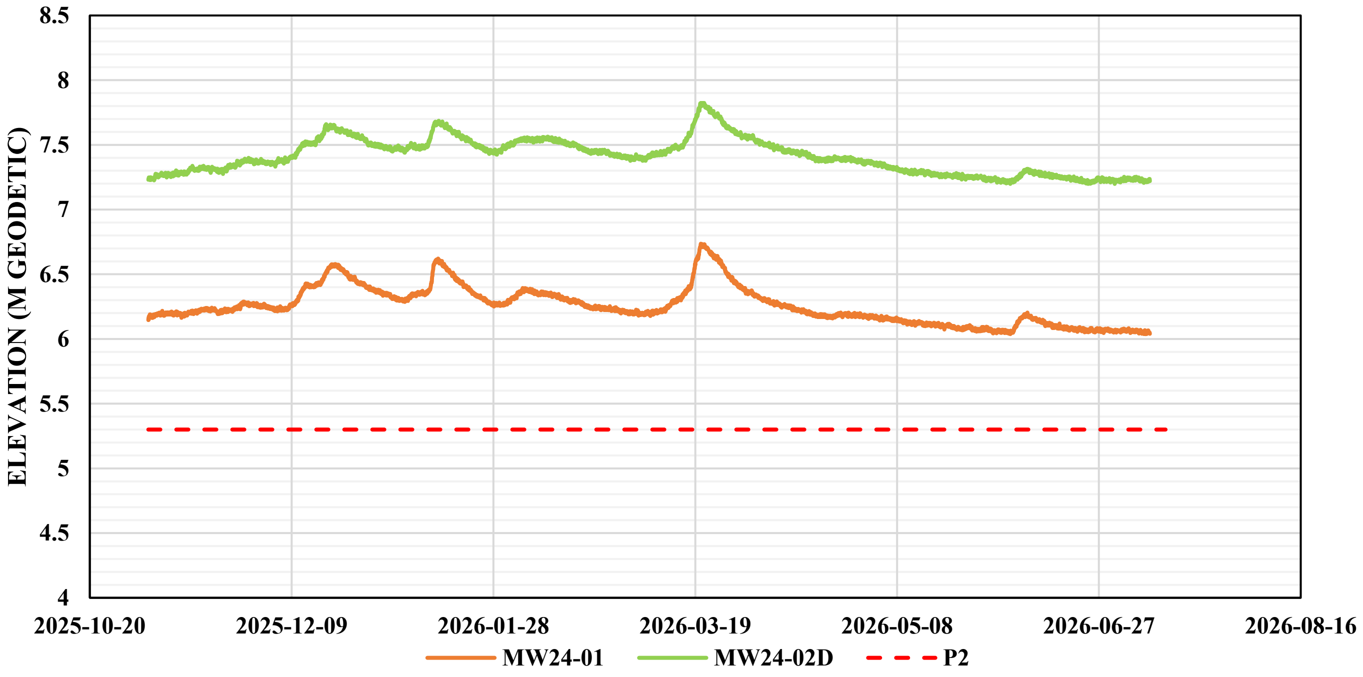

Figure 1 – Groundwater Monitoring Levels Recorded using Automated Piezometers

Groundwater levels are shown to be approximately 1 m higher at MW24-02D, compared to MW24-01. This is likely due to an upward hydraulic gradient between the lower till soils and the upper overbank and deltaic deposits, rather than a horizontal gradient variation between the north and south. The P2 slab is annotated with red dashed line. The static groundwater level recorded at MW24-01 is approximately 0.7 to 1.3 m above the P2 top-of-slab elevation.

The groundwater level trend over-time shows some variation, with three groundwater peaks recorded at both well locations around December 15th 2025, January 15th 2026 and March 24th 2026. The water level increases in December and January are attributed to heavy and persistent rainfall at these times, which led to an increase in the groundwater level in the aquifer. The increased groundwater level on March 24th is attributed to the Spring Freshet, where the groundwater levels increase due to melting snow on the north shore mountains which swells water levels in creeks in North Vancouver, which leads to increasing groundwater levels within Aquifer No.66.

It is our understanding that a tanked raft foundation is proposed for the project, which will prevent long-term discharge of groundwater from the site. Though, temporary dewatering will be required to facilitate the construction of the parkade below the static groundwater level. The temporary dewatering will likely comprise either a well point system or a deep well system.

5.6 Hydraulic Conductivity Testing

Slug testing was conducted to provide estimates of the hydraulic conductivity of subsurface soils. A PVC bailer was used to induce a near-instantaneous change in groundwater level, and the subsequent recovery to a rest water level was monitored using an automated pressure transducer that was set to a 0.5 second sampling frequency. A hydraulic conductivity test was not completed in MW24-02S due to insufficient water column in the monitoring well. The results of the hydraulic conductivity testing are summarised on the following table (Table 3):

Table 3 – Summary of Estimated Hydraulic Conductivity Values

Well No.	Screened Formation	Hydraulic Conductivity Estimate - Bouwer and Rice Solution (m/s)			
		Test 1	Test 2	Test 3	Geometric Mean
MW24-01	Sandy to gravelly sand (Overbank and Deltaic Deposits)	5.5 x 10^{-04}	6.1 x 10^{-04}	6.2 x 10^{-04}	5.9 x 10^{-04}
MW24-02D	Gravelly and silty sand (Glacial Till)	2.0 x 10^{-06}	2.9 x 10^{-06}	-	2.4 x 10^{-06}

The above estimated hydraulic conductivity values indicate that the hydraulic conductivity of the subsurface soils are reasonably consistent with the soil descriptions and hydrogeological units presented above in Sections 4.0 and 5.2. Slug testing completed at other nearby sites, such as the Capilano Mall and at 1421 Fell Avenue site, indicate that the wider aquifer hydraulic conductivity is typically in the 10^{-05} m/s range and as such the value obtained at MW24-01 is likely a conservative rate for estimating site specific seepage rates.

The slug test data was analyzed using Aquifer Test Pro 10.0 and the analysis sheets are presented in Appendix 'B'.

5.7 BC Water Atlas

A search was conducted on the BC Water Atlas website on the 14th of July 2026 (BC Gov, 2026). The search confirmed that the site is not located within the mapped extent of any known groundwater aquifer. Though, as mentioned above, the mapped boundary of Aquifer No. 66 is located within 15 m of the site boundary and the soils encountered at the site are considered representative of this formation and the mapped extent of the aquifer presented on the BC Water Atlas is likely inaccurate.

The search further concluded that there is a single well record located within 300 m of the site (Well Tag No (WTN) 71247). The well is located approximately 225 m south of the site. It was drilled in 1978 to a depth of 8.2 m and recorded static groundwater at approximately 1.5 m below grade. The purpose of the well is unclear, though it is assumed to be associated with a geotechnical site investigation. The test hole profile noted fill to 1.5 m, then interlayered peat, organic silt and silty sand to 3.3 m, then sand and gravel to 8.2 m. It is assumed that this well is no longer present, based on the date of drilling and the development in the vicinity.

5.8 Summary of Groundwater Conditions

Our review of the soil and groundwater conditions, presented in the previous sections, indicates that a shallow static groundwater regime is present below the site and will be encountered during excavation below an elevation of between approximately 6.1 m and 6.7 m geodetic, based on the groundwater monitoring conducted at the site between November 2025 and July 2026.

The described hydrogeological units, groundwater level data, well development notes and hydraulic conductivity testing all indicate that heavy and persistent groundwater seepage will occur during excavation through the upper overbank and deltaic deposits and below the level of static groundwater. These deposits are considered representative of Aquifer No. 66, and thus recharge to this aquifer is anticipated from both direct precipitation and creek interflows.

It is our understanding that the parkade will be completed with a tanked foundation, that is designed to resist hydrostatic pressure, thus post construction groundwater discharge will be reduced to a negligible rate. During construction active dewatering will be required to temporarily lower the groundwater level to permit construction, and this system will likely comprise either well points or deep wells.

6.0 SEEPAGE ANALYSIS

A seepage analysis was undertaken to assess groundwater seepage rates for the proposed excavation using a finite element computer program SEEP/W (GeoStudio, 2021). A west to east section through the site was chosen, and the 2D seepage results are subsequently scaled to be representative of 3D conditions.

Considering our field observations and experience in the area, the following assumptions were considered in the finite element seepage analysis:

1) All materials are modelled as saturated.
2) The constant head boundary was assessed using the Kusakin method, assuming 2 m of drawdown and a saturated thickness of 8.1 m, which calculated a radius of influence of 79 m, which was thus applied to the constant head boundary. However, it should be noted that site specific pump test would be required to refine the area of influence of temporary dewatering and this work should be completed at the detailed design stage.
3) The excavation measures 975.96 m^2.
4) The excavation depth for the purpose of the model is set to 4.7 m geodetic, which is 0.6 m below the lowest top-of-slab elevation to accommodate the construction of the raft foundation.
5) The constant head boundary condition groundwater level was set to both 6.1 m and 6.7 m geodetic, which is the approximate min and max groundwater elevation recorded at MW24-01.

6) The upper soils (including fill, topsoil and upper overbank and deltaic deposits) are modelled as a single continuous unit and are assigned an estimated hydraulic conductivity of 5.9 x 10^{-04} m/s, based on slug testing completed at MW24-01.

7) The lower fine-grained portion of the overbank and deltaic deposits is assigned an assumed hydraulic conductivity value of 1.0 x 10^{-06} m/s, based on literature values and our experience in the wider area.

8) The hydraulic conductivity of the glacial till soils has been assigned an estimated hydraulic conductivity of 2.4 x 10^{-06} m/s, based on slug testing completed at MW24-02D.

9) The Ky/Kx ratio for the granular layer is assumed to be 1:1 and for the fine-grained layers and lower glacial till the ratio is assumed to be 0.25.

10) The calculated seepage volumes are based on inflows from subsurface groundwater only. Inflows as a result of precipitation are not included.

The estimated steady-state seepage rate, based on the seepage modelling and assumptions described above, ranges between 500 L/min for a groundwater level of 6.1 m geodetic (i.e., summer conditions) to 740 L/min for a groundwater level of 6.7 m geodetic (i.e., peak winter conditions). Initial groundwater pumping rates may be higher until the steady-state condition is achieved. It should be noted that a pumping test is recommended prior to detailed design of the proposed active dewatering system. The graphical representations of our seepage analysis results are included in Appendix 'C'.

The seepage analysis has been undertaken based on some assumptions and in conjunction with the limitations of the software which include analysis in two-dimensional space with a somewhat simplified soil stratigraphy. The layers within the model have been inferred between drill logs. Slight variations in elevations, soil conditions, and fluctuating groundwater levels will ultimately impact the actual flow volumes encountered in the excavation.

7.0 GROUNDWATER MANAGEMENT PLAN

7.1 Construction

As previously noted, we recommend that an active dewatering system is utilised to temporarily lower the groundwater level to permit construction of the parkade below an elevation of approximately 6.7 m geodetic. The dewatering system can comprise either a well point or deep well system. Pumping rates are estimated to range between 500 and 740 L/min depending on the time of year at which the excavation advances below the static groundwater level. The temporary dewatering must continue until sufficient weight is added to the building to counteract buoyant upward pressure, and the stage at which this occurs must be confirmed by the project structural engineer.

Above approximately 6.7 m geodetic, we anticipate that dewatering can be completed using conventional sumps and sump pumps. Any shallow perched groundwater ingress and precipitation for the upper portion of the excavation will be directed to a sump or sumps. The sump is to be constructed at the low point(s) of the excavation to the specifications outlined on the Erosion and Sediment Control Plan. Water will then be pumped from the sump to the onsite water treatment system which includes CO_2 adjustment, settling tanks and mechanical filtration. Discharge water will then be directed to a catch basin adjacent to the site.

7.2 Post-Construction

In the post-construction condition, it is our understanding that the parkade will be tanked and designed to resist hydrostatic pressure. This will prevent, or reduce to a negligible rate, the permanent discharge of groundwater from the aquifer.

8.0 GROUNDWATER IMPACT ASSESSMENT

GeoPacific conducted the following impact assessment pertaining to the risk of ground subsidence, potential impacts to nearby wells, and potential interference with surface water courses (Mosquito Creek and Mackay Creek). Our comments are as follows:

I. Ground Subsidence

Based on soils encountered during our site investigation, which were predominantly granular within the anticipated zone of drawdown, we consider there to be a relatively low risk of ground subsidence. Granular soils are generally understood to have a low risk of subsidence caused by dewatering, as all groundwater stored within granular soils is within the pore spaces and as such removing the water will not cause the sands to compress (as may be the case for saturated clay and silt soils). While finer grained soil layers are present below the saturated sand, the risk of consolidation is considered low as groundwater drawdown towards the proposed active dewatering system will be from the surrounding saturated sand and should have minimal impact on the fine grained silt soils which are present at depths of between approximately 5.3 m (MW24-02) and 7.4 m (MW24-01) below the anticipated nominal excavation level elevation (which we assumed to be at an elevation of 4.7 m geodetic).

Thus, we can conclude that temporary dewatering during construction is unlikely to cause settlement, though monitoring is recommended during construction as a precautionary measure.

II. Impacts to Nearby Wells

It is our understanding, based on our review of BC Water Atlas Well records, and the prevalence of municipally supplied water from the North Vancouver reservoirs, that there are no active groundwater supply wells in the area. As such, there is no risk of detrimentally impacting any groundwater supply wells from the proposed groundwater management plan detailed above in Section 7.0.

III. Surface Waters

As noted previously, there are two surface waters located in the area. Mosquito Creek is situated approximately 145 m east of the site and Mackay Creek is situated approximately 350 m west of the site. It is generally understood that there is some connectivity between the sand in Aquifer No. 66 and the surface flows in Mosquito Creek/Mackay Creek. As Mosquito Creek is located much closer to the site than Mackay Creek, it is more likely to be impacted by temporary dewatering than Mackay Creek.

As part of our seepage analysis, presented above in Section 6.0, an assessment was conducted to infer the radius of influence for the temporary construction dewatering of the excavation, which was calculated using the Kusakin method and approximated at 79 m which was chosen to define the constant head boundary for the seepage analysis. Using the Sichardt Equation, another common analytical solution method, the radius of influence would be approximately 146 m which would place the outer edge of the drawdown cone at or beside Mosquito Creek.

A sensitivity analysis was completed on both the Sichardt and Kusakin analytical solutions, using a range of hydraulic conductivities and two different drawdown depths. These input variables were varied because hydraulic conductivity testing completed by GeoPacific in the wider aquifer has yielded a range of results, and because the drawdown depth required during construction may also vary. The following table summarises the estimated radius of influence for each analytical method (Table 4).

Table 4 – Estimated Radius of Influence derived using Sichardt and Kusakin Analytical Solution

Sichardt (m)			
Drawdown s (m)	**K = 5.9E-04 m/s**	**K = 1.0E-04 m/s**	**K = 5.0E-05 m/s**
2.2	160	66	47
2.7	197	81	57
Kusakin (m)			
Drawdown s (m)	**K = 5.9E-04 m/s**	**K = 1.0E-04 m/s**	**K = 5.0E-05 m/s**
2.2	89	37	26
2.7	109	45	32

The results presented above on Table 4 ultimately suggest that the radius of influence of the proposed dewatering is difficult to predict with confidence without completing a site-specific pumping test to emulate the proposed temporary active dewatering and thus be able to calculate a more accurate radius of influence.

Thus, we conclude that the risk of drawing water from Mosquito Creek is likely low to moderate though is currently inconclusive. Excavation timing is another factor to consider, such that during the winter months the volume of water flowing through the creek is far greater due to precipitation and run-off, whilst conversely during the summer months the volume of water flowing through the Creek would be much less and during these months there could be an impact to the Creek.

GeoPacific have reviewed the City of North Vancouver GIS (CityMap, 2026) and the storm mains adjacent to the site appear to be directed towards Mackay Creek and are not directed towards Mosquito Creek, which suggests that any discharge from a future active dewatering system will not be directed towards Mosquito Creek. Though, it should be noted that the proposed dewatering is temporary and that there is no permanent discharge of groundwater anticipated.

If the project design changes, then this report should be revisited and updated, as necessary.

9.0 DISCUSSION

The findings of our investigation indicate that the proposed development at 835 and 845 West 15th Street will interact with a shallow, productive, unconfined groundwater regime. The granular overbank and deltaic deposits encountered beneath the site are considered representative of the Capilano River Aquifer (Aquifer No. 66), notwithstanding that the mapped extent of the aquifer presented on the BC Water Atlas terminates within 15 m of the site boundary, and static groundwater levels recorded between April 2024 and July 2026 range between approximately 6.1 m and 6.7 m geodetic. With the lowest P2 top-of-slab elevation at approximately 5.3 m geodetic and a nominal excavation level of 4.7 m geodetic anticipated, the base of the excavation will extend between approximately 1.4 m and 2.0 m below the static groundwater, depending on the season in which the excavation is advanced. Groundwater levels at the site respond to both heavy winter rainfall and the spring freshet, and as such the timing of excavation will have a material influence on the groundwater volumes encountered.

The hydraulic conductivity testing completed at MW24-01 returned a geometric mean of 5.9 x 10^{-04} m/s for the upper granular deposits, which is consistent with the medium to coarse grained sand and gravel encountered during drilling and is approximately an order of magnitude higher than values obtained from testing elsewhere in the wider aquifer, such as at the Capilano Mall and 1421 Fell Avenue sites. Adopting the site-specific value in our seepage analysis is therefore considered a conservative approach. The underlying fine-grained overbank and deltaic deposits and the glacial till, both of which returned or were assigned hydraulic conductivities in the 10^{-06} m/s range, are interpreted to act as aquitards that limit the depth of the active flow system beneath the excavation. The upward hydraulic gradient observed between MW24-02D and MW24-01 supports this interpretation and indicates that the till is hydraulically distinct from the overlying aquifer.

Our seepage analysis indicates steady-state groundwater inflows of between approximately 500 L/min under summer groundwater conditions and 740 L/min under peak winter conditions, with initially higher pumping rates anticipated until steady-state drawdown is established. Inflows of this magnitude are beyond the practical capacity of sump pumping and confirm that an active dewatering system, comprising either well points or deep wells, will be required to lower groundwater ahead of excavation below approximately 6.7 m geodetic. Above this elevation, conventional sumps are considered adequate for the management of perched seepage and precipitation. Dewatering must be maintained until the structure has sufficient dead weight to resist buoyant uplift, as confirmed by the project structural engineer, following which the tanked raft foundation will resist hydrostatic pressure and reduce permanent groundwater discharge from the aquifer to a negligible rate.

The principal uncertainty in our assessment relates to the radius of influence of the temporary dewatering. The Kusakin and Sichardt analytical solutions return estimates of approximately 79 m and 146 m respectively for the modelled conditions, and the sensitivity analysis presented in Table 4 demonstrates that the estimated radius of influence varies by roughly a factor of five across the credible range of hydraulic conductivity and drawdown inputs. Given that Mosquito Creek is located approximately 145 m east of the site, the upper-bound estimates place the outer margin of the drawdown cone at the creek, and the risk of inducing leakage from the creek is accordingly assessed as low to moderate but presently inconclusive. This risk is mitigated by the temporary nature of the dewatering and would be further reduced by scheduling the below-groundwater portion of the excavation outside the summer low-flow period where practicable. We consider that a site-specific pumping test, completed at the detailed design stage, is the appropriate means of resolving this uncertainty, as it would provide a direct measurement of aquifer response, refine the predicted pumping rates and radius of influence, and support the dewatering system design.

The remaining elements of our impact assessment do not indicate significant constraints to the proposed groundwater management approach. The soils within the anticipated zone of drawdown are predominantly granular and the risk of dewatering-induced settlement is considered low, though settlement and groundwater level monitoring during construction is recommended as a precautionary measure. No active groundwater supply wells were identified in the vicinity of the site. Provided that any groundwater discharge is treated in accordance with municipal requirements, and that a pumping test is completed to better estimate the radius of influence of temporary during construction, we anticipate that the temporary dewatering and long-term groundwater management for the proposed development can be completed without adverse impact to the surrounding groundwater and surface water environment.

Lastly, monitoring wells can create preferential pathways for groundwater to travel and flow from zones of higher pressure towards areas with lower pressure and therefore it is recommended that any wells installed at the site be decommissioned in accordance with Provincial requirements.

10.0 CLOSURE

This report has been prepared exclusively for our client for the purpose of providing recommendations pertaining to groundwater management for the design and construction of the proposed building, temporary excavations and related earthworks. The report remains the property of GeoPacific Consultants Ltd. and unauthorized use of, or duplication of, this report is prohibited.

We are pleased to be of assistance to you on this project and we trust that our comments and recommendations are both helpful and sufficient for your current purposes. If you would like further details or would like clarification of any of the above, please do not hesitate to call.

For:
GeoPacific Consultants Ltd.
EGBC PERMIT TO PRACTISE NO. 1000782

S. HEFFERNAN
58000
2026-07-14

Sean Heffernan, M.Sc., P.Geo.
Hydrogeology Manager

Reviewed by:

Luke Hessen, M.Eng., P.Eng.
Senior Project Engineer

N

LEGEND:

- □ SITE BOUNDARY
- ⌖ GROUNDWATER MONITORING WELL
- — 1M ELEVATION CONTOURS (NV)

NOTES

LOCATION OF SITE BOUNDARY IS APPROXIMATE.

REFERENCE:

Basemap copyright Google (2025).

GEOPACIFIC
CONSULTANTS

DATE: 26 NOVEMBER 2025

DRAWN BY: SRH
APPROVED BY: RA
REVIEWED BY: RA

SCALE: NTS

GEOTECHNICAL INVESTIGATION
835 - 845 WEST 15TH STREET, NORTH VANCOUVER, BC
SITE INVESTIGATION LOCATIONS

FILE NO.: 23967

DWG. NO.: 23967-01

REVISIONS:
A.
B.
C.

APPENDIX A

Test Hole Log: MW24-01

File: 23967
Project: Proposed Mixed-Use Development
Client: Cascadia Green Development
Site Location: 835 - 845 W 15th Street, North Vancouver, BC

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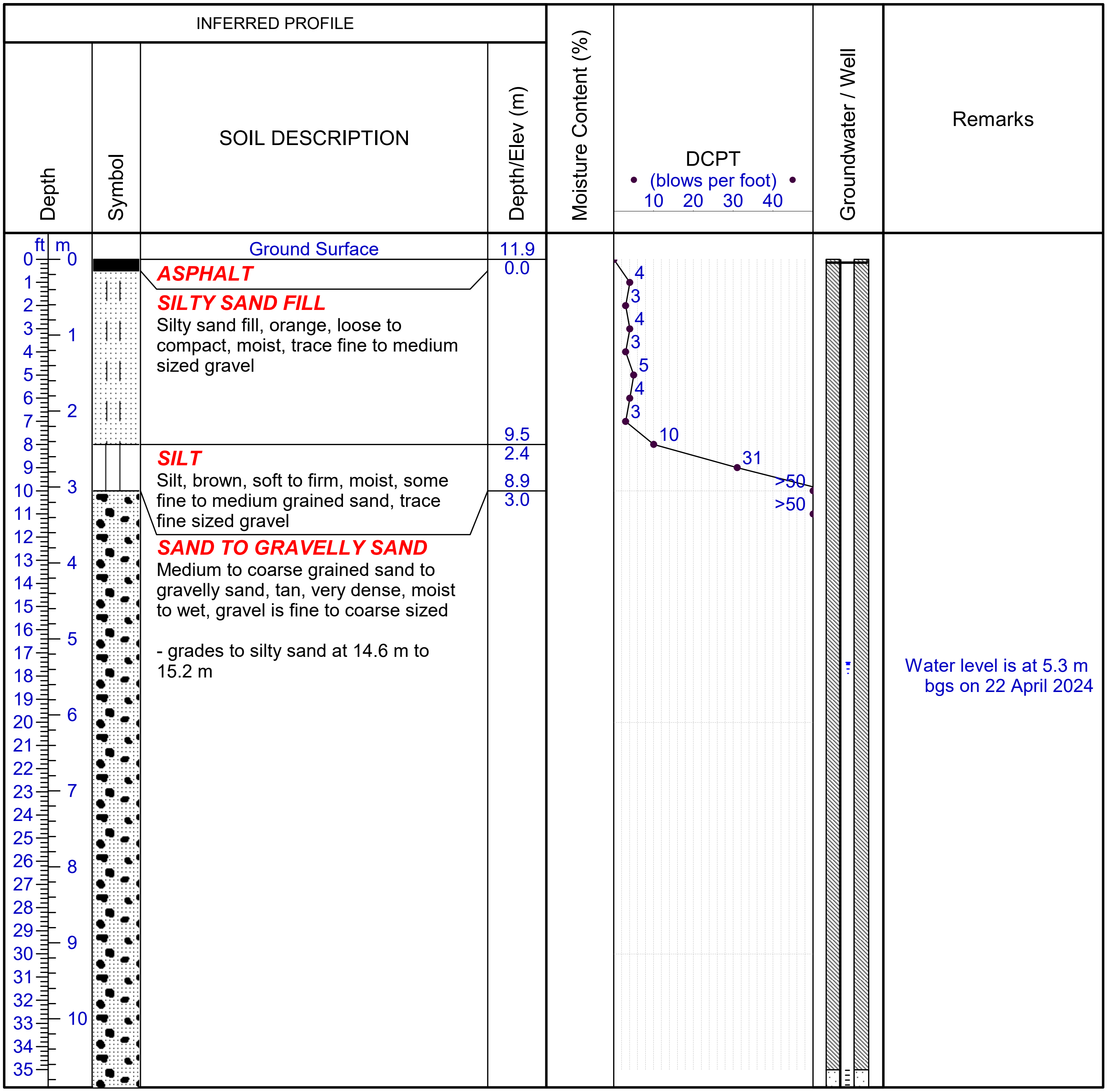
1779 W 75th Avenue, Vancouver, BC, V6P 6P2
Tel: 604-439-0922 Fax:604-439-9189



SOIL DESCRIPTION

Soil description	Depth/Elev (m)
Ground Surface	11.9 0.0
ASPHALT	
SILTY SAND FILL Silty sand fill, orange, loose to compact, moist, trace fine to medium sized gravel	9.5 2.4
SILT Silt, brown, soft to firm, moist, some fine to medium grained sand, trace fine sized gravel	8.9 3.0
SAND TO GRAVELLY SAND Medium to coarse grained sand to gravelly sand, tan, very dense, moist to wet, gravel is fine to coarse sized - grades to silty sand at 14.6 m to 15.2 m	

Remarks: Water level is at 5.3 m bgs on 22 April 2024

Logged: MM
Method: Sonic
Date: 19 April 2024

Datum: Geodetic
Figure Number: A01
Page: 1 of 2

Test Hole Log: MW24-01

File: 23967

Project: Proposed Mixed-Use Development

Client: Cascadia Green Development

Site Location: 835 - 845 W 15th Street, North Vancouver, BC

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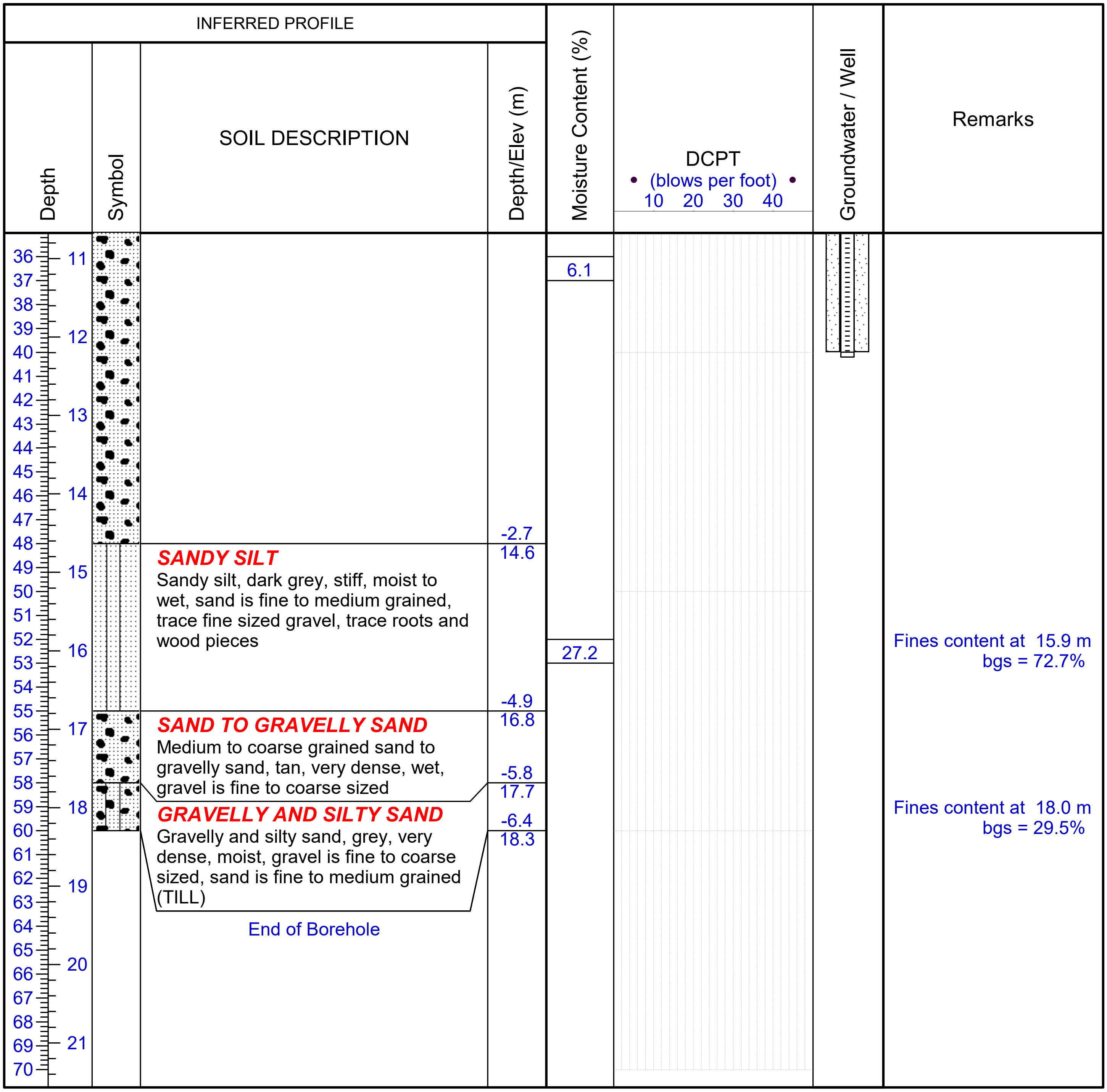

Depth/Elev (m)	Soil Description	Moisture Content (%)	Remarks
		6.1	
-2.7 14.6	**SANDY SILT** Sandy silt, dark grey, stiff, moist to wet, sand is fine to medium grained, trace fine sized gravel, trace roots and wood pieces	27.2	Fines content at 15.9 m bgs = 72.7%
-4.9 16.8	**SAND TO GRAVELLY SAND** Medium to coarse grained sand to gravelly sand, tan, very dense, wet, gravel is fine to coarse sized		
-5.8 17.7	**GRAVELLY AND SILTY SAND** Gravelly and silty sand, grey, very dense, moist, gravel is fine to coarse sized, sand is fine to medium grained (TILL)		Fines content at 18.0 m bgs = 29.5%
-6.4 18.3	End of Borehole		

Logged: MM
Method: Sonic
Date: 19 April 2024

Datum: Geodetic
Figure Number: A01
Page: 2 of 2

Test Hole Log: MW24-02

File: 23967
Project: Proposed Mixed-Use Development
Client: Cascadia Green Development
Site Location: 835 - 845 W 15th Street, North Vancouver, BC

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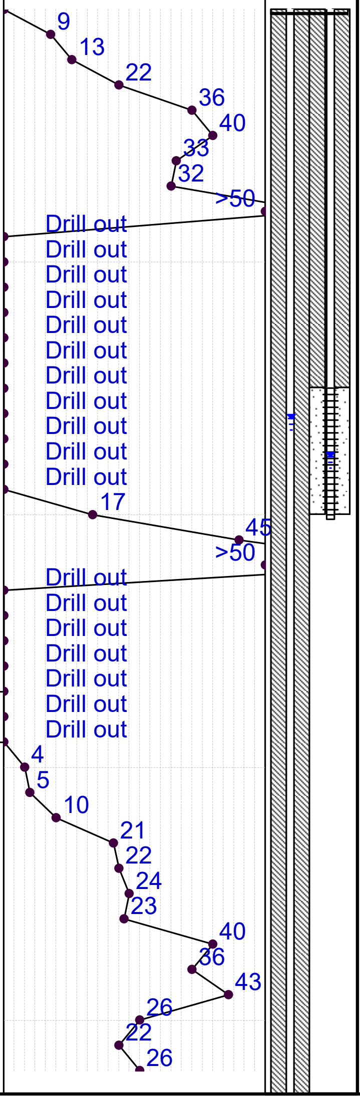
INFERRED PROFILE

Depth (ft / m)	SOIL DESCRIPTION	Depth/Elev (m)	Moisture Content (%)
0 / 0	Ground Surface	12.8 0.0	
0 – 0.9	***GRASSEY TOPSOIL***		
	SAND TO GRAVELLY SAND FILL Sand to gravelly sand fill, brown to orange, loose to compact, moist	11.9 0.9	
0.9 – 6.1	***SAND TO GRAVELLY SAND*** Medium to coarse grained sand to gravelly sand, tan, stiff to very dense, moist, trace cobbles <10cm, gravel is fine to coarse sized	6.7 6.1	
6.1 – 9.1	***GRAVELLY SAND TO SANDY GRAVEL*** Gravelly sand to sandy gravel, tan, very dense, damp to wet, sand is medium to coarse grained, gravel is medium to coarse sized, trace to some cobbles <9cm	3.7 9.1	7.6
9.1 – 10.4	***SAND*** Medium to coarse grained sand, tan to grey, loose to compact, wet, trace to some medium sized gravel	2.4 10.4	
10.4 – 12.2	***SILTY SAND*** Silty sand, grey, dense, wet, sand is mainly fine grained -grades to sandy silt at 11.9 m to 12.2 m	0.6 12.2	



Remarks

Water level is at 4.9 m bgs (deep well) and 5.4 m bgs (shallow well) on 22 April 2024)

Logged: MM
Method: Sonic
Date: 19 April 2024

Datum: Geodetic
Figure Number: A01
Page: 1 of 2

Test Hole Log: MW24-02

File: 23967
Project: Proposed Mixed-Use Development
Client: Cascadia Green Development
Site Location: 835 - 845 W 15th Street, North Vancouver, BC

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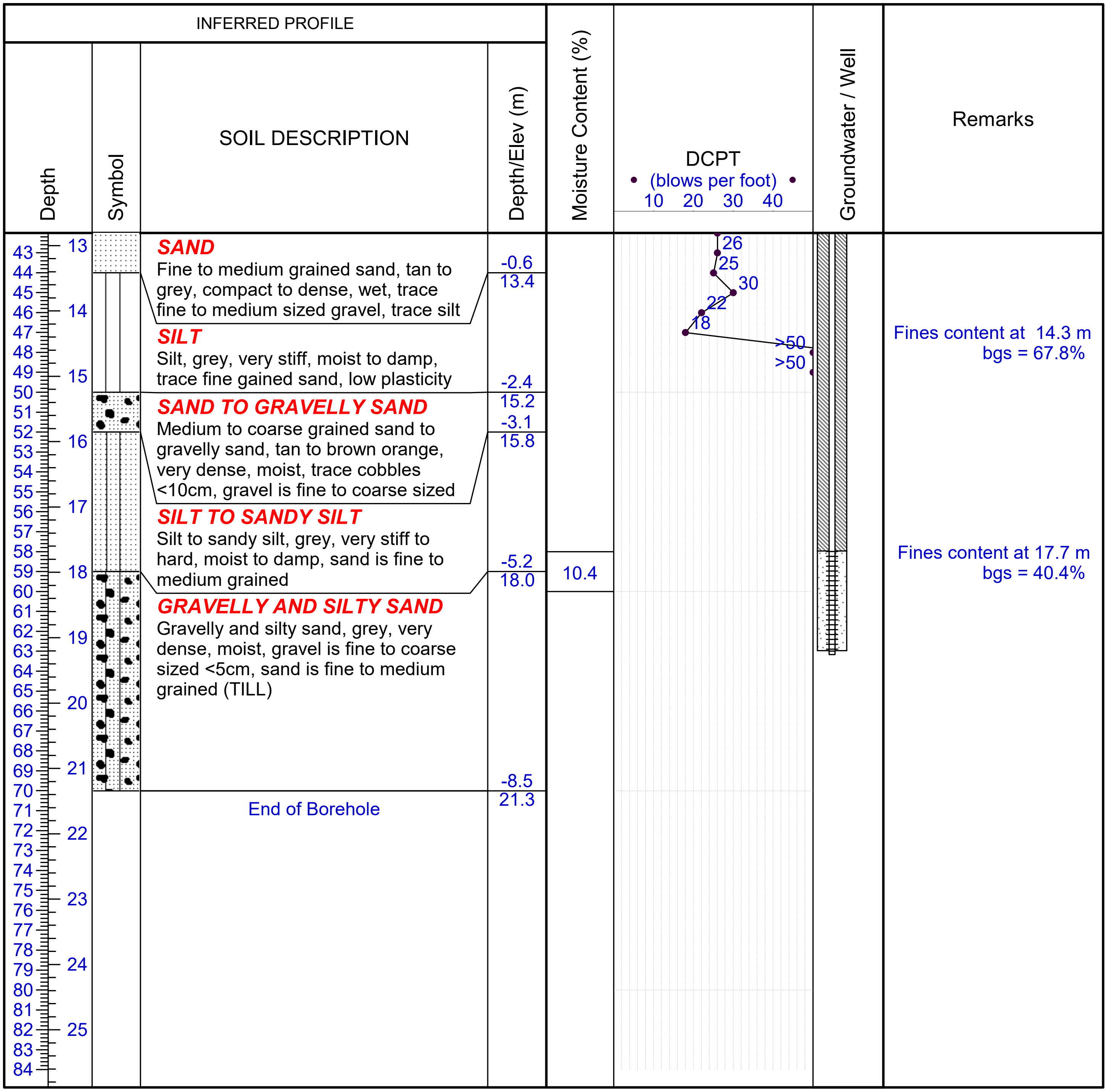


SOIL DESCRIPTION	Depth/Elev (m)	Moisture Content (%)	Remarks
SAND Fine to medium grained sand, tan to grey, compact to dense, wet, trace fine to medium sized gravel, trace silt	-0.6 13.4		
SILT Silt, grey, very stiff, moist to damp, trace fine gained sand, low plasticity	-2.4 15.2		Fines content at 14.3 m bgs = 67.8%
SAND TO GRAVELLY SAND Medium to coarse grained sand to gravelly sand, tan to brown orange, very dense, moist, trace cobbles <10cm, gravel is fine to coarse sized	-3.1 15.8		
SILT TO SANDY SILT Silt to sandy silt, grey, very stiff to hard, moist to damp, sand is fine to medium grained	-5.2 18.0	10.4	Fines content at 17.7 m bgs = 40.4%
GRAVELLY AND SILTY SAND Gravelly and silty sand, grey, very dense, moist, gravel is fine to coarse sized <5cm, sand is fine to medium grained (TILL)	-8.5 21.3		
End of Borehole			

Logged: MM
Method: Sonic
Date: 19 April 2024

Datum: Geodetic
Figure Number: A01
Page: 2 of 2

APPENDIX B

Slug Test Analysis Report

Project: Proposed Mixed-use Development

Number: 23967

Client: Cascadia Green

Location: West 15th St, N. Vancouver

Slug Test: MW24-01 Slug Test 2

Test Well: Well 1

Test Conducted by: COB

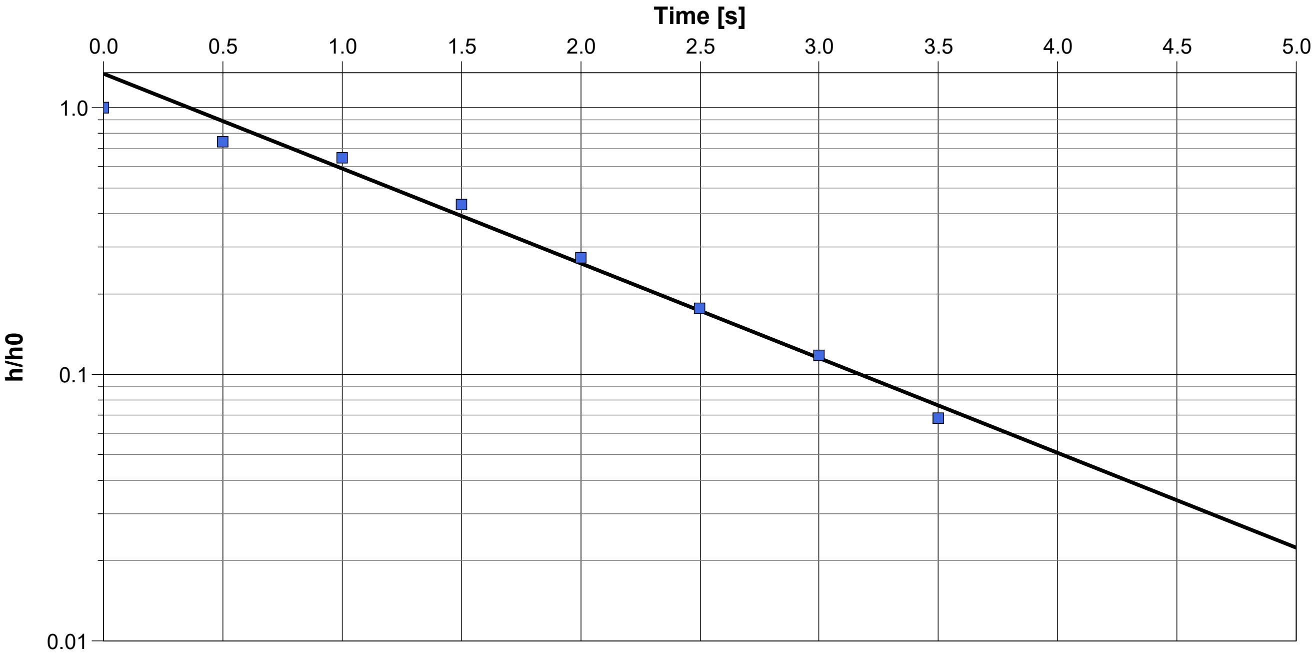
Test Date: 11/3/2025

Analysis Performed by: MEM

Slug Test 2

Analysis Date: 11/17/2025

Aquifer Thickness: 10.00 m



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
Well 1	5.54×10^{-4}	

Slug Test Analysis Report

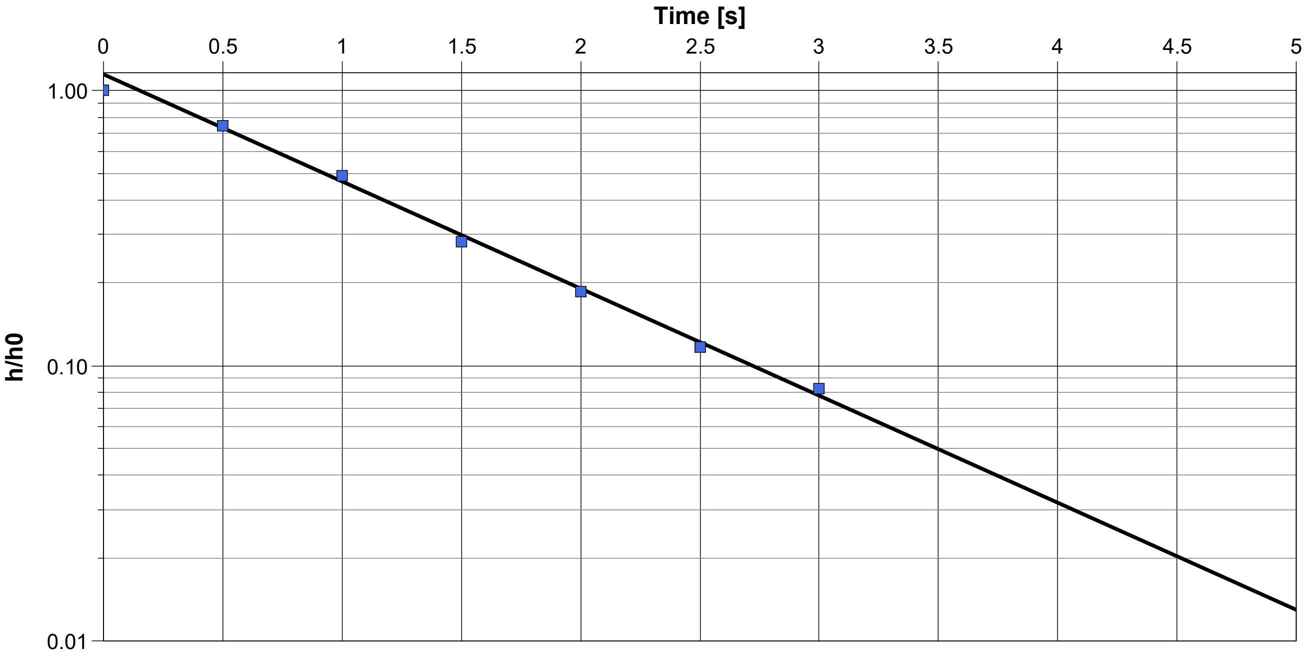
Project: Proposed Mixed-use Development

Number: 23967

Client: Cascadia Green

Location: West 15th St, N. Vancouver	Slug Test: MW24-01 Slug Test 3	Test Well: Well 1
Test Conducted by: COB		Test Date: 11/3/2025
Analysis Performed by: MEM	Slug test 3	Analysis Date: 11/17/2025

Aquifer Thickness: 10.00 m



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
Well 1	6.07×10^{-4}	

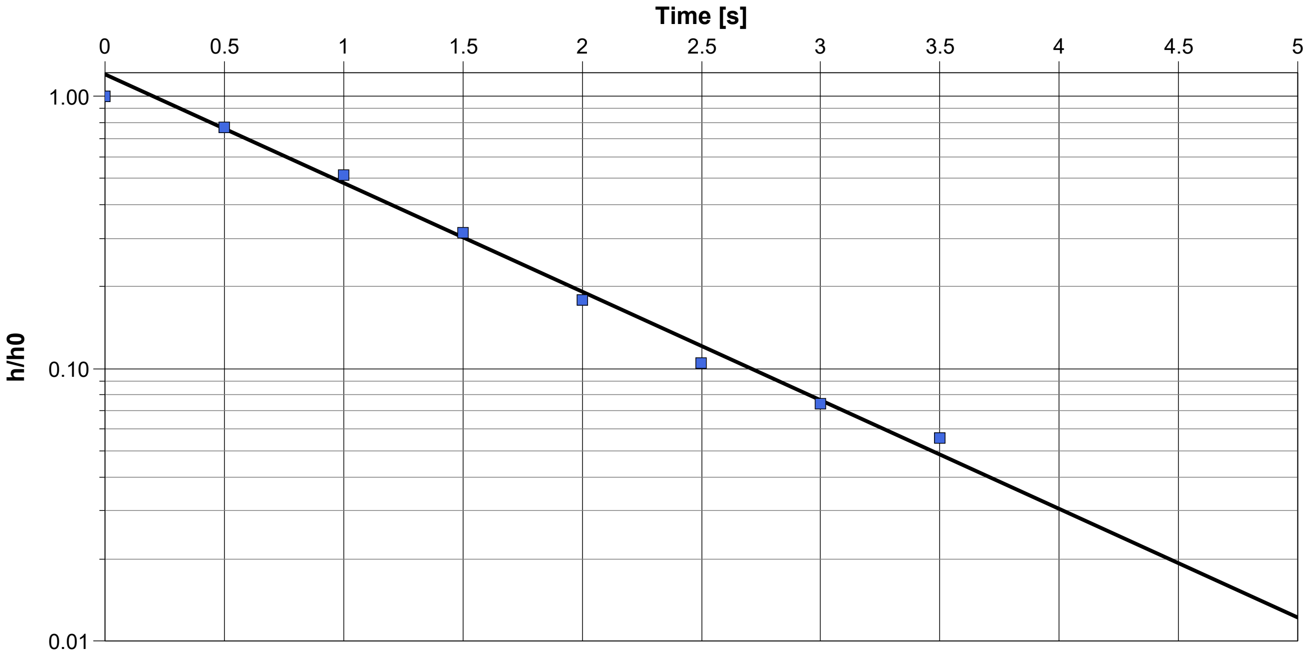
Slug Test Analysis Report

Project: Proposed Mixed-use Development

Number: 23967

Client: Cascadia Green

Location: West 15th St, N. Vancouver	Slug Test: MW24-01 Slug Test 4	Test Well: Well 1
Test Conducted by: COB		Test Date: 11/3/2025
Analysis Performed by: MEM	Slug Test 4	Analysis Date: 11/17/2025
Aquifer Thickness: 10.00 m		

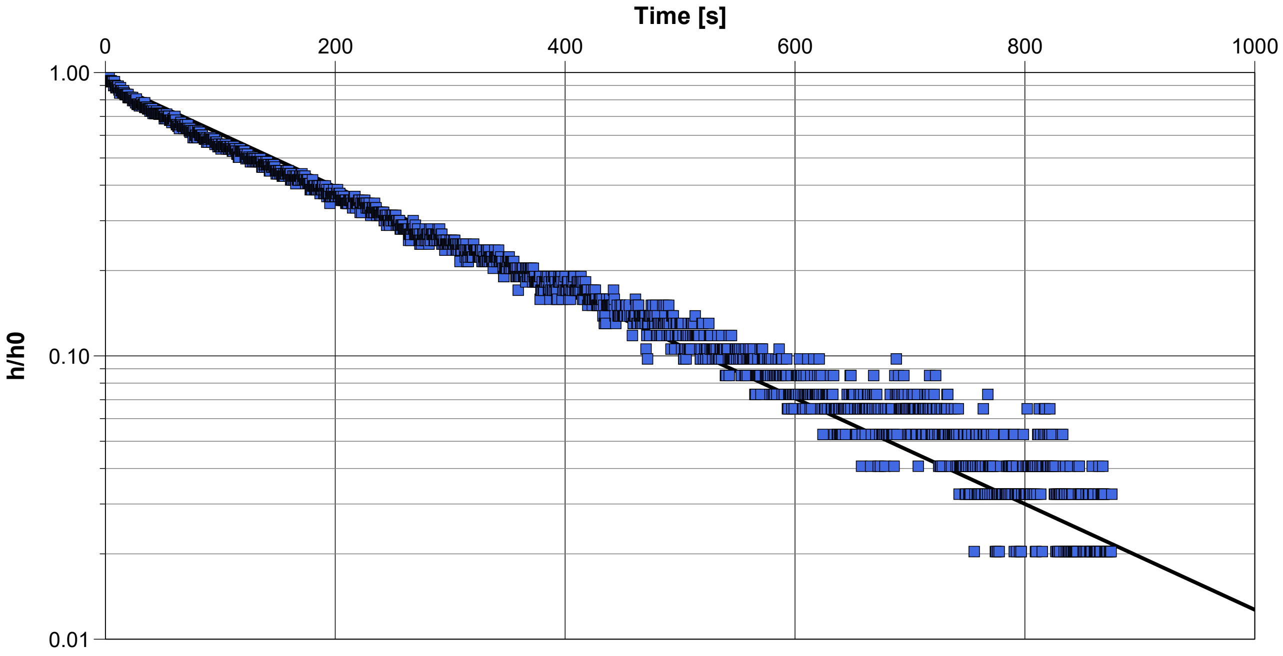


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
Well 1	6.21×10^{-4}	

	Slug Test Analysis Report
	Project: Proposed Mixed-use Development
	Number: 23967
	Client: Cascadia Green

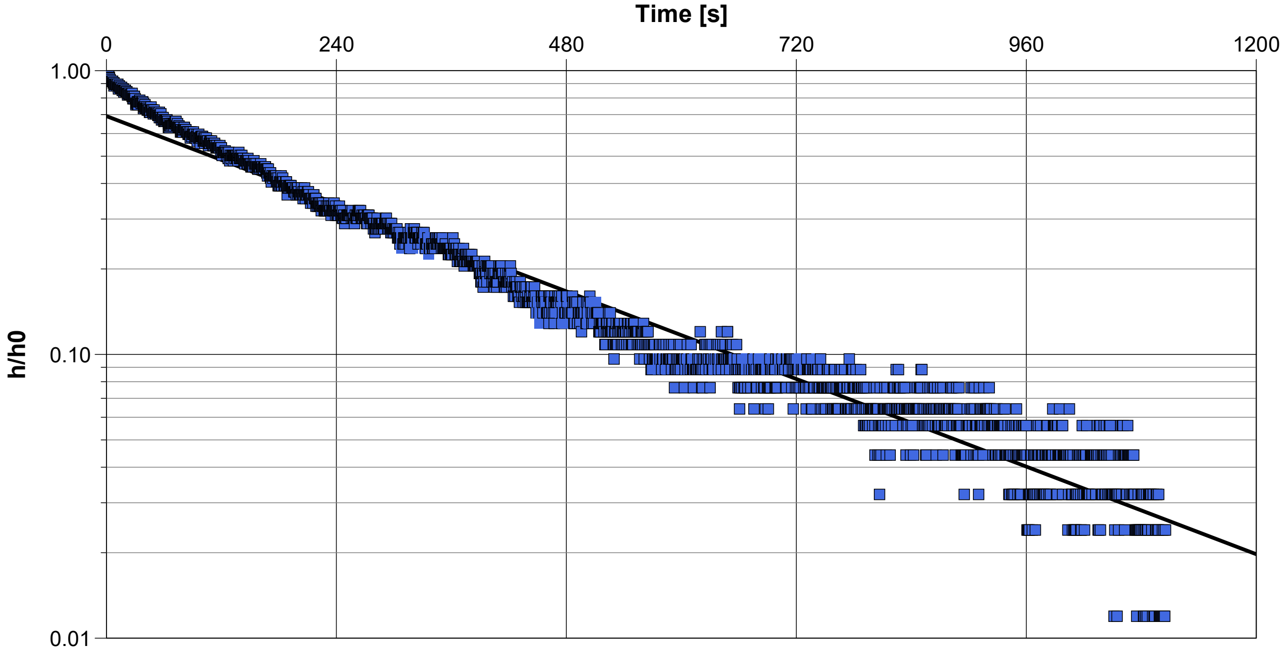
Location: West 15th St, N. Vancouver	Slug Test: MW24-02 D Slug Test 2	Test Well: Well 1
Test Conducted by: COB		Test Date: 2025-11-03
Analysis Performed by: COB	Slug Test 2	Analysis Date: 2025-11-04
Aquifer Thickness: 10.00 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
Well 1	2.91×10^{-6}	

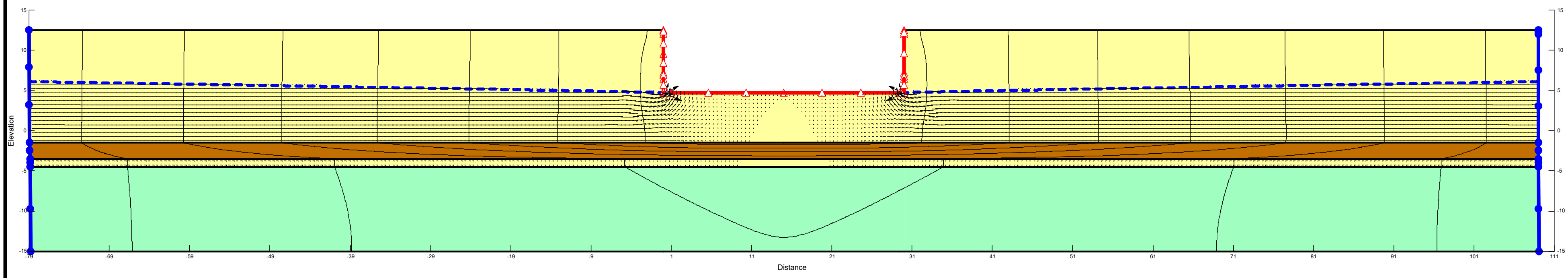
	Slug Test Analysis Report	
	Project: Proposed Mixed-use Development	
	Number: 23967	
	Client: Cascadia Green	
Location: West 15th St, N. Vancouver	Slug Test: MW24-02 D Slug Test 1	Test Well: Well 1
Test Conducted by: COB		Test Date: 2025-11-03
Analysis Performed by: COB	Slug Test 1	Analysis Date: 2025-11-04
Aquifer Thickness: 10.00 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
Well 1	2.00×10^{-6}	

APPENDIX C



Color	Name	Material Model	Sat Kx (m/sec)
🟫	Fine-Grained Overbank and Deltaic Deposits	Saturated Only	1e-06
🟩	Glacial Till	Saturated Only	2.4e-06
🟨	Granular Overbank and Deltaic Deposits	Saturated / Unsaturated	0.00059

Project: PROPOSED DEVELOPMENT

Job No.: 23967

Model: SEEP/W Analysis (4)

Date: July 14, 2026

Method: Steady-State

Scale : 1:757

Site Address : 835 - 845 WEST 15 STREET, NORTH VANCOUVER, BC

Analysis by: SRH

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