Hydrogeological and Groundwater Quality Assessment

19085 119B Avenue

Pitt Meadows, BC

May 5, 2022

Prepared for:

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Project # 123315738

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Executive Summary

Stantec Consulting Ltd. (Stantec) was retained by Metro Vancouver Housing Corporation (hereafter referred to as MVHC or the "Client") to conduct a Hydrogeological and Groundwater Quality Assessment at the property located at 19085 119B Ave, Pitt Meadows, BC, herein referred to as the "Site". This assessment is being performed in support of de-watering activities associated with the future construction at the Site which is expected to have underground parking.

A Phase I Environmental Site Assessment (ESA) was conducted in October 2021, by Metro Testing & Engineering Ltd. (Metro), prior to the execution of this current assessment. The Phase I ESA identified one area of potential environmental concern (APEC). This Hydrogeological and Groundwater Quality Assessment was conducted on the Site to assess groundwater flow conditions and groundwater quality in proximity to this APEC, summarized in the table below:

APEC	Potential Contaminants of Concern (PCOC)
1 – On-Site Fill Soil	LEPH, PAHs, BTEX, VPH, Metals, Salinity (Sodium and Chloride)

Notes: LEPH– light extractable petroleum hydrocarbons
PAH – polycyclic aromatic hydrocarbons
BTEX – benzene, toluene, ethylbenzene, and xylenes
VPH – volatile petroleum hydrocarbons

Samples were also analyzed for total suspended solids (TSS) and dissolved organic carbon (DOC) in support of future dewatering activities.

Ten boreholes were advanced, with three of them completed as groundwater monitoring wells. Soil samples from these boreholes, and groundwater samples from the installed monitoring wells, were submitted for laboratory analyses of the PCOCs associated with this APEC. The results of the soil sampling are provided under separate cover.

Based on the results of this Hydrogeological and Groundwater Quality Assessment, and in consideration of the applicable Greater Vancouver Sewer Use Bylaw No. 299, 2007, British Columbia Contaminated Sites Regulations (BC CSR) standards, and the BC Water Quality Guidelines (BC WQGs), Stantec provides the following conclusions for the Site with regards to the groundwater flow system, quality, and groundwater management during future construction activities on-site:

- A preliminary estimate for the total pumping rate to lower the groundwater table, within seven days, to approximately 0.5 m below the underground parking level excavation floor may range between 1,300 m^3/day to 2,400 m^3/day.
- Once the groundwater table has been lowered, the pumping rate to maintain a well-drained excavation area for the underground parking level may range between 100 m^3/day to 1200 m^3/day.

- Reported concentrations of the PCOCs were less than the applicable BC CSR and/or BC WQG standards/guidelines.
- Groundwater from the Site may be discharged to ground surface or to municipal storm or sanitary sewer systems without the need for treatment. Should the groundwater be discharged to municipal storm or sanitary sewer systems, a discharge permit will likely be required prior to the commencement of discharge.

The statements made in this Executive Summary are subject to the same limitations included in the Closure of this Report (Section 11.0) and are to be read in conjunction with the remainder of this report.

Abbreviations

AEC	Area of environmental concern
ALR	Agricultural Land Reserve
APEC	Area of potential environmental concern
AWF	Aquatic life (freshwater)
BC	British Columbia
BCWRA	British Columbia Water Resources Atlas
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
CALA	Canadian Association for Laboratory Accreditation
COC	Contaminant of concern
CRM	Certified reference material
CSR	Contaminated Sites Regulation
DW	Drinking Water
EPH	Extractable petroleum hydrocarbons
ESA	Environmental Site Assessment
ENV	BC Ministry of Environment and Climate Change Strategy
HEPH	Heavy Extractable Petroleum Hydrocarbons
HSVL	Headspace vapour level
IBL	Isobutylene
IW	Irrigation watering
LEPH	Light extractable petroleum hydrocarbons
LTDL	Less than detection limit
LW	Livestock watering
mbgs	Metres below ground surface
mBTOC	Metres below top of casing
MTBE	Methyl tert-butyl ether
m/s	Metres per second
NAPL	Non-aqueous phase liquids
PAH	Polycyclic aromatic hydrocarbons
PCOC	Potential contaminant of concern
ppm	Parts per million
PQRA	Preliminary quantitative risk assessment
ESA	Environmental Site Assessment
QA/QC	Quality assurance/quality control
RL_{LD}	Low-density residential land use
RPD	Relative percent difference
TG4	Technical Guidance #4
VOC	Volatile organic compounds
VPH	Volatile petroleum hydrocarbons
WSA	Water Sustainability Act

1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) was retained by Metro Vancouver Housing Corporation (hereafter referred to as MVHC or the "Client") to conduct a Hydrogeological and Groundwater Quality Assessment at 19085 119B Avenue, Pitt Meadows, BC, herein referred to as the "Site". The Site is currently occupied by a grass field and an asphalt and gravel parking lot. The boundaries of the Site are described in Section 2.0. This assessment is being performed in support of de-watering activities associated with the future construction at the Site which is expected to have underground parking.

Stantec has completed this assessment in general accordance with our proposal for the Site dated August 17, 2021 (21-311), CSA Phase II Environmental Site Assessment Standard Z769-00 (R2018), and with BC Ministry of Environment and Climate Change Strategy (ENV) protocols, procedures, and guidelines.

A Site Location Plan and Site Plan are presented in Figures 1 and 2 in Appendix A.

2.0 BACKGROUND

A Phase I Environmental Site Assessment (ESA) was conducted in October 2021, by Metro Testing & Engineering Ltd. (Metro), prior to the execution of this assessment. The Phase I ESA identified one area of potential environmental concern (APEC). This Hydrogeological and Groundwater Quality Assessment was conducted on the Site to assess the groundwater quality in proximity to this APEC, summarized in Table 1 below.

Table 1: 2021 Phase I ESA Findings Summary

APEC	Potential Contaminants of Concern (PCOC)
1 – On-Site Fill Soil	LEPH, PAHs, BTEX, VPH, Metals, Salinity (Sodium and Chloride)

Notes: LEPH/HEPH– light/heavy extractable petroleum hydrocarbons
PAH – polycyclic aromatic hydrocarbons
BTEX – benzene, toluene, ethylbenzene, and xylenes
VPH – volatile petroleum hydrocarbons

Samples were also analyzed for total metals, total suspended solids (TSS), dissolved organic carbon (DOC), total and dissolved hexavalent chromium in support of future dewatering activities associated with the pending construction activities on-site.

3.0 SCOPE OF WORK

The scope of work for the Hydrogeological and Groundwater Quality Assessment carried out by Stantec on the Site was in general accordance with Stantec's proposed work plan submitted on August 17, 2021 (21-311), and consisted of the following:

Regulatory Context

- Conducting a BC One Call request and retaining a private utility locator to establish and mark locations of underground utilities prior to drilling
- Retaining a drilling contractor to drill 10 boreholes (MW21-01, BH21-02, BH21-03, MW21-04, BH21-05, MW21-06, BH21-07 to BH21-10) using a track-mounted drill rig, equipped with solid and hollow stem augers, to a maximum depth of approximately 6.1 metres below ground surface (mbgs). Three of the locations (MW21-01, MW21-04 and MW21-06) were to be completed as groundwater monitoring wells with flush-mount casings (see attached Figure 2, Appendix A for locations)
- Developing the new groundwater monitoring wells and monitoring them for headspace vapour concentrations, depth to groundwater, and accumulation of Non-Aqueous Phase Liquid (NAPL)
- Performing three rising head-based hydraulic conductivity tests on each of the groundwater monitoring wells
- Purging and sampling the newly installed wells
- Submitting groundwater samples for laboratory analysis of one or more PCOCs outlined in Table 2 below
- Horizontally surveying the monitoring well and borehole locations
- Preparing this report outlining the field activities, methodology, analytical results, discussion, conceptual site model, and conclusions

Groundwater samples from the three monitoring wells, MW21-01, MW21-04, and MW21-06, were collected and submitted for analysis of the parameters outlined in Table 1.

Stantec understands that this report is required to support planning of dewatering activities that are likely required during development of the Site, and Stantec should be contacted if this report is to be used for any other purpose.

4.0 REGULATORY CONTEXT

4.1 BC CONTAMINATED SITES REGULATIONS

The BC CSR is the enabling regulation under the Environmental Management Act (EMA) that outlines procedures for the investigation and reporting of contaminated sites and includes numerical standards for soil and groundwater quality for specific land and water uses. Per the BC ENV *Protocol 21: Water Use Determination* (BC ENV, 2017), site-specific factors are used to determine if CSR standards protective of drinking water (DW) apply at the Site, with current and future uses evaluated separately. There is no reported current groundwater use on the Site. A review of the aquifers and registered water wells known to be present in the area was conducted using the BC Water Resource Atlas (BCWRA), and no registered aquifers were found to be on the Site or within a radius of 500 m from the Site boundaries. Registered water wells were not found within 500 m of the Site. To determine future drinking water capabilities, aquifer yield, aquifer water quality, and aquifer susceptibility are considered. Based on the current Site information available to Stantec, and since the hydrogeological and geochemical testing required to exclude future drinking water use was outside the scope of this investigation, standards for the protection of DW are currently deemed applicable to groundwater at the Site.

Regional surface drainage (i.e., anticipated shallow groundwater flow direction) at the Site, based on the 2021 Metro Phase I ESA report and the topography of the Site's surroundings, is inferred to be to the south towards the Fraser River which is approximately 1.5km from the Site. To be conservative, AWF standards were applied.

Water at the Site, and within 500 m of it, is not currently used for irrigation or livestock watering, and the Site is not located on Agricultural Land Reserve (ALR) land. Therefore, irrigation (IW) and livestock watering (LW) standards and guidelines were not included for comparison.

Regulatory Context

BC ENV *Protocol 9: Establishing Local Background Concentrations in Groundwater* (BC ENV, 2021) (P9) establishes the background concentrations for a variety of parameters in groundwater. Samples with a reported concentration above generic CSR standards, but below P9 standards for the region in which the Site is located, are not considered to be contaminated. The Site is located within the Lower Mainland Sub Region 2 under P9.

Based upon the Stage 8 Amendment to the CSR and the historical and current uses of the Site, the standards for dissolved iron and manganese were not considered to be applicable.

4.2 BC WATER QUALITY GUIDELINES

Groundwater extraction at construction site excavations is defined as a *Miscellaneous Industrial Use* of groundwater in the Water Sustainability Regulation under the *Water Sustainability Act* (WSA) and requires an *Authorization* from the Province to extract.

Water quality is regulated in BC under the BC Contaminated Sites Regulation (CSR) (BC CSR 2021) and BC Water Quality Guidelines (WQGs) (BC ENV 2019 and BC ENV 2021d). The BC CSR is the enabling regulation under the Environmental Management Act (EMA) that outlines procedures for the investigation and reporting of contaminated sites and includes numerical standards for soil and groundwater quality for specific land and water uses.

BC WQGs include both approved and working guidelines and have been used to evaluate the suitability of the groundwater for surficial discharge during future dewatering activities. The Fraser River in this area is considered to be a freshwater environment; therefore, the BC WQGs for freshwater aquatic life were applied.

To be able to discharge water to the ground, the groundwater would need to be less than the BC CSR DW and AWF standards. To be able to discharge to a drainage ditch or storm sewer, the groundwater would need to meet the BC WQG guidelines. To be able to discharge to the municipal sanitary sewer, the groundwater would need to meet the Greater Vancouver Sewer Use Bylaw standards.

4.3 GREATER VANCOUVE SEWEARAGE AND DRAINAGE DISTRICT BYLAW

The Greater Vancouver Sewerage and Drainage District has Sewer Use Bylaw No. 299, 2007 which regulates the quality of material which may be discharged into the Metro Vancouver sanitary sewer system. The parameters which are regulated are outlined in Tables A and B in the bylaw.

In summary, Bylaw No 299, 2007, BC CSR DW and AWF standards and the BC WQG Approved and Working freshwater guidelines were applied to the groundwater analytical results for the purposes of this assessment.

5.0 METHODS

5.1 UTILITY LOCATES

Prior to mobilization to the Site, Stantec completed a BC One Call and DigShaw desktop underground utility survey. On-Site utility locates were completed by Quadra Locating using ground penetrating radar and electromagnetic induction. Boreholes were not advanced within 2 m of a marked underground utility.

5.2 MONITORING WELL INSTALLATION

Drilling services were provided by Southland Drilling Co. Ltd. on November 26 and 29, 2021. Boreholes were advanced using a track mounted drill rig equipped with solid and hollow stem augers to a maximum depth of approximately 6.1 mbgs. Three of the 10 boreholes (MW21-01, MW21-04 and MW21-06) drilled on the Site were completed as monitoring wells. The monitoring wells were constructed with PVC pipe (50 mm 010 slot size). The screened intervals were installed below the water table for the purposes of hydraulic conductivity testing. During installation, the annular space of each monitoring well was filled with a silica sand pack to a minimum of 0.3 m above the slotted screen section of PVC pipe, followed by a bentonite seal placed above the sand pack up to the bottom of the concrete which held the flush mounted metal casing. The wells were completed with a J-plug sealing the casing. The locations of the monitoring wells installed on the Site are indicated on Figure 2 in Appendix A. Borehole and monitoring well construction logs are provided in Appendix B.

5.3 MONITORING WELL DEVELOPMENT

The newly installed wells were developed on November 29, 2021, following Stantec's standard operating procedures. Groundwater monitoring and sampling was subsequently conducted on December 2, 2021.

The newly installed monitoring wells were monitored for depth to water, depth to bottom of the well, and presence of NAPL during the monitoring/sampling event. Water levels and presence of NAPL were measured with an oil/water interface probe. After each use, the interface probe was cleaned with a solution of Alconox™ and de-ionized water and rinsed with de-ionized water prior to use in other wells.

Monitoring wells were developed by being purged manually using Waterra™ tubing until 10 well volumes had been removed and/or until the water was visually free of sediment; or if the well went dry, it was purged dry three times or until was visually free of sediment. The wells were then allowed to equilibrate and settle before field personnel returned and collected representative samples using a low-flow peristaltic pump.

5.4 HYDRAULIC CONDUCTIVITY TESTING

Rising head hydraulic conductivity tests (rising head tests) were completed at each monitoring well after development and sampling. Rising head tests are completed by rapidly depressing the groundwater level in a well, which induces groundwater flow into the well to re-establish the static, "natural" groundwater level in the well. The rate the water level recovers back to the static condition is diagnostic of the hydraulic conductivity of the screened formation in the vicinity of the well.

Methods

To complete the tests at the Site, a bailer (groundwater sampling device) was inserted below the water level and rapidly removed, extracting approximately 1.2 L of water from the well and causing the groundwater level to decrease by approximately 0.5 m. The subsequent groundwater level recovery during each rising head test was monitored over time via a Hobo™ pressure transducer, installed near the bottom of the monitoring well that recorded pressure data at one second intervals.

Groundwater level recovery data were analyzed using the Bouwer and Rice (1976); Cooper, Bredehoeft, and Papadopulous (1967); and Hyder et al. (1994) analytical solutions following the analysis procedure recommended by Butler (1997).

5.5 GROUNDWATER MONITORING AND SAMPLING

Prior to the collection of groundwater samples, wells were purged using a low-flow pump until parameters, such as turbidity, oxidation reduction potential, pH, conductivity, and temperature of the water had stabilized. Samples were collected in laboratory-supplied bottles and preserved and filtered in the field as appropriate.

Well headspace vapour level (HSVL) was measured using a handheld RKI Eagle II organic vapour meter calibrated by a trained technician using hexane and isobutylene gas. The inlet tube is put down the monitoring well and the hexane and isobutylene vapour reading are recorded once it has stabilized.

Sampling equipment was cleaned and wiped down after each sampling event according to Stantec's standard decontamination procedures.

Groundwater samples were stored in an ice-chilled cooler and submitted under chain-of-custody to the Bureau Veritas (BV) laboratory in Burnaby, BC for analysis of PCOCs.

5.6 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

The data quality objectives for the investigation were to collect precise, accurate, reproducible, and complete data in the field. This was achieved by following Stantec's standard operating procedures and the BC Field Sampling Manual (BC ENV, 2013), use of blind field duplicates, and adherence to the project's scope of work.

During the Investigation, sampling work was conducted in accordance with BC ENV *Technical Guidance 1: Site Characterization and Confirmation Testing* (BC ENV, 2009), the BC Field Sampling Manual (BC ENV, 2013), and Stantec's standard field procedures. Field equipment was visually assessed and cleaned before use in monitoring and sampling activities. A fresh pair of nitrile gloves was used for the collection of each sample, and replaced prior to sample collection, to reduce the risk of cross-contamination between samples. Samples were collected in laboratory-supplied clean jars and bottles as appropriate for the intended analysis.

After field collection, samples were placed into an ice-chilled cooler and were delivered to the BV laboratory in Burnaby, BC for analysis within the recommended hold time. All samples were delivered with a completed chain-of-custody form.

BV is a Canadian Association for Laboratory Accreditation (CALA) accredited laboratory that uses BC ENV recognized methods to conduct laboratory analyses. As conveyed by the laboratory, method blanks, control

standards samples, certified reference material (CRM) standards, method spikes, replicates, duplicates, and instrument blanks are routinely analyzed as part of their QA/QC programs.

Blind field duplicates were also submitted and analyzed to measure the precision of the field sampling and laboratory analysis.

6.0 OBSERVATIONS

Field observations and well monitoring data documented from the field program are presented and discussed in the following sub sections.

6.1 GROUNDWATER MONITORING

Groundwater was purged and sampled from MW21-01, MW21-04, and MW21-06 on December 2, 2021.

Depth to groundwater was measured below top of casing (BTOC) and ranged from 3.03 m BTOC in MW21-04 to 3.27 m BTOC at MW21-06. NAPL was not observed visually, nor detected by the interface probe, during the monitoring of the wells. Visual or olfactory indications of contamination were not observed in groundwater recovered from the monitoring wells. HSVL were measured at the well locations during monitoring and sampling. Both hexane and isobutylene concentrations were recorded. The measured HSVL were less than the detection limit of the instrument in the three monitoring wells.

Observations made at the groundwater monitoring wells are summarized in Table D.1 in Appendix D.

7.0 RESULTS

7.1 HYDRAULIC CONDUCTIVITY

Hydraulic conductivity estimates at each monitoring well are summarized in Table 2 below. Estimated values range from $8x10^{-5}$ m/s at MW21-06 to $1x10^{-3}$ m/s at MW21-01, consistent with generally accepted hydraulic conductivity ranges for poorly graded medium-grained sand (Table 2). Individual test hydraulic conductivity estimates are provided in Table C.1 in Appendix C. Analytical solutions fit to the groundwater level recovery measurements recorded during each rising head test are also provided in Appendix C.

Table 2 Hydraulic Conductivity Estimates

Monitoring Well	Screened Sediment Description	Hydraulic Conductivity Estimate (m/s)	Estimate Qualitative Confidence	Literature Range[1] for Sediment (m/s)
MW21-01	Poorly graded medium SAND (SP)[1]	$5x10^{-4}$ to $1x10^{-3}$	Low	$5x10^{-5}$ to $2x10^{-3}$
MW21-04	Poorly graded medium SAND with silt (SP-SM), trace gravel	$2x10^{-4}$ to $4x10^{-4}$	Moderate	
MW21-06	Poorly graded medium SAND (SP), trace gravel[1]	$8x10^{-5}$ to $2x10^{-4}$	Moderate	

[1] Hydraulic conductivity range for poorly graded medium sand from Powers et al. 2007.

Hydraulic conductivity estimates at MW21-01 are associated with a lower confidence than the tests completed at MW21-04 or MW21-06. Water level recovery during testing at MW21-01 occurred rapidly, such that groundwater levels recovered to the static condition within approximately ten seconds during all three tests (Appendix C, pages 2 to 10). This rapid response indicates a moderate to high hydraulic conductivity value (i.e., > $1x10^{-4}$ m/s) can be assigned to the material screened by MW21-01, but the number of data points available to fit an analytical solution were limited. Additionally, the initial displacement recorded by the transducer at MW21-01 after extraction of the bailer was inconsistent with the expected initial displacement (0.5 m, Table C.1, Appendix C). This indicates the data to which the analytic solution was fit may not have captured the full water level response.

7.2 HYDROGEOLOGICAL CONCEPTUAL MODEL

A hydrogeological conceptual site model has been compiled to support a preliminary, order-of-magnitude groundwater inflow estimate to the foundation excavation associated with the pending development on-site.

A north-south cross-section showing the stratigraphy beneath the Site is provided on Figure 3, Appendix A. The general stratigraphic column encountered at the Site, from ground surface to depth, includes the following:

- Ground surface: Topsoil, asphalt, or fill at ground surface.
- To 0.5 mbgs: topsoil and/or fill. Gravel with sand, sand with gravel, and/or silty sand fill encountered in all boreholes.
- 0.5 mbgs to 1.5 mbgs: Sandy silt (ML) and silty sand (SM): Encountered underlying fill soils in all boreholes except AH21-10.
- 1.5 mbgs to 6.1 mbgs: Poorly graded sand (SP) and poorly graded sand with silt (SP-SM): Poorly graded sand was encountered in all boreholes and is the material screened by monitoring wells MW21-01 and MW21-06. Poorly graded sand with silt was encountered in boreholes BH21-02 and BH21-04, beneath overlying silty sand. Poorly graded sand with silt was screened by MW21-04.

Other soils encountered included lean clay from 5.9 mbgs to the end-of-borehole at BH21-04. Interpretation of cone penetrating test (CPT) CPT/seismic cone penetration test (SCPT) data indicated the poorly graded medium sand (SP) continues to about 7 mbgs to 10 mbgs, where a transition between coarse-grained and fine-grained material occurs to about 12 mbgs to 14 mbgs. Fine-grained material was encountered from about 14 mbgs to the termination of the cone tests at 30 mbgs.

The poorly graded medium-grained sands are anticipated to constitute an unconfined aquifer and comprise the groundwater bearing unit at the Site with respect to the pending foundation excavation. The base of the aquifer is assumed to coincide with the transition to fine-grained material at 7 mbgs to 10 mbgs, at CPT21-08 and SCPT21-07, respectively.

Groundwater levels measured in monitoring wells after installation ranged from 3.03 mbgs in MW21-04 to 3.27 mbgs at MW21-06. Based on reports referenced in the *Draft Geotechnical Report – Pitt Meadows Affordable Housing and Childcare* (Stantec 2022), the groundwater level at the neighbouring sites is estimated to be approximately 2.5 mbgs to 3.5 mbgs.

Therefore, based on measured and referenced groundwater levels, groundwater at Site may be encountered between 2.5 mbgs and 3.5 mbgs. Groundwater will be encountered closer to surface during the wet season (November to April) and at greater depth during the dry season (May to October).

Results

For the purposes of this preliminary hydrogeological assessment, the excavation floor for the undergound parking level is understood to be at 3.5 mbgs. Therefore, the excavation should be assumed to encounter groundwater and dewatering will be required.

7.3 GROUNDWATER INFLOW ESTIMATE

Stantec recommends temporary dewatering of foundation excavations be completed with well points (Stantec 2022b). Groundwater should be lowered no more than 1 m below the base of the excavation, and dewatering should not extend for more than one week in a given area of the excavation (Stantec 2022b).

The Contractor is responsible for the well point design. Stantec has provided these order-of-magnitude groundwater inflow estimates based on the excavation geometry and the hydraulic conductivity testing results. These estimates are preliminary and should not be relied on exclusively to design the dewatering system. For example, the hydraulic conductivity estimates from the rising head tests only characterize the local geological material in the immediate vicinity of the well screen (Butler 1997). Groundwater conditions encountered during excavation may be considerably different than those encountered during the site investigation.

The information used to estimate the groundwater inflow rate (Q) is summarized in Table 4

Table 2 Groundwater Inflow Estimate Parameters

Parameter	Symbol	Value	Unit	Source
Hydraulic conductivity	K	$8x10^{-5}$ to $5x10^{-4}$	m/s	Rising head tests[1]
Groundwater storage estimate (Specific Yield)	Sy	0.2	Na	Powers et al. 2007
Static groundwater level	-	2.5 to 3.5	mbgs	Measured
Static saturated thickness to base of Aquifer	H	7 to 10	mbgs	CPT/SCPT material and groundwater level interpretations
Saturated thickness after dewatering	H	3 to 6	m	Geotechnical design
Radius of influence	R_o	100 to 400	m	Theis (1935) analytical solution
Effective well radius	r_s	38	m	Radial equivalent of excavation geometry[2]
Time requirement	t	$6.05x10^5$ seconds (7 days)	sec	Dewatering limit per area of excavation
Groundwater inflow rate	Q	Output	m^2/day	Calculated

NOTES:

1. Hydraulic Conductivity Estimates from MW21-01 were not used for the calculation due to the low confidence associated with the estimates (Section 7.3).
2. Based on a generalized 95 m x 50 m excavation area.

The groundwater inflow rate is approximated as the sum of the pumping rates required to

- Maintain a dry excavation with the groundwater level at 0.5 m below the excavation floor, and
- Initially remove groundwater stored in the soil at Site.

Results

7.3.1 Groundwater Inflow

In response to the proposed temporary dewatering, a zone of dewatered soil (radius of influence Ro), will extend radially out from the excavation area. The extent of this zone is estimated using the Theis (1935) solution for radial flow to well. The estimated value of Ro for this excavation ranges from 100 m to 400 m.

A steady-state groundwater inflow estimate to the excavation can be made by assuming the excavation area is equivalent to the radius of a large single well (Powers et al. 2007). The generalized 90 m length by 50 m width of the excavation results in an effective well radius of 38 m.

Steady-state groundwater flow to a large diameter well in an unconfined aquifer system can be approximated using the equation below (Powers et al. 2007):

$$Q_w = \frac{\pi K (H^2 - h_o^2)}{\ln ({}^{R_o}/_{r_s})}$$

Input parameters for the above equation are defined and estimated in Table 4 above. Given the range of values associated with most of the input parameters, Stantec calculated range of inflow estimates that correspond to the most conservative (greatest inflow), least conservative (least inflow), and best-guess input parameter selections.

Based on this equation, and the variables defined in Table 4, the steady-state pumping rate required to maintain a groundwater level 0.5 m below the excavation floor may range from about 100 m^3/day to about 1200 m^3/day. The base case estimate, calculated from best guess parameter values, is 425 m^3/day. The least and most conservative estimates, the base case estimate, and associated input parameter values are provided in Table 5 below.

Table 3 Steady-State Groundwater Inflow Estimate

Parameter	Unit	Least Conservative	Base Case	Most Conservative
Base of unconfined aquifer	mbgs	7	10	10
Groundwater level	mbgs	3.5	3	2.5
Max dewatering depth	mbgs	4	4	4
Maximum drawdown	mbgs	0.5	1	1.5
Hydraulic conductivity (K)	m/s	$8x10^{-5}$	$2x10^{-4}$	$5x10^{-4}$
Initial saturated thickness (H)	m	3.5	7	7.5
Saturated thickness at excavation (ho)	m	3	6	6
Radius of influence (Ro)	m	100	200	400
Effective radius of excavation (rs)	m	38	38	38
Steady-state Groundwater Inflow (Q)	m^3/day	**73**	**425**	**1168**

NOTES:
1. “mbgs” is metres below ground surface; “m/s” is metres per second; “L/s” is litres per second; “m^3/day” is cubic metres per day; “GPM” is US gallons per minute.

7.3.2 Groundwater in Storage

Using the base-case steady-state scenario parameters, and a groundwater specific yield of 20% (Table 4), groundwater stored in the unconfined aquifer (storage) underlying the Site can be estimated, to an order-of-magnitude, to be about 8,500 m^3. The pumping rate required to dewater this groundwater is dependent on the construction schedule. Assuming this groundwater is to be removed within one week of initiation of pumping, the pumping rate required is approximately 1,200 m^3/day.

7.3.3 Total Groundwater Inflow

The combined steady-state and storage removal groundwater inflow estimate to dewater and lower the groundwater level at 0.5 m below the excavation floor in seven days of pumping may range from **1,300 m^3/day to 2,400 m^3/day**. The steady-state pumping rate required to maintain the groundwater table at 0.5 m below the excavation floor, after initial groundwater storage has been removed, may range from **100 to 1200 m^3/day**. Required pumping rates can be reduced by excavating during dry summer months and by providing a longer pumping period to remove groundwater held in storage at the Site.

This inflow estimate does not consider detailed aspects of the dewatering system design such as the effects of well point partial penetration into the aquifer, which may considerably affect the estimate. This groundwater inflow estimate does not consider pumping requirements to remove direct precipitation onto and/or surface water flow into the excavation area.

7.4 GROUNDWATER ANALYTICAL RESULTS

Four groundwater samples (including one blind field duplicate) were collected and submitted for laboratory analysis of the identified PCOCs.

The groundwater analytical results from this current investigation, compared to the standards and guidelines outlined in Section 4.0, are presented in Table D.2 in Appendix D. The reported concentrations of the PCOCs in these samples were less than the Greater Vancouver Sewer Use Bylaw, BC WQG guidelines and/or the BC CSR DW and AWF standards. A summary of the groundwater analytical results is provided on Figure 2 in Appendix A. The laboratory analytical certificate for this assessment is provided in Appendix E.

7.5 QA/QC SUMMARY

7.5.1 Laboratory QA/QC

Appropriate laboratory methods were used by the laboratory and the recommended sample holding times were met. Laboratory quality assurance samples such as matrix spikes, matrix spike duplicates, spiked blanks, and method blanks were collected and analyzed according to the laboratory method. Laboratory quality control sample results were within method acceptance limits.

Stantec has reviewed the set of quality assurance data for the subject batch and the analytical results and have concluded that data quality is adequate for the purposes of this assessment.

7.5.2 Field Duplicates and Relative Percent Difference (RPD)

A blind field duplicate sample is a split of a homogenized soil, sediment, groundwater, or surface water sample that is prepared and analyzed following the same procedure as the original sample. The Relative Percent Different (RPD) is calculated for the results of the pair of samples. The RPD for two data points is equal to the difference divided by the mean multiplied by 100 percent, as shown below. The RPD is used to evaluate the precision of the laboratory analysis.

$$\left(\frac{|Xi - Xii|}{\overline{X}} \right) \times 100\ \%$$

NOTES:

Xi Concentration in Original Sample

Xii Concentration in Duplicate Sample

$\overline{X}$ Mean of Sample Concentrations

Throughout the investigation, blind field duplicates for groundwater were collected during the sampling event as part of Stantec's field QA/QC protocols. These blind field duplicates were collected at the same location, at the same time, by the same person utilizing the same equipment during field activities. The BC ENV suggests that blind field duplicates should be collected at a rate of approximately 10% of the total number of samples collected, and Table 6 below summarizes the percent of blind field duplicates obtained for groundwater.

Table 4 Sample and Blind Field Duplicate Summary

Sampled Media	Number of Samples	Number of Blind Field Duplicates	Total Samples Collected	Percentage of Blind Field Duplicates
Water	3	1	4	25 %

Once RPD values were calculated for analytical results of original and field duplicate samples, RPD values were compared to recommended BC ENV RPD targets, categorized by analytical parameter. These RPD targets are presented in Table 7 below and were obtained from Q.#36 of the Q&A section (Category: Standards, Sub-Category: General) on the BC ENV Land Remediation website. The BC ENV recommends that the RPD for duplicate field samples not exceed 1.5 times the acceptable lab RPD for the same compound. The lab RPDs can be found in the BC Environmental Laboratory Manual[1].

Table 5 Recommended RPD Targets

Parameter Category	Recommended RPD
Organics in Water	
Volatile Organics (including F1, BTEX and VH)	45%
Most other Typical Organic Parameters	45%
Others	
Metals in Water	30%
General Inorganics in Water	30%

[1] BC ENV, 2020. British Columbia Environmental Laboratory Manual, 2020 Edition.

Conclusions

During field sampling activities, one duplicate sample was collected and analyzed. The RPD between original samples and duplicates was calculated where the analytical results were at least five times the value of the reportable detection limit.

One blind field duplicate groundwater sample was collected (DUP21-01, blind field duplicate of parent sample MW21-04). Except for total aluminum and iron, this duplicate pair had RPDs, where they could be calculated, that were within the acceptance criteria for RPD values recommended by BC ENV. The concentration of total aluminum and total iron were more than an order of magnitude less than the most conservative standard. Therefore, the elevated RPDs are not likely to have impacted the conclusions of this report.

Stantec's review of field and laboratory data indicates that the analytical data produced by this investigation are representative and meet the objectives of the project's scope of work.

8.0 CONCLUSIONS

Based on the results of this Hydrogeological and Groundwater Quality Assessment, and in consideration of the applicable BC CSR standards and BC WQG guidelines, Stantec provides the following conclusions for the Site:

- An order-of-magnitude estimate for the total pumping rate required to remove groundwater storage and maintain a well-drained excavation area may range between 1,300 m^3/day and 2,400 m^3/day. Pumping requirements can be reduced by excavating during dry summer months and by providing a longer pumping period to remove groundwater held in storage at the Site. This estimate is preliminary only and should not be relied on exclusively to design the dewatering system. Groundwater conditions encountered during excavation may be considerably different than those encountered during the site investigation.
- A groundwater *use authorization* under the *Water Sustainability Act* (WSA) will be required to remove groundwater from the unconfined aquifer at the Site.
- The concentration of PCOCs in the samples collected were less than the applicable Greater Vancouver Sewer Bylaw standards, the BC CSR standards, and/or BC WQG guidelines.
- Groundwater from the Site may be discharged to ground surface downgradient of the Site or can likely be discharged to the municipal storm or sewer system.
- Should the groundwater be discharged to municipal storm or sewer systems, a discharge permit will likely be required prior to the commencement of discharge.

Stantec notes that groundwater wells are designed and installed to limit TSS. Therefore, it is likely that the groundwater well samples may not exhibit the same turbidity, TSS, total metals, and concentrations of other PCOCs as the subsequent excavation water. MVMC will likely need to plan for treatment of collected excavation water to reduce TSS, and possibly other PCOCs, prior to discharge to storm or sanitary sewer, if selected for discharge.

9.0 REFERENCES

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Limitations

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10.0 LIMITATIONS

This report documents work that was performed in accordance with generally accepted professional standards at the time and location in which the services were provided. No other representations, warranties or guarantees are made concerning the accuracy or completeness of the data or conclusions contained within this report, including no assurance that this work has uncovered all potential liabilities associated with the identified property.

This report provides an evaluation of selected environmental conditions associated with the identified portion of the property that was assessed at the time the work was conducted and is based on information obtained by and/or provided to Stantec at that time. There are no assurances regarding the accuracy and completeness of this information. All information received from the client or third parties in the preparation of this report has been assumed by Stantec to be correct. Stantec assumes no responsibility for any deficiency or inaccuracy in information received from others.

The opinions in this report can only be relied upon as they relate to the condition of the portion of the identified property that was assessed at the time the work was conducted. Activities at the property subsequent to Stantec's assessment may have significantly altered the property's condition. Stantec cannot comment on other areas of the property that were not assessed.

Conclusions made within this report consist of Stantec's professional opinion as of the time of the writing of this report and are based solely on the scope of work described in the report, the limited data available and the results of the work. They are not a certification of the property's environmental condition. This report should not be construed as legal advice.

This report has been prepared for the exclusive use of the client identified herein and any use by any third party is prohibited. Stantec assumes no responsibility for losses, damages, liabilities or claims, howsoever arising, from third party use of this report. The locations of any utilities, buildings and structures, and property boundaries illustrated in or described within this report, if any, including pole lines, conduits, water mains, sewers and other surface or sub-surface utilities and structures are not guaranteed. Before starting work, the exact location of all such utilities and structures should be confirmed and Stantec assumes no liability for damage to them.

The conclusions are based on the site conditions encountered by Stantec at the time the work was performed at the specific testing and/or sampling locations, and conditions may vary among sampling locations. Factors such as areas of potential concern identified in previous studies, site conditions (e.g., utilities) and cost may have constrained the sampling locations used in this assessment. In addition, analysis has been carried out for only a limited number of

chemical parameters, and it should not be inferred that other chemical species are not present. Due to the nature of the investigation and the limited data available, Stantec does not warrant against undiscovered environmental liabilities nor that the sampling results are indicative of the condition of the entire site. As the purpose of this report is to identify site conditions which may pose an environmental risk; the identification of non-environmental risks to structures or people on the site is beyond the scope of this assessment.

Should additional information become available which differs significantly from our understanding of conditions presented in this report, Stantec specifically disclaims any responsibility to update the conclusions in this report.

This report was prepared by Stewart McBride, P.Ag., and reviewed by Matthew Redmond, P.Eng. (sections pertaining to groundwater quality assessment) and Mundzir Basri (sections pertaining to hydrogeological assessment).

11.0 CLOSURE

We trust the information herein is sufficient for your needs at this time. Should you have any questions or concerns, please do not hesitate to contact the undersigned.

Respectfully submitted,

Stantec Consulting Ltd.

Digitally signed by McBride, Stewart
Date: 2022.05.05 13:46:45 -07'00'

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Date: 2022.05.05 13:36:27 -07'00'

On Behalf Of

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APPENDIX A
SITE PLANS

Appendix A SITE PLANS

Notes
1. Coordinate System: NAD 1983 UTM Zone 10N
2. Base map provided by ESRI Web Mapping Service (WMS)

SCALE IN METRES
0 200 400 600 800 1,000
1:25,000

Stantec

Project Information

Project No:	123315738
Scale:	1:25,000
Date:	2022-JAN-19
Drawn by:	G. HUYNH
Checked by:	S. McBRIDE

Project Location
19125 119b AVENUE
PITT MEADOWS, BC

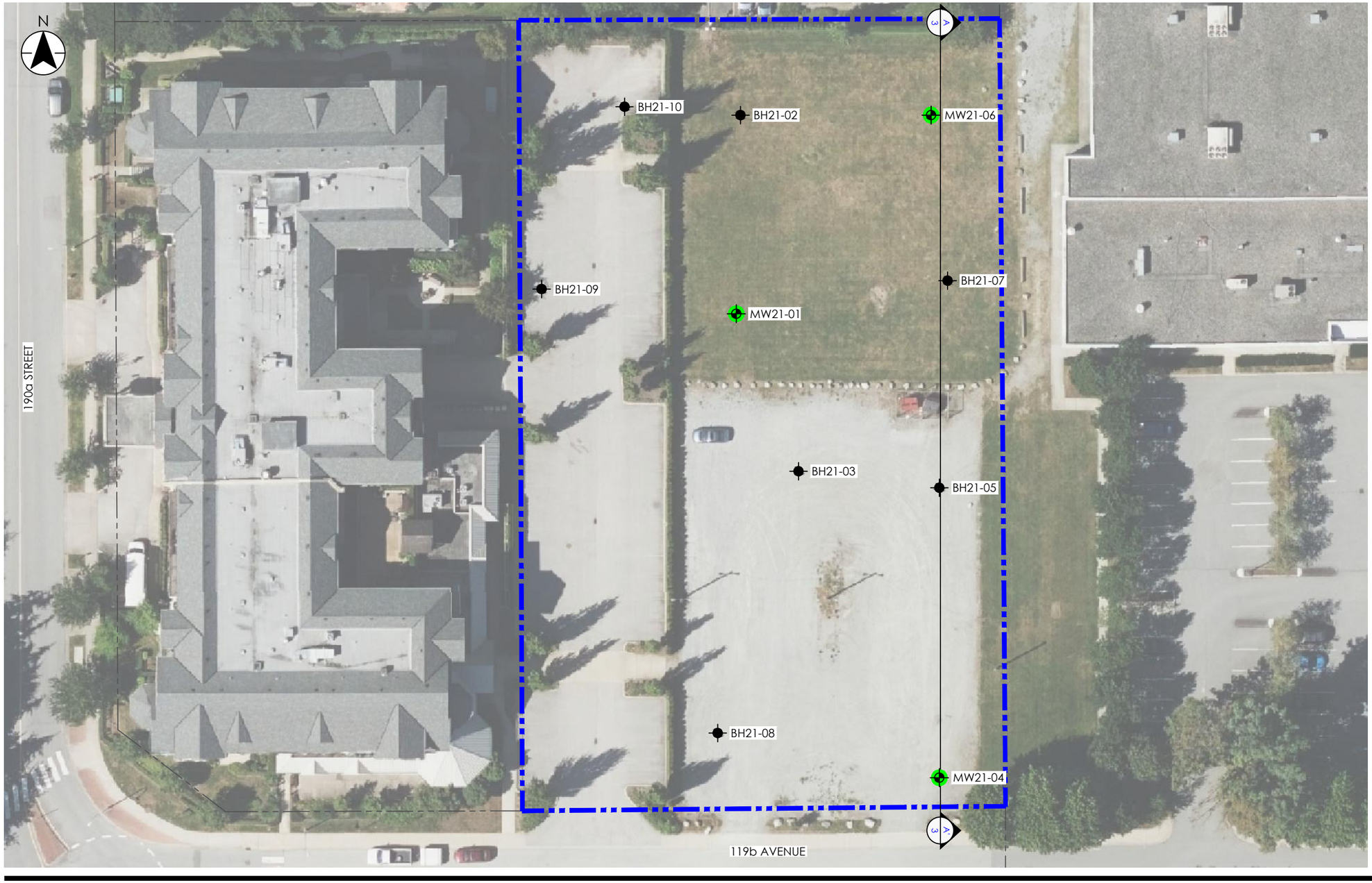
Client / Project
METRO VANCOUVER HOUSING CORPORATION

HYDROGEOLOGICAL AND GROUNDWATER QUALITY STUDY

Title: **SITE LOCATION PLAN**
Figure No.: **1**

S:\1232\projects\123315738\drawings\hydrogeo_study\123315738_001_site_location_plan.mxd
2022-01-28 By: ghuynh

ORIGINAL SHEET ANSI A



Stantec

ORIGINAL SHEET - ANSI B

Sources
- LOT LINES FROM PARCELMAP BC OPEN DATA CATALOGUE

Project Information

Project No.:	123315738
Scale:	1:500
Date:	2020-JAN-19
Drawn by:	G. HUYNH
Checked by:	S. McBRIDE

Project Location
19125 119b AVENUE
PITT MEADOWS, BC

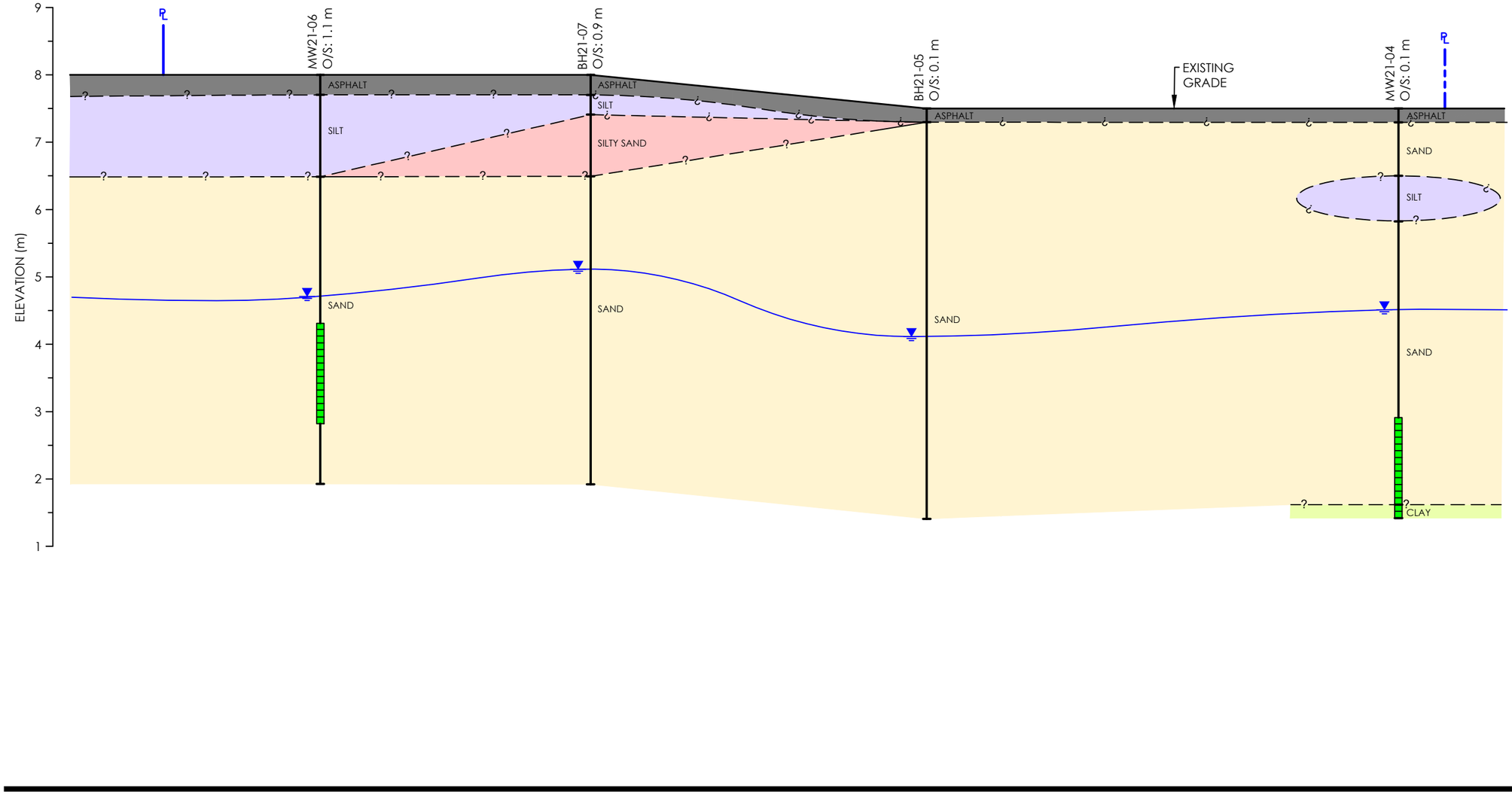
Client/Project
METRO VANCOUVER HOUSING CORPORATION

HYDROGEOLOGICAL AND GROUNDWATER QUALITY STUDY

TITLE
SITE PLAN AND GROUNDWATER ANALYTICAL RESULTS

Figure No.
2

S:\1232\projects\123315738\drawings\hydrogeo_study\123315738_002_GW_analytical.dwg
2022/01/28 10:03 AM By: Huynh, Gordon



NOTES

1. VERTICAL DATUM: GEODETIC (METERS)
2. VERTICAL EXAGGERATION: 1H: 5V

SCALE IN METRES
0 2.5 5 7.5 10
1:300

Stantec

ORIGINAL SHEET - ANSI B

Sources

Project Information

Project No.:	123315738
Scale:	1:300 HORIZ. | 1:70 VERT.
Date:	2020-JAN-19
Drawn by:	G. HUYNH
Checked by:	S. McBRIDE

Project Location
19125 119b AVENUE
PITT MEADOWS, BC

Client/Project
METRO VANCOUVER HOUSING CORPORATION

HYDROGEOLOGICAL AND
GROUNDWATER QUALITY STUDY

TITLE
CROSS SECTION A-A'

Figure No.
3

APPENDIX B
BOREHOLE LOGS

Appendix B BOREHOLE LOGS

Monitoring Well: MW21-01

Project:	Pitt Meadows Affordable Housing and Childcare	**Method:**	Solid Stem Augers
Client:	Metro Vancouver Housing Corporation	**Date started/completed:**	26-Nov-2021
Location:	19125 119B Avenue, Pitt Meadows	**Ground surface elevation:**	8.00 m AMSL
Number:	123315738	**Top of casing elevation:**	7.90 m AMSL
Field investigator:	SM	**Easting:**	n/a
Contractor:	Southland Drilling Co. Ltd.	**Northing:**	n/a

Depth (ft)	Depth (m)	Graphic Log	Stratigraphic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	%LEL / ppm (OTOV / Comb)	Diagram	Description
			Ground Surface	8.00					
			TOPSOIL: organic sandy silt with rootlets	0.00 7.70					
1			FILL: gravel with sand	0.30 7.54	1	AS	0/0		
2	0.5		Dark brown sandy SILT (ML) - moist - trace organics - trace gravel - brown, free of organics below 0.8 m	0.46					
3	1.0				2	AS	0/0		152 mm borehole
4									
5	1.5		- free of gravel below 1.5 m		3	AS	0/0		
6				6.02					
7	2.0		Grey poorly graded SAND (SP) - moist - medium sand - trace gravel	1.98					Bentonite 0.3 to 0.8 m
8	2.5				4	AS	0/0		
9									
10	3.0				5	AS	0/0		Water level: 3.261 m 02-Dec-2021
11	3.5								
12									
13	4.0		- wet below 4.0 m		6	AS	140/200		
14									No. 2 silica sand 4.3 to6.1 m
15	4.5		- free of gravel below 4.7 m						
16									
17	5.0				7	AS	25/100		No. 10 Slot Schedule 40 PVC Screen 51 mm Diameter 0.9 to 2.4 m
18	5.5								
19					8	AS	0/0		
20	6.0			1.90					
			End of Borehole	6.10					

Screen Interval: 4.60 - 6.10 m BGS
Sand Pack Interval: 4.30 - 6.10 m BGS
Well Seal Interval: 0.30 - 4.30 m BGS

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
AS - auger sample
ppm - parts per million by volume
%LEL - percent lower explosive limit
n/a - not available

Stantec

Drawn By/Checked By: MR

Borehole: BH21-02

Project:	Pitt Meadows Affordable Housing and Childcare	**Method:**	Solid Stem Augers
Client:	Metro Vancouver Housing Corporation	**Date started/completed:**	26-Nov-2021
Location:	19125 119B Avenue, Pitt Meadows	**Ground surface elevation:**	8.00 m AMSL
Number:	123315738	**Top of casing elevation:**	n/a m AMSL
Field investigator:	SM	**Easting:**	n/a
Contractor:	Southland Drilling Co. Ltd.	**Northing:**	n/a

SUBSURFACE PROFILE				SAMPLE DETAILS		
Depth (ft)	Depth (m)	Graphic Log	Stratigraphic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	%LEL Comb▲ 20 40 60 80 / ppm OTOV ● Comb 200 400 600 800
			Ground Surface	8.00			
			TOPSOIL: organic sandy silt with rootlets	0.00 7.70			
1			FILL: sand with gravel	0.30 7.54	1	AS	0/0
2	0.5		Brown sandy SILT (ML) - moist - trace organics	0.46			
3	1.0				2	AS	0/0
4				6.78			
			Light brown SILTY SAND (SM) - moist - fine sand	1.22 6.48			
5	1.5		Brown poorly graded SAND (SP-SM) with silt - moist - medium sand - trace gravel	1.52	3	AS	0/100
6	2.0						
7							
8	2.5		- grey below 2.4 m		4	AS	0/0
9							
10	3.0						
11	3.5				5	AS	0/0
12							
13	4.0			4.00			
			Grey poorly graded SAND (SP) - wet - medium sand - trace gravel	4.00	6	AS	0/0
14							
15	4.5						
16			- free of gravel below 4.8 m				
17	5.0				7	AS	75/8
18	5.5						
19					8	AS	0/0
20	6.0			1.90			
			End of Borehole	6.10			

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
AS - auger sample
ppm - parts per million by volume
%LEL - percent lower explosive limit
n/a - not available

Stantec

Drawn By/Checked By: MR

Borehole: BH21-03

Project:	Pitt Meadows Affordable Housing and Childcare	**Method:**	Solid Stem Augers
Client:	Metro Vancouver Housing Corporation	**Date started/completed:**	26-Nov-2021
Location:	19125 119B Avenue, Pitt Meadows	**Ground surface elevation:**	7.50 m AMSL
Number:	123315738	**Top of casing elevation:**	n/a m AMSL
Field investigator:	SM	**Easting:**	n/a
Contractor:	Southland Drilling Co. Ltd.	**Northing:**	n/a

SUBSURFACE PROFILE				SAMPLE DETAILS		
Depth (ft)	Depth (m)	Graphic Log	Stratigraphic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	%LEL Comb. 20 40 60 80 / ppm OTOV Comb 200 400 600 800
			Ground Surface	7.50			
			FILL: gravel with sand	0.00 7.30	1	AS	0/0
1			Brown sandy SILT (ML) - moist - fine sand - trace gravel	0.20			
2	0.5						
3							
4	1.0				2	AS	0/0
5	1.5			5.98			
6			Brown poorly graded SAND (SP) - moist - fine sand	1.52	3	AS	0/0
7	2.0		- grey, medium sand below 2.0 m - trace gravel, 2.0 m to 3.7 m				
8	2.5				4	AS	0/0
9							
10	3.0						
11	3.5				5	AS	0/0
12			- wet below 3.7 m				
13	4.0				6	AS	0/0
14							
15	4.5						
16	5.0				7	AS	0/0
17							
18	5.5				8	AS	0/0
19							
20	6.0			1.40			
			End of Borehole	6.10			

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
AS - auger sample
ppm - parts per million by volume
%LEL - percent lower explosive limit
n/a - not available

Stantec

Drawn By/Checked By: MR

Monitoring Well: MW21-04

Project:	Pitt Meadows Affordable Housing and Childcare	**Method:**	Solid Stem Augers
Client:	Metro Vancouver Housing Corporation	**Date started/completed:**	26-Nov-2021
Location:	19125 119B Avenue, Pitt Meadows	**Ground surface elevation:**	7.50 m AMSL
Number:	123315738	**Top of casing elevation:**	7.40 m AMSL
Field investigator:	SM	**Easting:**	n/a
Contractor:	Southland Drilling Co. Ltd.	**Northing:**	n/a

Depth (ft)	Depth (m)	Graphic Log	Stratigraphic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	%LEL (Comb) 20 40 60 80 / ppm (OTOV, Comb) 200 400 600 800	Diagram	Description
			Ground Surface	7.50					
			FILL: gravel with sand	0.00 7.30	1	AS	0/8		Concrete seal, J-Plug, Road Box 0 - 0.3 m
1	0.5		Brown silty SAND (SM) - moist - fine sand - trace gravel	0.20 6.50					
3	1.0		Brown sandy SILT (ML) - moist - trace gravel	1.00 5.82	2	AS	5/8		152 mm borehole
6	2.0		Grey poorly graded SAND (SP) - moist - medium sand - trace gravel	1.68 5.30	3	AS	0/8		
8	2.5		Grey silty SAND (SM) - moist - medium sand - trace gravel	2.20 4.50	4	AS	0/8		Bentonite 0.3 to 0.8 m
10	3.0		Grey poorly graded SAND (SP-SM) with silt - moist - medium sand - trace gravel - wet below 3.2 m	3.00	5	AS	95/8		Water level: 3.034 m 02-Dec-2021
13	4.0				6	AS	0/8		No. 2 silica sand 4.3 to 6.1 m
16	5.0				7	AS	25/8		No. 10 Slot Schedule 40 PVC Screen 51 mm Diameter 0.9 to 2.4 m
18	5.5				8	AS	5/8		
19	6.0		Brown lean CLAY (CL) - moist	1.60 5.90 1.40					
20			End of Borehole	6.10					

Screen Interval: 4.60 - 6.10 m BGS
Sand Pack Interval: 4.30 - 6.10 m BGS
Well Seal Interval: 0.30 - 4.30 m BGS

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
AS - auger sample
ppm - parts per million by volume
%LEL - percent lower explosive limit
n/a - not available

Stantec

Drawn By/Checked By: MR

Borehole: BH21-05

Project:	Pitt Meadows Affordable Housing and Childcare	**Method:**	Solid Stem Augers
Client:	Metro Vancouver Housing Corporation	**Date started/completed:**	26-Nov-2021
Location:	19125 119B Avenue, Pitt Meadows	**Ground surface elevation:**	7.50 m AMSL
Number:	123315738	**Top of casing elevation:**	n/a m AMSL
Field investigator:	SM	**Easting:**	n/a
Contractor:	Southland Drilling Co. Ltd.	**Northing:**	n/a

SUBSURFACE PROFILE				SAMPLE DETAILS		
Depth (ft)	Depth (m)	Stratigraphic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	%LEL (Comb) 20 40 60 80 / ppm OTOV / Comb 200 400 600 800
		Ground Surface	7.50			
		FILL: gravel with sand	0.00			0/0
			7.30	1	AS	
1	0.5	Brown silty SAND (SM) - moist - fine sand - trace clay - trace organics to 0.6 m	0.20			
3	1.0			2	AS	0/0
5	1.5					
			5.70	3	AS	0/0
6	2.0	Grey poorly graded SAND (SP) - moist - medium sand - trace gravel	1.80			
8	2.5					
9				4	AS	0/0
10	3.0					
11	3.5	- wet below 3.4 m		5	AS	5/0
12						
13	4.0					
14				6	AS	20/8
15	4.5					
16	5.0					
17				7	AS	0/8
18	5.5					
19				8	AS	5/8
20	6.0		1.40			
		End of Borehole	6.10			

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
AS - auger sample
ppm - parts per million by volume
%LEL - percent lower explosive limit
n/a - not available

Stantec

Drawn By/Checked By: MR

Monitoring Well: MW21-06

Project:	Pitt Meadows Affordable Housing and Childcare	**Method:**	Solid Stem Augers
Client:	Metro Vancouver Housing Corporation	**Date started/completed:**	26-Nov-2021
Location:	19125 119B Avenue, Pitt Meadows	**Ground surface elevation:**	8.00 m AMSL
Number:	123315738	**Top of casing elevation:**	7.90 m AMSL
Field investigator:	SM	**Easting:**	n/a
Contractor:	Southland Drilling Co. Ltd.	**Northing:**	n/a

Depth (ft)	Depth (m)	Graphic Log	Stratigraphic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	%LEL / ppm (OTOV, Comb)	Diagram	Description
			Ground Surface	8.00					
			FILL: silty sand with organics	0.00	1	AS	0/0		Concrete seal, J-Plug, Road Box 0 - 0.3 m
				7.70					
1	0.5		Dark brown sandy SILT (ML) - moist - trace organics	0.30					
3	1.0				2	AS	0/0		152 mm borehole
				6.48					
5	1.5		Brown poorly graded SAND (SP) - moist - medium sand - trace gravel - grey, free of gravel below 1.8 m	1.52	3	AS	0/0		Bentonite 0.3 to 0.8 m
8	2.5				4	AS	0/0		
10	3.0								
11	3.5				5	AS	0/0		Water level: 3.272 m 02-Dec-2021
12			- brown, trace gravel, 3.7 m to 4.3 m						No. 2 silica sand 3.5 to 5.8 m
13	4.0		- wet below 4.0 m		6	AS	0/0		
15	4.5								No. 10 Slot Schedule 40 PVC Screen 51 mm Diameter 0.9 to 2.4 m
16	5.0				7	AS	0/0		
18	5.5								No. 2 silica sand 2.4 to 2.8 m
19	6.0				8	AS	0/0		Bentonite seal 2.8 to 6.1 m
20				1.90					
			End of Borehole	6.10					

Screen Interval: 3.70 - 5.50 m BGS
Sand Pack Interval: 3.40 - 5.80 m BGS
Well Seal Interval: 0.30 - 3.40 m BGS

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
AS - auger sample
ppm - parts per million by volume
%LEL - percent lower explosive limit
n/a - not available

Stantec

Drawn By/Checked By: MR

Sheet 1 of 1

STANTEC BOREHOLE AND WELL V2 123315738_220124_ENV_BH_LOGS.GPJ STANTEC - DATA TEMPLATE.GDT 1/28/22 SMCBRIDE

Borehole: BH21-07

Project:	Pitt Meadows Affordable Housing and Childcare	**Method:**	Solid Stem Augers
Client:	Metro Vancouver Housing Corporation	**Date started/completed:**	29-Nov-2021
Location:	19125 119B Avenue, Pitt Meadows	**Ground surface elevation:**	8.00 m AMSL
Number:	123315738	**Top of casing elevation:**	n/a m AMSL
Field investigator:	SM	**Easting:**	n/a
Contractor:	Conetec Investigations Ltd.	**Northing:**	n/a

SUBSURFACE PROFILE				SAMPLE DETAILS	
Depth (ft)	Depth (m)	Graphic Log	Stratigraphic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type
			Ground Surface	8.00		
			FILL: silty sand with gravel	0.00		
				7.70		
1			Dark brown sandy SILT (ML) - moist - trace organics	0.30	1	AS
	0.5			7.40		
2			Brown SILTY SAND (SM) - moist - fine sand	0.60		
3	1.0				2	AS
4						
5	1.5			6.48		
			Grey poorly graded SAND (SP) - moist - medium sand - trace gravel - trace silt	1.52		
6					3	AS
7	2.0					
8					4	AS
9	2.5					
10						
11	3.0					
12	3.5		- free of gravel below 3.7 m		5	AS
13						
14	4.0		- wet below 4.0 m			
15	4.5					
16						
17	5.0				6	AS
18	5.5					
19						
20	6.0			1.90		
			End of Borehole	6.10		

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
AS - auger sample
n/a - not available

Stantec

Drawn By/Checked By: MR

Borehole: BH21-08

Project:	Pitt Meadows Affordable Housing and Childcare	**Method:**	Solid Stem Augers
Client:	Metro Vancouver Housing Corporation	**Date started/completed:**	29-Nov-2021
Location:	19125 119B Avenue, Pitt Meadows	**Ground surface elevation:**	7.50 m AMSL
Number:	123315738	**Top of casing elevation:**	n/a m AMSL
Field investigator:	SM	**Easting:**	n/a
Contractor:	Conetec Investigations Ltd.	**Northing:**	n/a

SUBSURFACE PROFILE				SAMPLE DETAILS	
Depth (ft)	Depth (m)	Graphic Log	Stratigraphic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number / Sample Type
			Ground Surface	7.50	
			FILL: grey gravel with sand	0.00	
				7.35	
1			Light brown SILTY SAND (SM) - moist - fine sand	0.15	
2	0.5				1 AS
3				6.59	
	1.0		Grey poorly graded SAND (SP) - moist - medium sand - trace gravel - trace silt	0.91	2 AS
4					
5	1.5				
6					
	2.0				3 AS
7					
8	2.5				
9					
10	3.0				
11			- wet below 3.4 m		
	3.5				4 AS
12					
13	4.0				
14					
15	4.5				
16					
	5.0				
17					
18	5.5				5 AS
19					
	6.0				
20				1.40	
			End of Borehole	6.10	

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
AS - auger sample
n/a - not available

Stantec

Drawn By/Checked By: MR

Borehole: BH21-09

Project:	Pitt Meadows Affordable Housing and Childcare	**Method:**	Solid Stem Augers
Client:	Metro Vancouver Housing Corporation	**Date started/completed:**	29-Nov-2021
Location:	19125 119B Avenue, Pitt Meadows	**Ground surface elevation:**	7.50 m AMSL
Number:	123315738	**Top of casing elevation:**	n/a m AMSL
Field investigator:	SM	**Easting:**	n/a
Contractor:	Conetec Investigations Ltd.	**Northing:**	n/a

SUBSURFACE PROFILE				SAMPLE DETAILS		
Depth (ft)	Depth (m)	Graphic Log	Stratigraphic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	%LEL Comb▲ 20 40 60 80 / ppm OTOV ● Comb 200 400 600 800
			Ground Surface	7.50			
			ASPHALT	0.00 7.32			
1	0.5		FILL: gravel with sand	0.18 6.89	1	AS	0/8
2			Brown silty SAND (SM) - moist - fine sand	0.61			
3	1.0			6.28	2	AS	0/8
4			Grey poorly graded SAND (SP) - moist - medium sand - trace gravel	1.22			
5	1.5						
6							
7	2.0				3	AS	0/8
8	2.5						
9							
10	3.0		- wet below 3.0 m				
11							
12	3.5				4	AS	610/8
13	4.0						
14							
15	4.5						
16							
17	5.0						
18	5.5						
19							
20	6.0			1.40			
			End of Borehole	6.10			

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
AS - auger sample
ppm - parts per million by volume
%LEL - percent lower explosive limit
n/a - not available

Stantec

Drawn By/Checked By: MR

Borehole: BH21-10

Project:	Pitt Meadows Affordable Housing and Childcare	**Method:**	Solid Stem Augers
Client:	Metro Vancouver Housing Corporation	**Date started/completed:**	29-Nov-2021
Location:	19125 119B Avenue, Pitt Meadows	**Ground surface elevation:**	7.50 m AMSL
Number:	123315738	**Top of casing elevation:**	n/a m AMSL
Field investigator:	SM	**Easting:**	n/a
Contractor:	Conetec Investigations Ltd.	**Northing:**	n/a

SUBSURFACE PROFILE				SAMPLE DETAILS		
Depth (ft)	Depth (m)	Graphic Log	Stratigraphic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	%LEL Comb▲ 20 40 60 80 / ppm OTOV ● Comb 200 400 600 800
			Ground Surface	7.50			
			ASPHALT	0.00			
			FILL: gravel with sand	7.35			
1				0.15			
				7.04			
2	0.5		Brown poorly graded SAND (SP) - moist - fine sand	0.46	1	AS	0/0 ▲
3	1.0		- grey, medium sand, trace gravel and silt below 0.9 m				
4					2	AS	0/8 ●
5	1.5						
6							
7	2.0				3	AS	0/8 ●
8	2.5						
9							
10	3.0						
11			- wet below 3.4 m				
12	3.5						
13							
14	4.0						
15							
16	4.5						
17	5.0						
18							
19	5.5						
20	6.0			1.40			
			End of Borehole	6.10			

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
AS - auger sample
ppm - parts per million by volume
%LEL - percent lower explosive limit
n/a - not available

Stantec

Drawn By/Checked By: MR

APPENDIX C
HYDRAULIC CONDUCTIVITY TESTS

Appendix C HYDRAULIC CONDUCTIVITY TEST

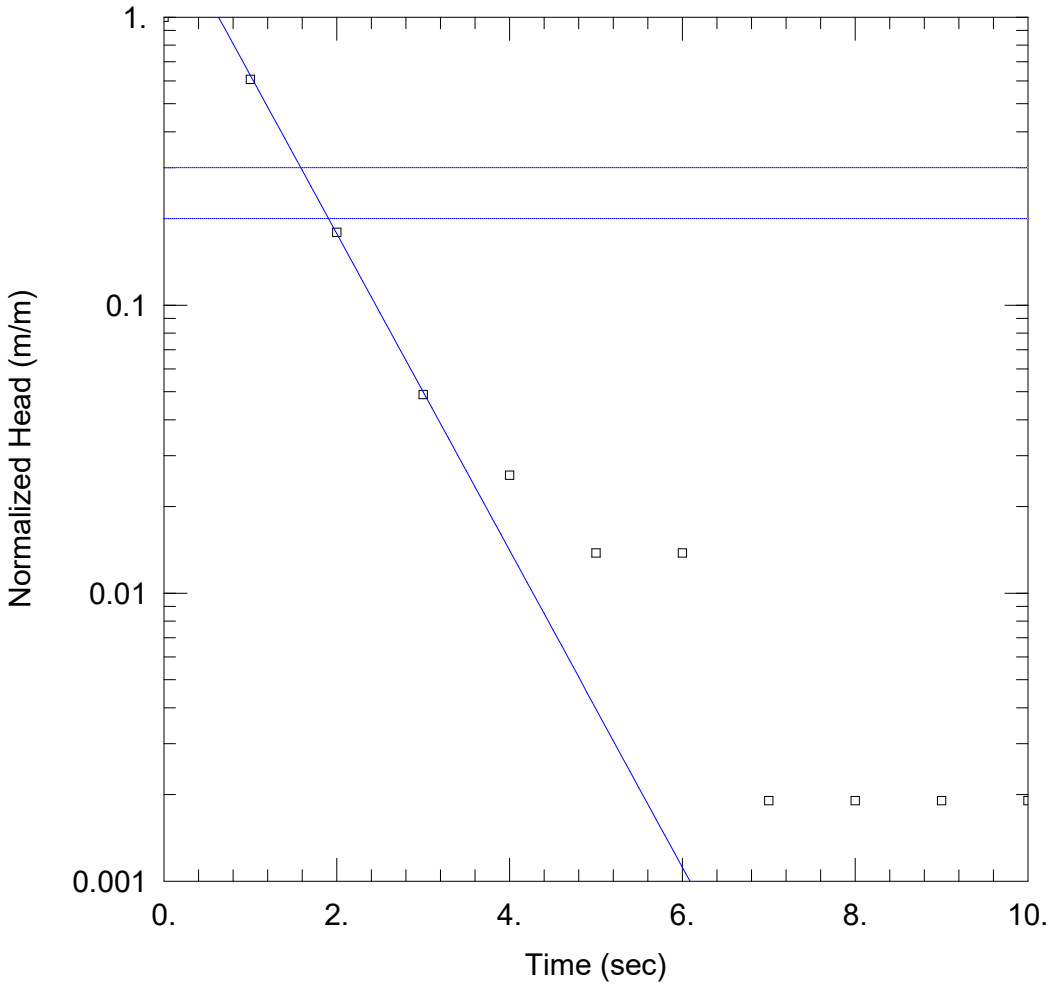
Table C.1. Rising Head Hydraulic Conductivity Test Results

Well ID	Test	Initial Displacement H(0)		Analysis Results								Test Confidence
				Bouwer and Rice (1976)		Cooper et al. (1967)				Hyder et al. (1994)		
		Expected	Recorded	K (m/s)	y(0)	T (m2/s)	K (m/s @ b = 10 m)	S (-)	Ss (/m)	Kr (m/s)	KGS (Ss)	
MW21-01	Test1	0.50	0.15	4.65E-04	0.33	3.87E-03	3.87E-04	1.00E-10	1.00E-11	4.87E-04	3.27E-04	**Low**: H(0) Recorded inconsistent with expected, limited measurements to fit analytical solution.
	Test2	0.50	0.36	5.34E-04	0.23	3.93E-03	3.93E-04	2.70E-04	2.70E-05	1.43E-03	0.00433	**Low**: Limited measurements to fit analytical solution.
	Test3	0.50	0.15	2.93E-04	0.15	1.61E-03	1.61E-04	9.44E-06	9.44E-07	1.12E-03	5.50E-02	**Low**: H(0) Recorded inconsistent with expected, limited measurements to fit analytical solution.
MW21-04	Test1	0.50	0.39	1.94E-04	0.50	1.67E-03	1.67E-04	4.70E-10	4.70E-11	2.41E-04	8.26E-04	**Moderate**: Recorded H(0) reasonably consistent with expected H(0). Sufficent data to fit analytical curve.
	Test2	0.50	0.46	1.94E-04	0.40	2.13E-03	2.13E-04	1.60E-10	1.60E-11	2.93E-04	7.16E-04	**Moderate**: Recorded H(0) reasonably consistent with expected H(0). Sufficent data to fit analytical curve.
	Test3	0.50	0.54	2.56E-04	0.55	2.40E-03	2.40E-04	1.00E-10	1.00E-11	3.31E-04	1.02E-03	**Moderate**: Recorded H(0) reasonably consistent with expected H(0). Sufficent data to fit analytical curve.
MW21-06	Test1	0.50	0.36	1.17E-04	0.36	2.44E-04	2.44E-05	3.85E-03	3.85E-04	1.01E-04	0.00925	**Moderate**: Recorded H(0) reasonably consistent with expected H(0). Sufficent data to fit analytical curve.
	Test2	0.50	0.74	1.69E-04	0.34	4.31E-04	4.31E-05	3.55E-02	3.55E-03	2.48E-04	3.55E-02	**Moderate**: Recorded H(0) somewhat consistent with expected H(0). Sufficent data to fit analytical curve.
	Test3	0.50	0.25	8.08E-05	0.17	1.58E-04	1.58E-05	2.11E-02	2.11E-03	1.04E-04	1.00E-02	**Moderate**: Recorded H(0) somewhat consistent with expected H(0). Sufficent data to fit analytical curve.

NOTES:

1. Parameters: Initial Displacement H(0) is water level change from bailer extraction; K is hydraulic conductivity; y(0) is effective initial displacement; T is transmissivity; S is storativity; Ss is storage coefficient; Kr is radial hyraulic conductivity.
2. Rising head tests analyzed using Bouwer and Rice (1976), Cooper et al. (1967), and Hyder et al. (1994) analytical solutions following Butler (2020).

3. Butler J.J., 2020. The Design, Performance, and Analysis of Slug Tests, 2nd Edition. Taylor and Francis Group 6000 Broken Sound Parkway NW, Suite 300 Boca Raton, FL 33487-2742.
4. Bouwer H., and R.C. Rice. 1976. A slug test for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells. Water Resour. Res. 12(3); 423-428.
5. Cooper ,H.H., J. D. Bredehoeft, I. S. Papadopolus. 1967. Response of a finite-diameter well to an instantaneous charge of water. Water Resour. Res. 3(1); 263-269.
6. Hyder, Z., J.J. Butler, C.D. McElwee, W.Z. Liu. 1994 Slug tests in partially penetrating wells. Water Resour. Res. 30(11):2945-2957.



RISING HEAD TESTS

Data Set: C:\...\MW21-01_test1_BR.aqt
Date: 01/20/22 Time: 12:48:13

PROJECT INFORMATION

Company: Stantec
Client: Metro Vancouver Housing Corp
Project: 123315738
Location: Pitt Meadows
Test Well: MW21-01
Test Date: 2021-12-02

AQUIFER DATA

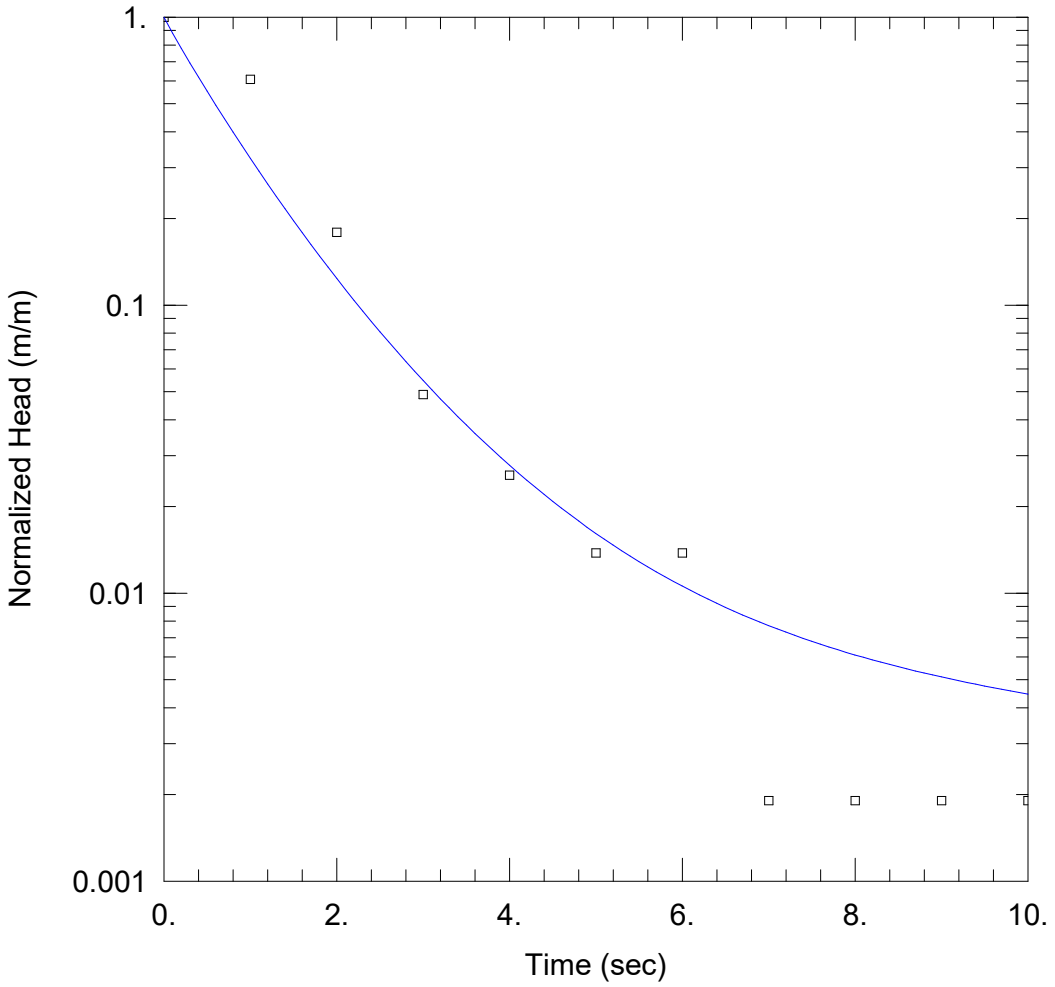
Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW21-01)

Initial Displacement: 0.148 m Static Water Column Height: 2.844 m
Total Well Penetration Depth: 2.844 m Screen Length: 1.5 m
Casing Radius: 0.0246 m Well Radius: 0.1 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice
K = 0.000465 m/sec y0 = 0.3293 m



RISING HEAD TESTS

Data Set: C:\...\MW21-01_test1_CBP.aqt
Date: 01/20/22 Time: 12:48:32

PROJECT INFORMATION

Company: Stantec
Client: Metro Vancouver Housing Corp
Project: 123315738
Location: Pitt Meadows
Test Well: MW21-01
Test Date: 2021-12-02

AQUIFER DATA

Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

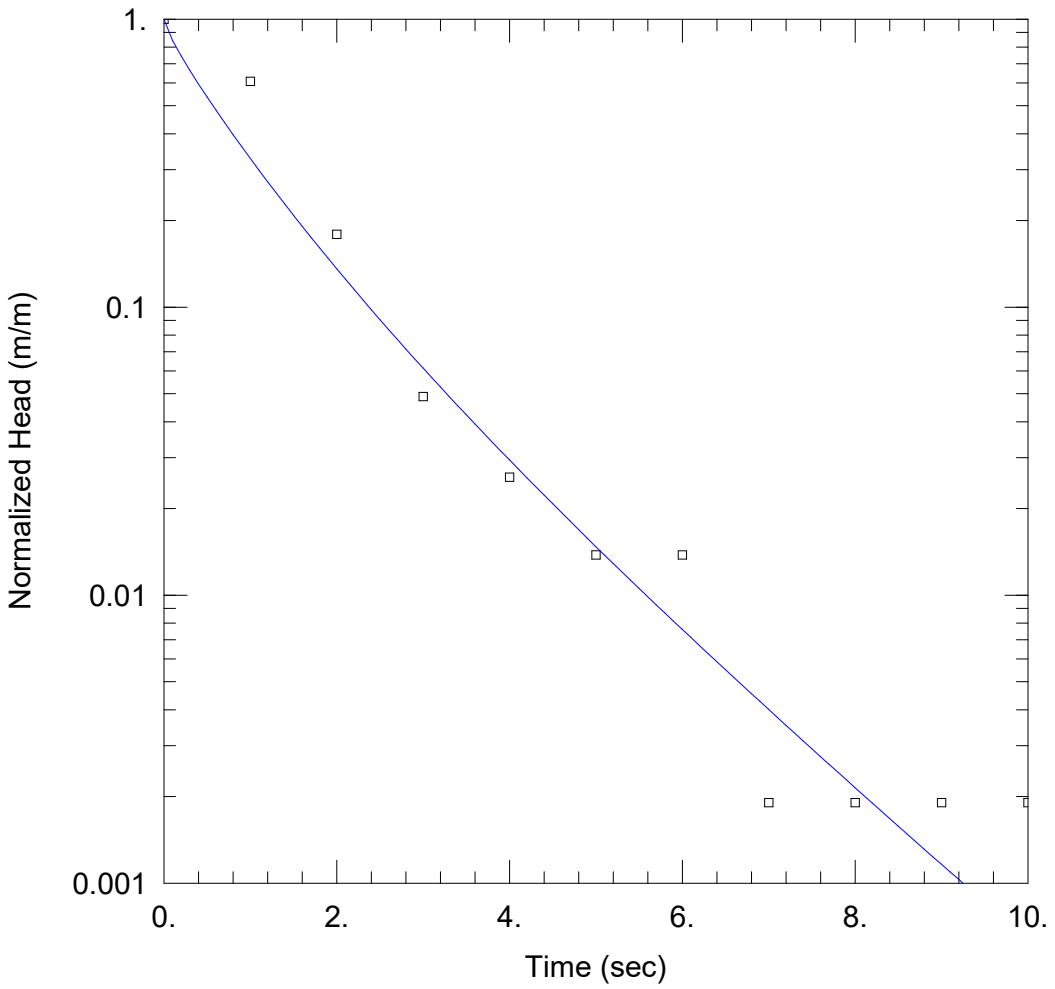
WELL DATA (MW21-01)

Initial Displacement: 0.148 m
Total Well Penetration Depth: 2.844 m
Casing Radius: 0.0246 m
Static Water Column Height: 2.844 m
Screen Length: 1.5 m
Well Radius: 0.1 m

SOLUTION

Aquifer Model: Confined
Solution Method: Cooper-Bredehoeft-Papadopulos

T = 0.003868 m^2/sec
S = 1.0E-10



RISING HEAD TESTS

Data Set: C:\...\MW21-01_test1_KGS.aqt
Date: 01/20/22 Time: 12:47:52

PROJECT INFORMATION

Company: Stantec
Client: Metro Vancouver Housing Corp
Project: 123315738
Location: Pitt Meadows
Test Well: MW21-01
Test Date: 2021-12-02

AQUIFER DATA

Saturated Thickness: 10. m

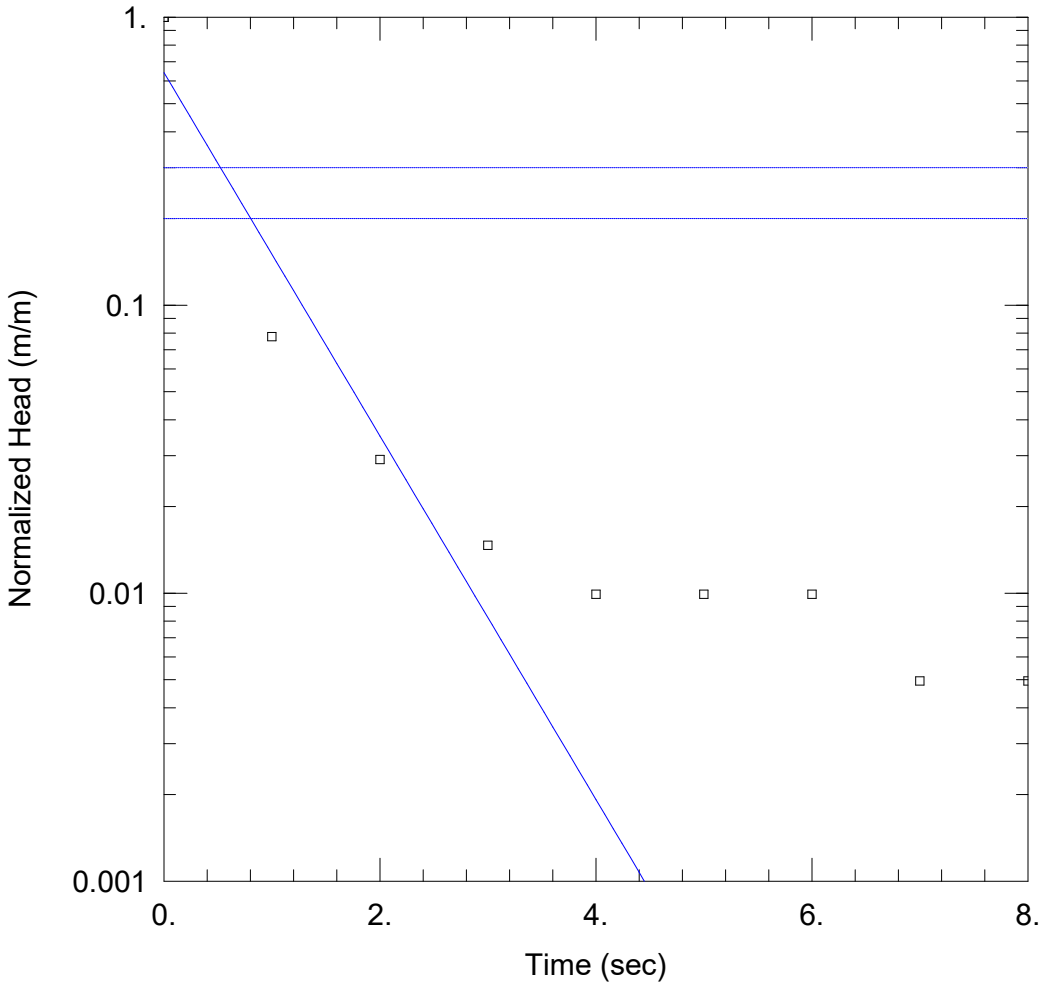
WELL DATA (MW21-01)

Initial Displacement: 0.148 m
Total Well Penetration Depth: 2.844 m
Casing Radius: 0.0246 m
Static Water Column Height: 2.844 m
Screen Length: 1.5 m
Well Radius: 0.1 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.0004869 m/sec
Ss = 0.0003273 m^{-1}
Kz/Kr = 1



RISING HEAD TESTS

Data Set: C:\...\MW21-01_test2_BR.aqt
Date: 01/20/22 Time: 12:58:13

PROJECT INFORMATION

Company: Stantec
Client: Metro Vancouver Housing Corp
Project: 123315738
Location: Pitt Meadows
Test Well: MW21-01
Test Date: 2021-12-02

AQUIFER DATA

Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

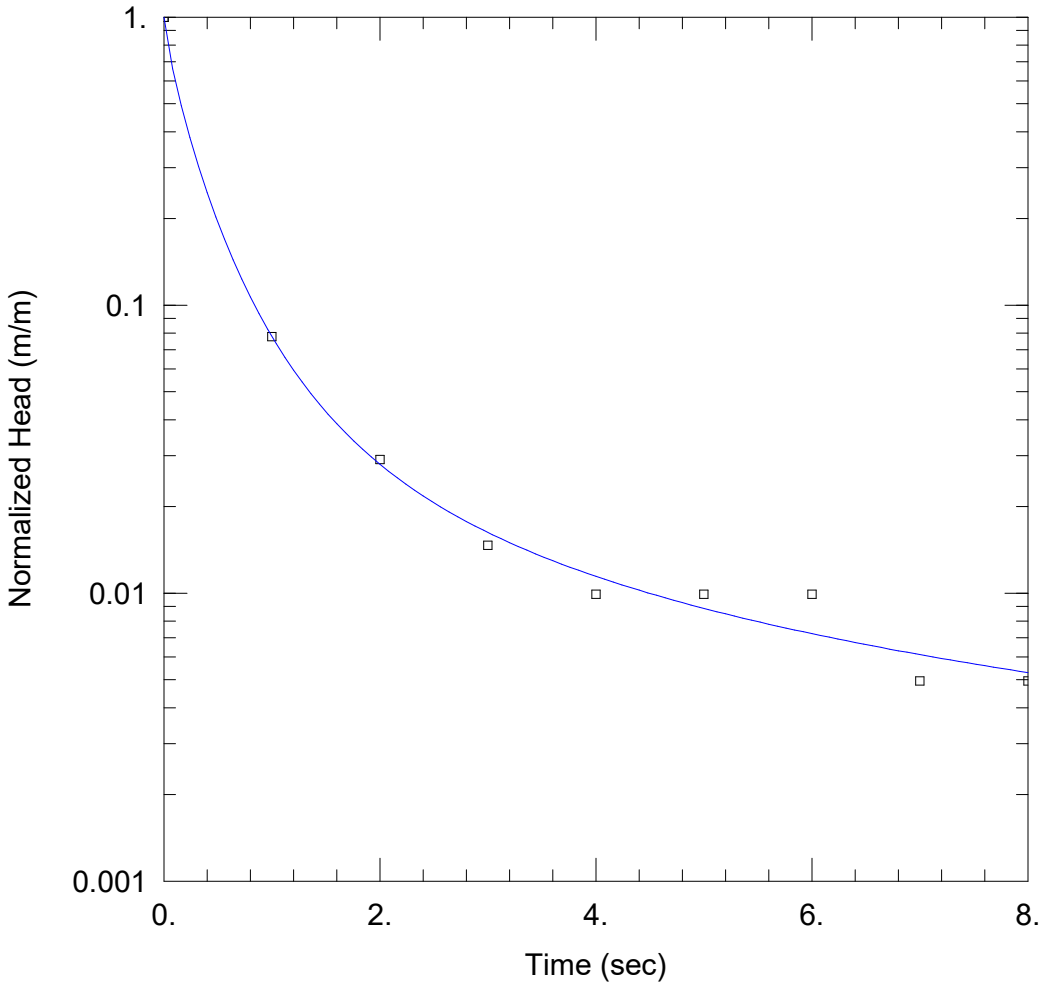
WELL DATA (MW21-01)

Initial Displacement: 0.355 m Static Water Column Height: 2.844 m
Total Well Penetration Depth: 2.844 m Screen Length: 1.5 m
Casing Radius: 0.0246 m Well Radius: 0.1 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0005339 m/sec y0 = 0.2278 m



RISING HEAD TESTS

Data Set: C:\...\MW21-01_test2_CBP.aqt
Date: 01/20/22 Time: 12:59:09

PROJECT INFORMATION

Company: Stantec
Client: Metro Vancouver Housing Corp
Project: 123315738
Location: Pitt Meadows
Test Well: MW21-01
Test Date: 2021-12-02

AQUIFER DATA

Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

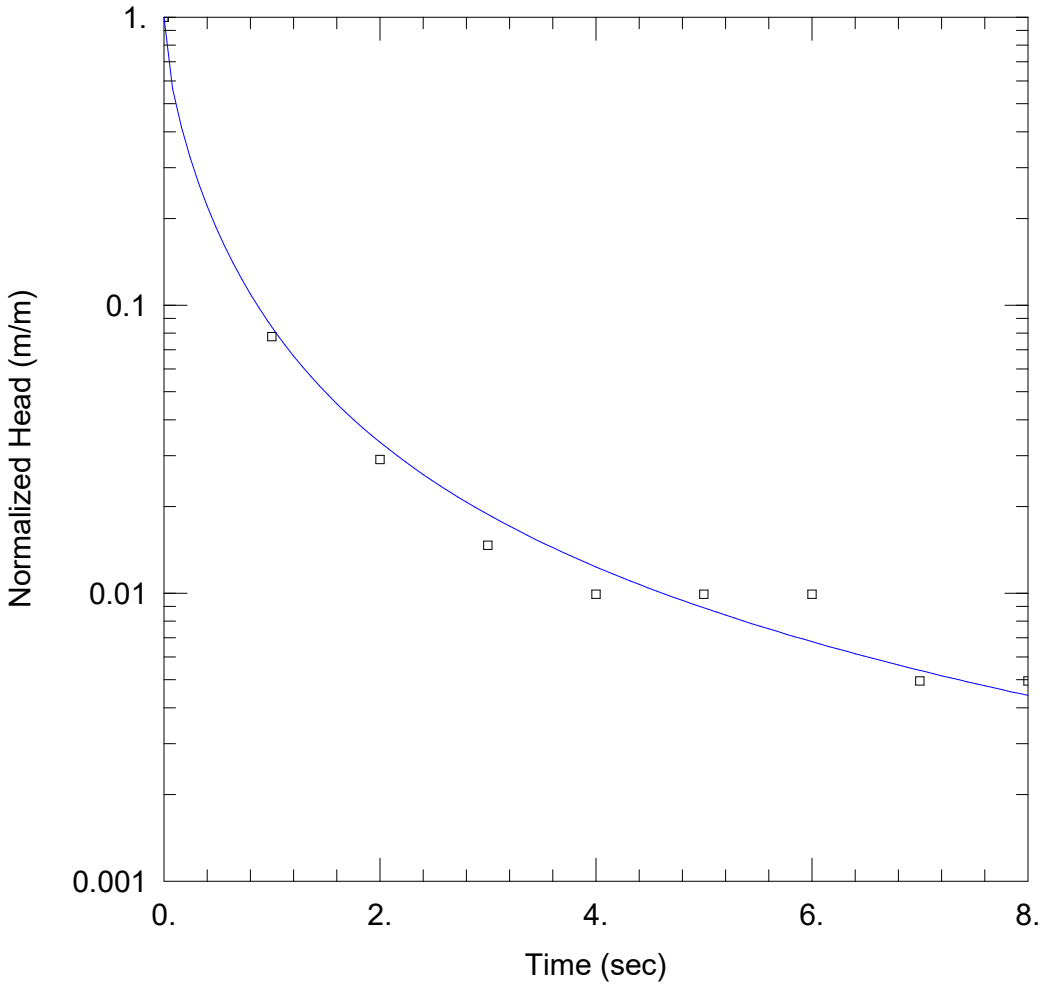
WELL DATA (MW21-01)

Initial Displacement: 0.355 m
Total Well Penetration Depth: 2.844 m
Casing Radius: 0.0246 m
Static Water Column Height: 2.844 m
Screen Length: 1.5 m
Well Radius: 0.1 m

SOLUTION

Aquifer Model: Confined
Solution Method: Cooper-Bredehoeft-Papadopulos

T = 0.003928 m^2/sec
S = 0.0002703



RISING HEAD TESTS

Data Set: C:\...\MW21-01_test2_KGS.aqt
Date: 01/20/22 Time: 13:00:41

PROJECT INFORMATION

Company: Stantec
Client: Metro Vancouver Housing Corp
Project: 123315738
Location: Pitt Meadows
Test Well: MW21-01
Test Date: 2021-12-02

AQUIFER DATA

Saturated Thickness: 10. m

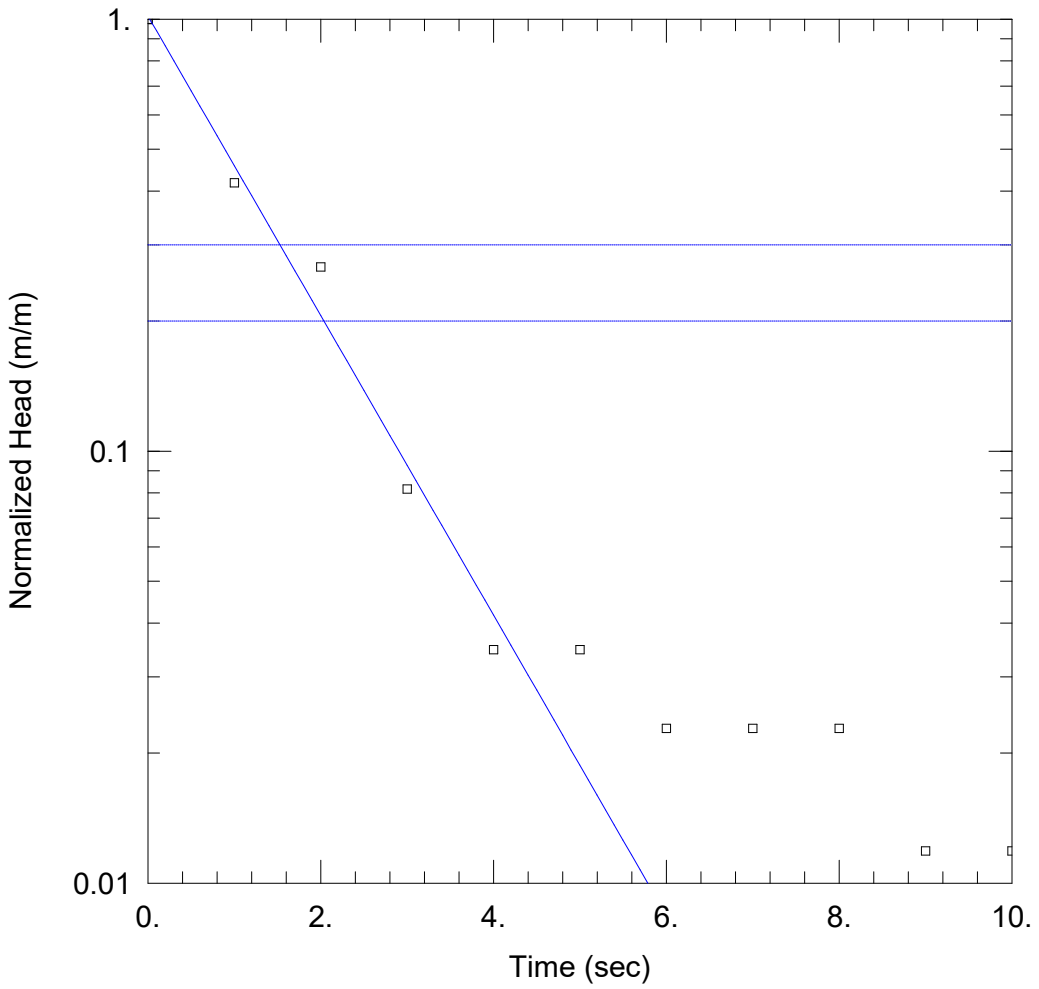
WELL DATA (MW21-01)

Initial Displacement: 0.355 m
Total Well Penetration Depth: 2.844 m
Casing Radius: 0.0246 m
Static Water Column Height: 2.844 m
Screen Length: 1.5 m
Well Radius: 0.1 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.001426 m/sec
Ss = 0.004334 m^{-1}
Kz/Kr = 0.2692



RISING HEAD TESTS

Data Set: C:\...\MW21-01_test3_BR.aqt
Date: 01/20/22 Time: 13:04:55

PROJECT INFORMATION

Company: Stantec
Client: Metro Vancouver Housing Corp
Project: 123315738
Location: Pitt Meadows
Test Well: MW21-01
Test Date: 2021-12-02

AQUIFER DATA

Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

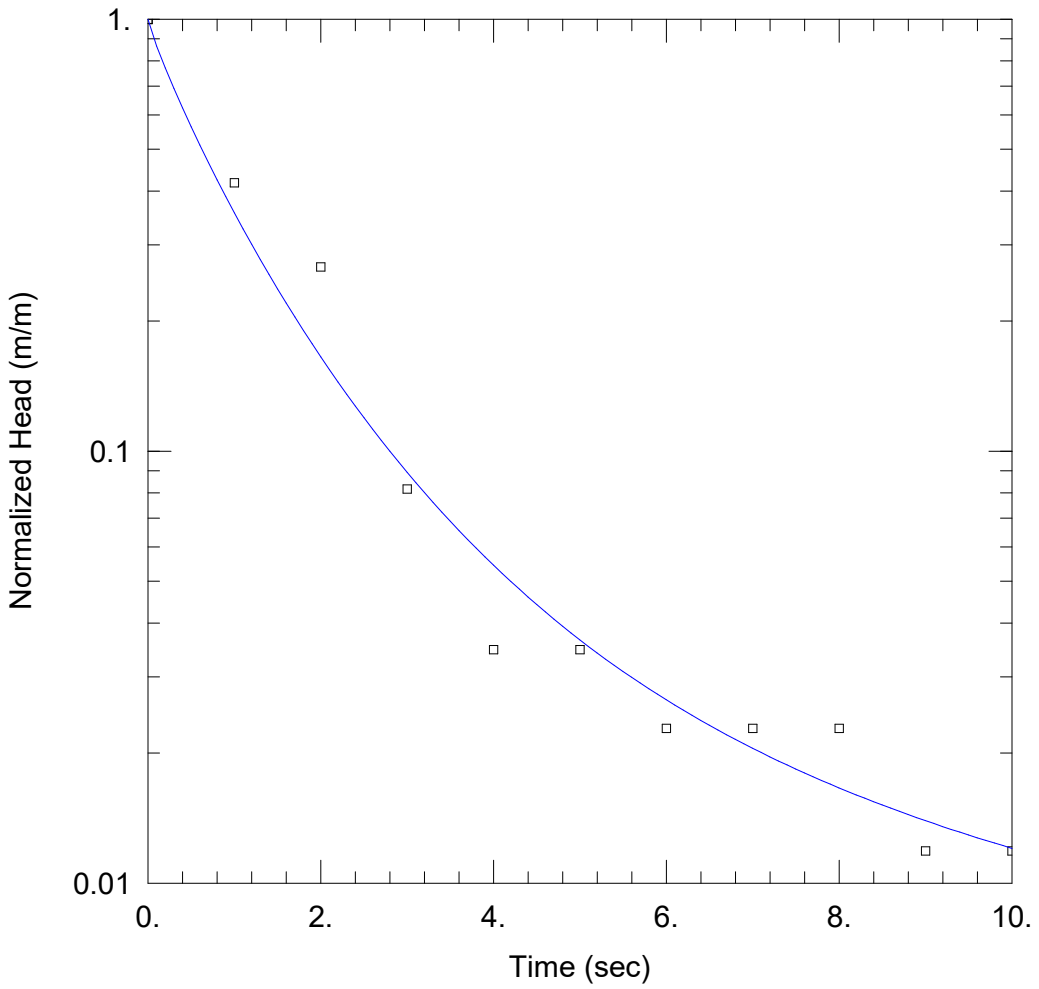
WELL DATA (MW21-01)

Initial Displacement: 0.148 m
Total Well Penetration Depth: 2.844 m
Casing Radius: 0.0246 m
Static Water Column Height: 2.844 m
Screen Length: 1.5 m
Well Radius: 0.1 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.0002934 m/sec
y0 = 0.1505 m



RISING HEAD TESTS

Data Set: C:\...\MW21-01_test3_CBP.aqt
Date: 01/20/22 Time: 13:09:01

PROJECT INFORMATION

Company: Stantec
Client: Metro Vancouver Housing Corp
Project: 123315738
Location: Pitt Meadows
Test Well: MW21-01
Test Date: 2021-12-02

AQUIFER DATA

Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

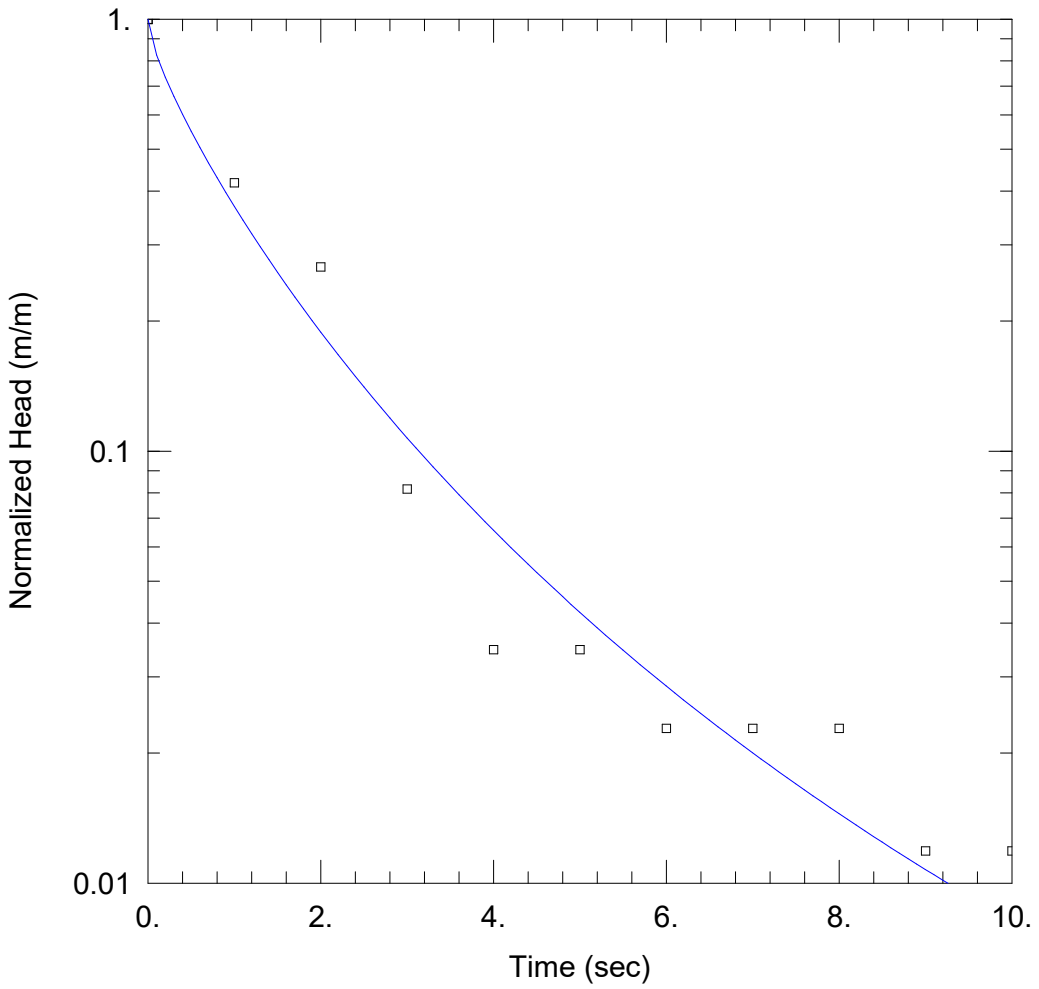
WELL DATA (MW21-01)

Initial Displacement: 0.148 m
Total Well Penetration Depth: 2.844 m
Casing Radius: 0.0246 m
Static Water Column Height: 2.844 m
Screen Length: 1.5 m
Well Radius: 0.1 m

SOLUTION

Aquifer Model: Confined
Solution Method: Cooper-Bredehoeft-Papadopulos

T = 0.001612 m^2/sec
S = 9.441E-6



RISING HEAD TESTS

Data Set: C:\...\MW21-01_test3_KGS.aqt
Date: 01/20/22 Time: 13:07:46

PROJECT INFORMATION

Company: Stantec
Client: Metro Vancouver Housing Corp
Project: 123315738
Location: Pitt Meadows
Test Well: MW21-01
Test Date: 2021-12-02

AQUIFER DATA

Saturated Thickness: 10. m

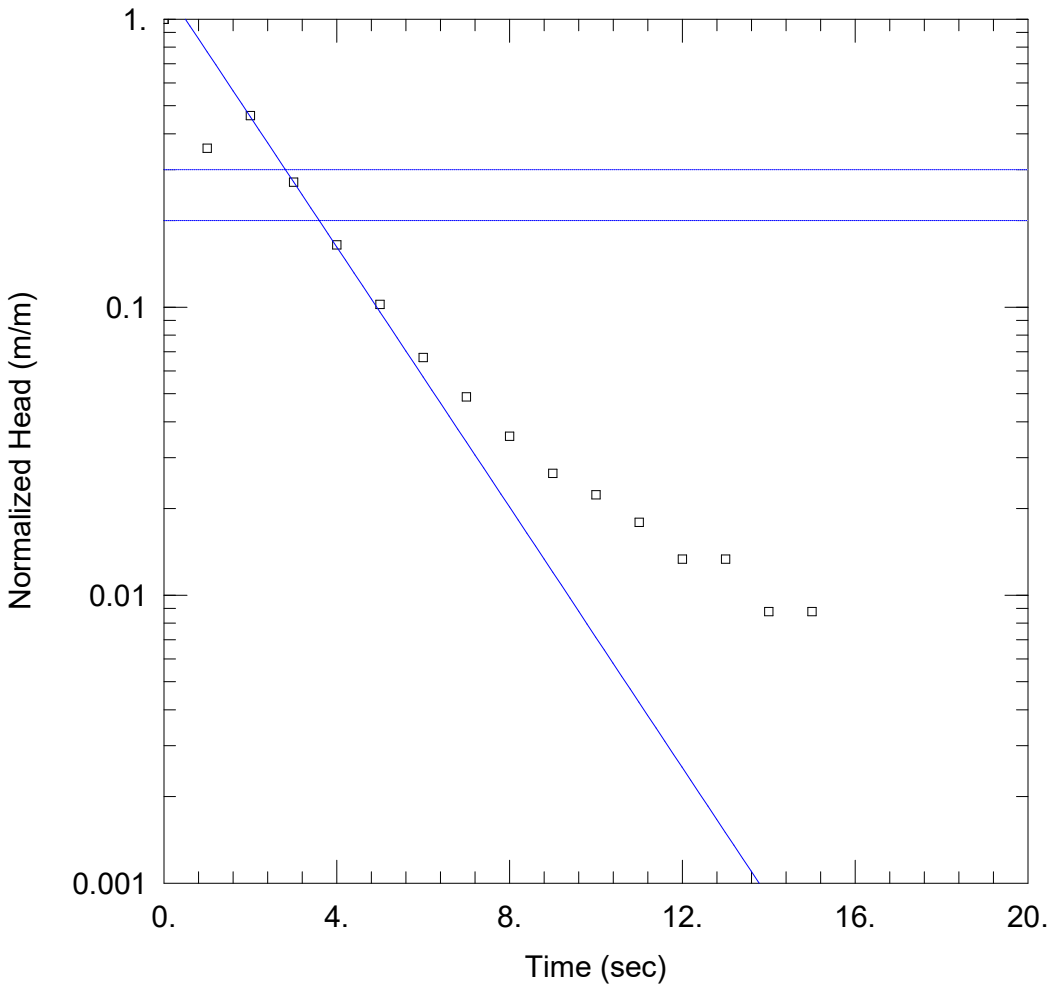
WELL DATA (MW21-01)

Initial Displacement: 0.148 m
Total Well Penetration Depth: 2.844 m
Casing Radius: 0.0246 m
Static Water Column Height: 2.844 m
Screen Length: 1.5 m
Well Radius: 0.1 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.0003694 m/sec
Ss = 0.001084 m^{-1}
Kz/Kr = 1



RISING HEAD TESTS

Data Set: C:\...\MW21-04_test1_BR.aqt
Date: 01/20/22 Time: 12:06:44

PROJECT INFORMATION

Company: Stantec
Client: Metro Vancouver Housing Corp
Project: 123315738
Location: Pitt Meadows
Test Well: MW21-01
Test Date: 2021-12-02

AQUIFER DATA

Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

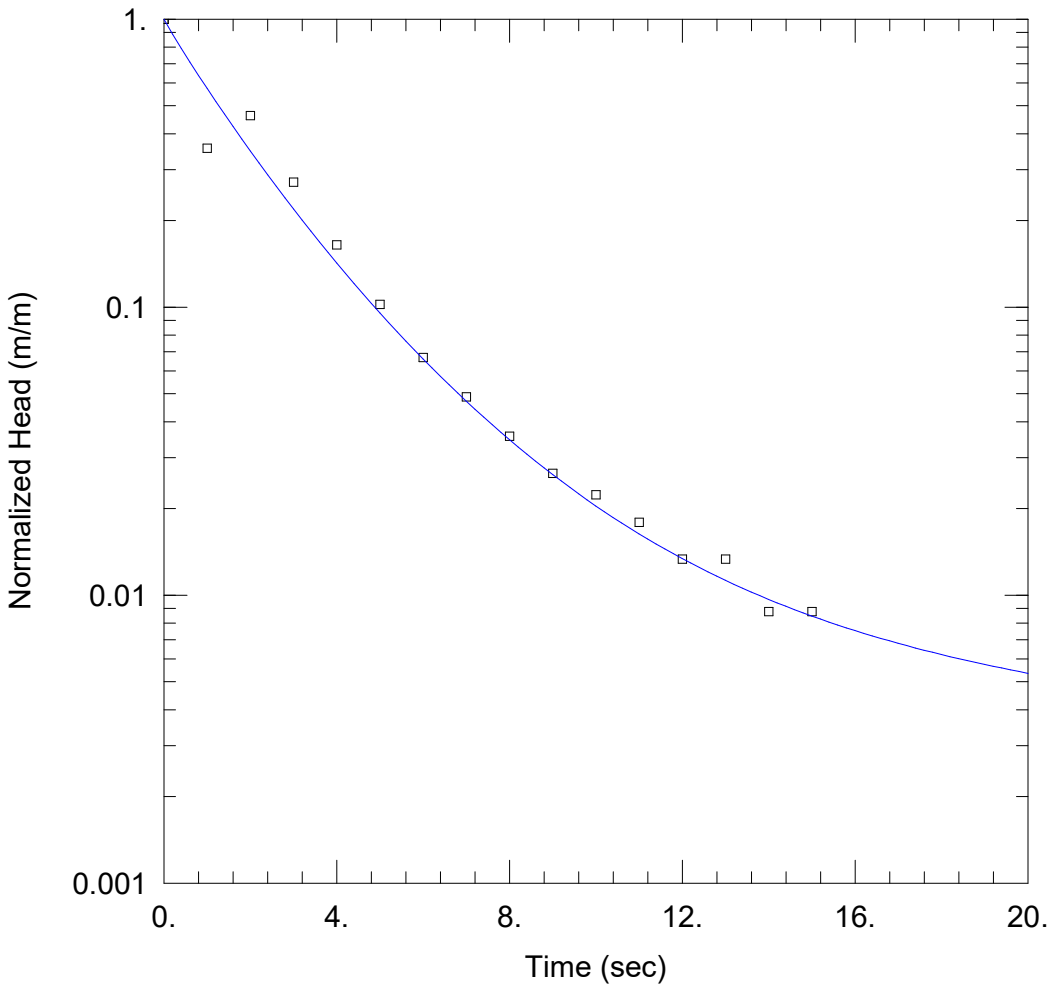
WELL DATA (MW21-04)

Initial Displacement: 0.385 m Static Water Column Height: 3.069 m
Total Well Penetration Depth: 3.069 m Screen Length: 1.5 m
Casing Radius: 0.0246 m Well Radius: 0.1 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0001939 m/sec y0 = 0.4984 m



RISING HEAD TESTS

Data Set: C:\...\MW21-04_test1_CBP.aqt
Date: 01/20/22 Time: 12:09:22

PROJECT INFORMATION

Company: Stantec
Client: Metro Vancouver Housing Corp
Project: 123315738
Location: Pitt Meadows
Test Well: MW21-01
Test Date: 2021-12-02

AQUIFER DATA

Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

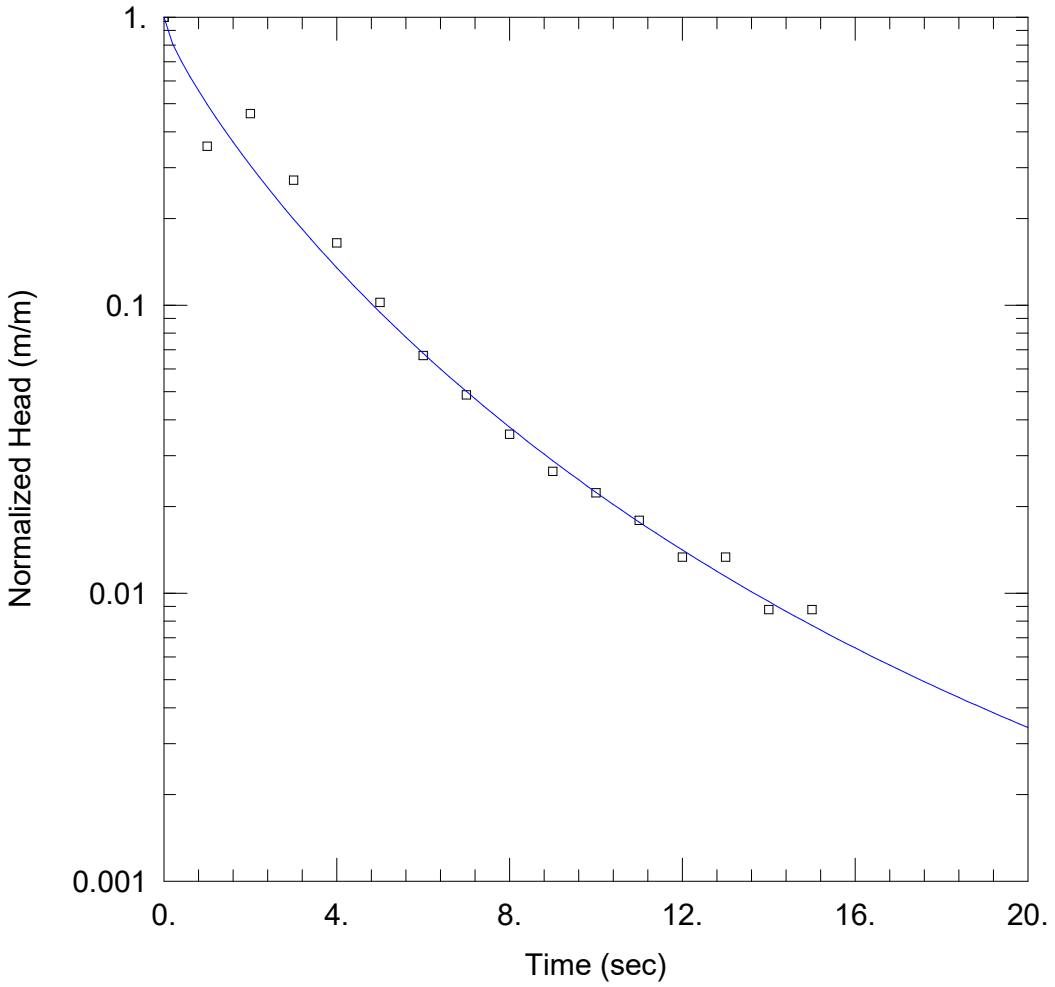
WELL DATA (MW21-04)

Initial Displacement: 0.385 m Static Water Column Height: 3.069 m
Total Well Penetration Depth: 3.069 m Screen Length: 1.5 m
Casing Radius: 0.0246 m Well Radius: 0.1 m

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Bredehoeft-Papadopulos

T = 0.001665 m^2/sec S = 4.7E-10



RISING HEAD TESTS

Data Set: C:\...\MW21-04_test1_KGS.aqt
Date: 01/20/22 Time: 12:11:05

PROJECT INFORMATION

Company: Stantec
Client: Metro Vancouver Housing Corp
Project: 123315738
Location: Pitt Meadows
Test Well: MW21-01
Test Date: 2021-12-02

AQUIFER DATA

Saturated Thickness: 10. m

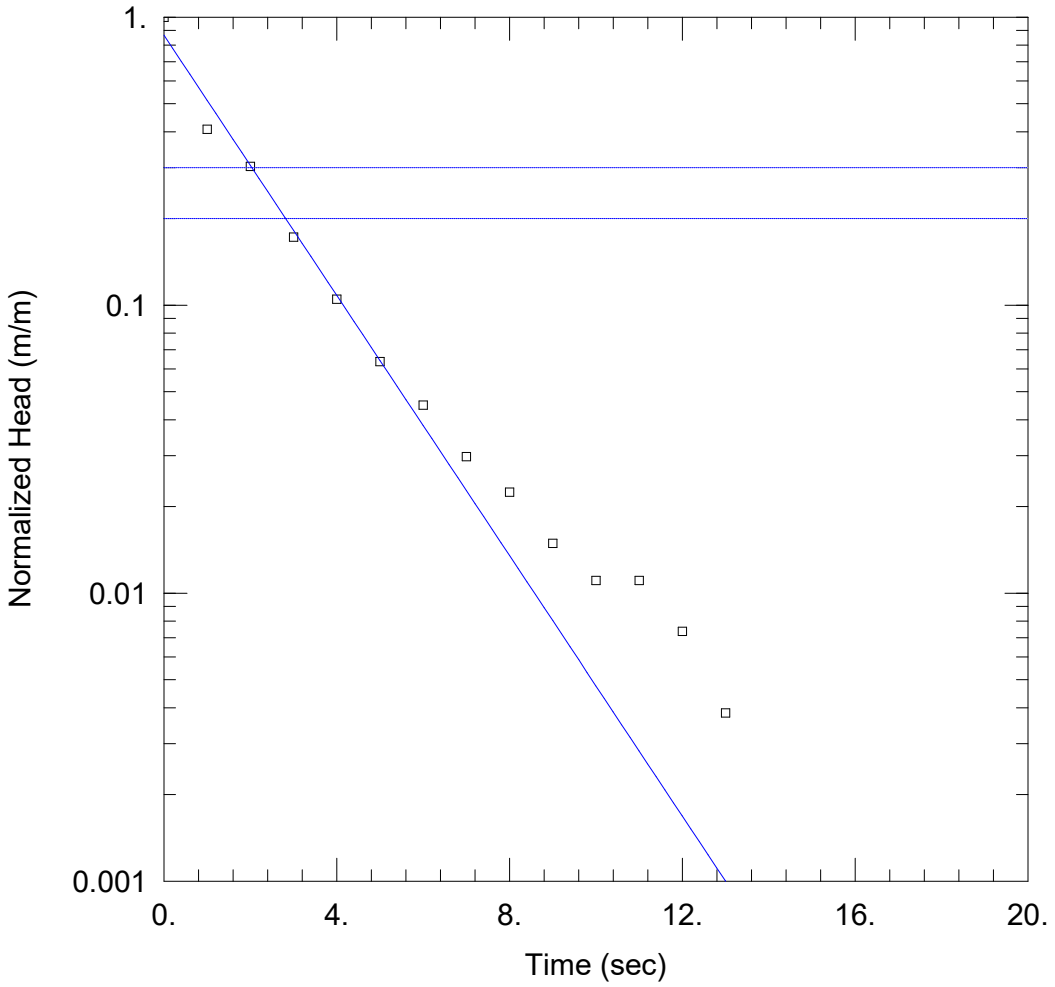
WELL DATA (MW21-04)

Initial Displacement: 0.385 m
Total Well Penetration Depth: 3.069 m
Casing Radius: 0.0246 m
Static Water Column Height: 3.069 m
Screen Length: 1.5 m
Well Radius: 0.1 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.0002407 m/sec
Ss = 0.0008261 m^{-1}
Kz/Kr = 1



RISING HEAD TESTS

Data Set: C:\...\MW21-04_test2_BR.aqt
Date: 01/20/22 Time: 12:14:47

PROJECT INFORMATION

Company: Stantec
Client: Metro Vancouver Housing Corp
Project: 123315738
Location: Pitt Meadows
Test Well: MW21-01
Test Date: 2021-12-02

AQUIFER DATA

Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

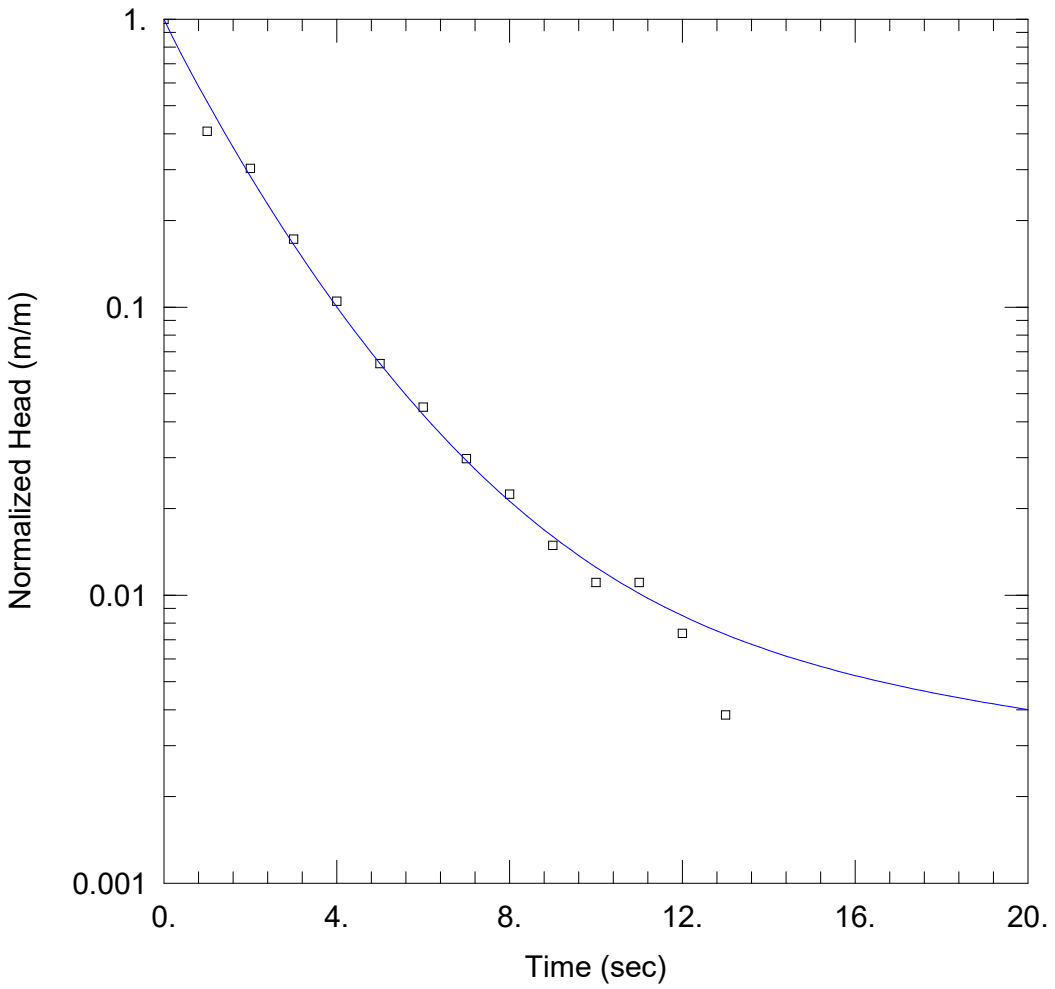
WELL DATA (MW21-04)

Initial Displacement: 0.458 m Static Water Column Height: 3.069 m
Total Well Penetration Depth: 3.069 m Screen Length: 1.5 m
Casing Radius: 0.0246 m Well Radius: 0.1 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0001939 m/sec y0 = 0.3959 m



RISING HEAD TESTS

Data Set: C:\...\MW21-04_test2_CBP.aqt
Date: 01/20/22 Time: 12:16:45

PROJECT INFORMATION

Company: Stantec
Client: Metro Vancouver Housing Corp
Project: 123315738
Location: Pitt Meadows
Test Well: MW21-01
Test Date: 2021-12-02

AQUIFER DATA

Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

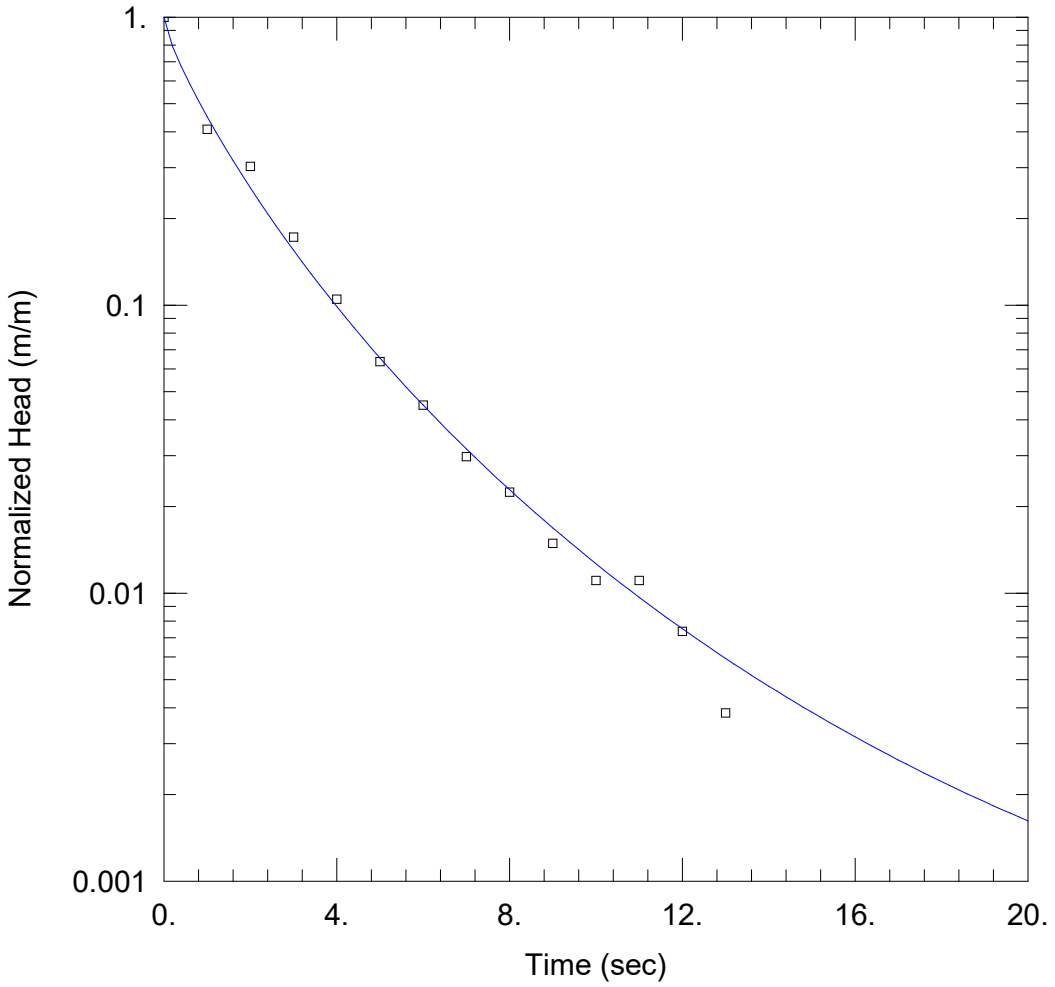
WELL DATA (MW21-04)

Initial Displacement: 0.458 m
Total Well Penetration Depth: 3.069 m
Casing Radius: 0.0246 m
Static Water Column Height: 3.069 m
Screen Length: 1.5 m
Well Radius: 0.1 m

SOLUTION

Aquifer Model: Confined
Solution Method: Cooper-Bredehoeft-Papadopulos

T = 0.002126 m^2/sec
S = 1.603E-10



RISING HEAD TESTS

Data Set: C:\...\MW21-04_test2_KGS.aqt
Date: 01/20/22 Time: 12:18:22

PROJECT INFORMATION

Company: Stantec
Client: Metro Vancouver Housing Corp
Project: 123315738
Location: Pitt Meadows
Test Well: MW21-01
Test Date: 2021-12-02

AQUIFER DATA

Saturated Thickness: 10. m

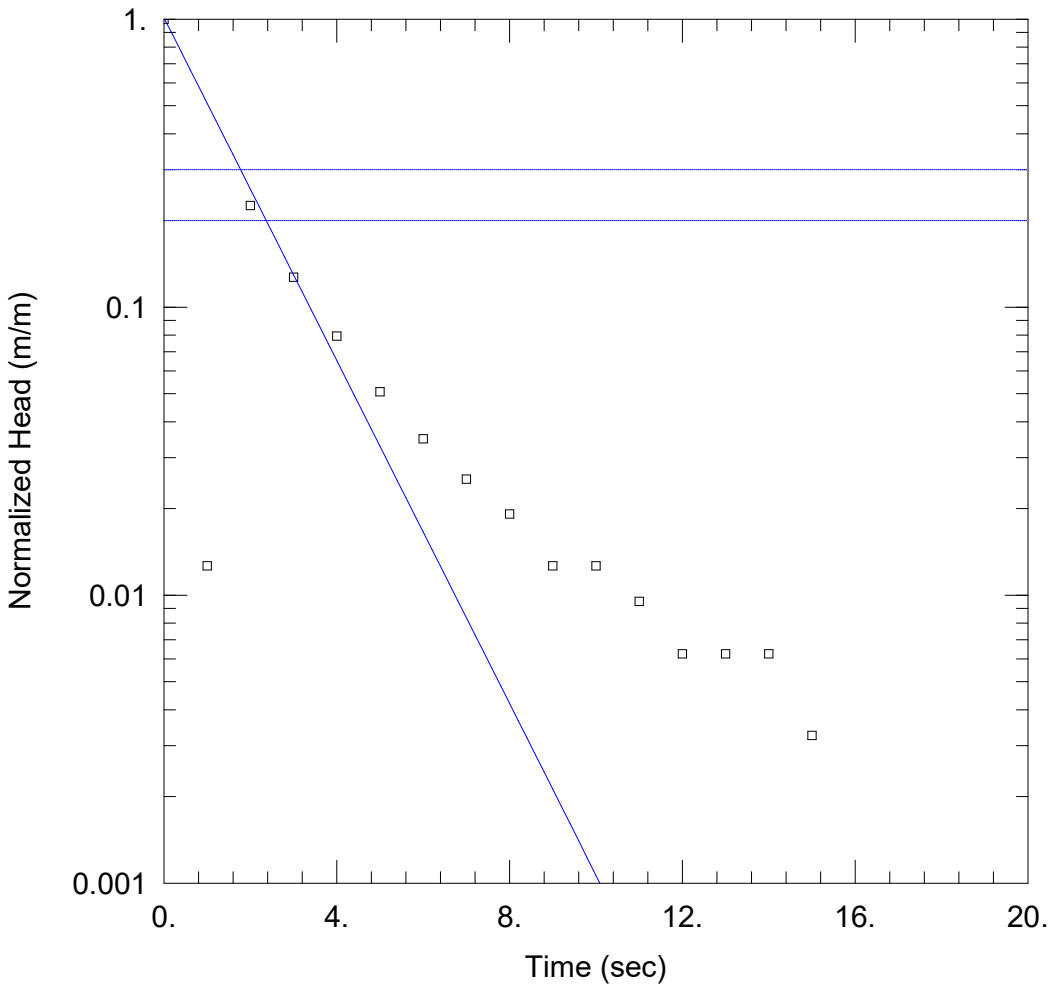
WELL DATA (MW21-04)

Initial Displacement: 0.458 m
Total Well Penetration Depth: 3.069 m
Casing Radius: 0.0246 m
Static Water Column Height: 3.069 m
Screen Length: 1.5 m
Well Radius: 0.1 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.0002934 m/sec
Ss = 0.0007161 m^{-1}
Kz/Kr = 1



RISING HEAD TESTS

Data Set: C:\...\MW21-04_test3_BR.aqt
Date: 01/20/22 Time: 12:23:23

PROJECT INFORMATION

Company: Stantec
Client: Metro Vancouver Housing Corp
Project: 123315738
Location: Pitt Meadows
Test Well: MW21-01
Test Date: 2021-12-02

AQUIFER DATA

Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

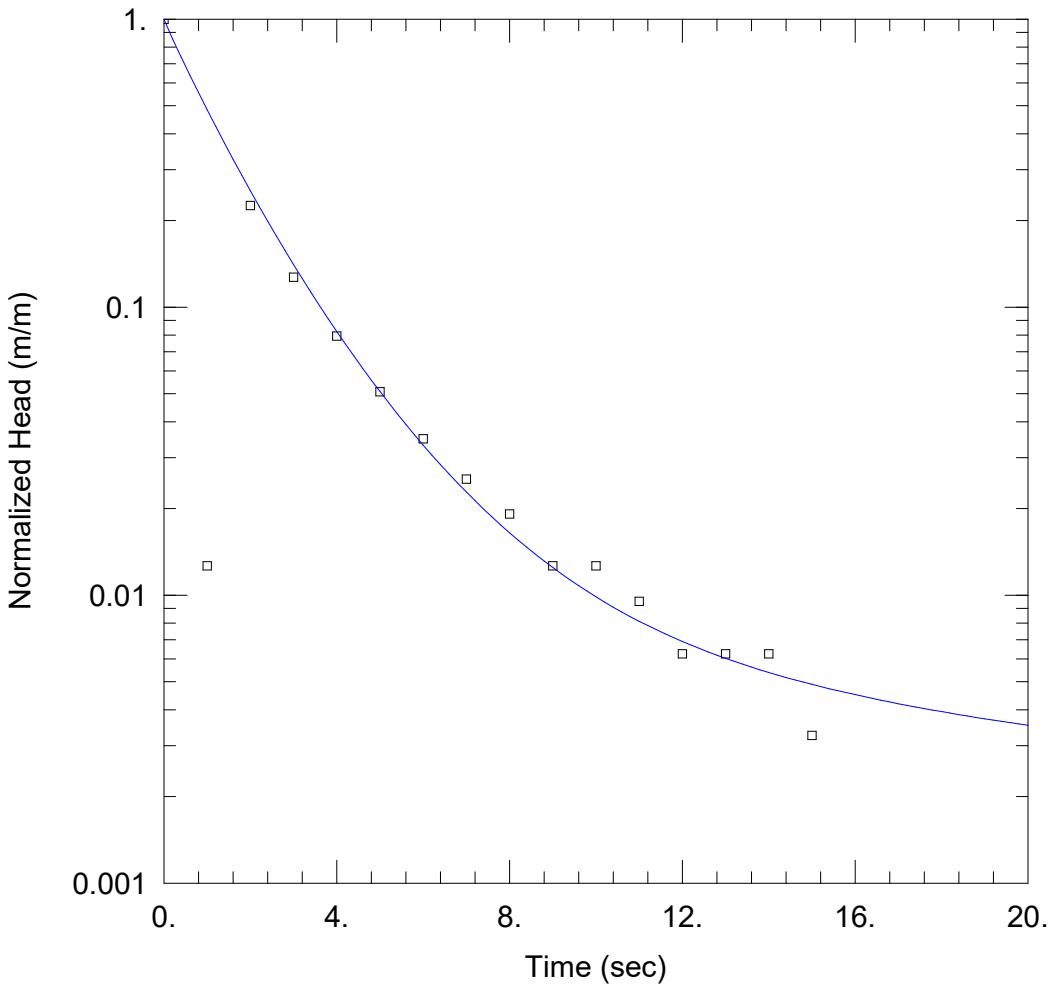
WELL DATA (MW21-04)

Initial Displacement: 0.54 m
Total Well Penetration Depth: 3.069 m
Casing Radius: 0.0246 m
Static Water Column Height: 3.069 m
Screen Length: 1.5 m
Well Radius: 0.1 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.0002555 m/sec
y0 = 0.5465 m



RISING HEAD TESTS

Data Set: C:\...\MW21-04_test3_CBP.aqt
Date: 01/20/22 Time: 13:12:14

PROJECT INFORMATION

Company: Stantec
Client: Metro Vancouver Housing Corp
Project: 123315738
Location: Pitt Meadows
Test Well: MW21-01
Test Date: 2021-12-02

AQUIFER DATA

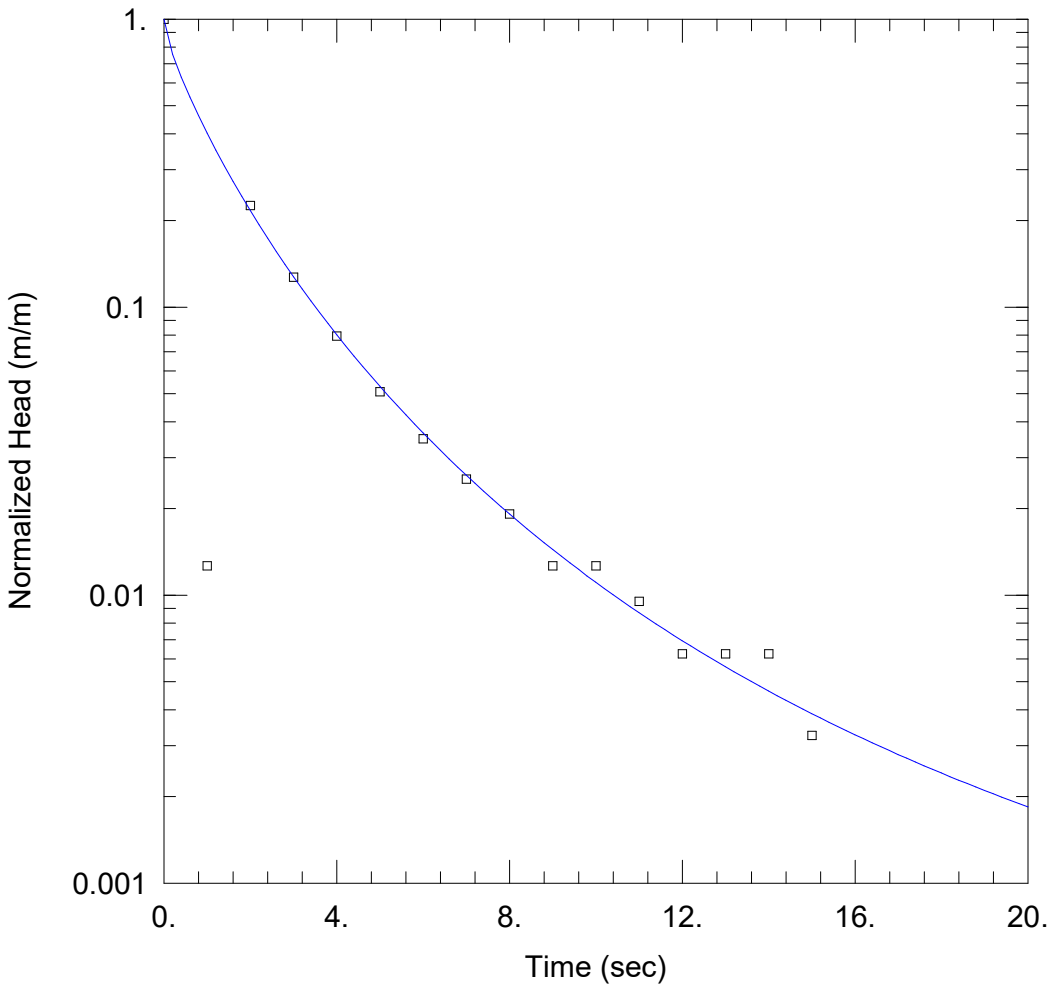
Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW21-04)

Initial Displacement: 0.54 m
Total Well Penetration Depth: 3.069 m
Casing Radius: 0.0246 m
Static Water Column Height: 3.069 m
Screen Length: 1.5 m
Well Radius: 0.1 m

SOLUTION

Aquifer Model: Confined
Solution Method: Cooper-Bredehoeft-Papadopulos
T = 0.002396 m^2/sec
S = 1.0E-10



RISING HEAD TESTS

Data Set: C:\...\MW21-04_test3_KGS.aqt
Date: 01/20/22 Time: 12:27:05

PROJECT INFORMATION

Company: Stantec
Client: Metro Vancouver Housing Corp
Project: 123315738
Location: Pitt Meadows
Test Well: MW21-01
Test Date: 2021-12-02

AQUIFER DATA

Saturated Thickness: 10. m

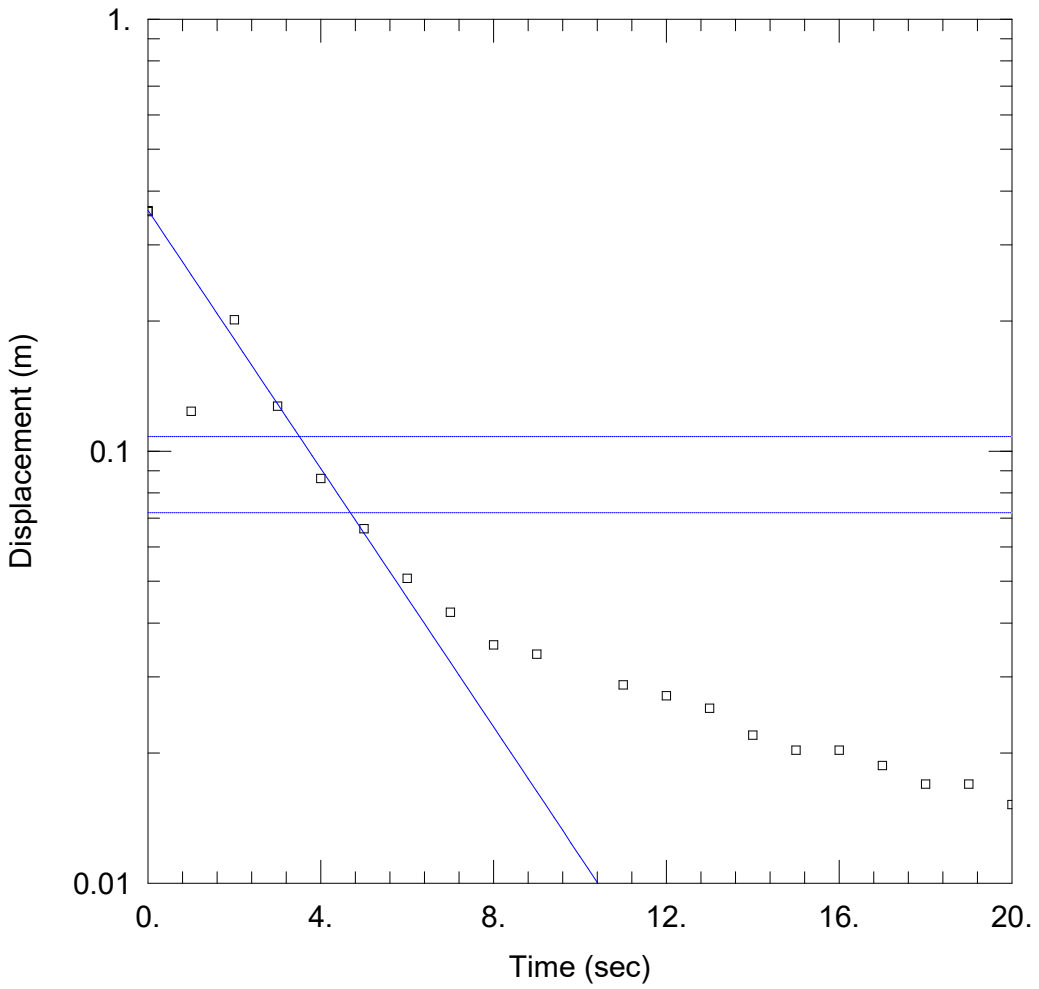
WELL DATA (MW21-04)

Initial Displacement: 0.54 m
Total Well Penetration Depth: 3.069 m
Casing Radius: 0.0246 m
Static Water Column Height: 3.069 m
Screen Length: 1.5 m
Well Radius: 0.1 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.0003307 m/sec
Ss = 0.001023 m^{-1}
Kz/Kr = 1



RISING HEAD TESTS

Data Set: C:\...\MW21-06_test1_BR.aqt
Date: 01/20/22 Time: 11:04:12

PROJECT INFORMATION

Company: Stantec
Client: Metro Vancouver Housing Corp
Project: 123315738
Location: Pitt Meadows
Test Well: MW21-01
Test Date: 2021-12-02

AQUIFER DATA

Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

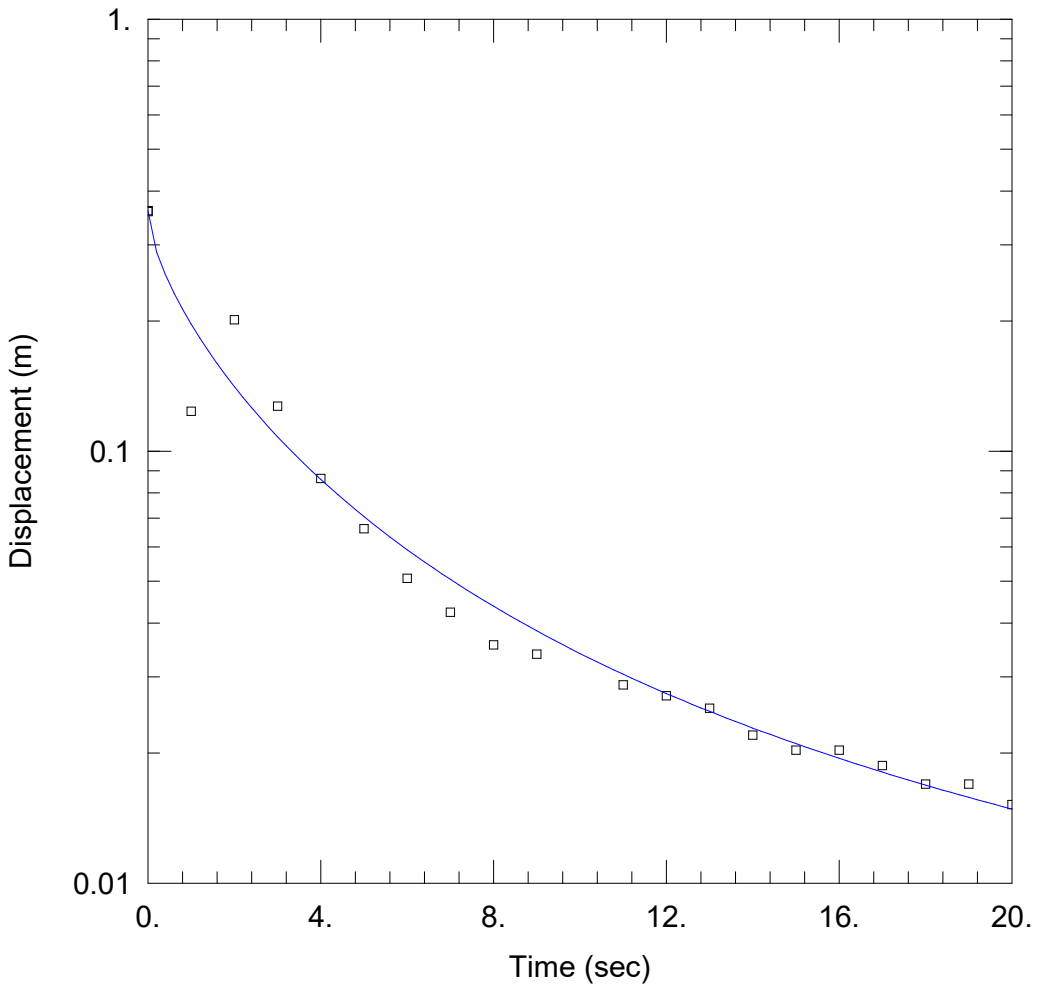
WELL DATA (MW21-06)

Initial Displacement: 0.36 m
Total Well Penetration Depth: 1.93 m
Casing Radius: 0.0246 m
Static Water Column Height: 1.93 m
Screen Length: 1.5 m
Well Radius: 0.1 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.0001168 m/sec
y0 = 0.361 m



RISING HEAD TESTS

Data Set: C:\...\MW21-06_test1_CBP.aqt
Date: 01/20/22 Time: 11:04:39

PROJECT INFORMATION

Company: Stantec
Client: Metro Vancouver Housing Corp
Project: 123315738
Location: Pitt Meadows
Test Well: MW21-01
Test Date: 2021-12-02

AQUIFER DATA

Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

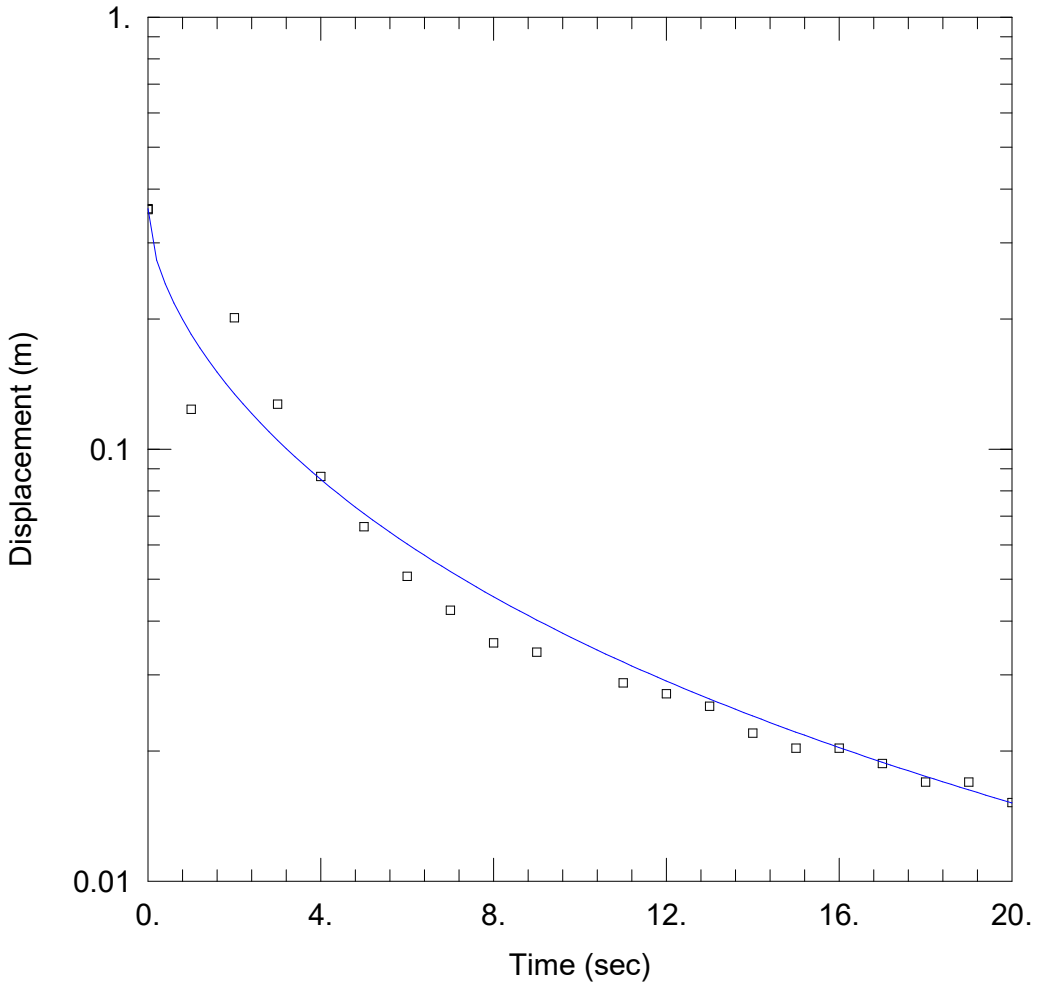
WELL DATA (MW21-06)

Initial Displacement: 0.36 m
Total Well Penetration Depth: 1.93 m
Casing Radius: 0.0246 m
Static Water Column Height: 1.93 m
Screen Length: 1.5 m
Well Radius: 0.1 m

SOLUTION

Aquifer Model: Confined
Solution Method: Cooper-Bredehoeft-Papadopulos

T = 0.000244 m^2/sec
S = 0.003846



RISING HEAD TESTS

Data Set: C:\...\MW21-06_test1_KGS.aqt
Date: 01/20/22 Time: 11:05:14

PROJECT INFORMATION

Company: Stantec
Client: Metro Vancouver Housing Corp
Project: 123315738
Location: Pitt Meadows
Test Well: MW21-01
Test Date: 2021-12-02

AQUIFER DATA

Saturated Thickness: 10. m

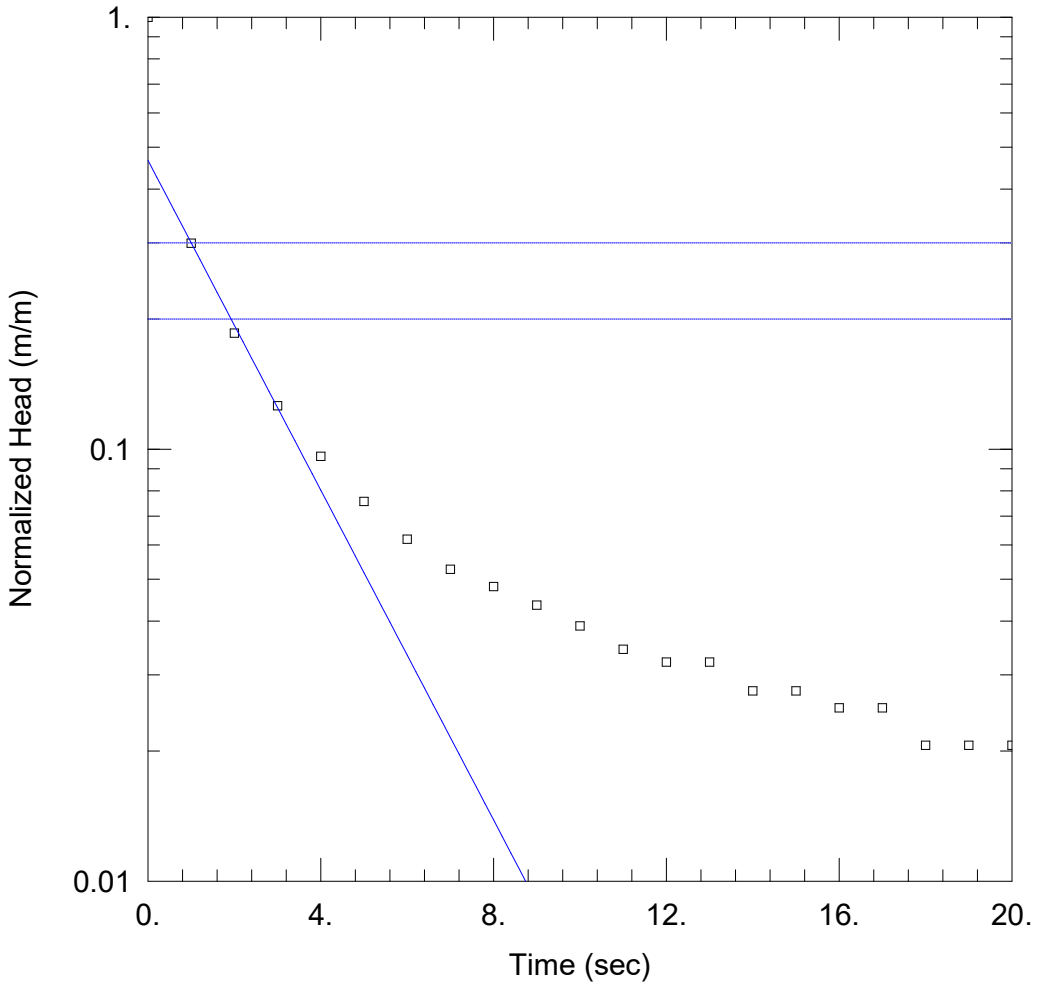
WELL DATA (MW21-06)

Initial Displacement: 0.36 m
Total Well Penetration Depth: 1.93 m
Casing Radius: 0.0246 m
Static Water Column Height: 1.93 m
Screen Length: 1.5 m
Well Radius: 0.1 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.0001005 m/sec
Ss = 0.009245 m^{-1}
Kz/Kr = 1



RISING HEAD TESTS

Data Set: C:\...\MW21-06_test2_BR.aqt
Date: 01/20/22 Time: 11:28:56

PROJECT INFORMATION

Company: Stantec
Client: Metro Vancouver Housing Corp
Project: 123315738
Location: Pitt Meadows
Test Well: MW21-01
Test Date: 2021-12-02

AQUIFER DATA

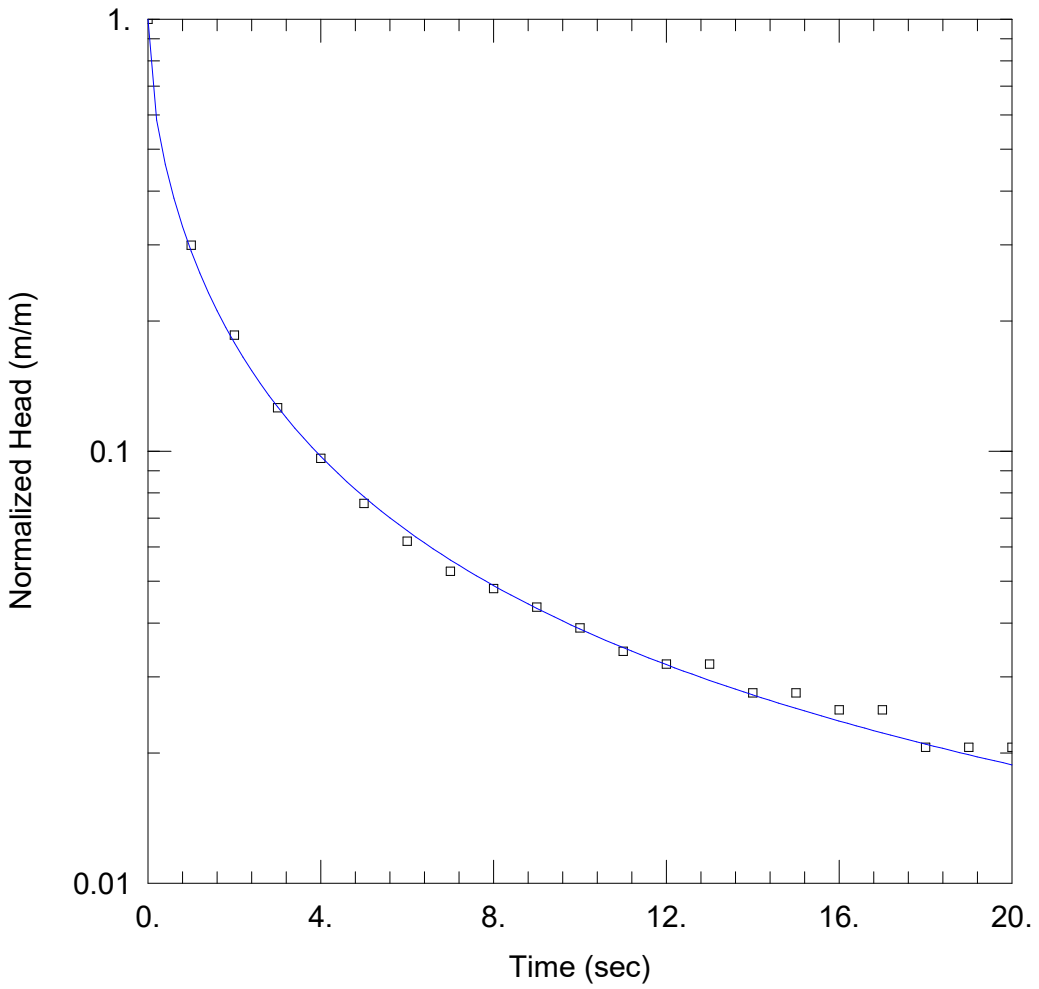
Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW21-06)

Initial Displacement: 0.74 m Static Water Column Height: 1.93 m
Total Well Penetration Depth: 1.93 m Screen Length: 1.5 m
Casing Radius: 0.0246 m Well Radius: 0.075 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice
K = 0.0001688 m/sec y0 = 0.3448 m



RISING HEAD TESTS

Data Set: C:\...\MW21-06_test2_CBP.aqt
Date: 01/20/22 Time: 11:28:37

PROJECT INFORMATION

Company: Stantec
Client: Metro Vancouver Housing Corp
Project: 123315738
Location: Pitt Meadows
Test Well: MW21-01
Test Date: 2021-12-02

AQUIFER DATA

Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

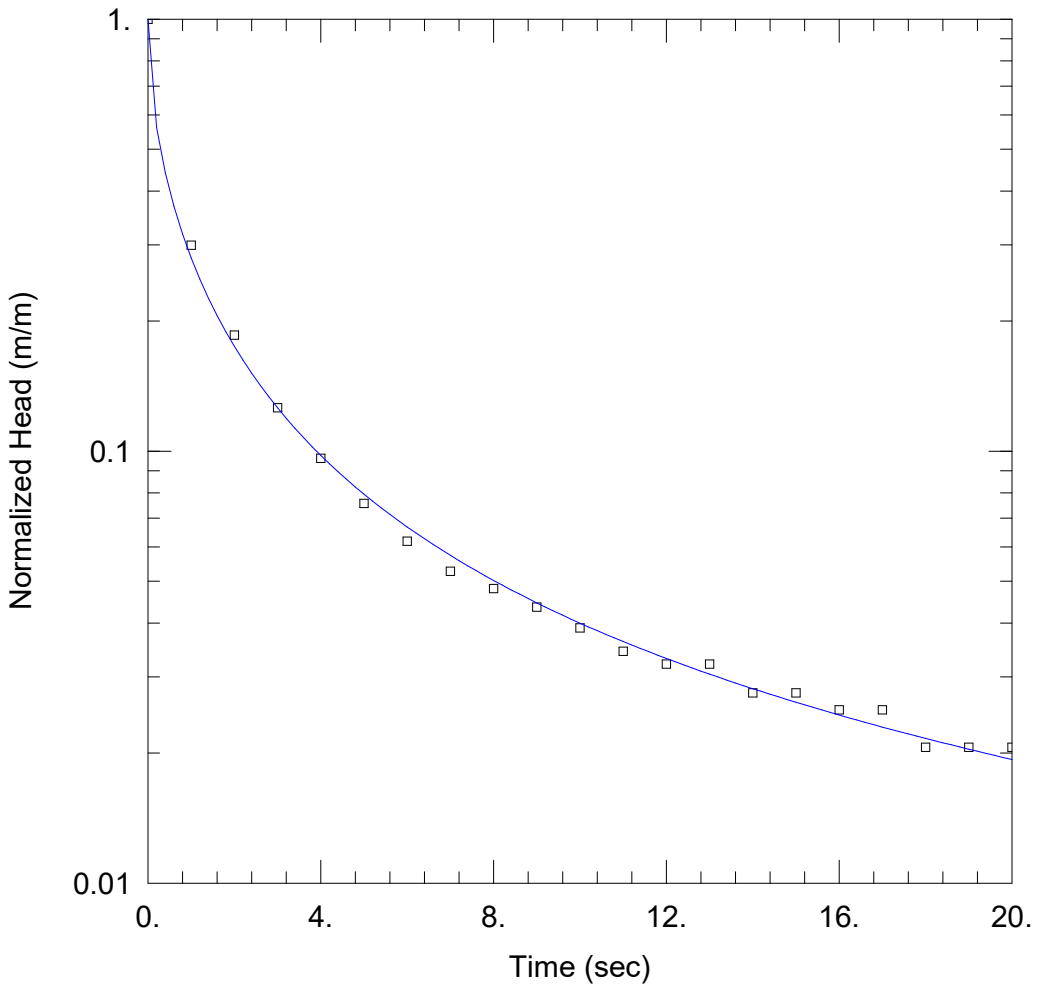
WELL DATA (MW21-06)

Initial Displacement: 0.74 m
Total Well Penetration Depth: 1.93 m
Casing Radius: 0.0246 m
Static Water Column Height: 1.93 m
Screen Length: 1.5 m
Well Radius: 0.075 m

SOLUTION

Aquifer Model: Confined
Solution Method: Cooper-Bredehoeft-Papadopulos

T = 0.0004311 m^2/sec
S = 0.03548



RISING HEAD TESTS

Data Set: C:\...\MW21-06_test2_KGS.aqt
Date: 01/20/22 Time: 11:31:04

PROJECT INFORMATION

Company: Stantec
Client: Metro Vancouver Housing Corp
Project: 123315738
Location: Pitt Meadows
Test Well: MW21-01
Test Date: 2021-12-02

AQUIFER DATA

Saturated Thickness: 10. m

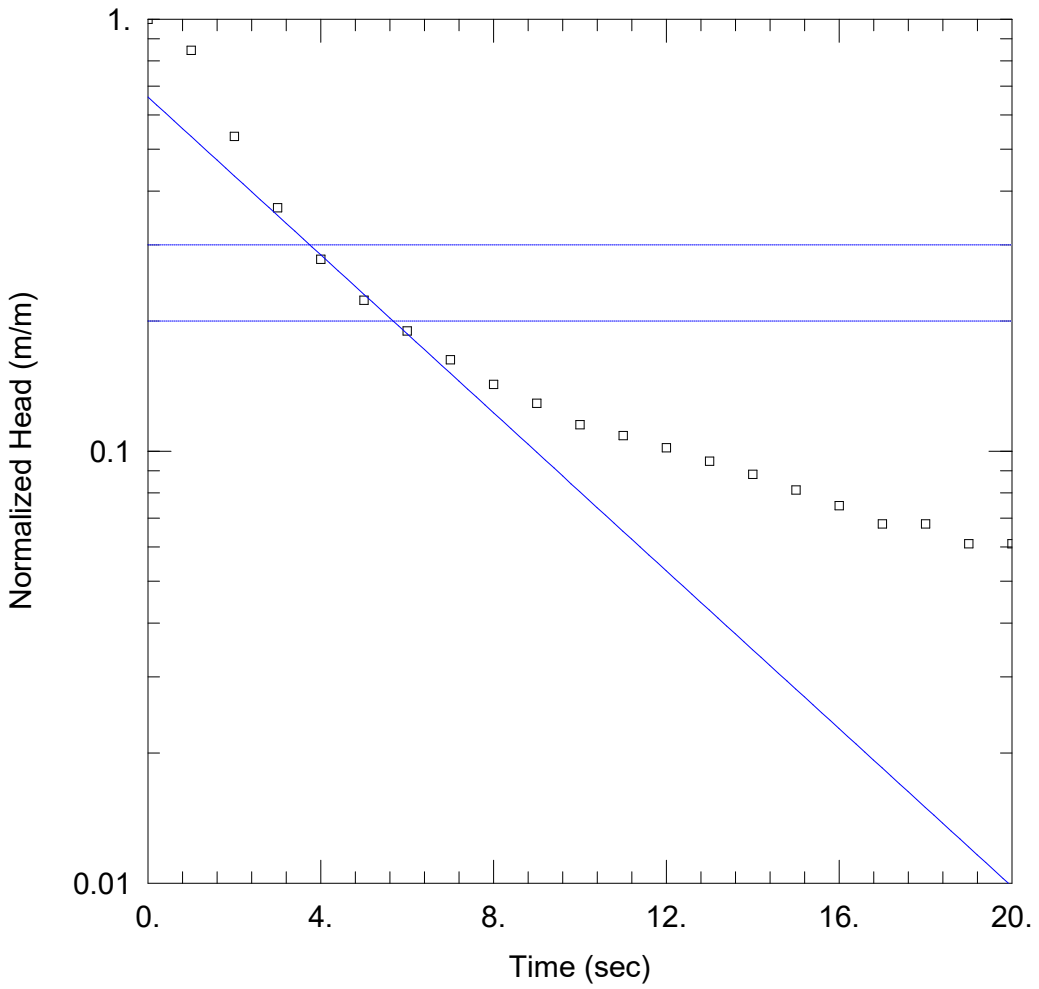
WELL DATA (MW21-06)

Initial Displacement: 0.74 m
Total Well Penetration Depth: 1.93 m
Casing Radius: 0.0246 m
Static Water Column Height: 1.93 m
Screen Length: 1.5 m
Well Radius: 0.075 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.0002478 m/sec
Ss = 0.03548 m^{-1}
Kz/Kr = 0.1023



RISING HEAD TESTS

Data Set: C:\...\MW21-06_test3_BR.aqt
Date: 01/20/22 Time: 11:25:36

PROJECT INFORMATION

Company: Stantec
Client: Metro Vancouver Housing Corp
Project: 123315738
Location: Pitt Meadows
Test Well: MW21-01
Test Date: 2021-12-02

AQUIFER DATA

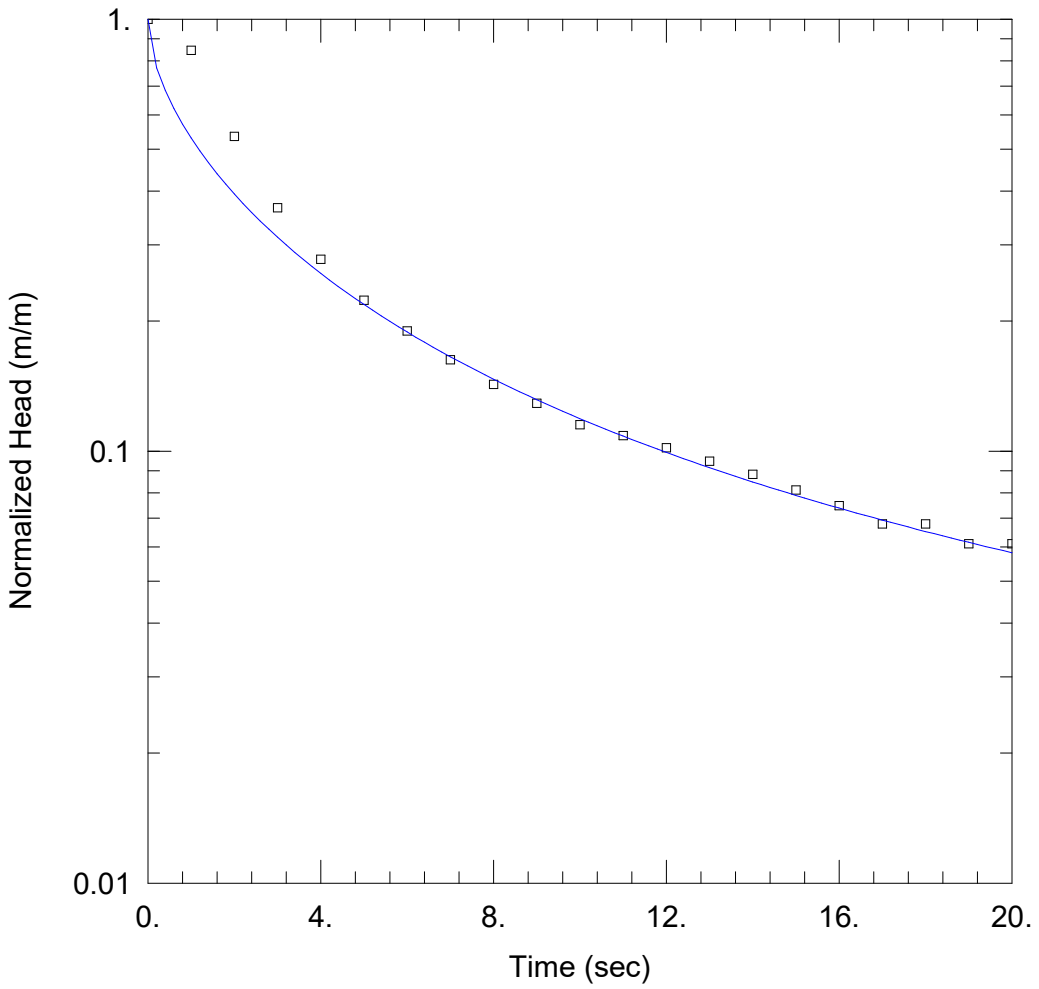
Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW21-06)

Initial Displacement: 0.25 m Static Water Column Height: 1.93 m
Total Well Penetration Depth: 1.93 m Screen Length: 1.5 m
Casing Radius: 0.0246 m Well Radius: 0.075 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice
K = 8.081E-5 m/sec y0 = 0.165 m



RISING HEAD TESTS

Data Set: C:\...\MW21-06_test3_CBP.aqt
Date: 01/20/22 Time: 11:23:51

PROJECT INFORMATION

Company: Stantec
Client: Metro Vancouver Housing Corp
Project: 123315738
Location: Pitt Meadows
Test Well: MW21-01
Test Date: 2021-12-02

AQUIFER DATA

Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

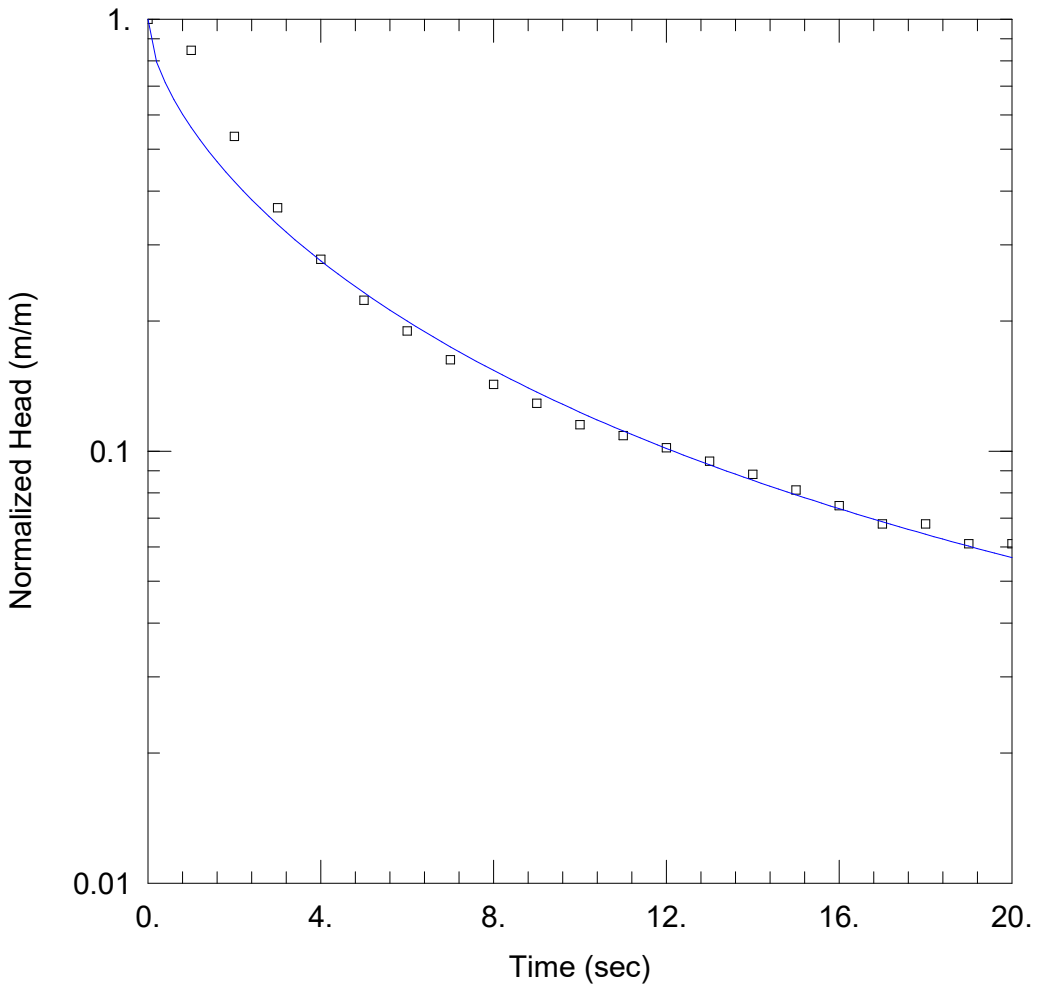
WELL DATA (MW21-06)

Initial Displacement: 0.25 m
Total Well Penetration Depth: 1.93 m
Casing Radius: 0.0246 m
Static Water Column Height: 1.93 m
Screen Length: 1.5 m
Well Radius: 0.075 m

SOLUTION

Aquifer Model: Confined
Solution Method: Cooper-Bredehoeft-Papadopulos

T = 0.0001581 m^2/sec
S = 0.02113



RISING HEAD TESTS

Data Set: C:\...\MW21-06_test3_KGS.aqt
Date: 01/20/22 Time: 11:22:39

PROJECT INFORMATION

Company: Stantec
Client: Metro Vancouver Housing Corp
Project: 123315738
Location: Pitt Meadows
Test Well: MW21-01
Test Date: 2021-12-02

AQUIFER DATA

Saturated Thickness: 10. m

WELL DATA (MW21-06)

Initial Displacement: 0.25 m
Total Well Penetration Depth: 1.93 m
Casing Radius: 0.0246 m
Static Water Column Height: 1.93 m
Screen Length: 1.5 m
Well Radius: 0.075 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.0001042 m/sec
Ss = 0.01 m^{-1}
Kz/Kr = 0.1096

APPENDIX D
TABLES OF ANALYTICAL RESULTS

Appendix D TABLES OF ANALYTICAL RESULTS

Table B1 - Groundwater Observations
Hydrogeological and Groundwater Quality Study
19085 119B Avenue, Pitt Meadows, BC
123315738

Monitor Well ID	Date	Wellspace Vapour Level[A] (ppmv) (HEX, IBL)	Top of Screen (mbg)	Bottom of Well (mbg)	Depth to Water BTOP* (m)	Apparent NAPL Thickness (mm)
MW21-01	2-Dec-21	LTDL, LTDL	4.60	6.10	3.261	0
MW21-04	2-Dec-21	LTDL, LTDL	4.60	6.10	3.034	0
MW21-06	2-Dec-21	LTDL, LTDL	3.70	8.20	3.272	0

Notes:

LTDL - Less than instrument detection limit
NAPL - Non aqueous phase liquid
m - Meters
mm - Millimeters
mbg - Meters below grade
ppmv - Parts per million by volume
BTOP - Below top of pipe
[A] - Indicates a wellspace vapour concentration of VOC vapour
HEX- Hexane
IBL- Isobutylene

Table B2
Summary of Groundwater Analytical Results
Hydrogeological and Groundwater Quality Study
19085 119B Avenue, Pitt Meadows, BC
123315738

Sample Location							MW21-01			MW21-04			MW21-06	
Sample Date							2-Dec-21	2-Dec-21	2-Dec-21	2-Dec-21	2-Dec-21		2-Dec-21	2-Dec-21
Sample ID							MW21-01	MW21-01 Lab-Dup	MW21-04	MW21-04 Lab-Dup	DUP21-01		MW21-06	MW21-06 Lab-Dup
Sampling Company							STANTEC	STANTEC	STANTEC	STANTEC	STANTEC		STANTEC	STANTEC
Laboratory							BV	BV	BV	BV	BV		BV	BV
Laboratory Work Order							C195821	C195821	C195821	C195821	C195821		C195821	C195821
Laboratory Sample ID							AMG285	AMG285	AMG286	AMG286	AMG288		AMG287	AMG287
Sample Type	Units	CSR-Schedule 3.2	BC WQG-Approved	BC WQG-Working	BCMOE Protocol 9	MV Sewer Use		Lab Replicate		Lab Replicate	Field Duplicate	RPD (%)		Lab Replicate
General Chemistry														
Chloride	mg/L	250[A] 1,500[B]	150[C] 600[E]	n/v	n/v	n/v	2.2	-	33	-	32	3%	1.3	-
Dissolved Organic Carbon (DOC)	mg/L	n/v	[C]	n/v	n/v	n/v	0.51	-	0.52	-	0.71	nc	1.2	-
Filter and HNO3 Preservation	none	n/v	n/v	n/v	n/v	n/v	FIELD	-	FIELD	-	FIELD	nc	FIELD	-
Hardness (as CaCO3), Dissolved	mg/L	n/v	n/v	n/v	530[G]	n/v	61.2	-	87.0	-	85.6	2%	126	-
Hardness (as CaCO3), Total	mg/L	n/v	n/v	n/v	530[G]	n/v	67.5	-	92.1	-	87.8	5%	130	-
pH, lab	S.U.	n/v	6.5-9[C]	n/v	n/v	5.5-10.5[H]	6.83	-	6.95	-	6.96	nc	7.43	-
Total Suspended Solids	mg/L	n/v	n/v	n/v	n/v	15[H]	12	-	10	-	4.0	nc	6.0	-
Petroleum Hydrocarbons														
Benzene	µg/L	5[A] 400[B]	40[C]	n/v	n/v	100[I]	<0.40	-	<0.40	<0.40	<0.40	nc	<0.40	-
Toluene	µg/L	60[A] 5[B]	0.5[C]	n/v	n/v	1,000[I]	<0.40	-	<0.40	<0.40	<0.40	nc	<0.40	-
Ethylbenzene	µg/L	140[A] 2,000[B]	200[C]	n/v	n/v	1,000[I]	<0.40	-	<0.40	<0.40	<0.40	nc	<0.40	-
Xylene, m & p-	µg/L	n/v	n/v	n/v	n/v	n/v	<0.40	-	<0.40	<0.40	<0.40	nc	<0.40	-
Xylene, o-	µg/L	n/v	n/v	n/v	n/v	n/v	<0.40	-	<0.40	<0.40	<0.40	nc	<0.40	-
Xylenes, Total	µg/L	90[A] 300[B]	30[C]	n/v	n/v	1,000[I]	<0.40	-	<0.40	<0.40	<0.40	nc	<0.40	-
Methyl tert-butyl ether (MTBE)	µg/L	95[A] 34,000[B]	3,400[E]	n/v	n/v	n/v	<4.0	-	<4.0	<4.0	<4.0	nc	<4.0	-
EPH C10-C19	mg/L	5.0[AB]	n/v	n/v	n/v	n/v	<0.20	-	<0.20	-	<0.20	nc	<0.20	-
EPH C19-C32	mg/L	n/v	n/v	n/v	n/v	n/v	<0.20	-	<0.20	-	<0.20	nc	<0.20	-
HEPH (C19-C32 less PAH)	mg/L	n/v	n/v	n/v	n/v	n/v	<0.20	-	<0.20	-	<0.20	nc	<0.20	-
LEPH (C10-C19 less PAH)	mg/L	0.50[B]	n/v	n/v	n/v	n/v	<0.20	-	<0.20	-	<0.20	nc	<0.20	-
VH (C6-C10)	µg/L	15,000[AB]	n/v	n/v	n/v	n/v	<300	-	<300	<300	<300	nc	<300	-
VPH (C6-C10 Minus BTEX)	µg/L	1,500[B]	n/v	n/v	n/v	n/v	<300	-	<300	-	<300	nc	<300	-
Metals, Dissolved														
Aluminum	µg/L	9,500[A]	0.05[C] 0.1[E]	n/v	180[G]	50,000[I]	73.6	73.6	<3.0	-	<3.0	nc	45.9	-
Antimony	µg/L	6[A] 90[B]	n/v	n/v	2.9[G]	n/v	<0.50	<0.50	<0.50	-	<0.50	nc	<0.50	-
Arsenic	µg/L	10[A] 50[B]	5[E]	n/v	13[G]	100[I]	0.19	0.19	0.18	-	0.17	nc	0.42	-
Barium	µg/L	1,000[A] 10,000[B]	n/v	1,000[F]	170[G]	n/v	41.5	41.7	46.9	-	44.8	5%	40.5	-
Beryllium	µg/L	8[A] 1.5[B]	n/v	0.13[F]	3.3[G]	n/v	<0.10	<0.10	<0.10	-	<0.10	nc	<0.10	-
Bismuth	µg/L	n/v	n/v	n/v	n/v	n/v	<1.0	<1.0	<1.0	-	<1.0	nc	<1.0	-
Boron	µg/L	5,000[A] 12,000[B]	1,200[C]	n/v	670[G]	50000[I]	<50	<50	<50	-	<50	nc	<50	-
Cadmium	µg/L	5[A] 1.5-2.5[S3][B]	0.147-0.251[C] 0.355-0.746[E]	n/v	0.56[G]	200[I]	0.019	0.022	0.026	-	0.024	nc	0.010	-
Calcium	µg/L	n/v	n/v	n/v	n/v	n/v	21,100	-	30,400	-	29,600	3%	43,600	-
Chromium	µg/L	50[S23][A] 10[S23][B]	n/v	n/v	3.9[G]	4,000[I]	<1.0	<1.0	<1.0	-	<1.0	nc	<1.0	-
Chromium (Hexavalent)	µg/L	50[A] 10[B]	n/v	1[F]	n/v	n/v	<0.99	-	<0.99	-	<0.99	nc	<0.99	<0.99
Cobalt	µg/L	1[A] 40[B]	4[C] 110[E]	n/v	18[G]	5,000	0.21	0.21	<0.20	-	<0.20	nc	<0.20	-
Copper	µg/L	1,500[A] 30-60[S4][B]	0.2[C] 0.2[E]	n/v	13[G]	2,000[I]	1.06	1.03	<0.20	-	<0.20	nc	0.32	-
Iron	µg/L	6,500[A]	350[E]	n/v	6,900[G]	10,000[I]	20.8	21.8	<5.0	-	<5.0	nc	11.6	-
Lead	µg/L	10[A] 50-60[S6][B]	n/v	n/v	3.0[G]	1,000[I]	<0.20	<0.20	<0.20	-	<0.20	nc	<0.20	-
Lithium	µg/L	8[A]	n/v	n/v	19[G]	n/v	<2.0	<2.0	<2.0	-	<2.0	nc	<2.0	-
Magnesium	µg/L	n/v	n/v	n/v	n/v	n/v	2,050	-	2,710	-	2,800	3%	4,240	-
Manganese	µg/L	1,500[A]	n/v	n/v	3,600[G]	5,000[I]	59.2	58.6	58.8	-	58.1	1%	51.1	-
Mercury	µg/L	1[A] 0.25[B]	n/v	n/v	0.36[G]	50[I]	<0.0019	<0.0019	<0.0019	-	<0.0019	nc	<0.0019	-
Molybdenum	µg/L	250[A] 10,000[B]	7,600[C] 46,000[E]	n/v	58[G]	1,000[I]	<1.0	<1.0	<1.0	-	<1.0	nc	<1.0	-
Nickel	µg/L	80[A] 650-1,100[S7][B]	n/v	[F]	100[G]	2,000[I]	<1.0	<1.0	<1.0	-	<1.0	nc	<1.0	-
Potassium	µg/L	n/v	n/v	n/v	n/v	n/v	1,010	-	2,230	-	2,210	1%	2,010	-
Selenium	µg/L	10[A] 20[B]	2[C]	n/v	4.9[G]	1000[I]	0.17	0.18	0.27	-	0.29	nc	0.21	-
Silicon	µg/L	n/v	n/v	n/v	n/v	n/v	3,480	3,500	4,460	-	4,340	3%	4,040	-
Silver	µg/L	20[A] 0.5-15[S11][B]	n/v	n/v	0.25[G]	1000[I]	<0.020	<0.020	<0.020	-	<0.020	nc	<0.020	-
Sodium	µg/L	200,000[A]	n/v	n/v	2,100,000[G]	n/v	9,920	-	19,100	-	18,900	1%	2,970	-
Strontium	µg/L	2,500[A]	n/v	n/v	670[G]	n/v	59.9	59.6	150	-	144	4%	99.9	-
Sulfur	µg/L	n/v	n/v	n/v	n/v	n/v	3,200	-	4,100	-	4,600	nc	<3,000	-
Thallium	µg/L	3[B]	n/v	0.8[F]	0.42[G]	n/v	0.010	0.010	0.017	-	0.017	nc	0.016	-
Tin	µg/L	2,500[A]	n/v	n/v	n/v	n/v	<5.0	<5.0	<5.0	-	<5.0	nc	<5.0	-
Titanium	µg/L	1,000[B]	n/v	n/v	94[G]	n/v	<5.0	<5.0	<5.0	-	<5.0	nc	<5.0	-
Uranium	µg/L	20[A] 85[B]	n/v	8.5[n7][F]	18[G]	n/v	<0.10	<0.10	<0.10	-	<0.10	nc	0.26	-
Vanadium	µg/L	20[A]	n/v	n/v	26[G]	n/v	<5.0	<5.0	<5.0	-	<5.0	nc	<5.0	-
Zinc	µg/L	3,000[A] 75-900[S13][B]	n/v	n/v	43[G]	3000[I]	<5.0	<5.0	<5.0	-	<5.0	nc	<5.0	-
Zirconium	µg/L	n/v	n/v	n/v	n/v	n/v	<0.10	<0.10	<0.10	-	<0.10	nc	<0.10	-
See notes on last page.														
Metals, Total														
Aluminum	µg/L	9,500[A]	n/v	n/v	180[G]	50,000[I]	1,870	-	483	-	352	**31%**	767	-
Antimony	µg/L	6[A] 90[B]	n/v	n/v	2.9[G]	n/v	<0.50	-	<0.50	-	<0.50	nc	<0.50	-
Arsenic	µg/L	10[A] 50[B]	5[E]	n/v	13[G]	100[I]	1.04	-	0.53	-	0.41	nc	0.84	-
Barium	µg/L	1,000[A] 10,000[B]	n/v	1,000[F]	170[G]	n/v	49.6	-	49.1	-	50.7	3%	43.0	-
Beryllium	µg/L	8[A] 1.5[B]	n/v	0.13[F]	3.3[G]	n/v	<0.10	-	<0.10	-	<0.10	nc	<0.10	-
Bismuth	µg/L	n/v	n/v	n/v	n/v	n/v	<1.0	-	<1.0	-	<1.0	nc	<1.0	-
Boron	µg/L	5,000[A] 12,000[B]	1,200[C]	n/v	670[G]	50000[I]	<50	-	<50	-	<50	nc	<50	-
Cadmium	µg/L	5[A] 1.5-2.5[S3][B]	n/v	n/v	0.56[G]	200[I]	0.022	-	0.029	-	0.027	nc	0.014	-

Table B2
Summary of Groundwater Analytical Results
Hydrogeological and Groundwater Quality Study
19085 119B Avenue, Pitt Meadows, BC
123315738

Sample Location							MW21-01		MW21-04				MW21-06	
Sample Date							2-Dec-21	2-Dec-21	2-Dec-21	2-Dec-21	2-Dec-21		2-Dec-21	2-Dec-21
Sample ID							MW21-01	MW21-01 Lab-Dup	MW21-04	MW21-04 Lab-Dup	DUP21-01		MW21-06	MW21-06 Lab-Dup
Sampling Company							STANTEC	STANTEC	STANTEC	STANTEC	STANTEC		STANTEC	STANTEC
Laboratory							BV	BV	BV	BV	BV		BV	BV
Laboratory Work Order							C195821	C195821	C195821	C195821	C195821		C195821	C195821
Laboratory Sample ID							AMG285	AMG285	AMG286	AMG286	AMG288		AMG287	AMG287
Sample Type	Units	CSR-Schedule 3.2	BC WQG-Approved	BC WQG-Working	BCMOE Protocol 9	MV Sewer Use		Lab Replicate		Lab Replicate	Field Duplicate	RPD (%)		Lab Replicate
Calcium	µg/L	n/v	n/v	n/v	n/v	n/v	23,000	-	31,900	-	30,500	4%	44,500	-
Chromium	µg/L	50_{S23}^{A} 10_{S23}^{B}	n/v	n/v	3.9[G]	4,000[I]	<1.0	-	<1.0	-	<1.0	nc	<1.0	-
Chromium (Hexavalent)	µg/L	50[A] 10[B]	n/v	1[F]	n/v	n/v	<0.99	-	<0.99	-	<0.99	nc	<0.99	-
Cobalt	µg/L	1[A] 40[B]	4[C] 110[E]	n/v	20[G]	5,000	1.02	-	0.34	-	0.29	nc	0.31	-
Copper	µg/L	$1,500^{A}$ $30\text{-}60_{S4}^{B}$	n/v	n/v	13[G]	2,000[I]	1.43	-	0.55	-	<0.50	nc	0.76	-
Iron	µg/L	n/v	1000[E]	n/v	6,900[G]	10,000[I]	844	-	452	-	321	**34%**	391	-
Lead	µg/L	10^{A} $50\text{-}60_{S6}^{B}$	5.24-7.76[C] 49.5-114[E]	n/v	3.0[G]	1,000[I]	0.31	-	<0.20	-	<0.20	nc	<0.20	-
Lithium	µg/L	8[A]	n/v	n/v	19[G]	n/v	<2.0	-	<2.0	-	<2.0	nc	<2.0	-
Magnesium	µg/L	n/v	n/v	n/v	n/v	n/v	2,420	-	3,010	-	2,810	7%	4,500	-
Manganese	µg/L	1,500[A]	0.902-1.18[C] 1.28-1.97[E]	n/v	3,600[G]	5,000[I]	78.1	-	67.1	-	60.2	11%	59.2	-
Mercury	µg/L	1[A] 0.25[B]	0.02[C]	n/v	0.36[G]	50[I]	0.0033	0.0030	<0.0019	-	<0.0019	nc	0.0021	-
Molybdenum	µg/L	250[A] 10,000[B]	7,600[C] 46,000[E]	n/v	58[G]	1,000[I]	<1.0	-	<1.0	-	<1.0	nc	<1.0	-
Nickel	µg/L	80^{A} $650\text{-}1{,}100_{S7}^{B}$	n/v	$_{n9}^{F}$	100[G]	2,000[I]	1.5	-	1.1	-	<1.0	nc	<1.0	-
Potassium	µg/L	n/v	n/v	n/v	n/v	n/v	1,030	-	2,350	-	2,400	2%	2,160	-
Selenium	µg/L	10[A] 20[B]	2[C]	n/v	4.9[G]	1000[I]	0.18	-	0.27	-	0.25	nc	0.22	-
Silicon	µg/L	n/v	n/v	n/v	n/v	n/v	5,200	-	5,280	-	4,920	7%	4,850	-
Silver	µg/L	20^{A} $0.5\text{-}15_{S11}^{B}$	0.05-1.5[C] 1-3[E]	n/v	0.25[G]	1000[I]	<0.020	-	<0.020	-	<0.020	nc	<0.020	-
Sodium	µg/L	200,000[A]	n/v	n/v	2,100,000[G]	n/v	9,210	-	20,100	-	20,400	1%	3,170	-
Strontium	µg/L	2,500[A]	n/v	n/v	670[G]	n/v	66.0	-	147	-	148	1%	104	-
Sulfur	µg/L	n/v	n/v	n/v	n/v	n/v	3,500	-	4,600	-	4,700	nc	<3,000	-
Thallium	µg/L	3[B]	n/v	0.8[F]	0.42[G]	n/v	0.015	-	0.018	-	0.018	nc	0.016	-
Tin	µg/L	2,500[A]	n/v	n/v	n/v	n/v	<5.0	-	<5.0	-	<5.0	nc	<5.0	-
Titanium	µg/L	1,000[B]	n/v	n/v	94[G]	n/v	36.4	-	16.9	-	11.6	nc	18.1	-
Uranium	µg/L	20[A] 85[B]	n/v	8.5_{n7}^{F}	18[G]	n/v	<0.10	-	<0.10	-	<0.10	nc	0.27	-
Vanadium	µg/L	20[A]	n/v	n/v	26[G]	n/v	<5.0	-	<5.0	-	<5.0	nc	<5.0	-
Zinc	µg/L	$3{,}000^{A}$ $75\text{-}900_{S13}^{B}$	7.5-34.5[C] 33-60[E]	n/v	43[G]	3000[I]	<5.0	-	<5.0	-	<5.0	nc	<5.0	-
Zirconium	µg/L	n/v	n/v	n/v	n/v	n/v	0.38	-	0.18	-	0.14	nc	0.25	-
Polycyclic Aromatic Hydrocarbons														
Acenaphthene	µg/L	250[A] 60[B]	6[C]	n/v	n/v	50[I]	<0.050	-	<0.050	-	<0.050	nc	<0.050	-
Acenaphthylene	µg/L	n/v	n/v	n/v	n/v	50[I]	<0.050	-	<0.050	-	<0.050	nc	<0.050	-
Acridine	µg/L	0.5[B]	3[C] 0.05[D]	n/v	n/v	n/v	<0.050	-	<0.050	-	<0.050	nc	<0.050	-
Anthracene	µg/L	1,000[A] 1[B]	4[C] 0.1[D]	n/v	n/v	50[I]	<0.010	-	<0.010	-	<0.010	nc	<0.010	-
Benzo(a)anthracene	µg/L	0.07[A] 1[B]	0.1[CD]	n/v	n/v	50[I]	<0.010	-	<0.010	-	<0.010	nc	<0.010	-
Benzo(a)pyrene	µg/L	0.01[A] 0.1[B]	0.01[CD]	n/v	n/v	50[I]	<0.0050	-	<0.0050	-	<0.0050	nc	<0.0050	-
Benzo(b)pyridine (Quinoline)	µg/L	0.05[A] 34[B]	n/v	3.4[F]	n/v	50[I]	<0.020	-	<0.020	-	<0.020	nc	<0.020	-
Benzo(b/j)fluoranthene	µg/L	0.07[A]	n/v	n/v	n/v	50[I]	<0.030	-	<0.030	-	<0.030	nc	<0.030	-
Benzo(g,h,i)perylene	µg/L	n/v	n/v	n/v	n/v	50[I]	<0.050	-	<0.050	-	<0.050	nc	<0.050	-
Benzo(k)fluoranthene	µg/L	n/v	n/v	n/v	n/v	50[I]	<0.050	-	<0.050	-	<0.050	nc	<0.050	-
Chrysene	µg/L	7[A] 1[B]	n/v	n/v	n/v	50[I]	<0.020	-	<0.020	-	<0.020	nc	<0.020	-
Dibenzo(a,h)anthracene	µg/L	0.01[A]	n/v	n/v	n/v	50[I]	<0.0030	-	<0.0030	-	<0.0030	nc	<0.0030	-
Fluoranthene	µg/L	150[A] 2[B]	4[C] 0.2[D]	n/v	n/v	50[I]	<0.020	-	<0.020	-	<0.020	nc	<0.020	-
Fluorene	µg/L	150[A] 120[B]	12[C]	n/v	n/v	50[I]	<0.050	-	<0.050	-	<0.050	nc	<0.050	-
High Molecular Weight PAHs	µg/L	n/v	n/v	n/v	n/v	n/v	<0.050	-	<0.050	-	<0.050	nc	<0.050	-
Indeno(1,2,3-cd)pyrene	µg/L	n/v	n/v	n/v	n/v	50[I]	<0.050	-	<0.050	-	<0.050	nc	<0.050	-
Low Molecular Weight PAHs	µg/L	n/v	n/v	n/v	n/v	n/v	<0.10	-	<0.10	-	<0.10	nc	<0.10	-
Methylnaphthalene, 1-	µg/L	5.5[A]	n/v	n/v	n/v	n/v	<0.050	-	<0.050	-	<0.050	nc	<0.050	-
Methylnaphthalene, 2-	µg/L	15[A]	n/v	n/v	n/v	n/v	<0.10	-	<0.10	-	<0.10	nc	<0.10	-
Naphthalene	µg/L	80[A] 10[B]	1[CE]	n/v	n/v	50[I]	<0.10	-	<0.10	-	<0.10	nc	<0.10	-
Phenanthrene	µg/L	3[B]	0.3[C]	n/v	n/v	50[I]	<0.050	-	<0.050	-	<0.050	nc	<0.050	-
Pyrene	µg/L	100[A] 0.2[B]	0.02[D]	n/v	n/v	50[I]	<0.020	-	<0.020	-	<0.020	nc	<0.020	-
Total PAH	µg/L	n/v	n/v	n/v	n/v	n/v	<0.10	-	<0.10	-	<0.10	nc	<0.10	-
See notes on last page.														
Volatile Organic Compounds														
Bromobenzene	µg/L	30[A]	n/v	n/v	n/v	n/v	<2.0	-	<2.0	<2.0	<2.0	nc	<2.0	-
Bromodichloromethane	µg/L	100[A]	n/v	n/v	n/v	n/v	<1.0	-	<1.0	<1.0	<1.0	nc	<1.0	-
Bromoform (Tribromomethane)	µg/L	100[A]	n/v	n/v	n/v	n/v	<1.0	-	<1.0	<1.0	<1.0	nc	<1.0	-
Bromomethane (Methyl bromide)	µg/L	5.5[A]	n/v	n/v	n/v	n/v	<1.0	-	<1.0	<1.0	<1.0	nc	<1.0	-
Carbon Tetrachloride (Tetrachloromethane)	µg/L	2[A] 130[B]	n/v	13.3[F]	n/v	n/v	<0.50	-	<0.50	<0.50	<0.50	nc	<0.50	-
Chlorobenzene (Monochlorobenzene)	µg/L	80[A] 13[B]	n/v	1.3[F]	n/v	n/v	<0.50	-	<0.50	<0.50	<0.50	nc	<0.50	-
Chloroethane (Ethyl Chloride)	µg/L	n/v	n/v	n/v	n/v	n/v	<1.0	-	<1.0	<1.0	<1.0	nc	<1.0	-
Chloroform (Trichloromethane)	µg/L	100[A] 20[B]	n/v	1.8[F]	n/v	n/v	<1.0	-	<1.0	<1.0	<1.0	nc	<1.0	-
Chloromethane	µg/L	n/v	n/v	n/v	n/v	n/v	<1.0	-	<1.0	<1.0	<1.0	nc	<1.0	-
Dibromochloromethane	µg/L	100[A]	n/v	n/v	n/v	n/v	<1.0	-	<1.0	<1.0	<1.0	nc	<1.0	-
Dichlorobenzene, 1,2-	µg/L	200[A] 7[B]	n/v	0.7[F]	n/v	n/v	<0.50	-	<0.50	<0.50	<0.50	nc	<0.50	-
Dichlorobenzene, 1,3-	µg/L	1,500[B]	n/v	150[F]	n/v	n/v	<0.50	-	<0.50	<0.50	<0.50	nc	<0.50	-
Dichlorobenzene, 1,4-	µg/L	5[A] 260[B]	n/v	26[F]	n/v	n/v	<0.50	-	<0.50	<0.50	<0.50	nc	<0.50	-
Dichlorodifluoromethane (Freon 12)	µg/L	800[A]	n/v	n/v	n/v	n/v	<2.0	-	<2.0	<2.0	<2.0	nc	<2.0	-
Dichloroethane, 1,1-	µg/L	30[A]	n/v	n/v	n/v	n/v	<0.50	-	<0.50	<0.50	<0.50	nc	<0.50	-
Dichloroethane, 1,2-	µg/L	5[A] 1,000[B]	n/v	100[F]	n/v	n/v	<0.50	-	<0.50	<0.50	<0.50	nc	<0.50	-

Table B2
Summary of Groundwater Analytical Results
Hydrogeological and Groundwater Quality Study
19085 119B Avenue, Pitt Meadows, BC
123315738

Sample Location							MW21-01			MW21-04				MW21-06	
Sample Date							2-Dec-21	2-Dec-21	2-Dec-21	2-Dec-21	2-Dec-21		2-Dec-21	2-Dec-21
Sample ID							MW21-01	MW21-01 Lab-Dup	MW21-04	MW21-04 Lab-Dup	DUP21-01		MW21-06	MW21-06 Lab-Dup
Sampling Company							STANTEC	STANTEC	STANTEC	STANTEC	STANTEC		STANTEC	STANTEC
Laboratory							BV	BV	BV	BV	BV		BV	BV
Laboratory Work Order							C195821	C195821	C195821	C195821	C195821		C195821	C195821
Laboratory Sample ID							AMG285	AMG285	AMG286	AMG286	AMG288		AMG287	AMG287
Sample Type	Units	CSR-Schedule 3.2	BC WQG-Approved	BC WQG-Working	BCMOE Protocol 9	MV Sewer Use		Lab Replicate		Lab Replicate	Field Duplicate	RPD (%)		Lab Replicate
Dichloroethene, 1,1-	µg/L	14[A]	n/v	n/v	n/v	n/v	<0.50	-	<0.50	<0.50	<0.50	nc	<0.50	-
Dichloroethene, cis-1,2-	µg/L	8[A]	n/v	n/v	n/v	n/v	<1.0	-	<1.0	<1.0	<1.0	nc	<1.0	-
Dichloroethene, trans-1,2-	µg/L	80[A]	n/v	n/v	n/v	n/v	<1.0	-	<1.0	<1.0	<1.0	nc	<1.0	-
Dichloropropane, 1,2-	µg/L	4.5[A]	n/v	n/v	n/v	n/v	<0.50	-	<0.50	<0.50	<0.50	nc	<0.50	-
Dichloropropane, 1,3-	µg/L	80[A]	n/v	n/v	n/v	n/v	<1.0	-	<1.0	<1.0	<1.0	nc	<1.0	-
Dichloropropene, 1,3- (sum of isomers cis + trans)	µg/L	1.5[A]	n/v	n/v	n/v	n/v	<1.0	-	<1.0	-	<1.0	nc	<1.0	-
Dichloropropene, cis-1,3-	µg/L	n/v	n/v	n/v	n/v	n/v	<1.0	-	<1.0	<1.0	<1.0	nc	<1.0	-
Dichloropropene, trans-1,3-	µg/L	n/v	n/v	n/v	n/v	n/v	<1.0	-	<1.0	<1.0	<1.0	nc	<1.0	-
Ethylene Dibromide (Dibromoethane, 1,2-)	µg/L	0.5[A]	n/v	n/v	n/v	n/v	<0.20	-	<0.20	<0.20	<0.20	nc	<0.20	-
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	µg/L	2[A] 15[B]	n/v	1.3[F]	n/v	n/v	<0.50	-	<0.50	<0.50	<0.50	nc	<0.50	-
Isopropylbenzene	µg/L	400[A]	n/v	n/v	n/v	n/v	<2.0	-	<2.0	<2.0	<2.0	nc	<2.0	-
Methylene Chloride (Dichloromethane)	µg/L	50[A] 980[B]	n/v	98.1[F]	n/v	n/v	<2.0	-	<2.0	<2.0	<2.0	nc	<2.0	-
Styrene	µg/L	800[A] 720[B]	n/v	72[F]	n/v	n/v	<0.50	-	<0.50	<0.50	<0.50	nc	<0.50	-
Tetrachloroethane, 1,1,1,2-	µg/L	6[A]	n/v	n/v	n/v	n/v	<0.50	-	<0.50	<0.50	<0.50	nc	<0.50	-
Tetrachloroethane, 1,1,2,2-	µg/L	0.8[A]	n/v	n/v	n/v	n/v	<0.50	-	<0.50	<0.50	<0.50	nc	<0.50	-
Tetrachloroethene (PCE)	µg/L	30[A] 1,100[B]	n/v	110[F]	n/v	n/v	<0.50	-	<0.50	<0.50	<0.50	nc	1.2	-
Trichlorobenzene, 1,2,3-	µg/L	3[A] 80[B]	n/v	8[F]	n/v	n/v	<2.0	-	<2.0	<2.0	<2.0	nc	<2.0	-
Trichlorobenzene, 1,2,4-	µg/L	5.5[A] 240[B]	n/v	24[F]	n/v	n/v	<2.0	-	<2.0	<2.0	<2.0	nc	<2.0	-
Trichloroethane, 1,1,1-	µg/L	8,000[A]	n/v	n/v	n/v	n/v	<0.50	-	<0.50	<0.50	<0.50	nc	<0.50	-
Trichloroethane, 1,1,2-	µg/L	3[A]	n/v	n/v	n/v	n/v	<0.50	-	<0.50	<0.50	<0.50	nc	<0.50	-
Trichloroethene (TCE)	µg/L	5[A] 200[B]	n/v	21[F]	n/v	n/v	<0.50	-	<0.50	<0.50	<0.50	nc	<0.50	-
Trichlorofluoromethane (Freon 11)	µg/L	1,000[A]	n/v	n/v	n/v	n/v	<4.0	-	<4.0	<4.0	<4.0	nc	<4.0	-
Trichlorotrifluoroethane (Freon 113)	µg/L	100,000[A]	n/v	n/v	n/v	n/v	<2.0	-	<2.0	<2.0	<2.0	nc	<2.0	-
Trimethylbenzene, 1,3,5-	µg/L	40[A]	n/v	n/v	n/v	n/v	<2.0	-	<2.0	<2.0	<2.0	nc	<2.0	-
Vinyl Chloride	µg/L	2[A]	n/v	n/v	n/v	n/v	<0.50	-	<0.50	<0.50	<0.50	nc	<0.50	-

See notes on last page.

Table B2
Summary of Groundwater Analytical Results
Metro Vancouver Housing Corporation

Notes:

CSR-Schedule 3.2	CSR Schedule 3.2 - Generic Numerical Water Standards (Contaminated Sites Regulation [B.C. Reg. 375/96, April 1, 1997: includes amendments up to B.C. Reg. 64/2021, March 11, 2021])
A	Generic Standard - Drinking Water
B	Generic Standard - Aquatic Life (Freshwater)
BC WQG-Approved	British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture (Aug 2019)
C	Approved Water Quality Guidelines - Long-Term Chronic (Freshwater Aquatic Life)
D	Approved Water Quality Guidelines - Long-Term Chronic (Freshwater Aquatic Life)-Phototoxic
E	Approved Water Quality Guidelines - Short-Term Acute (Freshwater Aquatic Life)
BC WQG-Working	British Columbia Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture (June 2017)
F	Working Water Quality Guidelines - Freshwater aquatic life
BCMOE Protocol 9	Ministry of Environment and Climate Change Strategy - Protocol 9 for Contaminated Sites, Establishing Background Concentrations in Groundwater, Prepared pursuant to Section 64 of the Environmental Management Act, version 2 (February 1, 2021)
G	Table 1. Regional Estimates For Local Background Concentrations In Groundwater For Inorganic Substances (Lower Mainland Sub-Region 2)
MV Sewer Use	Greater Vancouver Sewerage and Drainage District Sewer Use Bylaw No. 299, 2007
H	Table A - Conventaional Contaminants
I	Table B - Organic Contaminants
6.5[A]	Concentration exceeds the indicated standard.
15.2	Measured concentration did not exceed the indicated standard.
<0.03	Analyte was not detected at a concentration greater than the laboratory reporting limit.
n/v	No standard/guideline value.
-	Parameter not analyzed / not available.
n1	Long-term median within 20% of background median
n7	Guideline was developed by CCME using the species sensitivity distribution (SSD) method. This method has not been adopted by BC and therefore the lower fudicial limit of the SSD 5th percentile is adopted as the BC WWQG.
n9	To calculate the WWQG for nickel at hardness >60 to <180 mg/L use the equation: WWQG (µg/L)=e^{0.76[ln(hardness)]+1.06}; where hardness is in mg/L CaCO3.
S3	Cadmium varies with hardness for freshwater aquatic life. 0.5 ug/L@H<30 mg/L, 1.5 ug/L@H30-<90 mg/L, 2.5 ug/L@H90-<150 mg/L, 3.5 ug/L@H150-<210 mg/L, 4 ug/L@H≥210 mg/L.
S4	Copper varies with hardness for freshwater aquatic life. 20 ug/L@H<50 mg/L, 30 ug/L@H=50-<75 mg/L, 40 ug/L@H=75-<100 mg/L, 50 ug/L@H=100-<125 mg/L, 60 ug/L@H=125-<150 mg/L, 70 ug/L@H=150-<175 mg/L, 80 ug/L@H=175-<200 mg/L, 90 ug/L@H≥200 mg/L.
S6	Lead varies with hardness for freshwater aquatic life. 40 ug/L@H<50 mg/L, 50 ug/L@H=50-<100 mg/L, 60 ug/L@H=100-<200 mg/L, 110 ug/L@H=200-<300 mg/L, 160 ug/L@H≥300 mg/L.
S7	Nickel varies with hardness for freshwater aquatic life. 250 ug/L@H<60 mg/L, 650 ug/L@H60-<120 mg/L, 1100 ug/L@H120-<180 mg/L, 1500 ug/L@H≥180 mg/L.
S11	Silver varies with hardness for freshwater aquatic life. 0.5 ug/L@H≤100 mg/L, 15 ug/L@H>100 mg/L.
S13	Zinc varies with hardness for freshwater aquatic life. 75 ug/L@H<90 mg/L, 150 ug/L@H=90-<100 mg/L, 900 ug/L@H=100-<200 mg/L, 1650 ug/L@H=200-<300 mg/L, 2400 ug/L@H=300-<400 mg/L.
S23	The standard is for Chromium Hexavalent.
RPD	Relative Percent Difference.
61%	RPD exceeds data quality objective of 20%.
nc	RPD is not calculated if one or more values is non detect or if one or more values is less than five times the reportable detection limit.

APPENDIX E
LABORATORY ANALYTICAL CERTIFICATES

Appendix E LABORATORY ANALYTICAL CERTIFICATES

Your Project #: 123315738
Your C.O.C. #: g160395

Attention: Stewart McBride

STANTEC CONSULTING LTD
Metrotower III
Suite 500, 4730 Kingsway
BURNABY, BC
CANADA V5H 4M1

Report Date: 2022/01/11
Report #: R3120376
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C195821
Received: 2021/12/02, 17:40

Sample Matrix: Water
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Chloride/Sulphate by Auto Colourimetry	4	N/A	2021/12/06	BBY6SOP-00011 / BBY6SOP-00017	SM23-4500-Cl/SO4-E m
Dissolved Hexavalent Chromium (1)	4	N/A	2021/12/06	AB SOP-00063	SM 23 3500-Cr B m
Total Hexavalent Chromium (1)	4	N/A	2021/12/06	AB SOP-00063	SM 23 3500-Cr B m
Total 1,3-Dichloropropene Calculation	4	N/A	2021/12/31		
Carbon (DOC) (1, 2)	4	N/A	2021/12/07	AB SOP-00087	MMCW 119 1996 m
Hardness Total (calculated as CaCO3) (3)	4	N/A	2022/01/11	BBY WI-00033	Auto Calc
Hardness (calculated as CaCO3)	4	N/A	2022/01/10	BBY WI-00033	Auto Calc
Mercury (Dissolved) by CV (4)	4	2021/12/03	2021/12/03	AB SOP-00084	BCMOE BCLM Oct2013 m
Mercury (Total) by CV	4	2021/12/03	2021/12/03	AB SOP-00084	BCMOE BCLM Oct2013 m
EPH in Water when PAH required	4	2021/12/06	2021/12/06	BBY8SOP-00029	BCMOE BCLM Sep2017 m
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	4	N/A	2022/01/10	BBY WI-00033	Auto Calc
Elements by CRC ICPMS (dissolved) (4)	4	N/A	2021/12/04	BBY7SOP-00002	EPA 6020b R2 m
Na, K, Ca, Mg, S by CRC ICPMS (total)	4	2021/12/30	2022/01/11	BBY WI-00033	Auto Calc
Elements by CRC ICPMS (total)	4	2021/12/06	2021/12/06	BBY7SOP-00003 / BBY7SOP-00002	EPA 6020b R2 m
PAH in Water by GC/MS (SIM)	4	2021/12/06	2021/12/06	BBY8SOP-00021	BCMOE BCLM Jul2017m
Total LMW, HMW, Total PAH Calc (5)	4	N/A	2022/01/05	BBY WI-00033	Auto Calc
Filter and HNO3 Preserve for Metals	4	N/A	2021/12/30	BBY7 WI-00004	SM 23 3030B m
pH @25°C (6)	4	N/A	2021/12/04	BBY6SOP-00026	SM 23 4500-H+ B m
EPH less PAH in Water by GC/FID (7)	4	N/A	2022/01/05	BBY WI-00033	Auto Calc
Total Suspended Solids (NFR)	4	2021/12/06	2021/12/07	BBY6SOP-00034	SM 23 2540 D m
VOCs, VH, F1, LH in Water by HS GC/MS	4	N/A	2021/12/04	BBY8SOP-00009 / BBY8SOP-00011 / BBY8SOP-00012	BCMOE BCLM Jul2017 m
Volatile HC-BTEX (8)	4	N/A	2021/12/31	BBY WI-00033	Auto Calc

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession

Your Project #: 123315738
Your C.O.C. #: g160395

Attention: Stewart McBride

STANTEC CONSULTING LTD
Metrotower III
Suite 500, 4730 Kingsway
BURNABY, BC
CANADA V5H 4M1

Report Date: 2022/01/11
Report #: R3120376
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C195821
Received: 2021/12/02, 17:40

using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) This test was performed by Bureau Veritas Calgary, 4000 - 19 St. , Calgary, AB, T2E 6P8
(2) DOC present in the sample should be considered as non-purgeable DOC. Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.
(3) "Total Hardness" was calculated from Total Ca and Mg concentrations and may be biased high (Hardness, or Dissolved Hardness, calculated from Dissolved Ca and Mg, should be used for compliance if available).
(4) Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.
(5) Total PAHs in Water include: Quinoline, Naphthalene, 1-Methylnaphthalene, 2-Methylnaphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Acridine, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b&j)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene, and Benzo(g,h,i)perylene.
(6) The CCME method requires pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the CCME holding time. Bureau Veritas Laboratories endeavours to analyze samples as soon as possible after receipt.
(7) LEPH = EPH (C10 to C19) - (Acenaphthene + Acridine + Anthracene + Fluorene + Naphthalene + Phenanthrene)
HEPH = EPH (C19 to C32) - (Benzo(a)anthracene + Benzo(a)pyrene + Fluoranthene + Pyrene)
(8) VPH = VH - (Benzene + Toluene + Ethylbenzene + m & p-Xylene + o-Xylene + Styrene)

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Your Project #: 123315738
Your C.O.C. #: g160395

Attention: Stewart McBride

STANTEC CONSULTING LTD
Metrotower III
Suite 500, 4730 Kingsway
BURNABY, BC
CANADA V5H 4M1

Report Date: 2022/01/11
Report #: R3120376
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C195821
Received: 2021/12/02, 17:40

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Geraldlyn Gouthro, Key Account Specialist
Email: geraldlyn.gouthro@bureauveritas.com
Phone# (780)577-7173
==========
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

RESULTS OF CHEMICAL ANALYSES OF WATER

Bureau Veritas ID		AMG285	AMG286	AMG287			AMG287		
Sampling Date		2021/12/02 15:45	2021/12/02 14:00	2021/12/02 16:25			2021/12/02 16:25		
COC Number		g160395	g160395	g160395			g160395		
	UNITS	**MW21-01**	**MW21-04**	**MW21-06**	**RDL**	**QC Batch**	**MW21-06 Lab-Dup**	**RDL**	**QC Batch**
Calculated Parameters									
Filter and HNO3 Preservation	N/A	FIELD	FIELD	FIELD		ONSITE			
Misc. Inorganics									
Dissolved Organic Carbon (C)	mg/L	0.51	0.52	1.2	0.50	A459208			
pH	pH	6.83	6.95	7.43	N/A	A463318			
Total Suspended Solids	mg/L	12	10	6.0	1.0	A461690			
Anions									
Dissolved Chloride (Cl)	mg/L	2.2	33	1.3	1.0	A460742			
Metals									
Dissolved Hex. Chromium (Cr 6+)	mg/L	<0.00099	<0.00099	<0.00099	0.00099	A453877	<0.00099	0.00099	A453877
Total Hex. Chromium (Cr 6+)	mg/L	<0.00099	<0.00099	<0.00099	0.00099	A453785			

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

Bureau Veritas ID		AMG288		
Sampling Date		2021/12/02		
COC Number		g160395		
	UNITS	**DUP21-01**	**RDL**	**QC Batch**
Calculated Parameters				
Filter and HNO3 Preservation	N/A	FIELD		ONSITE
Misc. Inorganics				
Dissolved Organic Carbon (C)	mg/L	0.71	0.50	A459208
pH	pH	6.96	N/A	A463326
Total Suspended Solids	mg/L	4.0	1.0	A461690
Anions				
Dissolved Chloride (Cl)	mg/L	32	1.0	A460742
Metals				
Dissolved Hex. Chromium (Cr 6+)	mg/L	<0.00099	0.00099	A453877
Total Hex. Chromium (Cr 6+)	mg/L	<0.00099	0.00099	A453785

RDL = Reportable Detection Limit
N/A = Not Applicable

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VOLATILE ORGANICS BY GC-MS (WATER)

Bureau Veritas ID		AMG285	AMG286	AMG287	AMG288		
Sampling Date		2021/12/02 15:45	2021/12/02 14:00	2021/12/02 16:25	2021/12/02		
COC Number		g160395	g160395	g160395	g160395		
	UNITS	**MW21-01**	**MW21-04**	**MW21-06**	**DUP21-01**	**RDL**	**QC Batch**
Volatiles							
1,3-Dichloropropene (total)	ug/L	<1.0	<1.0	<1.0	<1.0	1.0	A461402
RDL = Reportable Detection Limit							

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LEPH & HEPH WITH CSR/CCME PAH IN WATER (WATER)

Bureau Veritas ID		AMG285	AMG286	AMG287	AMG288		
Sampling Date		2021/12/02 15:45	2021/12/02 14:00	2021/12/02 16:25	2021/12/02		
COC Number		g160395	g160395	g160395	g160395		
	UNITS	**MW21-01**	**MW21-04**	**MW21-06**	**DUP21-01**	**RDL**	**QC Batch**
Calculated Parameters							
Low Molecular Weight PAH`s	ug/L	<0.10	<0.10	<0.10	<0.10	0.10	A461341
High Molecular Weight PAH`s	ug/L	<0.050	<0.050	<0.050	<0.050	0.050	A461341
Total PAH	ug/L	<0.10	<0.10	<0.10	<0.10	0.10	A461341
Polycyclic Aromatics							
Quinoline	ug/L	<0.020	<0.020	<0.020	<0.020	0.020	A458132
Naphthalene	ug/L	<0.10	<0.10	<0.10	<0.10	0.10	A458132
1-Methylnaphthalene	ug/L	<0.050	<0.050	<0.050	<0.050	0.050	A458132
2-Methylnaphthalene	ug/L	<0.10	<0.10	<0.10	<0.10	0.10	A458132
Acenaphthylene	ug/L	<0.050	<0.050	<0.050	<0.050	0.050	A458132
Acenaphthene	ug/L	<0.050	<0.050	<0.050	<0.050	0.050	A458132
Fluorene	ug/L	<0.050	<0.050	<0.050	<0.050	0.050	A458132
Phenanthrene	ug/L	<0.050	<0.050	<0.050	<0.050	0.050	A458132
Anthracene	ug/L	<0.010	<0.010	<0.010	<0.010	0.010	A458132
Acridine	ug/L	<0.050	<0.050	<0.050	<0.050	0.050	A458132
Fluoranthene	ug/L	<0.020	<0.020	<0.020	<0.020	0.020	A458132
Pyrene	ug/L	<0.020	<0.020	<0.020	<0.020	0.020	A458132
Benzo(a)anthracene	ug/L	<0.010	<0.010	<0.010	<0.010	0.010	A458132
Chrysene	ug/L	<0.020	<0.020	<0.020	<0.020	0.020	A458132
Benzo(b&j)fluoranthene	ug/L	<0.030	<0.030	<0.030	<0.030	0.030	A458132
Benzo(k)fluoranthene	ug/L	<0.050	<0.050	<0.050	<0.050	0.050	A458132
Benzo(a)pyrene	ug/L	<0.0050	<0.0050	<0.0050	<0.0050	0.0050	A458132
Indeno(1,2,3-cd)pyrene	ug/L	<0.050	<0.050	<0.050	<0.050	0.050	A458132
Dibenz(a,h)anthracene	ug/L	<0.0030	<0.0030	<0.0030	<0.0030	0.0030	A458132
Benzo(g,h,i)perylene	ug/L	<0.050	<0.050	<0.050	<0.050	0.050	A458132
Calculated Parameters							
LEPH (C10-C19 less PAH)	mg/L	<0.20	<0.20	<0.20	<0.20	0.20	A461339
HEPH (C19-C32 less PAH)	mg/L	<0.20	<0.20	<0.20	<0.20	0.20	A461339
Ext. Pet. Hydrocarbon							
EPH (C10-C19)	mg/L	<0.20	<0.20	<0.20	<0.20	0.20	A463707
EPH (C19-C32)	mg/L	<0.20	<0.20	<0.20	<0.20	0.20	A463707
Surrogate Recovery (%)							
O-TERPHENYL (sur.)	%	94	95	96	96		A463707
RDL = Reportable Detection Limit							

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LEPH & HEPH WITH CSR/CCME PAH IN WATER (WATER)

Bureau Veritas ID		AMG285	AMG286	AMG287	AMG288		
Sampling Date		2021/12/02 15:45	2021/12/02 14:00	2021/12/02 16:25	2021/12/02		
COC Number		g160395	g160395	g160395	g160395		
	UNITS	**MW21-01**	**MW21-04**	**MW21-06**	**DUP21-01**	**RDL**	**QC Batch**
D10-ANTHRACENE (sur.)	%	91	92	95	97		A458132
D8-ACENAPHTHYLENE (sur.)	%	87	87	90	92		A458132
D8-NAPHTHALENE (sur.)	%	80	89	85	88		A458132
TERPHENYL-D14 (sur.)	%	78	78	80	83		A458132
RDL = Reportable Detection Limit							

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

CSR DISSOLVED METALS IN WATER WITH CV HG (WATER)

Bureau Veritas ID		AMG285			AMG285			AMG286	AMG287		
Sampling Date		2021/12/02 15:45			2021/12/02 15:45			2021/12/02 14:00	2021/12/02 16:25		
COC Number		g160395			g160395			g160395	g160395		
	UNITS	MW21-01	RDL	QC Batch	MW21-01 Lab-Dup	RDL	QC Batch	MW21-04	MW21-06	RDL	QC Batch
Calculated Parameters											
Dissolved Hardness (CaCO3)	mg/L	61.2	0.50	A461141				87.0	126	0.50	A461141
Elements											
Dissolved Mercury (Hg)	ug/L	<0.0019	0.0019	A463550	<0.0019	0.0019	A463550	<0.0019	<0.0019	0.0019	A463550
Dissolved Metals by ICPMS											
Dissolved Aluminum (Al)	ug/L	73.6	3.0	A456579	73.6	3.0	A456579	<3.0	45.9	3.0	A456579
Dissolved Antimony (Sb)	ug/L	<0.50	0.50	A456579	<0.50	0.50	A456579	<0.50	<0.50	0.50	A456579
Dissolved Arsenic (As)	ug/L	0.19	0.10	A456579	0.19	0.10	A456579	0.18	0.42	0.10	A456579
Dissolved Barium (Ba)	ug/L	41.5	1.0	A456579	41.7	1.0	A456579	46.9	40.5	1.0	A456579
Dissolved Beryllium (Be)	ug/L	<0.10	0.10	A456579	<0.10	0.10	A456579	<0.10	<0.10	0.10	A456579
Dissolved Bismuth (Bi)	ug/L	<1.0	1.0	A456579	<1.0	1.0	A456579	<1.0	<1.0	1.0	A456579
Dissolved Boron (B)	ug/L	<50	50	A456579	<50	50	A456579	<50	<50	50	A456579
Dissolved Cadmium (Cd)	ug/L	0.019	0.010	A456579	0.022	0.010	A456579	0.026	0.010	0.010	A456579
Dissolved Chromium (Cr)	ug/L	<1.0	1.0	A456579	<1.0	1.0	A456579	<1.0	<1.0	1.0	A456579
Dissolved Cobalt (Co)	ug/L	0.21	0.20	A456579	0.21	0.20	A456579	<0.20	<0.20	0.20	A456579
Dissolved Copper (Cu)	ug/L	1.06	0.20	A456579	1.03	0.20	A456579	<0.20	0.32	0.20	A456579
Dissolved Iron (Fe)	ug/L	20.8	5.0	A456579	21.8	5.0	A456579	<5.0	11.6	5.0	A456579
Dissolved Lead (Pb)	ug/L	<0.20	0.20	A456579	<0.20	0.20	A456579	<0.20	<0.20	0.20	A456579
Dissolved Lithium (Li)	ug/L	<2.0	2.0	A456579	<2.0	2.0	A456579	<2.0	<2.0	2.0	A456579
Dissolved Manganese (Mn)	ug/L	59.2	1.0	A456579	58.6	1.0	A456579	58.8	51.1	1.0	A456579
Dissolved Molybdenum (Mo)	ug/L	<1.0	1.0	A456579	<1.0	1.0	A456579	<1.0	<1.0	1.0	A456579
Dissolved Nickel (Ni)	ug/L	<1.0	1.0	A456579	<1.0	1.0	A456579	<1.0	<1.0	1.0	A456579
Dissolved Selenium (Se)	ug/L	0.17	0.10	A456579	0.18	0.10	A456579	0.27	0.21	0.10	A456579
Dissolved Silicon (Si)	ug/L	3480	100	A456579	3500	100	A456579	4460	4040	100	A456579
Dissolved Silver (Ag)	ug/L	<0.020	0.020	A456579	<0.020	0.020	A456579	<0.020	<0.020	0.020	A456579
Dissolved Strontium (Sr)	ug/L	59.9	1.0	A456579	59.6	1.0	A456579	150	99.9	1.0	A456579
Dissolved Thallium (Tl)	ug/L	0.010	0.010	A456579	0.010	0.010	A456579	0.017	0.016	0.010	A456579
Dissolved Tin (Sn)	ug/L	<5.0	5.0	A456579	<5.0	5.0	A456579	<5.0	<5.0	5.0	A456579
Dissolved Titanium (Ti)	ug/L	<5.0	5.0	A456579	<5.0	5.0	A456579	<5.0	<5.0	5.0	A456579
Dissolved Uranium (U)	ug/L	<0.10	0.10	A456579	<0.10	0.10	A456579	<0.10	0.26	0.10	A456579
Dissolved Vanadium (V)	ug/L	<5.0	5.0	A456579	<5.0	5.0	A456579	<5.0	<5.0	5.0	A456579
Dissolved Zinc (Zn)	ug/L	<5.0	5.0	A456579	<5.0	5.0	A456579	<5.0	<5.0	5.0	A456579

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate

CSR DISSOLVED METALS IN WATER WITH CV HG (WATER)

Bureau Veritas ID		AMG285			AMG285			AMG286	AMG287		
Sampling Date		2021/12/02 15:45			2021/12/02 15:45			2021/12/02 14:00	2021/12/02 16:25		
COC Number		g160395			g160395			g160395	g160395		
	UNITS	MW21-01	RDL	QC Batch	MW21-01 Lab-Dup	RDL	QC Batch	MW21-04	MW21-06	RDL	QC Batch
Dissolved Zirconium (Zr)	ug/L	<0.10	0.10	A456579	<0.10	0.10	A456579	<0.10	<0.10	0.10	A456579
Dissolved Calcium (Ca)	mg/L	21.1	0.050	A461295				30.4	43.6	0.050	A461295
Dissolved Magnesium (Mg)	mg/L	2.05	0.050	A461295				2.71	4.24	0.050	A461295
Dissolved Potassium (K)	mg/L	1.01	0.050	A461295				2.23	2.01	0.050	A461295
Dissolved Sodium (Na)	mg/L	9.92	0.050	A461295				19.1	2.97	0.050	A461295
Dissolved Sulphur (S)	mg/L	3.2	3.0	A461295				4.1	<3.0	3.0	A461295

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate

CSR DISSOLVED METALS IN WATER WITH CV HG (WATER)

Bureau Veritas ID		AMG288		
Sampling Date		2021/12/02		
COC Number		g160395		
	UNITS	DUP21-01	RDL	QC Batch
Calculated Parameters				
Dissolved Hardness (CaCO3)	mg/L	85.6	0.50	A461141
Elements				
Dissolved Mercury (Hg)	ug/L	<0.0019	0.0019	A463550
Dissolved Metals by ICPMS				
Dissolved Aluminum (Al)	ug/L	<3.0	3.0	A456579
Dissolved Antimony (Sb)	ug/L	<0.50	0.50	A456579
Dissolved Arsenic (As)	ug/L	0.17	0.10	A456579
Dissolved Barium (Ba)	ug/L	44.8	1.0	A456579
Dissolved Beryllium (Be)	ug/L	<0.10	0.10	A456579
Dissolved Bismuth (Bi)	ug/L	<1.0	1.0	A456579
Dissolved Boron (B)	ug/L	<50	50	A456579
Dissolved Cadmium (Cd)	ug/L	0.024	0.010	A456579
Dissolved Chromium (Cr)	ug/L	<1.0	1.0	A456579
Dissolved Cobalt (Co)	ug/L	<0.20	0.20	A456579
Dissolved Copper (Cu)	ug/L	<0.20	0.20	A456579
Dissolved Iron (Fe)	ug/L	<5.0	5.0	A456579
Dissolved Lead (Pb)	ug/L	<0.20	0.20	A456579
Dissolved Lithium (Li)	ug/L	<2.0	2.0	A456579
Dissolved Manganese (Mn)	ug/L	58.1	1.0	A456579
Dissolved Molybdenum (Mo)	ug/L	<1.0	1.0	A456579
Dissolved Nickel (Ni)	ug/L	<1.0	1.0	A456579
Dissolved Selenium (Se)	ug/L	0.29	0.10	A456579
Dissolved Silicon (Si)	ug/L	4340	100	A456579
Dissolved Silver (Ag)	ug/L	<0.020	0.020	A456579
Dissolved Strontium (Sr)	ug/L	144	1.0	A456579
Dissolved Thallium (Tl)	ug/L	0.017	0.010	A456579
Dissolved Tin (Sn)	ug/L	<5.0	5.0	A456579
Dissolved Titanium (Ti)	ug/L	<5.0	5.0	A456579
Dissolved Uranium (U)	ug/L	<0.10	0.10	A456579
Dissolved Vanadium (V)	ug/L	<5.0	5.0	A456579
Dissolved Zinc (Zn)	ug/L	<5.0	5.0	A456579
Dissolved Zirconium (Zr)	ug/L	<0.10	0.10	A456579
RDL = Reportable Detection Limit				

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CSR DISSOLVED METALS IN WATER WITH CV HG (WATER)

Bureau Veritas ID		AMG288		
Sampling Date		2021/12/02		
COC Number		g160395		
	UNITS	**DUP21-01**	**RDL**	**QC Batch**
Dissolved Calcium (Ca)	mg/L	29.6	0.050	A461295
Dissolved Magnesium (Mg)	mg/L	2.80	0.050	A461295
Dissolved Potassium (K)	mg/L	2.21	0.050	A461295
Dissolved Sodium (Na)	mg/L	18.9	0.050	A461295
Dissolved Sulphur (S)	mg/L	4.6	3.0	A461295
RDL = Reportable Detection Limit				

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CSR TOTAL METALS IN WATER WITH CV HG (WATER)

Bureau Veritas ID		AMG285			AMG285			AMG286	AMG287		
Sampling Date		2021/12/02 15:45			2021/12/02 15:45			2021/12/02 14:00	2021/12/02 16:25		
COC Number		g160395			g160395			g160395	g160395		
	UNITS	MW21-01	RDL	QC Batch	MW21-01 Lab-Dup	RDL	QC Batch	MW21-04	MW21-06	RDL	QC Batch
Calculated Parameters											
Total Hardness (CaCO3)	mg/L	67.5	0.50	A461294				92.1	130	0.50	A461294
Elements											
Total Mercury (Hg)	ug/L	0.0033	0.0019	A462557	0.0030	0.0019	A462557	<0.0019	0.0021	0.0019	A462557
Total Metals by ICPMS											
Total Aluminum (Al)	ug/L	1870	3.0	A467642				483	767	3.0	A467642
Total Antimony (Sb)	ug/L	<0.50	0.50	A467642				<0.50	<0.50	0.50	A467642
Total Arsenic (As)	ug/L	1.04	0.10	A467642				0.53	0.84	0.10	A467642
Total Barium (Ba)	ug/L	49.6	1.0	A467642				49.1	43.0	1.0	A467642
Total Beryllium (Be)	ug/L	<0.10	0.10	A467642				<0.10	<0.10	0.10	A467642
Total Bismuth (Bi)	ug/L	<1.0	1.0	A467642				<1.0	<1.0	1.0	A467642
Total Boron (B)	ug/L	<50	50	A467642				<50	<50	50	A467642
Total Cadmium (Cd)	ug/L	0.022	0.010	A467642				0.029	0.014	0.010	A467642
Total Chromium (Cr)	ug/L	<1.0	1.0	A467642				<1.0	<1.0	1.0	A467642
Total Cobalt (Co)	ug/L	1.02	0.20	A467642				0.34	0.31	0.20	A467642
Total Copper (Cu)	ug/L	1.43	0.50	A467642				0.55	0.76	0.50	A467642
Total Iron (Fe)	ug/L	844	10	A467642				452	391	10	A467642
Total Lead (Pb)	ug/L	0.31	0.20	A467642				<0.20	<0.20	0.20	A467642
Total Lithium (Li)	ug/L	<2.0	2.0	A467642				<2.0	<2.0	2.0	A467642
Total Manganese (Mn)	ug/L	78.1	1.0	A467642				67.1	59.2	1.0	A467642
Total Molybdenum (Mo)	ug/L	<1.0	1.0	A467642				<1.0	<1.0	1.0	A467642
Total Nickel (Ni)	ug/L	1.5	1.0	A467642				1.1	<1.0	1.0	A467642
Total Selenium (Se)	ug/L	0.18	0.10	A467642				0.27	0.22	0.10	A467642
Total Silicon (Si)	ug/L	5200	100	A467642				5280	4850	100	A467642
Total Silver (Ag)	ug/L	<0.020	0.020	A467642				<0.020	<0.020	0.020	A467642
Total Strontium (Sr)	ug/L	66.0	1.0	A467642				147	104	1.0	A467642
Total Thallium (Tl)	ug/L	0.015	0.010	A467642				0.018	0.016	0.010	A467642
Total Tin (Sn)	ug/L	<5.0	5.0	A467642				<5.0	<5.0	5.0	A467642
Total Titanium (Ti)	ug/L	36.4	5.0	A467642				16.9	18.1	5.0	A467642
Total Uranium (U)	ug/L	<0.10	0.10	A467642				<0.10	0.27	0.10	A467642
Total Vanadium (V)	ug/L	<5.0	5.0	A467642				<5.0	<5.0	5.0	A467642
Total Zinc (Zn)	ug/L	<5.0	5.0	A467642				<5.0	<5.0	5.0	A467642

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate

CSR TOTAL METALS IN WATER WITH CV HG (WATER)

Bureau Veritas ID		AMG285			AMG285			AMG286	AMG287		
Sampling Date		2021/12/02 15:45			2021/12/02 15:45			2021/12/02 14:00	2021/12/02 16:25		
COC Number		g160395			g160395			g160395	g160395		
	UNITS	**MW21-01**	**RDL**	**QC Batch**	**MW21-01 Lab-Dup**	**RDL**	**QC Batch**	**MW21-04**	**MW21-06**	**RDL**	**QC Batch**
Total Zirconium (Zr)	ug/L	0.38	0.10	A467642				0.18	0.25	0.10	A467642
Total Calcium (Ca)	mg/L	23.0	0.050	A461296				31.9	44.5	0.050	A461296
Total Magnesium (Mg)	mg/L	2.42	0.050	A461296				3.01	4.50	0.050	A461296
Total Potassium (K)	mg/L	1.03	0.050	A461296				2.35	2.16	0.050	A461296
Total Sodium (Na)	mg/L	9.21	0.050	A461296				20.1	3.17	0.050	A461296
Total Sulphur (S)	mg/L	3.5	3.0	A461296				4.6	<3.0	3.0	A461296

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate

CSR TOTAL METALS IN WATER WITH CV HG (WATER)

Bureau Veritas ID		AMG288		
Sampling Date		2021/12/02		
COC Number		g160395		
	UNITS	**DUP21-01**	**RDL**	**QC Batch**
Calculated Parameters				
Total Hardness (CaCO3)	mg/L	87.8	0.50	A461294
Elements				
Total Mercury (Hg)	ug/L	<0.0019	0.0019	A462557
Total Metals by ICPMS				
Total Aluminum (Al)	ug/L	352	3.0	A467642
Total Antimony (Sb)	ug/L	<0.50	0.50	A467642
Total Arsenic (As)	ug/L	0.41	0.10	A467642
Total Barium (Ba)	ug/L	50.7	1.0	A467642
Total Beryllium (Be)	ug/L	<0.10	0.10	A467642
Total Bismuth (Bi)	ug/L	<1.0	1.0	A467642
Total Boron (B)	ug/L	<50	50	A467642
Total Cadmium (Cd)	ug/L	0.027	0.010	A467642
Total Chromium (Cr)	ug/L	<1.0	1.0	A467642
Total Cobalt (Co)	ug/L	0.29	0.20	A467642
Total Copper (Cu)	ug/L	<0.50	0.50	A467642
Total Iron (Fe)	ug/L	321	10	A467642
Total Lead (Pb)	ug/L	<0.20	0.20	A467642
Total Lithium (Li)	ug/L	<2.0	2.0	A467642
Total Manganese (Mn)	ug/L	60.2	1.0	A467642
Total Molybdenum (Mo)	ug/L	<1.0	1.0	A467642
Total Nickel (Ni)	ug/L	<1.0	1.0	A467642
Total Selenium (Se)	ug/L	0.25	0.10	A467642
Total Silicon (Si)	ug/L	4920	100	A467642
Total Silver (Ag)	ug/L	<0.020	0.020	A467642
Total Strontium (Sr)	ug/L	148	1.0	A467642
Total Thallium (Tl)	ug/L	0.018	0.010	A467642
Total Tin (Sn)	ug/L	<5.0	5.0	A467642
Total Titanium (Ti)	ug/L	11.6	5.0	A467642
Total Uranium (U)	ug/L	<0.10	0.10	A467642
Total Vanadium (V)	ug/L	<5.0	5.0	A467642
Total Zinc (Zn)	ug/L	<5.0	5.0	A467642
Total Zirconium (Zr)	ug/L	0.14	0.10	A467642
RDL = Reportable Detection Limit				

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CSR TOTAL METALS IN WATER WITH CV HG (WATER)

Bureau Veritas ID		AMG288		
Sampling Date		2021/12/02		
COC Number		g160395		
	UNITS	**DUP21-01**	**RDL**	**QC Batch**
Total Calcium (Ca)	mg/L	30.5	0.050	A461296
Total Magnesium (Mg)	mg/L	2.81	0.050	A461296
Total Potassium (K)	mg/L	2.40	0.050	A461296
Total Sodium (Na)	mg/L	20.4	0.050	A461296
Total Sulphur (S)	mg/L	4.7	3.0	A461296
RDL = Reportable Detection Limit				

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CSR VOC + VPH IN WATER (WATER)

Bureau Veritas ID		AMG285	AMG286			AMG286			AMG287		
Sampling Date		2021/12/02 15:45	2021/12/02 14:00			2021/12/02 14:00			2021/12/02 16:25		
COC Number		g160395	g160395			g160395			g160395		
	UNITS	MW21-01	MW21-04	RDL	QC Batch	MW21-04 Lab-Dup	RDL	QC Batch	MW21-06	RDL	QC Batch
Calculated Parameters											
VPH (VH6 to 10 - BTEX)	ug/L	<300	<300	300	A461322				<300	300	A461322
Volatiles											
VH C6-C10	ug/L	<300	<300	300	A439966	<300	300	A439966	<300	300	A439966
1,1,1,2-tetrachloroethane	ug/L	<0.50	<0.50	0.50	A439966	<0.50	0.50	A439966	<0.50	0.50	A439966
1,1,1-trichloroethane	ug/L	<0.50	<0.50	0.50	A439966	<0.50	0.50	A439966	<0.50	0.50	A439966
1,1,2,2-tetrachloroethane	ug/L	<0.50	<0.50	0.50	A439966	<0.50	0.50	A439966	<0.50	0.50	A439966
1,1,2Trichloro-1,2,2Trifluoroethane	ug/L	<2.0	<2.0	2.0	A439966	<2.0	2.0	A439966	<2.0	2.0	A439966
1,1,2-trichloroethane	ug/L	<0.50	<0.50	0.50	A439966	<0.50	0.50	A439966	<0.50	0.50	A439966
1,1-dichloroethane	ug/L	<0.50	<0.50	0.50	A439966	<0.50	0.50	A439966	<0.50	0.50	A439966
1,1-dichloroethene	ug/L	<0.50	<0.50	0.50	A439966	<0.50	0.50	A439966	<0.50	0.50	A439966
1,2,3-trichlorobenzene	ug/L	<2.0	<2.0	2.0	A439966	<2.0	2.0	A439966	<2.0	2.0	A439966
1,2,4-trichlorobenzene	ug/L	<2.0	<2.0	2.0	A439966	<2.0	2.0	A439966	<2.0	2.0	A439966
1,2-dibromoethane	ug/L	<0.20	<0.20	0.20	A439966	<0.20	0.20	A439966	<0.20	0.20	A439966
1,2-dichlorobenzene	ug/L	<0.50	<0.50	0.50	A439966	<0.50	0.50	A439966	<0.50	0.50	A439966
1,2-dichloroethane	ug/L	<0.50	<0.50	0.50	A439966	<0.50	0.50	A439966	<0.50	0.50	A439966
1,2-dichloropropane	ug/L	<0.50	<0.50	0.50	A439966	<0.50	0.50	A439966	<0.50	0.50	A439966
1,3,5-trimethylbenzene	ug/L	<2.0	<2.0	2.0	A439966	<2.0	2.0	A439966	<2.0	2.0	A439966
1,3-dichlorobenzene	ug/L	<0.50	<0.50	0.50	A439966	<0.50	0.50	A439966	<0.50	0.50	A439966
1,3-dichloropropane	ug/L	<1.0	<1.0	1.0	A439966	<1.0	1.0	A439966	<1.0	1.0	A439966
1,4-dichlorobenzene	ug/L	<0.50	<0.50	0.50	A439966	<0.50	0.50	A439966	<0.50	0.50	A439966
Benzene	ug/L	<0.40	<0.40	0.40	A439966	<0.40	0.40	A439966	<0.40	0.40	A439966
Bromobenzene	ug/L	<2.0	<2.0	2.0	A439966	<2.0	2.0	A439966	<2.0	2.0	A439966
Bromodichloromethane	ug/L	<1.0	<1.0	1.0	A439966	<1.0	1.0	A439966	<1.0	1.0	A439966
Bromoform	ug/L	<1.0	<1.0	1.0	A439966	<1.0	1.0	A439966	<1.0	1.0	A439966
Bromomethane	ug/L	<1.0	<1.0	1.0	A439966	<1.0	1.0	A439966	<1.0	1.0	A439966
Carbon tetrachloride	ug/L	<0.50	<0.50	0.50	A439966	<0.50	0.50	A439966	<0.50	0.50	A439966
Chlorobenzene	ug/L	<0.50	<0.50	0.50	A439966	<0.50	0.50	A439966	<0.50	0.50	A439966
Dibromochloromethane	ug/L	<1.0	<1.0	1.0	A439966	<1.0	1.0	A439966	<1.0	1.0	A439966
Chloroethane	ug/L	<1.0	<1.0	1.0	A439966	<1.0	1.0	A439966	<1.0	1.0	A439966
Chloroform	ug/L	<1.0	<1.0	1.0	A439966	<1.0	1.0	A439966	<1.0	1.0	A439966
Chloromethane	ug/L	<1.0	<1.0	1.0	A439966	<1.0	1.0	A439966	<1.0	1.0	A439966

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate

CSR VOC + VPH IN WATER (WATER)

Bureau Veritas ID		AMG285	AMG286			AMG286			AMG287		
Sampling Date		2021/12/02 15:45	2021/12/02 14:00			2021/12/02 14:00			2021/12/02 16:25		
COC Number		g160395	g160395			g160395			g160395		
	UNITS	MW21-01	MW21-04	RDL	QC Batch	MW21-04 Lab-Dup	RDL	QC Batch	MW21-06	RDL	QC Batch
cis-1,2-dichloroethene	ug/L	<1.0	<1.0	1.0	A439966	<1.0	1.0	A439966	<1.0	1.0	A439966
cis-1,3-dichloropropene	ug/L	<1.0	<1.0	1.0	A439966	<1.0	1.0	A439966	<1.0	1.0	A439966
Dichlorodifluoromethane	ug/L	<2.0	<2.0	2.0	A439966	<2.0	2.0	A439966	<2.0	2.0	A439966
Dichloromethane	ug/L	<2.0	<2.0	2.0	A439966	<2.0	2.0	A439966	<2.0	2.0	A439966
Ethylbenzene	ug/L	<0.40	<0.40	0.40	A439966	<0.40	0.40	A439966	<0.40	0.40	A439966
Hexachlorobutadiene	ug/L	<0.50	<0.50	0.50	A439966	<0.50	0.50	A439966	<0.50	0.50	A439966
Isopropylbenzene	ug/L	<2.0	<2.0	2.0	A439966	<2.0	2.0	A439966	<2.0	2.0	A439966
Methyl-tert-butylether (MTBE)	ug/L	<4.0	<4.0	4.0	A439966	<4.0	4.0	A439966	<4.0	4.0	A439966
Styrene	ug/L	<0.50	<0.50	0.50	A439966	<0.50	0.50	A439966	<0.50	0.50	A439966
Tetrachloroethene	ug/L	<0.50	<0.50	0.50	A439966	<0.50	0.50	A439966	1.2	0.50	A439966
Toluene	ug/L	<0.40	<0.40	0.40	A439966	<0.40	0.40	A439966	<0.40	0.40	A439966
trans-1,2-dichloroethene	ug/L	<1.0	<1.0	1.0	A439966	<1.0	1.0	A439966	<1.0	1.0	A439966
trans-1,3-dichloropropene	ug/L	<1.0	<1.0	1.0	A439966	<1.0	1.0	A439966	<1.0	1.0	A439966
Trichloroethene	ug/L	<0.50	<0.50	0.50	A439966	<0.50	0.50	A439966	<0.50	0.50	A439966
Trichlorofluoromethane	ug/L	<4.0	<4.0	4.0	A439966	<4.0	4.0	A439966	<4.0	4.0	A439966
Vinyl chloride	ug/L	<0.50	<0.50	0.50	A439966	<0.50	0.50	A439966	<0.50	0.50	A439966
m & p-Xylene	ug/L	<0.40	<0.40	0.40	A439966	<0.40	0.40	A439966	<0.40	0.40	A439966
o-Xylene	ug/L	<0.40	<0.40	0.40	A439966	<0.40	0.40	A439966	<0.40	0.40	A439966
Xylenes (Total)	ug/L	<0.40	<0.40	0.40	A439966	<0.40	0.40	A439966	<0.40	0.40	A439966
Surrogate Recovery (%)											
1,4-Difluorobenzene (sur.)	%	104	104		A439966	100		A439966	100		A439966
4-Bromofluorobenzene (sur.)	%	83	81		A439966	80		A439966	78		A439966
D4-1,2-Dichloroethane (sur.)	%	93	94		A439966	91		A439966	89		A439966

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate

CSR VOC + VPH IN WATER (WATER)

Bureau Veritas ID		AMG288		
Sampling Date		2021/12/02		
COC Number		g160395		
	UNITS	DUP21-01	RDL	QC Batch
Calculated Parameters				
VPH (VH6 to 10 - BTEX)	ug/L	<300	300	A461322
Volatiles				
VH C6-C10	ug/L	<300	300	A439966
1,1,1,2-tetrachloroethane	ug/L	<0.50	0.50	A439966
1,1,1-trichloroethane	ug/L	<0.50	0.50	A439966
1,1,2,2-tetrachloroethane	ug/L	<0.50	0.50	A439966
1,1,2Trichloro-1,2,2Trifluoroethane	ug/L	<2.0	2.0	A439966
1,1,2-trichloroethane	ug/L	<0.50	0.50	A439966
1,1-dichloroethane	ug/L	<0.50	0.50	A439966
1,1-dichloroethene	ug/L	<0.50	0.50	A439966
1,2,3-trichlorobenzene	ug/L	<2.0	2.0	A439966
1,2,4-trichlorobenzene	ug/L	<2.0	2.0	A439966
1,2-dibromoethane	ug/L	<0.20	0.20	A439966
1,2-dichlorobenzene	ug/L	<0.50	0.50	A439966
1,2-dichloroethane	ug/L	<0.50	0.50	A439966
1,2-dichloropropane	ug/L	<0.50	0.50	A439966
1,3,5-trimethylbenzene	ug/L	<2.0	2.0	A439966
1,3-dichlorobenzene	ug/L	<0.50	0.50	A439966
1,3-dichloropropane	ug/L	<1.0	1.0	A439966
1,4-dichlorobenzene	ug/L	<0.50	0.50	A439966
Benzene	ug/L	<0.40	0.40	A439966
Bromobenzene	ug/L	<2.0	2.0	A439966
Bromodichloromethane	ug/L	<1.0	1.0	A439966
Bromoform	ug/L	<1.0	1.0	A439966
Bromomethane	ug/L	<1.0	1.0	A439966
Carbon tetrachloride	ug/L	<0.50	0.50	A439966
Chlorobenzene	ug/L	<0.50	0.50	A439966
Dibromochloromethane	ug/L	<1.0	1.0	A439966
Chloroethane	ug/L	<1.0	1.0	A439966
Chloroform	ug/L	<1.0	1.0	A439966
Chloromethane	ug/L	<1.0	1.0	A439966
cis-1,2-dichloroethene	ug/L	<1.0	1.0	A439966
RDL = Reportable Detection Limit				

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

CSR VOC + VPH IN WATER (WATER)

Bureau Veritas ID		AMG288		
Sampling Date		2021/12/02		
COC Number		g160395		
	UNITS	**DUP21-01**	**RDL**	**QC Batch**
cis-1,3-dichloropropene	ug/L	<1.0	1.0	A439966
Dichlorodifluoromethane	ug/L	<2.0	2.0	A439966
Dichloromethane	ug/L	<2.0	2.0	A439966
Ethylbenzene	ug/L	<0.40	0.40	A439966
Hexachlorobutadiene	ug/L	<0.50	0.50	A439966
Isopropylbenzene	ug/L	<2.0	2.0	A439966
Methyl-tert-butylether (MTBE)	ug/L	<4.0	4.0	A439966
Styrene	ug/L	<0.50	0.50	A439966
Tetrachloroethene	ug/L	<0.50	0.50	A439966
Toluene	ug/L	<0.40	0.40	A439966
trans-1,2-dichloroethene	ug/L	<1.0	1.0	A439966
trans-1,3-dichloropropene	ug/L	<1.0	1.0	A439966
Trichloroethene	ug/L	<0.50	0.50	A439966
Trichlorofluoromethane	ug/L	<4.0	4.0	A439966
Vinyl chloride	ug/L	<0.50	0.50	A439966
m & p-Xylene	ug/L	<0.40	0.40	A439966
o-Xylene	ug/L	<0.40	0.40	A439966
Xylenes (Total)	ug/L	<0.40	0.40	A439966
Surrogate Recovery (%)				
1,4-Difluorobenzene (sur.)	%	105		A439966
4-Bromofluorobenzene (sur.)	%	82		A439966
D4-1,2-Dichloroethane (sur.)	%	95		A439966
RDL = Reportable Detection Limit				

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

GENERAL COMMENTS

Results relate only to the items tested.

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
A439966	1,4-Difluorobenzene (sur.)	2021/12/04			101	50 - 140	104	%		
A439966	4-Bromofluorobenzene (sur.)	2021/12/04			102	50 - 140	82	%		
A439966	D4-1,2-Dichloroethane (sur.)	2021/12/04			102	50 - 140	87	%		
A458132	D10-ANTHRACENE (sur.)	2021/12/06	89	50 - 140	105	50 - 140	95	%		
A458132	D8-ACENAPHTHYLENE (sur.)	2021/12/06	89	50 - 140	103	50 - 140	91	%		
A458132	D8-NAPHTHALENE (sur.)	2021/12/06	87	50 - 140	96	50 - 140	84	%		
A458132	TERPHENYL-D14 (sur.)	2021/12/06	78	50 - 140	91	50 - 140	81	%		
A463707	O-TERPHENYL (sur.)	2021/12/06			97	60 - 140	96	%		
A439966	1,1,1,2-tetrachloroethane	2021/12/04			98	60 - 130	<0.50	ug/L	NC	30
A439966	1,1,1-trichloroethane	2021/12/04			104	60 - 130	<0.50	ug/L	NC	30
A439966	1,1,2,2-tetrachloroethane	2021/12/04			95	60 - 130	<0.50	ug/L	NC	30
A439966	1,1,2Trichloro-1,2,2Trifluoroethane	2021/12/04			101	60 - 130	<2.0	ug/L	NC	30
A439966	1,1,2-trichloroethane	2021/12/04			93	60 - 130	<0.50	ug/L	NC	30
A439966	1,1-dichloroethane	2021/12/04			97	60 - 130	<0.50	ug/L	NC	30
A439966	1,1-dichloroethene	2021/12/04			83	60 - 130	<0.50	ug/L	NC	30
A439966	1,2,3-trichlorobenzene	2021/12/04			102	60 - 130	<2.0	ug/L	NC	30
A439966	1,2,4-trichlorobenzene	2021/12/04			103	60 - 130	<2.0	ug/L	NC	30
A439966	1,2-dibromoethane	2021/12/04			103	60 - 130	<0.20	ug/L	NC	30
A439966	1,2-dichlorobenzene	2021/12/04			99	60 - 130	<0.50	ug/L	NC	30
A439966	1,2-dichloroethane	2021/12/04			94	60 - 130	<0.50	ug/L	NC	30
A439966	1,2-dichloropropane	2021/12/04			94	60 - 130	<0.50	ug/L	NC	30
A439966	1,3,5-trimethylbenzene	2021/12/04			104	60 - 130	<2.0	ug/L	NC	30
A439966	1,3-dichlorobenzene	2021/12/04			86	60 - 130	<0.50	ug/L	NC	30
A439966	1,3-dichloropropane	2021/12/04			79	60 - 130	<1.0	ug/L	NC	30
A439966	1,4-dichlorobenzene	2021/12/04			95	60 - 130	<0.50	ug/L	NC	30
A439966	Benzene	2021/12/04			98	60 - 130	<0.40	ug/L	NC	30
A439966	Bromobenzene	2021/12/04			101	60 - 130	<2.0	ug/L	NC	30
A439966	Bromodichloromethane	2021/12/04			98	60 - 130	<1.0	ug/L	NC	30
A439966	Bromoform	2021/12/04			101	60 - 130	<1.0	ug/L	NC	30
A439966	Bromomethane	2021/12/04			93	50 - 140	<1.0	ug/L	NC	30
A439966	Carbon tetrachloride	2021/12/04			106	60 - 130	<0.50	ug/L	NC	30
A439966	Chlorobenzene	2021/12/04			94	60 - 130	<0.50	ug/L	NC	30

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
A439966	Chloroethane	2021/12/04			105	50 - 140	<1.0	ug/L	NC	30
A439966	Chloroform	2021/12/04			100	60 - 130	<1.0	ug/L	NC	30
A439966	Chloromethane	2021/12/04			112	50 - 140	<1.0	ug/L	NC	30
A439966	cis-1,2-dichloroethene	2021/12/04			92	60 - 130	<1.0	ug/L	NC	30
A439966	cis-1,3-dichloropropene	2021/12/04			88	50 - 140	<1.0	ug/L	NC	30
A439966	Dibromochloromethane	2021/12/04			109	60 - 130	<1.0	ug/L	NC	30
A439966	Dichlorodifluoromethane	2021/12/04			114	50 - 140	<2.0	ug/L	NC	30
A439966	Dichloromethane	2021/12/04			92	60 - 130	<2.0	ug/L	NC	30
A439966	Ethylbenzene	2021/12/04			108	60 - 130	<0.40	ug/L	NC	30
A439966	Hexachlorobutadiene	2021/12/04			106	60 - 130	<0.50	ug/L	NC	30
A439966	Isopropylbenzene	2021/12/04			102	60 - 130	<2.0	ug/L	NC	30
A439966	m & p-Xylene	2021/12/04			94	60 - 130	<0.40	ug/L	NC	30
A439966	Methyl-tert-butylether (MTBE)	2021/12/04			96	60 - 130	<4.0	ug/L	NC	30
A439966	o-Xylene	2021/12/04			91	60 - 130	<0.40	ug/L	NC	30
A439966	Styrene	2021/12/04			85	60 - 130	<0.50	ug/L	NC	30
A439966	Tetrachloroethene	2021/12/04			104	60 - 130	<0.50	ug/L	NC	30
A439966	Toluene	2021/12/04			87	60 - 130	<0.40	ug/L	NC	30
A439966	trans-1,2-dichloroethene	2021/12/04			88	60 - 130	<1.0	ug/L	NC	30
A439966	trans-1,3-dichloropropene	2021/12/04			81	50 - 140	<1.0	ug/L	NC	30
A439966	Trichloroethene	2021/12/04			103	60 - 130	<0.50	ug/L	NC	30
A439966	Trichlorofluoromethane	2021/12/04			113	60 - 130	<4.0	ug/L	NC	30
A439966	VH C6-C10	2021/12/04			84	70 - 130	<300	ug/L	NC	30
A439966	Vinyl chloride	2021/12/04			113	50 - 140	<0.50	ug/L	NC	30
A439966	Xylenes (Total)	2021/12/04							NC	30
A453785	Total Hex. Chromium (Cr 6+)	2021/12/06	91	80 - 120	103	80 - 120	<0.00099	mg/L	1.1	20
A453877	Dissolved Hex. Chromium (Cr 6+)	2021/12/06	90	80 - 120	103	80 - 120	<0.00099	mg/L	NC	20
A456579	Dissolved Aluminum (Al)	2021/12/04	95	80 - 120	101	80 - 120	<3.0	ug/L	0.044	20
A456579	Dissolved Antimony (Sb)	2021/12/04	98	80 - 120	103	80 - 120	<0.50	ug/L	NC	20
A456579	Dissolved Arsenic (As)	2021/12/04	102	80 - 120	102	80 - 120	<0.10	ug/L	1.3	20
A456579	Dissolved Barium (Ba)	2021/12/04	93	80 - 120	102	80 - 120	<1.0	ug/L	0.55	20
A456579	Dissolved Beryllium (Be)	2021/12/04	96	80 - 120	99	80 - 120	<0.10	ug/L	NC	20
A456579	Dissolved Bismuth (Bi)	2021/12/04	91	80 - 120	99	80 - 120	<1.0	ug/L	NC	20

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
A456579	Dissolved Boron (B)	2021/12/04	94	80 - 120	101	80 - 120	<50	ug/L	NC	20
A456579	Dissolved Cadmium (Cd)	2021/12/04	98	80 - 120	101	80 - 120	<0.010	ug/L	15	20
A456579	Dissolved Chromium (Cr)	2021/12/04	93	80 - 120	101	80 - 120	<1.0	ug/L	NC	20
A456579	Dissolved Cobalt (Co)	2021/12/04	91	80 - 120	99	80 - 120	<0.20	ug/L	1.1	20
A456579	Dissolved Copper (Cu)	2021/12/04	89	80 - 120	98	80 - 120	<0.20	ug/L	2.3	20
A456579	Dissolved Iron (Fe)	2021/12/04	99	80 - 120	104	80 - 120	<5.0	ug/L	4.6	20
A456579	Dissolved Lead (Pb)	2021/12/04	95	80 - 120	100	80 - 120	<0.20	ug/L	NC	20
A456579	Dissolved Lithium (Li)	2021/12/04	92	80 - 120	98	80 - 120	<2.0	ug/L	NC	20
A456579	Dissolved Manganese (Mn)	2021/12/04	NC	80 - 120	101	80 - 120	<1.0	ug/L	0.93	20
A456579	Dissolved Molybdenum (Mo)	2021/12/04	106	80 - 120	107	80 - 120	<1.0	ug/L	NC	20
A456579	Dissolved Nickel (Ni)	2021/12/04	90	80 - 120	99	80 - 120	<1.0	ug/L	NC	20
A456579	Dissolved Selenium (Se)	2021/12/04	103	80 - 120	102	80 - 120	<0.10	ug/L	3.9	20
A456579	Dissolved Silicon (Si)	2021/12/04	97	80 - 120	106	80 - 120	<100	ug/L	0.79	20
A456579	Dissolved Silver (Ag)	2021/12/04	93	80 - 120	99	80 - 120	<0.020	ug/L	NC	20
A456579	Dissolved Strontium (Sr)	2021/12/04	NC	80 - 120	103	80 - 120	<1.0	ug/L	0.46	20
A456579	Dissolved Thallium (Tl)	2021/12/04	94	80 - 120	99	80 - 120	<0.010	ug/L	1.2	20
A456579	Dissolved Tin (Sn)	2021/12/04	95	80 - 120	103	80 - 120	<5.0	ug/L	NC	20
A456579	Dissolved Titanium (Ti)	2021/12/04	100	80 - 120	106	80 - 120	<5.0	ug/L	NC	20
A456579	Dissolved Uranium (U)	2021/12/04	99	80 - 120	105	80 - 120	<0.10	ug/L	NC	20
A456579	Dissolved Vanadium (V)	2021/12/04	97	80 - 120	103	80 - 120	<5.0	ug/L	NC	20
A456579	Dissolved Zinc (Zn)	2021/12/04	97	80 - 120	101	80 - 120	<5.0	ug/L	NC	20
A456579	Dissolved Zirconium (Zr)	2021/12/04	102	80 - 120	105	80 - 120	<0.10	ug/L	NC	20
A458132	1-Methylnaphthalene	2021/12/06	90	50 - 140	103	50 - 140	<0.050	ug/L	NC	40
A458132	2-Methylnaphthalene	2021/12/06	91	50 - 140	103	50 - 140	<0.10	ug/L	NC	40
A458132	Acenaphthene	2021/12/06	88	50 - 140	102	50 - 140	<0.050	ug/L	NC	40
A458132	Acenaphthylene	2021/12/06	88	50 - 140	102	50 - 140	<0.050	ug/L	NC	40
A458132	Acridine	2021/12/06	115	50 - 140	114	50 - 140	<0.050	ug/L	NC	40
A458132	Anthracene	2021/12/06	98	50 - 140	115	50 - 140	<0.010	ug/L	NC	40
A458132	Benzo(a)anthracene	2021/12/06	90	50 - 140	107	50 - 140	<0.010	ug/L	NC	40
A458132	Benzo(a)pyrene	2021/12/06	86	50 - 140	103	50 - 140	<0.0050	ug/L	NC	40
A458132	Benzo(b&j)fluoranthene	2021/12/06	79	50 - 140	95	50 - 140	<0.030	ug/L	NC	40
A458132	Benzo(g,h,i)perylene	2021/12/06	88	50 - 140	108	50 - 140	<0.050	ug/L	NC	40

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
A458132	Benzo(k)fluoranthene	2021/12/06	93	50 - 140	108	50 - 140	<0.050	ug/L	NC	40
A458132	Chrysene	2021/12/06	87	50 - 140	105	50 - 140	<0.020	ug/L	NC	40
A458132	Dibenz(a,h)anthracene	2021/12/06	98	50 - 140	117	50 - 140	<0.0030	ug/L	NC	40
A458132	Fluoranthene	2021/12/06	86	50 - 140	104	50 - 140	<0.020	ug/L	NC	40
A458132	Fluorene	2021/12/06	88	50 - 140	103	50 - 140	<0.050	ug/L	NC	40
A458132	Indeno(1,2,3-cd)pyrene	2021/12/06	99	50 - 140	118	50 - 140	<0.050	ug/L	NC	40
A458132	Naphthalene	2021/12/06	97	50 - 140	109	50 - 140	<0.10	ug/L	NC	40
A458132	Phenanthrene	2021/12/06	94	50 - 140	113	50 - 140	<0.050	ug/L	NC	40
A458132	Pyrene	2021/12/06	85	50 - 140	104	50 - 140	<0.020	ug/L	NC	40
A458132	Quinoline	2021/12/06	117	50 - 140	117	50 - 140	<0.020	ug/L	NC	40
A459208	Dissolved Organic Carbon (C)	2021/11/29	106	80 - 120	110	80 - 120	<0.50	mg/L	1.6	20
A460742	Dissolved Chloride (Cl)	2021/12/06			103	80 - 120	<1.0	mg/L		
A461690	Total Suspended Solids	2021/12/01	104	80 - 120	102	80 - 120	<1.0	mg/L	NC	20
A462557	Total Mercury (Hg)	2021/12/03	92	80 - 120	101	80 - 120	<0.0019	ug/L	11	20
A463318	pH	2021/12/04			101	97 - 103			2.7	N/A
A463326	pH	2021/12/04			101	97 - 103			0.61	N/A
A463550	Dissolved Mercury (Hg)	2021/12/03	96	80 - 120	102	80 - 120	<0.0019	ug/L	NC	20
A463707	EPH (C10-C19)	2021/12/06			105	70 - 130	<0.20	mg/L		
A463707	EPH (C19-C32)	2021/12/06			102	70 - 130	<0.20	mg/L		
A467642	Total Aluminum (Al)	2021/12/06	100	80 - 120	101	80 - 120	<3.0	ug/L		
A467642	Total Antimony (Sb)	2021/12/06	104	80 - 120	102	80 - 120	<0.50	ug/L		
A467642	Total Arsenic (As)	2021/12/06	104	80 - 120	102	80 - 120	<0.10	ug/L		
A467642	Total Barium (Ba)	2021/12/06	104	80 - 120	102	80 - 120	<1.0	ug/L		
A467642	Total Beryllium (Be)	2021/12/06	95	80 - 120	96	80 - 120	<0.10	ug/L		
A467642	Total Bismuth (Bi)	2021/12/06	99	80 - 120	99	80 - 120	<1.0	ug/L		
A467642	Total Boron (B)	2021/12/06	95	80 - 120	95	80 - 120	<50	ug/L		
A467642	Total Cadmium (Cd)	2021/12/06	104	80 - 120	101	80 - 120	<0.010	ug/L		
A467642	Total Chromium (Cr)	2021/12/06	98	80 - 120	99	80 - 120	<1.0	ug/L		
A467642	Total Cobalt (Co)	2021/12/06	98	80 - 120	98	80 - 120	<0.20	ug/L		
A467642	Total Copper (Cu)	2021/12/06	97	80 - 120	97	80 - 120	<0.50	ug/L		
A467642	Total Iron (Fe)	2021/12/06	101	80 - 120	104	80 - 120	<10	ug/L		
A467642	Total Lead (Pb)	2021/12/06	101	80 - 120	102	80 - 120	<0.20	ug/L		

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
A467642	Total Lithium (Li)	2021/12/06	91	80 - 120	91	80 - 120	<2.0	ug/L		
A467642	Total Manganese (Mn)	2021/12/06	101	80 - 120	101	80 - 120	<1.0	ug/L		
A467642	Total Molybdenum (Mo)	2021/12/06	110	80 - 120	105	80 - 120	<1.0	ug/L		
A467642	Total Nickel (Ni)	2021/12/06	98	80 - 120	100	80 - 120	<1.0	ug/L		
A467642	Total Selenium (Se)	2021/12/06	105	80 - 120	102	80 - 120	<0.10	ug/L		
A467642	Total Silicon (Si)	2021/12/06	NC	80 - 120	113	80 - 120	<100	ug/L		
A467642	Total Silver (Ag)	2021/12/06	102	80 - 120	100	80 - 120	<0.020	ug/L		
A467642	Total Strontium (Sr)	2021/12/06	113	80 - 120	100	80 - 120	<1.0	ug/L		
A467642	Total Thallium (Tl)	2021/12/06	99	80 - 120	99	80 - 120	<0.010	ug/L		
A467642	Total Tin (Sn)	2021/12/06	104	80 - 120	100	80 - 120	<5.0	ug/L		
A467642	Total Titanium (Ti)	2021/12/06	106	80 - 120	105	80 - 120	<5.0	ug/L		
A467642	Total Uranium (U)	2021/12/06	105	80 - 120	104	80 - 120	<0.10	ug/L		
A467642	Total Vanadium (V)	2021/12/06	103	80 - 120	102	80 - 120	<5.0	ug/L		
A467642	Total Zinc (Zn)	2021/12/06	102	80 - 120	102	80 - 120	<5.0	ug/L		
A467642	Total Zirconium (Zr)	2021/12/06	107	80 - 120	103	80 - 120	<0.10	ug/L		

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

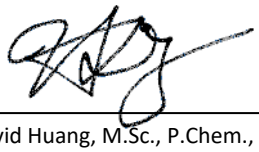
Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

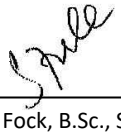
NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:



David Huang, M.Sc., P.Chem., QP, Scientific Services Manager



Sze Yeung Fock, B.Sc., Scientific Specialist

Bureau Veritas Proprietary Software
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Automated Statchk

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5 Toll Free (833) 282-5227
Victoria: 851 Viewfield Road, Unit 1, Victoria, BC V9A 4V2 Toll Free (833) 282-5227
bvlabs.com

CHAIN OF CUSTODY RECORD

G 160395

Page 1 of 1

Invoice Information	Report Information (if differs from invoice)	Project Information	Turnaround Time (TAT) Required
Company: Stantec	Company: Stantec	Quotation	☑ 5 - 7 Days Regular (Most analyses)
Contact Name: Matt Redmond	Contact Name: Stewart McBride	P.O. #/AFE#:	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	Address:		Rush TAT (Surcharges will be applied)
PC:	PC:	Project #: 123315738	☐ Same Day ☐ 2 Days
Phone/Fax:	Email: Stewart.mcbride@stantec.com	Site Location:	☐ 1 Day ☐ 3-4 Days
Email: SAPinvoices@stantec.com		Site #:	Date Required:
Copies:	Copies: Matthew.Redmond@stantec.com	Sampled By: C. Smith	Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID			
Seal Present		X				
Seal Intact		X	Temp	10	10	9
Cooling Media	X					
	YES	NO	Cooler ID			
Seal Present						
Seal Intact			Temp			
Cooling Media						
	YES	NO	Cooler ID			
Seal Present						
Seal Intact			Temp			
Cooling Media						

Depot Reception

Analysis Requested

	Sample Identification	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	BTEXS / VPH	BTEX F1	PAH	EPH	Dissolved Metals	Dissolved Mercury	Total Metals	Total Mercury	Chloride	TSS	pH	Nitrite	Cr VI (Dissolved)	Cr VI (total)	Organic Carbon (Dissolved)	Hardness	HOLD - DO NOT ANALYZE
1	MW21-01	21/12/2	15:45	water	12	X		X		X	X	X	X	X	X	X		X	X	X	X	
2	MW21-04	//	14:00	//	12	X		X		X	X	X	X	X	X	X		X	X	X	X	
3	MW21-06	//	16:25	//	12	X		X		X	X	X	X	X	X	X		X	X	X	X	
4	DUP21-01	//	~	//	12	X		X		X	X	X	X	X	X	X		X	X	X	X	
5																						
6																						
7																						
8																						
9																						
10																						

Regulatory Criteria

- ☒ BC CSR
- ☐ YK CSR
- ☐ CCME
- ☒ Drinking Water
- ☒ BC Water Quality
- ☐ Other

Special Instructions

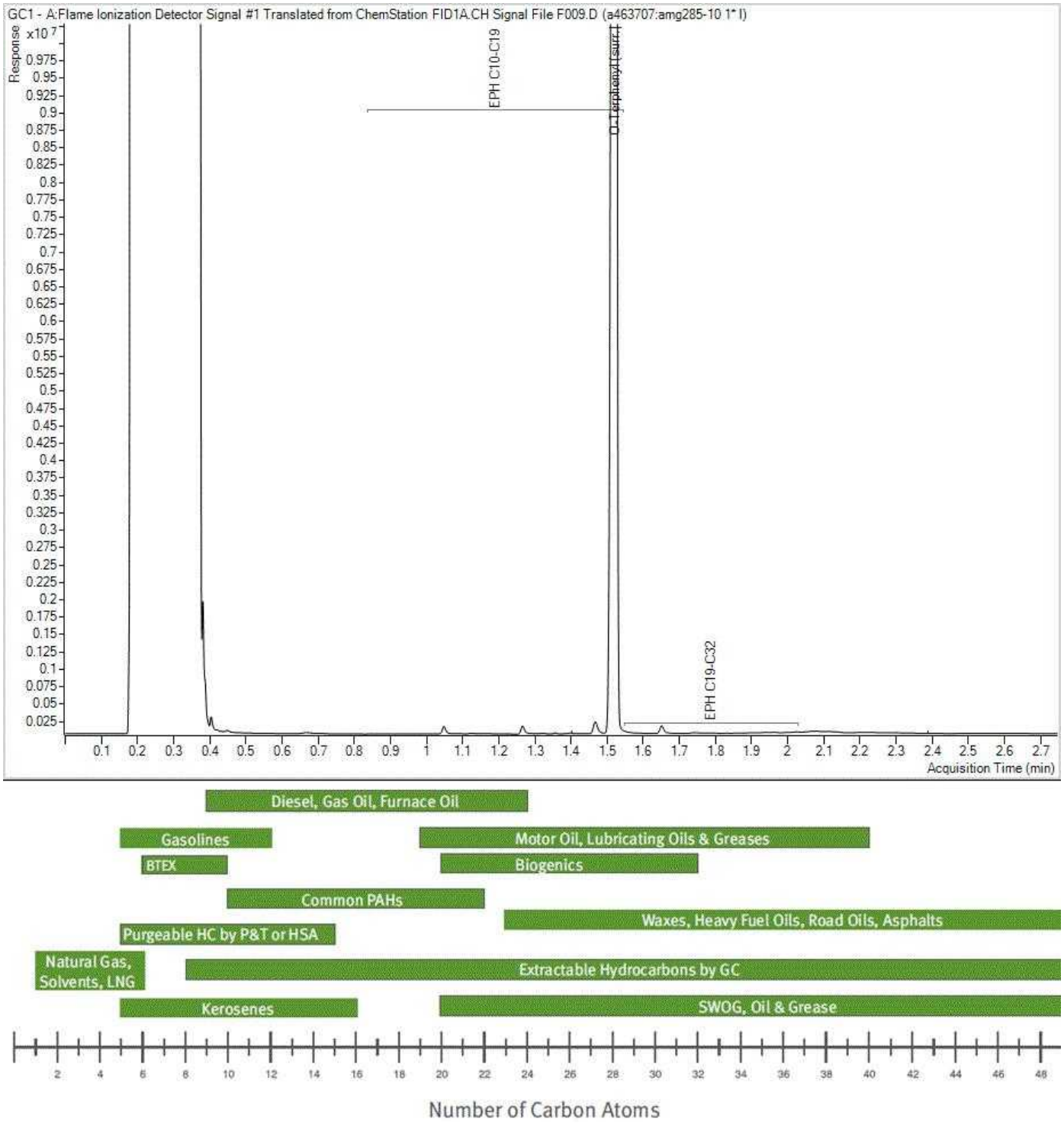
Total metals NOT filtered

Unless otherwise agreed to in writing, work submitted on this Chain of Custody is subject to Bureau Veritas' standard Terms and Conditions. Signing of this Chain of Custody document is acknowledgement and acceptance of our terms which

Relinquished by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	Received by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):
CS / Christian Smith	21/12/2	17:30	Francisco Cuartas	2021/12/02	17:40

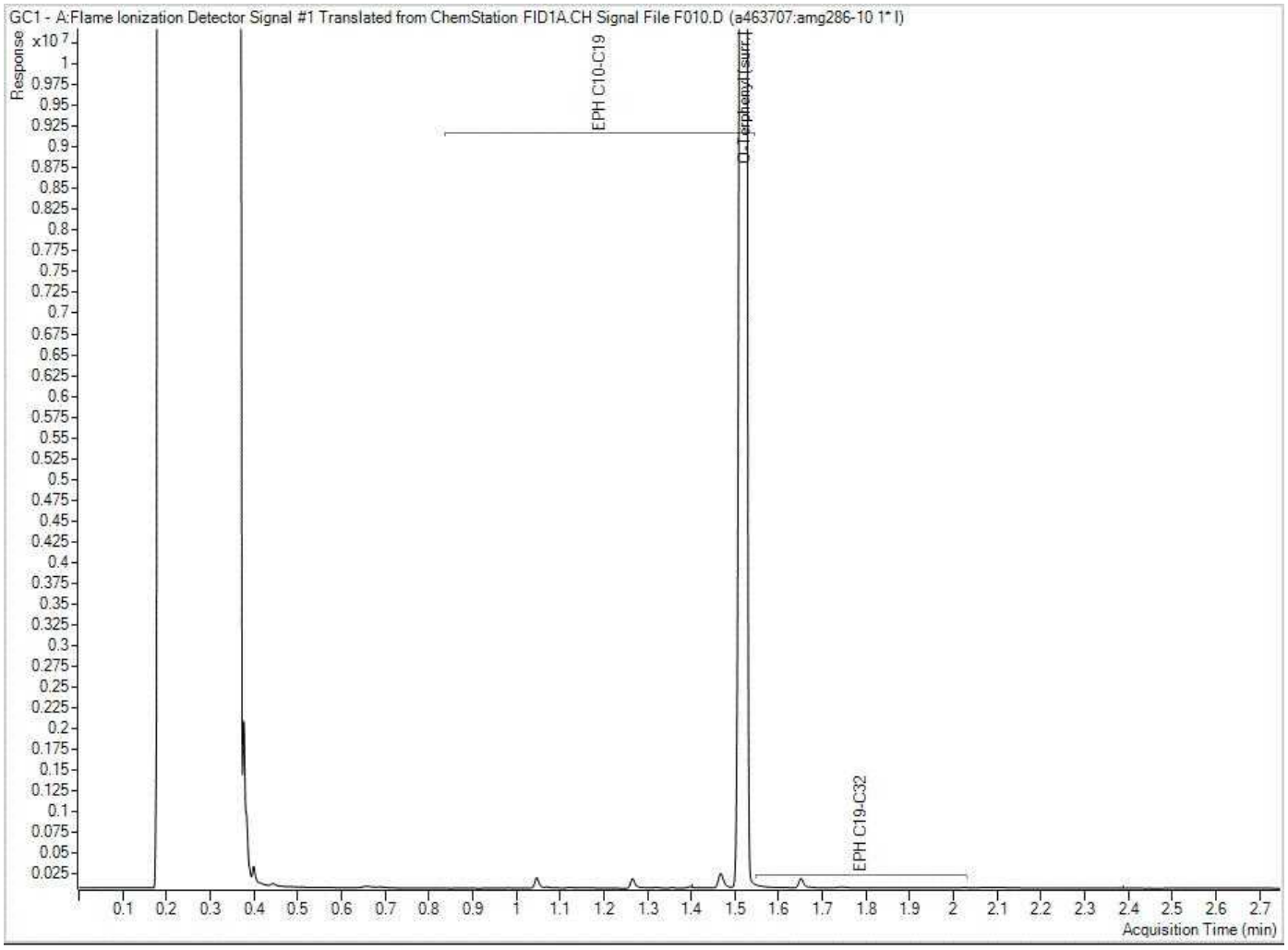
C195821_COC

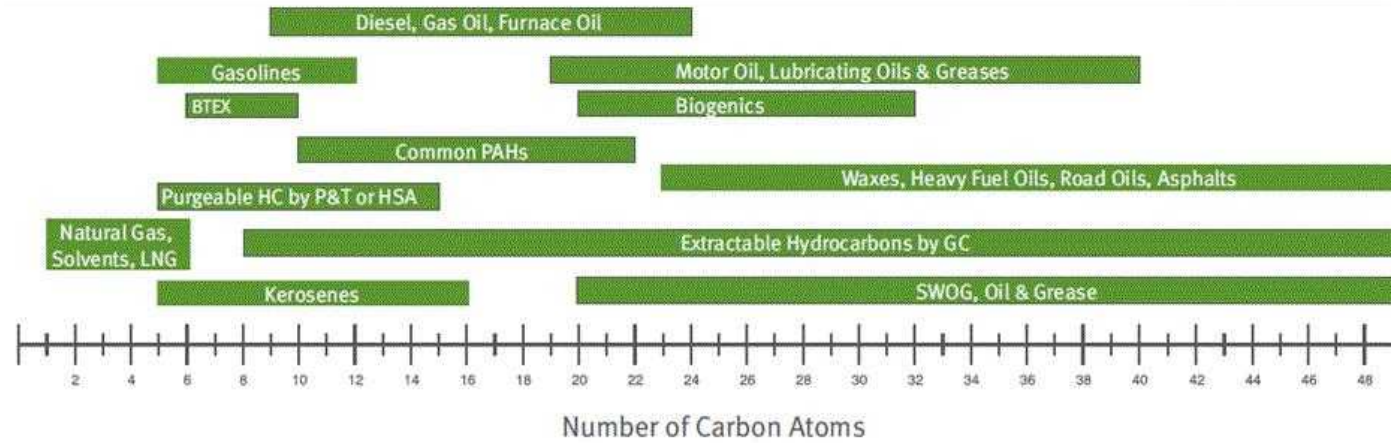
EPH in Water when PAH required Chromatogram



Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

EPH in Water when PAH required Chromatogram





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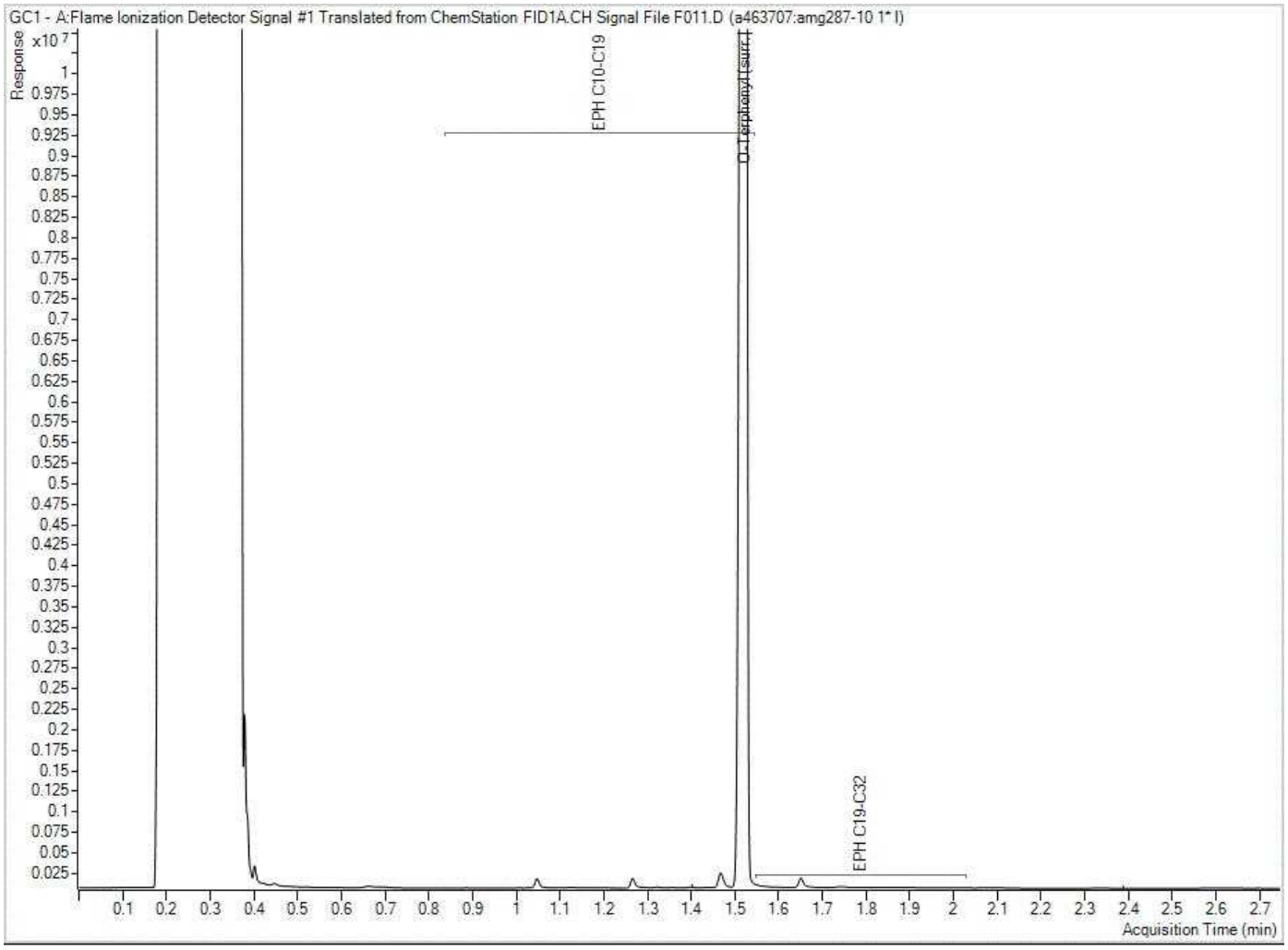
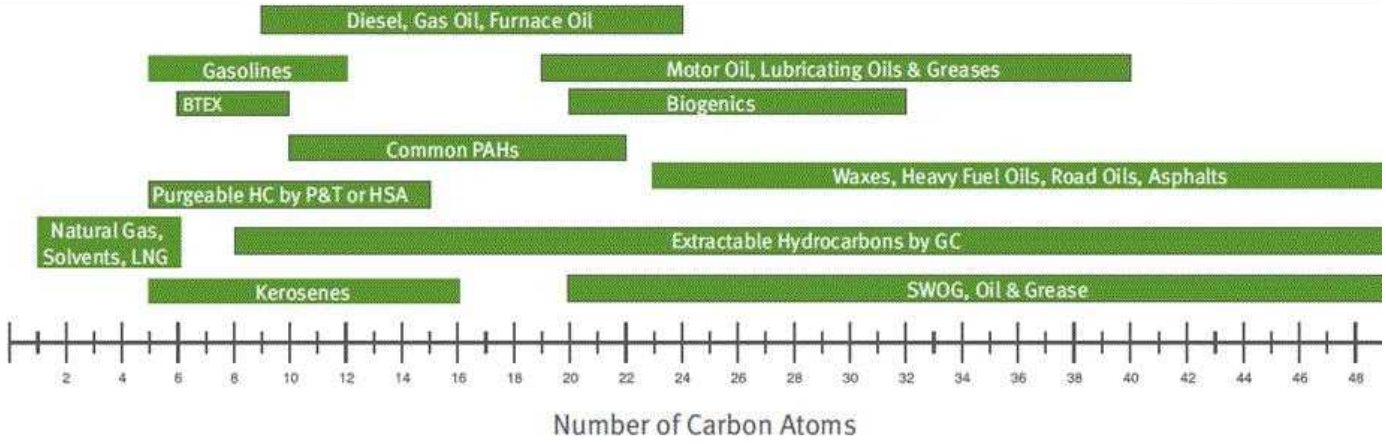
Bureau Veritas Job #: C195821
Report Date: 2022/01/11
Bureau Veritas Sample: AMG287

STANTEC CONSULTING LTD
Client Project #: 123315738
Client ID: MW21-06

EPH in Water when PAH required Chromatogram





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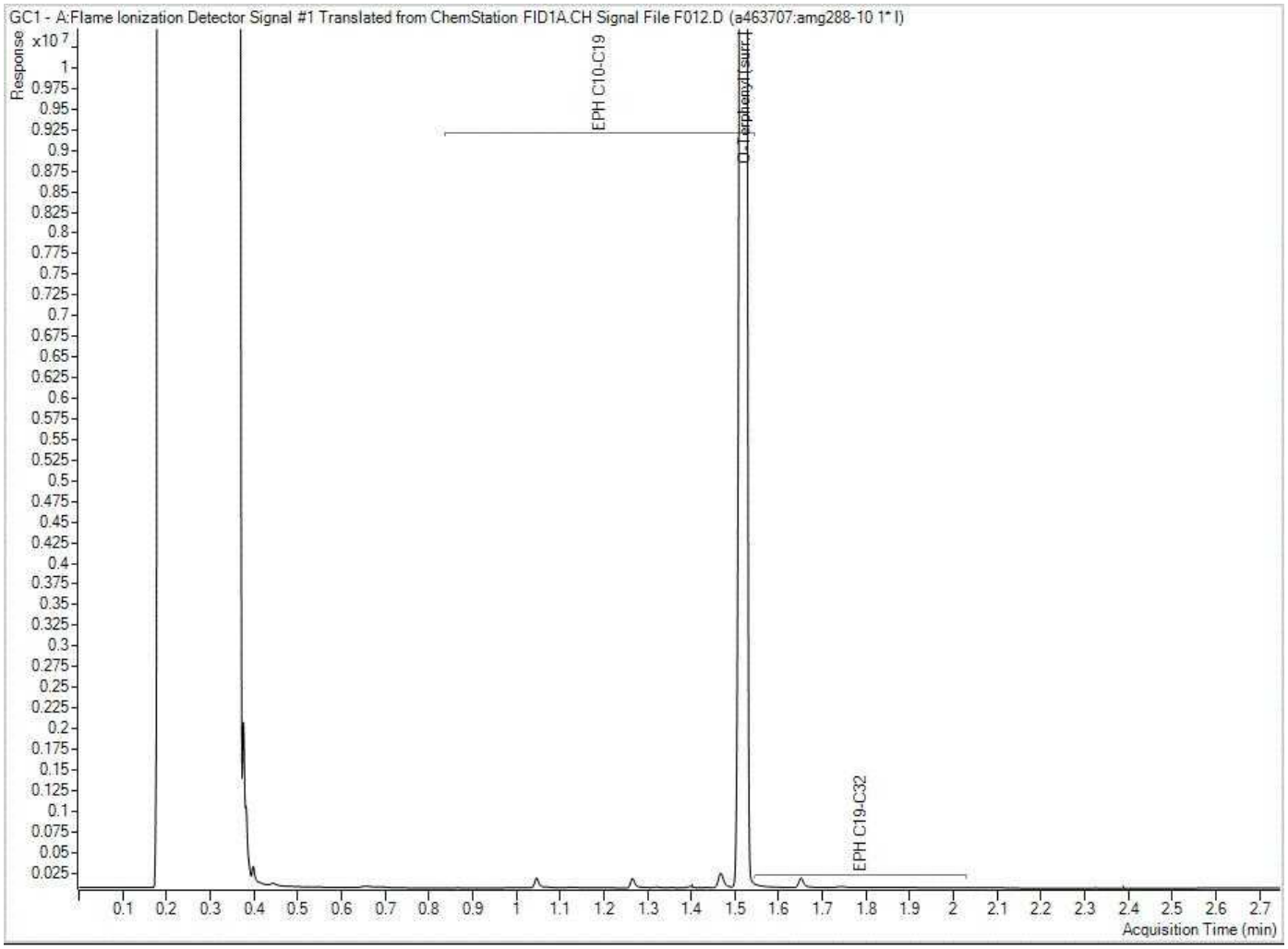
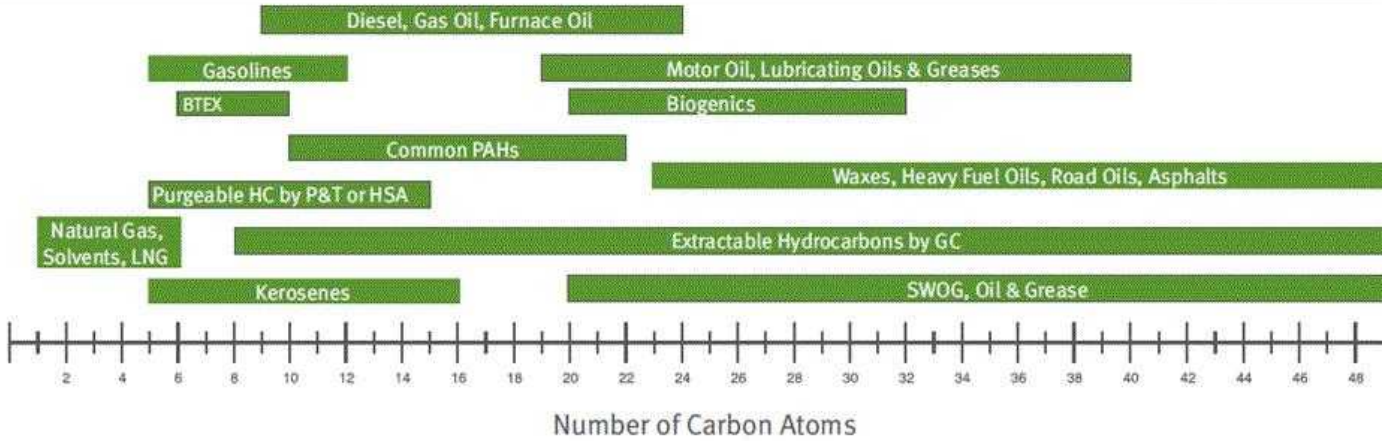
Bureau Veritas Job #: C195821
Report Date: 2022/01/11
Bureau Veritas Sample: AMG288

STANTEC CONSULTING LTD
Client Project #: 123315738
Client ID: DUP21-01

EPH in Water when PAH required Chromatogram





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