Secondary Water Resource Assessment

West Cochrane Gravel Pit

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1.0 Introduction

SLR Consulting (Canada) Ltd. (SLR) was retained by BURNCO Rock Products Ltd. (BURNCO) to conduct a secondary water resource assessment of a proposed aggregate mining expansion in Rocky View County, Alberta. The assessment, review of water chemistry literature, and a description of hydrological conditions in the vicinity of the West Cochrane Gravel Pit are required to address issues raised by intervenors during BURNCO's application process to Rocky View County (County).

1.1 Background

In May of 2020, BURNCO applied to expand their West Cochrane Gravel Pit operation, currently located at NW13-26-5-W5M in Rocky View County, with the intention of rezoning the lands from agriculture to aggregate extraction. This would secure a long-term source of high-quality sand and gravel along an established transportation corridor to continue to serve the construction industry in Calgary and the intervening region. In July 2022, Rocky View County Council (Council) held a public hearing on the application. As part of that public hearing, many submissions were made that raised fears of environmental damage that, while addressed in the technical documentation, may have mitigated enthusiasm for the project. In particular a submission by Dr. Fennell (Fennell, J. 2021) on supposed physical and chemical impacts to water quality downgradient of the pit, and a submission by Mayhood (Mayhood, D.W. 2021), who accepted Dr. Fennell's conclusions and then raised conjectures on impact to fish habitat in the Bow River.

Since that time, BURNCO has been working to revise its application and return to Council. These revisions include enhancements to the groundwater monitoring network and baseline data, particularly around the existing pit, and examination for potential impacts. This included ground and surface water sampling and scientific assessment of the mechanisms that govern the movement of groundwater from this pit towards the surface water bodies. Their intent is to see if the issues raised by the intervenors are valid, in light of what is known about gravel pit impacts and their own site specific information.

1.2 Purpose

The purpose of this report is to assess the true impact of the proposed works by drawing upon existing documentation, known scientific methodologies, reviewing key literature, and the extensive experience of the report authors on aggregate extraction and its effects on the natural environment.

1.3 Objectives

The objective of the field studies is to provide additional information about the receiving water courses, hydrogeological conditions within the vicinity of the site, and scientific literature to evaluate turbidity and metal concerns raised during BURNCO's application for the expansion of aggregate mining operations. The information was compiled into a risk assessment to evaluate the risk of aggregate mining operation impacts to surface water turbidity, metals, and trace elements.

2.0 Methodology

In order to achieve the objectives outlined above, the surface water assessment was divided into four main parts:

1 Desktop data review;

2 Field program;

3 Literature review; and

4 Hydrogeological risk assessment.

A summary of the methodology is provided below with further details provided in Appendix A.

2.1 Desktop Data Review

Available data collected previously by BURNCO and Matrix Solutions Inc. (Matrix) was reviewed and used to determine and confirm the geology, hydrogeology, groundwater and soil chemistry beneath the site, and the locations of potential sensitive groundwater receptors (wells, wetlands, creeks, rivers, and springs). The data included soil and groundwater quality analyses, aggregate leaching analysis, and groundwater monitoring measurements.

2.2 Field Program

Following the initial information review, field assessments were carried out in accordance with SLR's standard field investigation procedures. This included a bedrock outcrop field survey, the installation of drive point piezometers and staff gauges, stream flow measurements, and surface water sampling. Additional details on the field methodologies employed are provided in Appendix A.

2.3 Literature Review

SLR conducted a review of scientific literature to obtain information about the possible correlation between aggregate mining and elevated turbidity, metal, and trace element concentrations in downgradient water receptors.

2.4 Hydrogeological Risk Assessment

In order to conduct a hydrogeological impact assessment for the site, the literature / data review and field data have been combined into a conceptual site model (CSM) on which the effects of an aggregate operation can be superimposed. As part of the hydrogeological risk assessment, a water budget was created for the site, which would provide the water input to the site and output from the site to the neighboring surface water bodies. This was then combined with the soil and groundwater quality data to assess the relative contributions of groundwater from the site when compared with natural contributions from the aquifers and surface water bodies present off-site. Further details on the methodologies employed for the risk assessment are provided in Appendix A.

3.0 Site Setting

3.1 General

The site is located approximately 4 kilometres (km) northwest of Cochrane, Alberta on a prehistoric terrace of the Bow River, which flows towards the east approximately 150 m south of the site. Topography at the site is relatively flat and slopes gently to the south/southeast at an average elevation of approximately 1,183 metres above sea level (mASL). Immediately south of the site, the land slopes steeply into the Bow River valley, with the river at an elevation of approximately 1,140 mASL. The steep-sided Grand Valley Creek divides the western and eastern halves of the proposed site and flows south to drain into the Bow River. The western edge of the proposed site is defined by Beaupre Creek, which drains southwards into the Bow River. The site location and surrounding area is presented on Drawing 1.

3.2 Geology

Drawing 2 shows the site layout and lines of two vertical cross-sections (Drawings 3 and 4) that run along the direction of groundwater flow to the Grand Valley Creek (A-A') and along the direction of groundwater flow to the Bow River (B-B'). The drawings have been prepared to illustrate the relationship between the various geological units in the study area and are referred to in the subsections below (particularly in constructing the conceptual site model). Borehole logs for the site are presented in Appendix B.

3.2.1 Surficial Geology

Surficial geology in the vicinity of the site has been determined from the published geology maps and stratigraphic and sedimentologic site data (Fenton et al. 2013; Jackson Jr., MacDonald, and Wilson 1982; Scafe and Sham 1987). The site is located on Pleistocene-age, fine- and coarse- fluvial deposits including sand and gravel with minor silt beds associated with the Bow River and Calgary buried bedrock valley. Regionally, gravel deposits can be found along the Bow River Corridor for 100 km from the eastern margin of the Rocky Mountain Front Ranges to Calgary and beyond (Jackson Jr., MacDonald, and Wilson, 1982). The thickness of the gravel terraces can range from 10 metres (m) near Calgary to 30 m near the mountain front. Borehole logs indicate surficial geology over the majority of the site is composed of a cap of clay or silt to a depth of 0.8 to 2.8 meters below grade (mbg), overlying gravel to a depth of 6.1 to 11.0 mbg. There is an increase in the thickness of the clay and silt overlying the gravel to between 4.0 and 15.3 m in the north of the site. The site stratigraphy is presented in cross-sections in Drawings 3 and 4. North of the site in the valleys of Beaupre Creek and Grand Valley Creek, the surficial geology is predominately composed of lacustrine deposits consisting of silt and clay with local ice-rafted stones (Shetsen 1987). The bedrock rises to the north as well and can be relatively shallow. In the upland areas between and north of the creeks, the surficial geology changes to thin, undulating layers of draped till immediately overlying bedrock.

3.2.2 Bedrock Geology

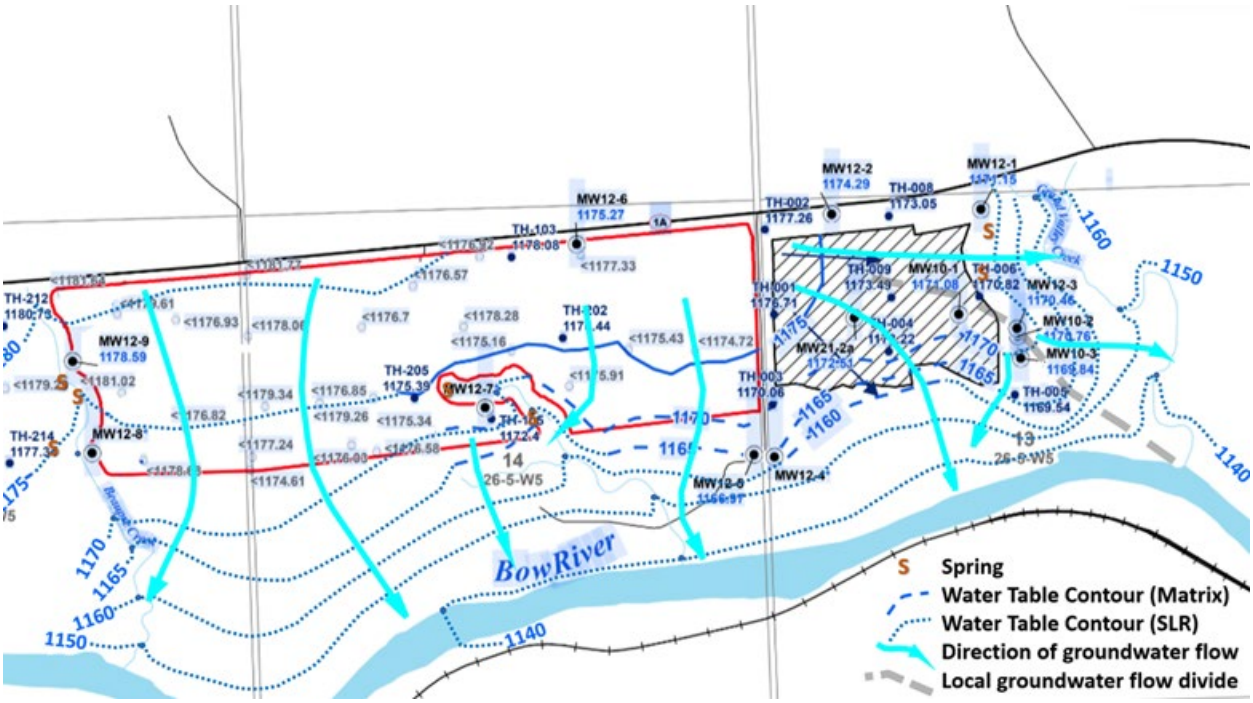
The site lies just west of the Cordilleran deformation front within the transition zone between the plains and Rocky Mountain foothills. The upper bedrock beneath the site is composed of two formations that are divided by the shallowly-dipping, north-northwest to south-southeast trending Brazeau Thrust Fault, which is located approximately 1.5 km west of Grand Valley Creek (Pana and Elgr 2013). The upper bedrock to the west of the Brazeau Thrust Fault is the Upper Cretaceous-age Brazeau Formation and to the east is the Upper Cretaceous to Paleogene-aged Coalspur Formation, which underlies the majority of the site (Prior et al. 2013). Both formations comprise interbedded sequences of sandstone, siltstone, and shale with occasional coal beds as indicated by onsite borehole logs and description from the observation of outcrops in the valley of Grand Valley Creek (see Appendix C for details). One of the outcrops at the northern end of the Grand Valley Creek showed a potential thrust fault structure with strong, massive sandstone juxtaposed above a weak, thinly bedded, highly fractured shale and siltstone. The contact between the two units was highly weathered and small reverse faults were seen within the thinly-bedded rocks below, which did not appear to propagate into the sandstone above. These lithological and tectonic features are presented in Appendix C and are consistent with the site location just within the disturbed zone.

3.3 Hydrogeology

3.3.1 Surficial Deposits

The main surficial aquifers in the area comprise the saturated parts of lower glaciolacustrine sand and silt and upper fluvial gravels, the latter of which are located beneath the site. These sand and gravel deposits are generally partially saturated and unconfined. The Bow River is the regional discharge point for the groundwater system, and groundwater flow generally follows topography and is inferred to be towards the south, south-west, and southeast in the sand and gravel deposits beneath the site, as indicated on Figure A below. Shallow groundwater is also captured by the incised Grand Valley Creek, which cuts through the gravel deposits into the underlying bedrock and shows the presence of seepages and springs in the valley sides at several locations where the gravel likely outcrops beneath the vegetation. Flow around Grand Valley Creek follows topography and is towards the east or to the southwest on the western and eastern sides, respectively. Seepages and springs are also observed and sampled in Beaupre Creek and the approximate hydraulic gradient in the sand and gravel is 0.008 metres of head/metre (m/m) (Levelton 2014) to 0.01 m/m towards the Bow River.

Figure A Groundwater Flow



The inferred groundwater flow direction is based on static groundwater levels taken by Matrix in October and November 2021 (Matrix 2022), and surface water measurements collected by SLR in December 2021. The static levels were aggregated to provide approximate flow directions; however, it should be noted that the water levels were taken at different times and possibly before several newly installed wells could recover from drilling, so it should be treated as indicative of most likely conditions.

Slug tests undertaken at four groundwater wells installed in the sand and gravel deposit (MW12-1, MW12-2, MW12-7, and MW12-9), indicated hydraulic conductivities between 6 x 10^{-5} to 1 x 10^{-4} metres per second (m/s) (Levelton 2014). Further slug testing was undertaken in the sand and gravel by Matrix in 2022 (Matrix 2022), with a hydraulic conductivity of 2 × 10^{-4} m/s estimated in MW21-2a.

The average linear groundwater velocity (V) in the sand and gravel can be calculated from:

Equation 1. $V = K\, i / n_e$

Where **K** is the geometric mean hydraulic conductivity (11.6 m/day), **i** is the average horizontal hydraulic gradient (0.009 m/m), and n_e is the effective porosity. Without site specific measurements of porosity, the sand and gravel soils are estimated to have an effective porosity of approximately 0.3 m^3/m^3 based on the average effective porosity (30%) of a gravel.

Therefore, **V** = (11.6 x 0.009) / 0.3 = **0.35 m/day**

This groundwater velocity agrees with the groundwater flow velocity of 0.35 m/day (128 m/year) calculated by Levelton (2014).

3.3.2 Bedrock

As discussed in Section 3.2.2 above, bedrock beneath the site comprises the Coalspur and Brazeau Formations. The Brazeau Formation lithology is similar to the Paskapoo Formation, a main bedrock aquifer used throughout the Western Alberta Plains. Tectonic features in the disturbed belt, such as non-horizontal bedding planes, high-fracture porosity, and tectonic groundwater barriers are likely to be present in the Brazeau Formation aquifer (Ozoray and Barnes 1977).

Recharge to the bedrock aquifer mainly occurs through leakage from the overlying surficial deposits, except where the bedrock is exposed at or close to the surface. Vertical gradients between sand and gravel well MW12-2 and the uppermost bedrock well at this location (MW21-1a) show a downwards gradient, which would indicate the sand and gravel is recharging the bedrock. South of the excavation, however, groundwater levels in the sand and gravel (MW21-2a) and bedrock (MW21-2b) indicate a small upwards gradient which would suggest that bedrock is discharging to the sand and gravel at this point. Vertical gradients within the bedrock measured between MW21-1a and MW21-1b on the northern site boundary demonstrate an upwards vertical gradient within the bedrock indicative of a regional discharge zone.

Regional groundwater flow direction in the Disturbed Belt bedrock aquifer is towards the Bow River (Hydrological Consultants Ltd. 2002). It is likely that the Coalspur and Brazeau Formations have a complex relationship of recharge and discharge with the Bow River, which will depend upon the stage of the river and the level of groundwater extraction from the bedrock aquifer by water users. Where the gravel deposit is saturated, the underlying bedrock is also fully saturated; however, where the gravel is absent or unsaturated, the water table dips down into the bedrock. This occurs to the south of the proposed extraction area where the water table dips into the bedrock towards the Bow River valley under an approximate hydraulic gradient of 0.15 m/m.

Slug tests were conducted in one well installed in a clay surficial deposit and coal, sandstone, and siltstone bedrock (MW18-05), and in one well installed in sandstone bedrock (MW21-2B). A hydraulic conductivity of 1 x 10^{-6} m/s was calculated for MW18-05, and at MW21-2b was calculated as 1 x 10^{-5} m/s (Matrix 2022), which was within the upper range expected for sandstone. Applying Equation 1 to calculate the average linear groundwater velocity (V) in the bedrock, we can use the hydraulic conductivities above and the hydraulic gradient of 0.15 m/m. The effective porosity of a poorly cemented sandstone such as this is 15% (0.15), so when combined, the range of groundwater flow velocities is in the region of 0.09 m/day to 0.86 m/day. Where the bedrock is more competent and groundwater flow is primarily along bedding planes and fractures, the effective porosity is in the region of 2% to 5% depending upon depth. When these are combined[1] for fracture flow, the range of groundwater flow velocities would typically range from 0.65 m/day to 2.6 m/day.

[1] Typically, the lower porosity is used with the lower permeability when the two vary, in calculating the range. For example, the 2% porosity was used with the hydraulic conductivity of 10^{-6} m/s, and the 5% porosity used with the 10^{-5} m/s hydraulic conductivity.

3.3.3 Groundwater Quality

Groundwater samples have been collected from onsite groundwater monitoring wells since March 2012, with a total of six groundwater sampling events in March/April 2012, May 2013, August and November 2018, October/November 2021, and May 2022. Groundwater results are provided in Appendix D, and a brief summary of the data is discussed below.

Both lab and field pH values in the sand and gravel are generally in the range of 7.1 to 8.2, and bedrock pH values are generally in the range of 7.5 to 9.7, indicating a neutral to alkaline groundwater. The majority of bedrock pH values are above the Tier 1 maximum of 8.5.

Field turbidity measurements are high from standard piezometer designs and may not be representative of actual groundwater turbidity. For example, the turbidity measured in the unfiltered groundwater samples has a large range of 124 to 1,000 Nephelometric Turbidity Units (NTU) in the gravel and 1 to > 1,000 NTU in the bedrock, although it seems to be slightly lower in the bedrock. Laboratory turbidity shows even larger ranges in both the gravel and the bedrock with 6 to 26,800 NTU, and 1 to 59,300 NTU, respectively, due to the sampling methodology used and disturbing sediment remaining in the well after drilling. It is important to note that conventional field methods were used during the collection of groundwater samples in 2021 and no additional steps were taken to reduce the disturbance of residual sediments from drilling in groundwater samples. These field methods may have contributed to concentrations being skewed significantly higher than is representative of the natural groundwater conditions.

The majority of dissolved metal concentrations in groundwater within the gravel fall below the Tier 1 guidelines with only aluminum, iron, and manganese exceeding the guidelines. Exceedances were in background / upgradient wells MW18-02 (all three parameters) and MW12-9 (manganese), and downgradient wells MW21-2a (all three parameters), MW10-3 (manganese) and MW10-1 (aluminum). Natural exceedances of the guidelines are common in Alberta and not likely due to the presence of the gravel extraction operation.

The majority of dissolved metal concentrations in groundwater within the bedrock fall below the Tier 1 guidelines with only aluminum, antimony, arsenic, copper, manganese, and selenium exceeding the guidelines. Exceedances were in background / upgradient wells MW18-05 (manganese), MW21-1a (aluminum and selenium), MW21-1b (aluminum, antimony, arsenic, copper, and selenium), and Bedrock Well 3 (copper and selenium). Downgradient wells had exceedances of similar parameters with MW21-2b (aluminum, antimony, arsenic, and selenium), MW21-3 (aluminum, arsenic, and selenium) and MW21-4 (antimony, arsenic, and selenium).

Based on these results occasional exceedances of certain dissolved metal parameters would occur as part of the natural variability within the groundwater system, as they are intermittently present in wells which cannot be affected by the existing operation.

3.4 Hydrology

All surface water drainage in the area is to the Bow River, which flows from west to east approximately 150 to 850 m south of the site. Flows at the closest current monitoring station are measured within the Bow River approximately 7 km downstream (Bow River Near Cochrane – 05BH005). The river at this station drains 6,687 square kilometres (km^2) and reaches well back into the mountains as shown in Drawing 5. The records indicate seasonal variations in flow with the highest flows in the late spring and early summer with flows in the region of 150 to 360 cubic metres per second (m^3/s). Flow typically declines through the summer, fall, and winter down to lows of around 40 m^3/sec.

At the confluence with Grand Valley Creek beside south of the site, the Bow River drains 5,795 km^2. It is reasonable to assume that the seasonal flows at this confluence can be estimated by a pro-rata of the watershed. This pro-rata is 5,795/6,687 = 86.7% of the measured flow at 05BH005. Seasonally, this is 130 to 312 m^3/s. Winter low flows might drop to 35 m^3/s.

The Grand Valley Creek has a catchment area of about 352 km^2. This is about 6 % of the Bow River catchment area at the confluence. There is no gauging station on this stream; however, some spot-flow measurements were made by SLR in December 2021 during a period of baseflow (no storm runoff). Based on the potential error of measurement the Grand Valley Creek, discharge was 39 to 66 L/s, which is 0.04 to 0.07 m^3/s. These and the above values will be further examined in Section 5 to assess the impact of the site on water quality.

3.4.1 Surface Water Quality

Surface water samples were collected from upstream and downstream locations along the Bow River and Grand Valley Creek in December 2021. Sampling methodologies are described in Appendix A and the laboratory analysis certificate is provided in Appendix E. Surface water concentrations of all parameters at all Bow River and Grand Valley Creek sample locations were below AEP Tier 1 Guidelines in December 2021. TSS concentrations were below laboratory detection limits, while the pH range of 8.23 to 8.48 was within the background range of values.

The Government of Alberta also completed three surface water sampling programs along the Grand Valley Creek between 2003 and 2005 which indicated background TSS concentrations ranging from 3 to 58 mg/L, with median concentration of 11 mg/L (Sosiak 2003 and 2006). The median pH of the creek ranged from 8.2 to 8.4.

4.0 Results

4.1 Aggregate Quality

Eight samples of the gravel deposit were collected by BURNCO personnel in October 2021, with four from the operating pit and four from the riverbank south of the operation (Matrix 2022). A number of laboratory analyses were completed on the samples including grain size sieve analysis; salinity; leachate metals; hydrocarbons; polycyclic aromatic hydrocarbons (PAH); and waste characterization.

Grain size analysis indicated that Pit sample 3 from a stockpile within the operation (68% gravel, 19% sand and 13% silt and below) was generally coarser than River sample 4 from the riverbank (55% gravel, 9% sand, and 36% silt). The salinity, leachate metals and hydrocarbon results on all eight samples were below the Alberta Tier 1 guidelines, which are protective of all potential groundwater receptors, including drinking water and aquatic life.

PAH and hydrocarbon results in the pit samples were all below laboratory detection limits; however, several PAH parameters including anthracene, phenanthrene, fluoranthene, and naphthalene exceeded the Tier 1 guideline for protection of aquatic life in samples from the riverbank. Hydrocarbon fraction F3 (C>16-C34) was also detected in riverbank samples but remained below the Tier 1 guideline. Not found in the pit samples, the higher PAH and hydrocarbons in the river samples may be due to the presence of potential sources upstream in the Bow River valley which are building up in the riverbank sediments.

The waste characterization testing, or Toxicity Characteristic Leaching Procedure (TCLP) test, is designed to determine the mobility of both organic and inorganic analytes present in waste materials. The test is designed to replicate the acidic conditions within a landfill to see whether parameters will leach out of waste material. In this case, the material was natural sand and gravel rather than waste. The acidic conditions under which the test is conducted are far more conservative, i.e., more parameters will be leached, than would occur under the alkaline pH groundwater conditions present in both the sand and gravel and bedrock groundwater. The metals leached using the TCLP test were all below detection limits except barium, which was detected in three of the composite samples at or below the Alberta Tier 1 guideline of 1 mg/L. All aggregate testing laboratory analytical results are presented in Appendix F. It may be concluded that the exposure of the aggregate materials will be creating no worse a risk than what is already present in the Bow riverbed sediments.

4.2 Water Budget

A water budget has been prepared to understand the movement and source of groundwater beneath the existing site. By assessing the amount of groundwater recharge that occurs on the site, and the potential change to that by developing the site, one can assess if there is a significant change to groundwater flow pathways and to those who make use of this groundwater (such as wells or the natural creeks and rivers that bound the site).

4.2.1 Meteorological Water Budget

Three meteorological stations exist surrounding the site at varying distances. Due to the length of period of record, and similarity of elevation and distance from the mountains, the Springbank A station was selected to best represent site conditions. The thirty-one year average (1991-2021) annual precipitation at this station is 500 millimetres (mm) per year. The driest year (2021) experienced just 327 mm of rain, whereas the wettest year (2005) experienced 720 mm of precipitation.

Since groundwater moves much more slowly than surface water, it is our experience that an average annual condition (meteorologically) best represents the conditions in the ground. Using Thornthwaite and Mather (1957) method the following water budgets presented in Figure B and Figure C were determined for the two areas of the site that exhibit different surficial soil conditions, as shown on Drawing 6.

Figure B Average Annual Water Balance, North End of Site, Silty Cap Soils

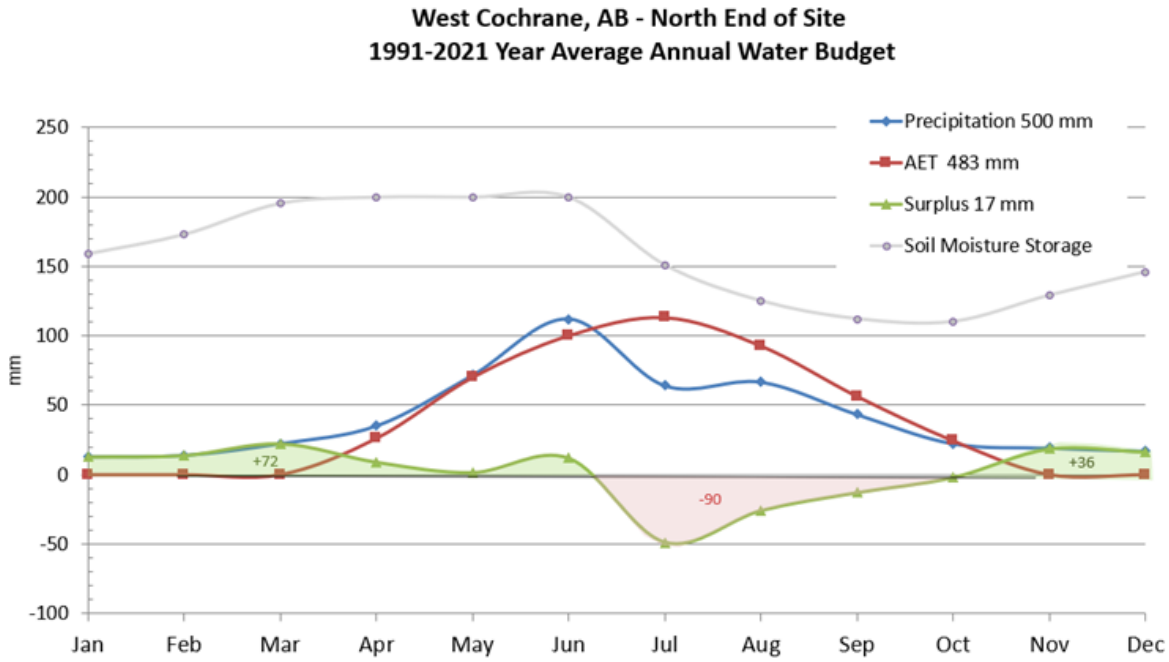
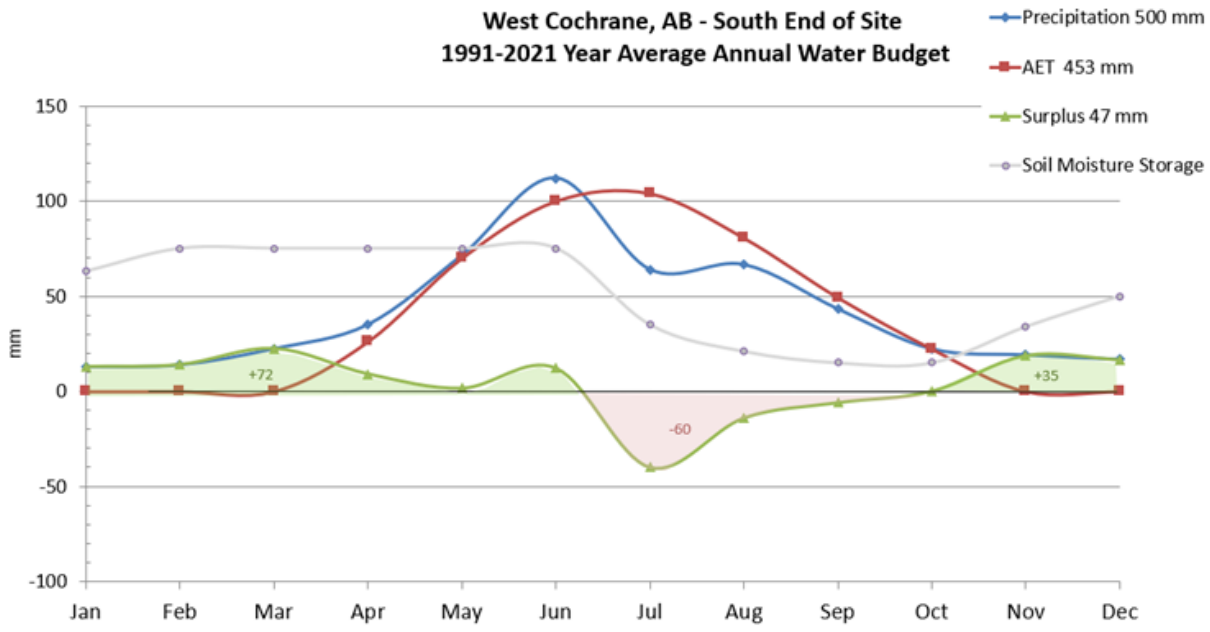


Figure C Average Annual Water Balance, South End of Site, Sand and Gravel Soils at Surface



The upper end of the site to the north is capped by silty till soils (Drawing 6) and exhibits a soil moisture storage of about 200 mm/yr. The lower end of the site, where the sand and gravel soils are at surface (Drawing 6), exhibits a soil moisture storage of about 75 mm/yr. Because of its better drainage characteristics to depth, there is less evapotranspiration and a greater surplus available for groundwater recharge in any given year in that area.

4.2.2 Groundwater Recharge Rates

Due to the low precipitation amounts typical of the leeward side of the Rockies, the annual surplus is not great, with 18 mm on the uphill side and 47 mm on the lower part of the site. This annual surplus water may be partitioned between groundwater recharge and annual runoff using infiltration factors. Using the method of MOE 1995, a partitioning factor of 0.45 was derived for the lower permeability soils along the north of the site, and 0.60 for the more permeable soils to the south. Table A lists the recharge rates that can then be applied to the site.

Table A Recharge Rates

	Soil Type	Annual Surplus	Infiltration Factor	Average Annual Recharge Rate
Upland	Silt till	17 mm	0.45	8 mm/yr
Lowland	Sand and gravel	47 mm	0.6	28 mm/yr

5.0 Discussion

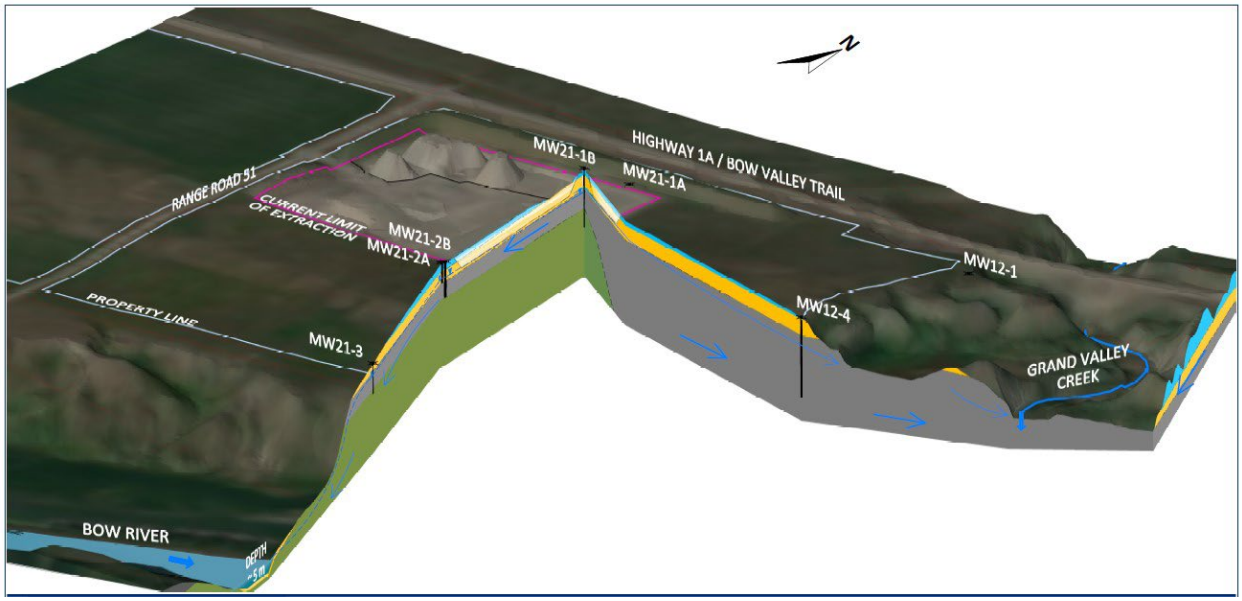
5.1 Water Pathways and Conceptual Model

Drawing 7 has been prepared to illustrate the physical setting of the site around the existing pit and a smaller version has been provided for ease of reference in Figure D, below. Given the uniformity of geologic conditions, it is SLR's opinion that this setting will be the same across the greater site. The outwash sand and gravel deposit, shown in yellow on Figure D, lies at surface along the south edge of the site. It is capped by the lower permeability silt and clay along the north portion of the property, shown in blue. Underlying the property is the bedrock of the Coalspur formation, largely sandstone (shown as grey), but underlain by siltstone and sandstone interbeds (collectively shown as green). This bedrock outcrops along the Bow River valley walls, and the Grand Valley Creek cuts into it as well. Mapping of the bedrock along the creek found that the bedding dips to the east-north-east at about 16 degrees and strikes parallel to the Rocky Mountains at north-north-west. This is consistent with the eastern reaches of what geologists call the "disturbed zone."[2]

From a groundwater perspective, the permanent water table lies at the base of the sand and gravel, some two to three metres above the bedrock surface. Under the existing pit there is a flow component to the south towards the Bow River, generally from the southwest half of the pit. This is also the direction of groundwater flow from the rest of the site to the west of Beaupre Creek. As the groundwater approaches the Bow Valley, it drops into the bedrock and ultimately discharges to the river sediments. Vertical hydraulic gradients are downwards into the bedrock, but the water will take the path of least resistance and flow laterally while it can in the sand and gravel.

[2] The disturbed zone is the zone of deformation of rock caused by the tectonic forces which thrust up the Rocky Mountains. It is typically less disturbed (folded and faulted) as one moves further east from the mountains.

Figure D Conceptual Site Model



LEGEND:

- PROPERTY BOUNDARY
- CURRENT OPERATIONS
- PROPOSED PROPERTY BOUNDARY
- WATER FEATURE - CREEKS
- WATER FEATURE - RIVER OR WATER BODY
- BOREHOLE LOCATION COMPLETED AS A MONITORING WELL (OTHERS)
- GROUNDWATER ELEVATION
- GROUNDWATER FLOW DIRECTION
- SURFACE WATER FLOW DIRECTION
- SILT AND CLAY OVERBURDEN
- GRAVEL
- SANDSTONE
- SILTSTONE / SANDSTONE INTERBEDS

A groundwater divide transects the existing pit in a southeasterly direction towards the confluence of the creek with the main Bow River. Groundwater under the northeast half of the pit flows easterly towards the Grand Valley Creek and drops into the bedrock before discharging into the creek. Several springs were found along the valley walls during the December 2021 field reconnaissance. Some seepage was seen from the shallow sediment over the bedrock at the water's edge just where the block model intersects the creek on Figure D, and is inferred to be coming from the bedrock which is just below surface in this area. Matrix (2022) documented springs where Beaupre Creek incises, as well as springs at the headwater of the small tributary in the middle of the site.

The surficial clay and silt caps the northern portion of the site, as shown in Figure D and Drawings 3, 4, and 6. Despite its lower permeability, there is no perched water table in this soil. The groundwater recharge rate through the soil is lower (8 mm/yr) than the sand and gravel to the south (28 mm/yr), but both are low, being driven by the (lack of) availability of meteoric water. Temporary removal of this layer to facilitate aggregate extraction will increase groundwater recharge until it is replaced upon pit rehabilitation.

5.2 Literature Review

A total of 23 papers and publications were reviewed for pertinent issues relating to the impact of aggregate pits on groundwater and receptors that use groundwater (rivers, creeks, wetlands, private wells). The purpose of this section is to summarize key findings from this review; individual papers are listed in the Reference section of this document.

It is apparent that there are three types of aggregate pits that mine sand and gravel:

- Pits above the water table;
- Pits below the water table; and
- Pits that use groundwater to wash crushed aggregate.

The literature is in fair agreement that the first type of pit has very little impact with respect to water quality (Mead 1995). This is because it is the most straightforward way of extraction whereby the material is dug out, loaded on trucks, and shipped off-site. There is, of course, the implication of poor management of servicing vehicles and the fluids associated with that, which is common to all types of pits. With best management practices, such as those proposed by BURNCO, this should not be an issue at this site.

Mining below the water table either by lowering the water table or extracting by dragline is more complicated. Dragline extraction introduces the risks of increased turbidity and mobilization of fines, which then require a buffer to allow settlement along the groundwater pathway (Piryonesi et al. 2021; Mead 1995). It is our understanding that BURNCO's initial plan was to use the dredging approach to gravel removal (through use of an excavator), but this has now been changed to localized dewatering. Dewatering will change groundwater levels in and around the pit, but generally reintroduces the clean extraction water to the water table downgradient of the pit. There are no private wells directly downgradient of the current pit; however, one exists to the west.

BURNCO is proposing to have a wash plant. They will have settlement ponds built from low permeability clay sourced on site and will recycle water sourced from the Bow River. In the published literature, the concept of progressive clogging of the bottoms of such ponds by fines is seen as a positive aspect (Mead 1995), which BURNCO will immediately achieve through the use of clay constructed ponds as per best practice (Alberta 1996). This will mitigate the potential turbid water from entering the aquifer.

Other issues raised by the literature include the possibility of increases in dissolved metals, thermal plumes in the groundwater, and increases in turbidity downgradient in the groundwater. The main articles on dissolved metals come from Finland (Hatva 1994; Piispanen & Nykyri, 1997), where the acidity of the water (pH of six) promotes mineral dissolution, and many of the rock-types forming the gravel are igneous and metamorphic rocks which comprise minerals containing higher sulphide and metal content. In the Cochrane area of Alberta, the natural groundwater pH is well buffered by the significant carbonate rock content and is a pH of about eight. The issue of dissolved metals is not an issue for the BURNCO property. Recently the question of water warming was raised locally in the Mountain Ash application north of Cochrane. Examination of the problem there by SLR found that a thermal plume is not likely to be great and dissipates within a few tens of metres from the edge of the pit, largely due to thermal buffering in the ground.

With respect to turbidity, there are no examples of above-water table pits that have such a problem in the literature. For those pits that are below the water table, a Finnish study identified turbidity plumes, but did not describe the conditions of the pits nor operations (Hatva 1994). For BURNCO, the excavation below the water table is not deep, at most three metres. Since dewatering will be used, there is not the

stirring up of the materials that mobilizes fine sediment. Thus, sufficient buffer to filter any possible turbidity will be the main mitigation measure. BURNCO has installed groundwater monitoring wells downgradient of their active pit and it is expected they will have hard data to help inform this aspect. SLR prepared an assessment of turbidity on behalf of Mountain Ash in 2022 and found that migration of turbidity is expected no more than 30 m from the pit edge. This is described in more detail below but is also supported in the literature, which identifies gravitational settling as being the prime mechanism in turbidity reduction (Mead 1995; Saskatchewan 1995). To establish a lower bound for the continued suspension of fines, some American studies found a mobilization velocity of 0.18 miles per hour (mph) (about 300 meters per hour) in open watercourses (Mead 1995). The groundwater velocity at the BURNCO site is about 0.35 meters per day, well below this threshold, and therefore, even the fine sediments would be expected to be attenuated.

5.3 Review of Dr. Fennell Column Experiment

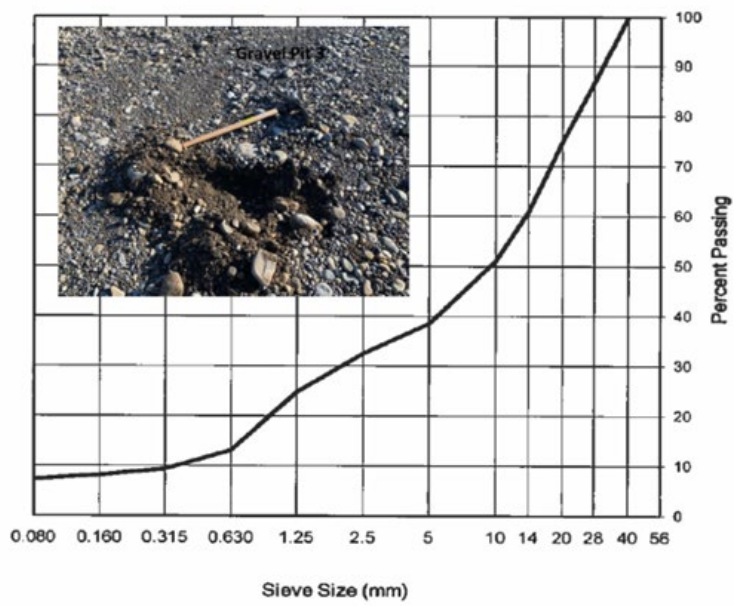
A submission by Dr. Jon Fennell (Fennell, J. 2021) during the municipal hearings in July 2022 reported on the results of a column experiment he performed on a sample of soil from the BURNCO Pit. Dr. Fennell reported high turbidity and inferred that the same condition would happen in the natural groundwater system. The experiment, while well-intentioned, does not reflect actual conditions and overstates the potential impact for the following reasons.

He states in his report that a “mixture of clay, silt, sand, and cobbles was loaded into a pre-cleaned 1.5 m x 51 mm ID PVC pipe to produce a vertical soil column mimicking what would be left beneath the BURNCO pit after mining.” He reportedly tapped the column to induce settlement whereby the soil in the column was 1.2 m deep. This does not mimic natural deposition and will be comparatively unconsolidated; the soil left in place will be of a more compact nature. This method does not mimic natural conditions as claimed. He then filled the column with water and left it overnight. He then added water and sampled the discharge during the next day. The flow rate is not reported, the sample volumes were not recorded, and the time the samples were collected was not provided. This information would have been helpful in assessing the methodology and reliability of findings.

He reports that he obtained material from the BURNCO property; however, the sampling methodology was not presented. There are accepted ways to representatively sample soils, and it is unknown if his field person was aware of that. Where on the site did the sample come from? Was it in-situ, from a stockpile, from the top or bottom of the stockpile, from a ditch, from the pit face, from the pit floor, etc.? All of these factors influence the nature of the sample and, thus it is unknown if it is truly a representative sample. He has assumed the soil he tested has similar physical and chemical properties as the aggregate materials that will be left in place below the BURNCO Pit. However, this does not appear to be the case, based on his description above of the soil he tested, as the stated presence of fines is not consistent with the aggregate resource. For example, a representative sample from the pit floor collected on behalf of SLR showed silt content (< 0.05 mm) of less than 7 %, as per the test results from Tetratech Laboratories in Calgary, shown in Figure E.

Figure E Test Results from Tetratech Laboratories

Sieve Sizes	Percent Passing
40	100
28	87
20	75
14	61
10	51
5	38
2.5	32
1.25	25
0.630	13
0.315	9
0.160	8
0.080	7.3



Dr Fennell does not provide any grain size information, so we cannot compare the two directly, but the material tested by Dr. Fennell, based on his description (quoted above), contained more clay and silt and didn't seem to contain any gravel.

Therefore, it appears that the material tested by Dr. Fennell is not representative of the material being left in place below the BURNCO pit. The higher content of clay and silt in Dr. Fennell's materials is very likely to have resulted in higher suspended sediment and turbidity than would be expected from the almost completely gravel and sand materials being left in place below the BURNCO Pit.

Dr Fennell flushed the column for two days, taking two water samples. In his testing, all concentrations were reduced by about 35% after two days, which implies a simple flushing process of a disturbed sample and not prolonged production of turbidity.

Dr. Fennell reports elevated concentrations of metals in the effluent water. The higher, unrepresentative suspended sediment/turbidity in Dr. Fennell's samples is also the reason for the elevated concentrations of aluminum, arsenic, chromium, cobalt, iron, manganese, and zinc he reports[3]. This is because the metals analysis he completed included a sampling technique whereby the unfiltered sample was acidified. When an unfiltered sample is acidified, the preservative acid dissolves the sediment within the sample and effectively includes the metals present in the particulate material with the dissolved concentrations. This leads to excessively and unrepresentatively high dissolved metal concentrations. However, given the materials that will be left in place below the BURNCO Pit have very little clay and silt in them, similar increases in suspended sediment/turbidity and elevated metals associated with the suspended sediment/turbidity, as suggested by Dr. Fennell, do not appear likely.

[3] It should be noted that the reported effluent concentrations from Dr. Fennell's experiment fell within the natural range measured on the unfiltered groundwater samples at the BURNCO site.

So, the column test carried out by Dr. Fennell potentially used material that is not considered to be representative of the material known to be present, used unknown flow rates and retention times, ceased after only two days when a longer test would have been more representative, and analysed water using a method that overestimated the dissolved metals concentration. Based on this, Dr. Fennell's experiment cannot be relied upon to represent actual conditions.

5.4 Impact Assessment

The natural groundwater quality in and around the pit is typical of groundwater quality in this part of Alberta. Some parameters are naturally elevated. No real pattern of elevated concentrations is seen downgradient of the pit. Turbidity is high in the groundwater monitoring wells, but that appears to be related to monitoring well construction and sampling techniques which agitate the water. Appendix G provides an assessment of how turbidity would migrate in the groundwater from an active pit that is in contact with the water table. The assessment considers the settlement of fines and the rate of groundwater flow as determined for this site and concludes that the average migration distance would be about 40 m, based on the smallest silt size particle.

Turbidity has been measured in groundwater samples taken from various groundwater monitoring wells surrounding this site. Measured values are high both upgradient of the site (that is, in areas unaffected by the presence of the pit) and downgradient of the site. This is largely due to the design of these groundwater monitoring wells, which allow the egress of fines into them, coupled with the agitation created by sampling. Thus, they are not representative of actual turbidity in the ground water and can be misleading to the casual observer. Part of the proof lies in the water chemistry determined in the springs downhill from the pit. Matrix reports that the turbidity at the NE springs along Grand Valley Creek was 0.04 to 0.5 NTU on May 10, 2022.

It is useful to examine the implications of any potential impacts to groundwater receptors. Around the existing pit, groundwater travels laterally either to the Grand Valley Creek or to the Bow River. These water courses are permanently flowing streams and derive their own water quality from the kilometres the water has traversed to reach the area of the BURNCO property. A simple calculation of groundwater flow volumes, calibrated against groundwater recharge informs the relatively small contribution this site has. Based on the measured hydraulic conductivity[4] (K) of 5.2 m/day measured in the area at monitoring well MW12-2, a gradient (i) of 0.009 m/m, and a cross-sectional area (A), the overburden groundwater flow (Q) to the Grand Valley Creek may be determined. Assuming a saturated thickness of 1 m and a breadth of flow of 120 m from the groundwater divide to the north site boundary, the cross-sectional area is 120 m^2. Applying Darcy's Principle, Q =KiA, a flow of 5.2 X 0.009 X 120 = 5.6 m^3/day can be calculated. This is about 0.065 L/s, which is only 0.1% of the average baseflow in the creek measured in December 2021 (55 L/s, Section 3.4).

To test this theoretical estimate, one can estimate the recharge in the pit area, as to how much water the site is contributing, and to calibrate the estimated flow. Based on Table A in Section 4.2.2, the average annual recharge rate through the silt and clay cap is 8 mm/yr. This, however, only happens over 120 days of the year (Figure B, Section 4.2), so the rate works out to 0.067 mm/day for that period. A contributing recharge volume may be calculated by multiplying the recharge by the 36,000 m^2 site area west of the eastern property line (and north of the groundwater divide). This yields 2.4 m^3/day, which is just

[4] This is not a measure of groundwater velocity but a parameter that describes the ability of soil to allow water to move through it. They coincidentally have the same units.

under 0.03 L/s, and although low, it is comparable to the 0.065 L/s determined above. We conclude from this simple calculation that the site contributes a very small amount to the flow in the Grand Valley Creek, which has a catchment area (and therefore groundwater recharge area) of over 350 km^2.

Finally, one has to consider that once the pit is open the recharge rate increases to 28 mm/day from 8 mm/day, and thus the site contribution temporarily rises from 0.03 L/s to 0.11 L/s. Nonetheless this suggests a dilution factor of about 500 times.

The same approach can be taken for the Bow River, and it can be found that about 0.6 L/s passes under the site, which pales in comparison to even the low flow of 35,000 L/s in the Bow River (Section 3.4). Once the site is developed over to Beaupre Creek, open site areas are never higher than 280,000 m^2, since rehabilitation of mined out areas will have progressively occurred. By pro-rata, the most groundwater that passes under the site in this fashion would be less than 5 L/s, the dilution by the Bow River remains overwhelming (about 7,000 times).

One final note to consider is the existing groundwater quality in comparison to the receiving streams. Sampling in the creek and river in December 2021 established typical surface water quality in this baseflow time of the year. In the Bow River, there is no appreciable difference between the upstream water quality and the downstream water quality. In the Grand Valley Creek, water quality concentrations actually decline from upstream to downstream, perhaps the clean groundwater from both sides dilutes the water quality that may be affected by the highway or other upstream sources.

It could be argued that these positive observations may be due to the fact that the existing pit has not yet penetrated the water table. It is possible to examine the possible effect using the most onerous water quality concentrations found near the pit and performing a mass balance with the river. This was done for Total Dissolved Solids (TDS), found at 182 mg/L in the Bow River, and 474 mg/L measured at MW 21-2a just downgradient from the pit. Due to the relative contributions of groundwater (0.6 L/s) and surface water (35,000 L/s), no measurable change was found. This same calculation was done for the creek where the contributions are closer (55 L/s in the creek, but 0.11 L/s coming from groundwater from the pit). The TDS of 306 mg/L in the upstream surface water would only increase to 306.3 mg/L, which is virtually immeasurable.

The nature of these results is overwhelming and demonstrate how implausible it is that the pit could affect surface water resources. No residential water wells are downgradient of the proposed extraction areas at present.

6.0 Conclusions and Recommendations

6.1 Conclusions

We provide the following conclusions for your consideration:

- The geologic descriptions presented in the site hydrogeologic documentation to date is consistent with our understanding of the local geology.
- Groundwater flow is generally southward towards the Bow River over much of the site, but locally flows east or west towards the creeks that cross the site. Groundwater flow is initially hosted in the base of the sand and gravel above the bedrock, but with distance enters the bedrock. From there it discharges to the Bow River in the subsurface. A portion also discharges to the local creeks, sometimes as springs but also through the bedrock below these watercourses.
- The literature identifies varying degrees of impact on groundwater quality depending upon the nature of the pit studied (above water table, extraction below water table, and/or compounded by aggregate washing should best practices not be followed).
- The literature also identifies that the standard mitigation measures employed by the industry works. Examination of BURNCO's proposals shows that due consideration has been given to these measures, several of which are being employed.
- At present there are no downgradient water users from the existing or presently proposed expansion of the pit.
- Based on leach testing of representative samples of the site sand and gravel, and the streambank sand and gravel deposits already existing along the Bow River, it may be concluded that the exposure of the aggregate materials will creating no worse a risk than what is already present in the Bow riverbed sediments.
- The amount of surface water flow in both the Bow River and the contributing creeks is much greater than the groundwater contributions from the proposed site. Initial mass balance calculations show that surface water quality cannot be adversely affected.
- Turbidity impacts suggested by some Intervenors, are more a result of their experimental methodology than what could be expected in-situ. Examination of physical principles and measured site conditions shows that silt sized particles contributing to turbidity would settle out within 40 m of any pit wall. Surface water receptors are many times further away.
- Dissolved metals increases discussed in the literature are not consistent with the alkaline environment in which this site sits. The experimental results discussed above that show an increase in dissolved metals reflects the experiment conditions whereby acidic sample preservatives created elevated concentrations.
- Much of our work examined the existing site in detail. The similarity of the physical setting (soil types, groundwater flow direction, etc.) of the additional lands in the BURNCO application westerly to Beaupre Creek lends confidence that the positive findings will apply to those lands as well.

Based on the hydrogeologic analysis presented above, it is our opinion that the re-zoning of the subject lands to aggregate production, and the subsequent extraction and processing, provided best practices are followed, will not create an adverse impact to groundwater or surface water resources in the area.

6.2 Recommendations

Based on these conclusions we provide the following recommendations:

- Development of this pit should continue to be based on the best practices outlined by the proponents and that appropriate inspection and response planning be in place to so document this.
- The groundwater monitoring program continue for the existing site area to document conditions as the operation proceeds below the water table. (This is most important down gradient, that is in the direction of groundwater flow, from the operational areas, because potential effects can only move in that direction.) As each phase is completed and rehabilitated, the monitoring program can be adapted to these conditions. That is, groundwater monitoring does not have to be intensive post-operation but should be initially increased as new areas are prepared and come online.
- As the pit develops, it would be prudent to examine the monitoring results on a regular basis to see if the conclusions of this report are borne out, and to adapt to any unusual conditions that might arise.

7.0 Statement of Limitations

This report has been prepared and the work referred to in this report has been undertaken by SLR Consulting (Canada) Ltd. (SLR) for BURNCO Rock Products Ltd., hereafter referred to as the "Client." It is intended for the sole and exclusive use of BURNCO Rock Products Ltd. Other than by the Client and as set out herein, copying or distribution of this report or use of or reliance on the information contained herein, in whole or in part, is not permitted unless payment for the work has been made in full and express written permission has been obtained from SLR.

This report has been prepared for specific application to this site and conditions existing at the time work for the report was completed. Any conclusions or recommendations made in this report reflect SLR's professional opinion based on limited investigations including visual observation of the site, surface and subsurface investigation at discrete locations and depths, and laboratory analysis of specific chemical parameters. The results cannot be extended to previous or future site conditions, portions of the site that were unavailable for direct investigation, subsurface locations which were not investigated directly, or chemical parameters and materials that were not addressed. Substances other than those addressed by the investigation may exist within the site; and substances addressed by the investigation may exist in areas of the site not investigated in concentrations that differ from those reported. SLR does not warranty information from third party sources used in the development of investigations and subsequent reporting.

Nothing in this report is intended to constitute or provide a legal opinion. SLR expresses no warranty to the accuracy of laboratory methodologies and analytical results. SLR expresses no warranty with respect to the toxicity data presented in various references or the validity of toxicity studies on which it was based. Scientific models employed in the evaluations were selected based on accepted scientific methodologies and practices in common use at the time and are subject to the uncertainties on which they are based.

SLR makes no representation as to the requirements of compliance with environmental laws, rules, regulations, or policies established by federal, provincial, or local government bodies. Revisions to the regulatory standards referred to in this report may be expected over time. As a result, modifications to the findings, conclusions and recommendations in this report may be necessary.

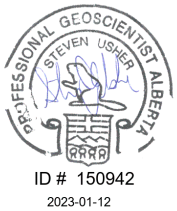
The Client may submit this report to the Alberta Environment and Parks and/or related Alberta environmental regulatory authorities or persons for review and comment purposes.

8.0 Closure

We trust that the information presented in this report meets your current requirements; however, should you have any questions or require additional information, please do not hesitate to contact SLR.

Sincerely,

SLR Consulting (Canada) Ltd.



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Figures

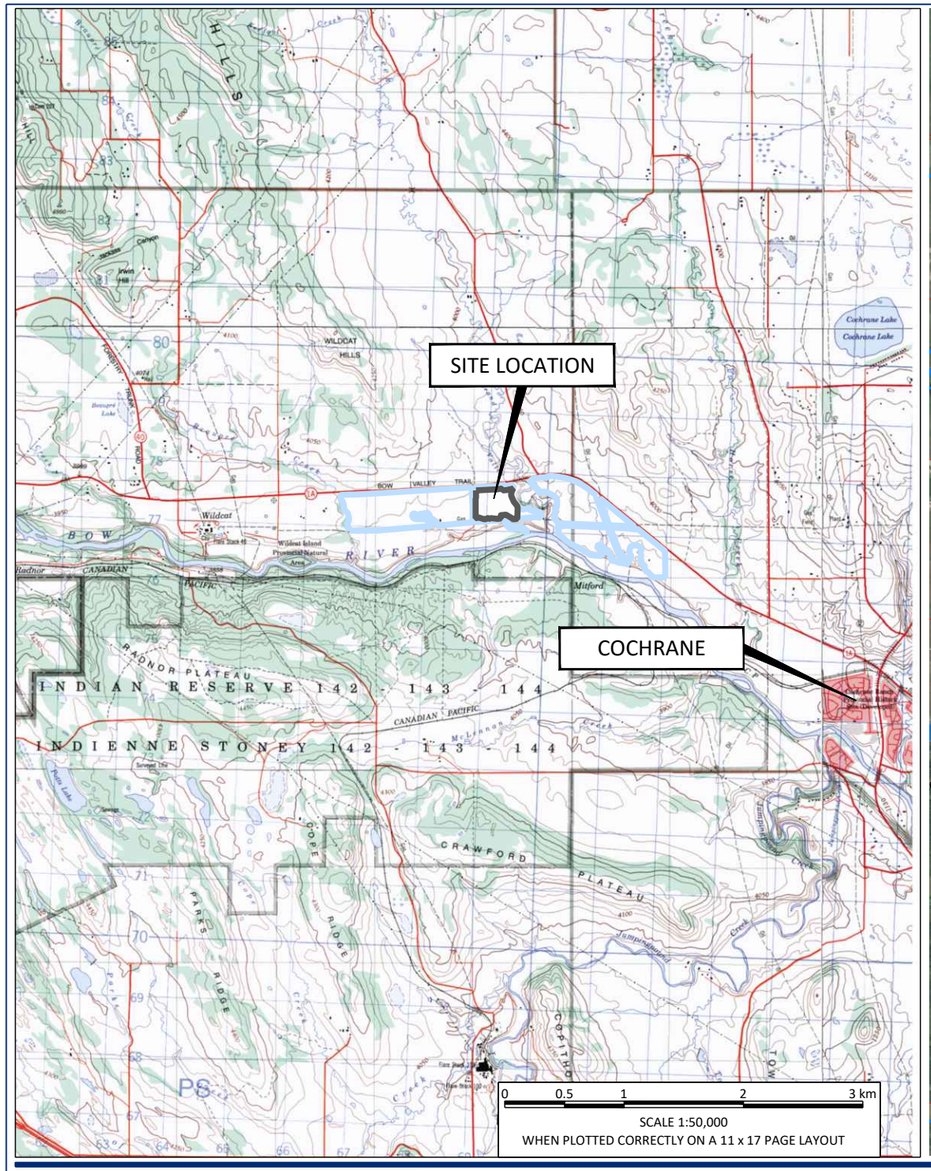
Secondary Water Resource Assessment

West Cochrane Gravel Pit

BURNCO Rock Products Ltd.

SLR Project No. 212.30025.00000

January 12, 2023



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REFERENCED FROM ABADATA 2.0 CADASTRAL DATA, ALTALIS CADASTRAL DATA, MATRIX SOLUTIONS INC. PROJECT 26388-LP FIGURE 1 TITLED "LOCATION PLAN", TOPOGRAPHICAL DATA AS PROVIDED BY CLIENT FILE NO. "2022-02-02_EG OGL LiDAR 06272018.DWG", NTS MAPS 82 O/01 TITLED "CALGARY", 82 O/02 TITLED "JUMPINGPOUND CREEK", 82 O/07 TITLED "WILDCAT HILLS" AND 82 O/08 TITLED "CROSSFIELD" AND SITE RECONNAISSANCE INFORMATION.

NOT ALL PROPERTY BOUNDARIES ARE SHOWN ON THIS DRAWING.

IMAGERY SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY.
IMAGE DATE: 2020

LEGAL DESCRIPTION:
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CALGARY, ALBERTA

LEGEND:

- PROPERTY BOUNDARY
- EXISTING OPERATIONS
- PROPOSED GRAVEL PIT BOUNDARIES
- CANADIAN PACIFIC RAIL LINE
- ID — WATER WELL LOCATION (AS PER PROVINCIAL RECORDS)
- ID (D) — DECOMMISSIONED WATER WELL

0 10 20 40 60 m
SCALE 1:1,000
WHEN PLOTTED CORRECTLY ON A 11 x 17 PAGE LAYOUT
NAD 1983 UTM Zone 11N

BURNCO ROCK PRODUCTS LTD.
SUITE 200, 5055 11 STREET NE
CALGARY, ALBERTA

SECONDARY WATER RESOURCE ASSESSMENT - WEST COCHRANE GRAVEL PIT

SITE LOCATION & SURROUNDING LAND USE

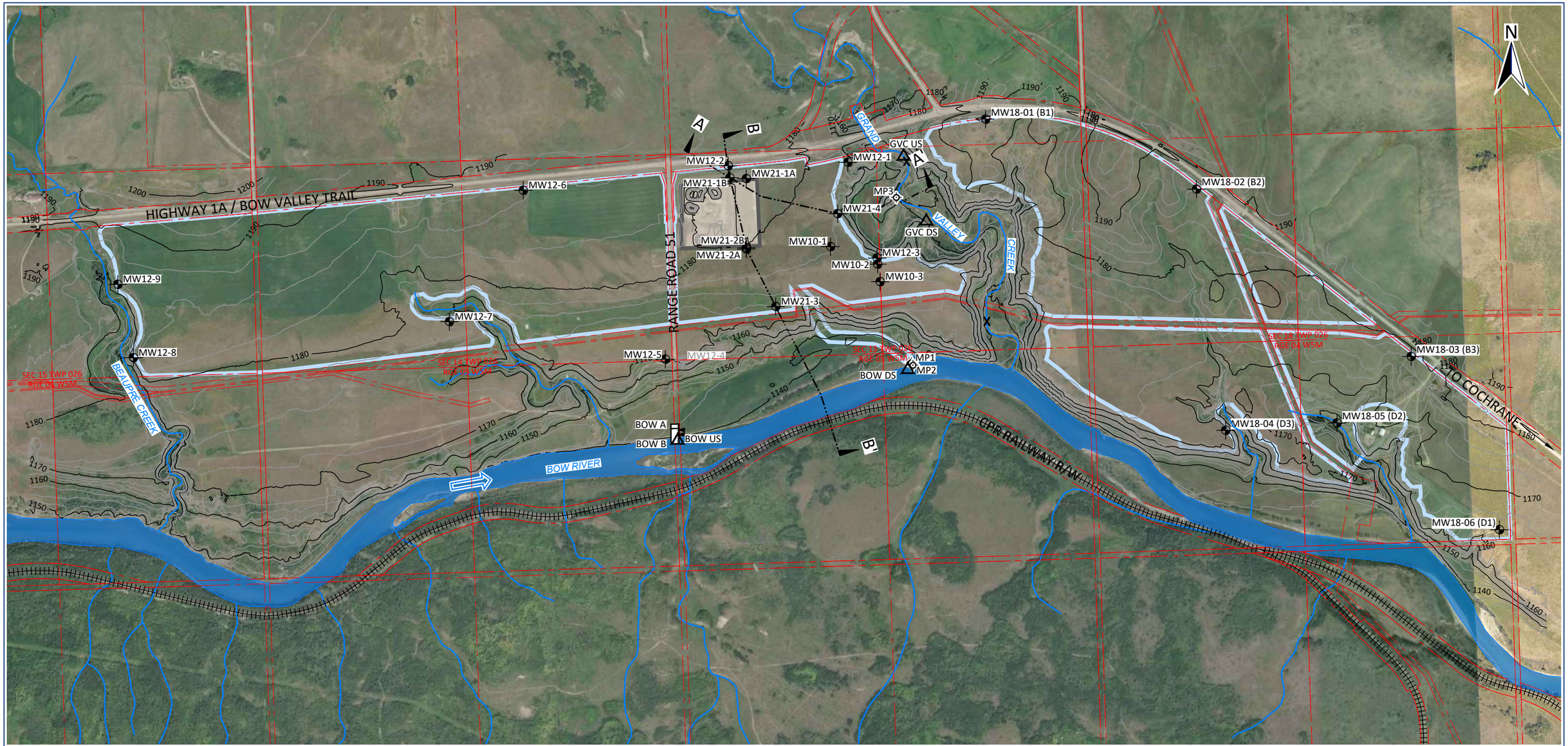
SLR

FIGURE NO: **1**

DATE: December 14, 2022

PROJECT NO: 212.30025.00000

CADFILE NAME: S_212-30025-00000-A2.dwg



LEGEND:

- PROPERTY BOUNDARY
- CURRENT OPERATIONS
- PROPOSED PROPERTY BOUNDARY
- WATER FEATURE - CREEKS
- WATER FEATURE - RIVER OR WATER BODY
- CANADIAN PACIFIC RAIL LINE
- MINOR EXISTING GROUND SURFACE CONTOURS (FROM LIDAR)
- 1170 MAJOR EXISTING GROUND SURFACE CONTOURS (FROM LIDAR)
- BOREHOLE LOCATION COMPLETED AS A MONITORING WELL (OTHERS)
- PIEZOMETER
- SURFACE WATER SAMPLE
- STREAM TRANSECT LOCATION
- STAFF GUAGE LOCATION
- A A' STRATIGRAPHIC CROSS SECTION

NOTES:

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REFERENCED FROM ABADATA 2.0 CADASTRAL DATA, ALTALIS CADASTRAL DATA, MATRIX SOLUTIONS INC. PROJECT 26388-LP FIGURE 1 TITLED "LOCATION PLAN", TOPOGRAPHICAL DATA AS PROVIDED BY CLIENT FILE NO. "2022-02-02_EG OGL LiDAR 06272018.DWG", NTS MAPS 82 O/01 TITLED "CALGARY", 82 O/02 TITLED "JUMPINGPOUND CREEK", 82 O/07 TITLED "WILDCAT HILLS" AND 82 O/08 TITLED "CROSSFIELD" AND SITE RECONNAISSANCE INFORMATION.

IMAGERY SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY.
IMAGE DATE: 2020

LEGAL DESCRIPTION:
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CALGARY, ALBERTA

0 0.25 0.5 1.0 km

SCALE 1:15,000
WHEN PLOTTED CORRECTLY ON A 11 x 17 PAGE LAYOUT
NAD 1983 UTM Zone 11N

BURNCO ROCK PRODUCTS LTD.
SUITE 200, 5055 11 STREET NE
CALGARY, ALBERTA

SECONDARY WATER RESOURCE ASSESSMENT - WEST COCHRANE GRAVEL PIT

SITE PLAN

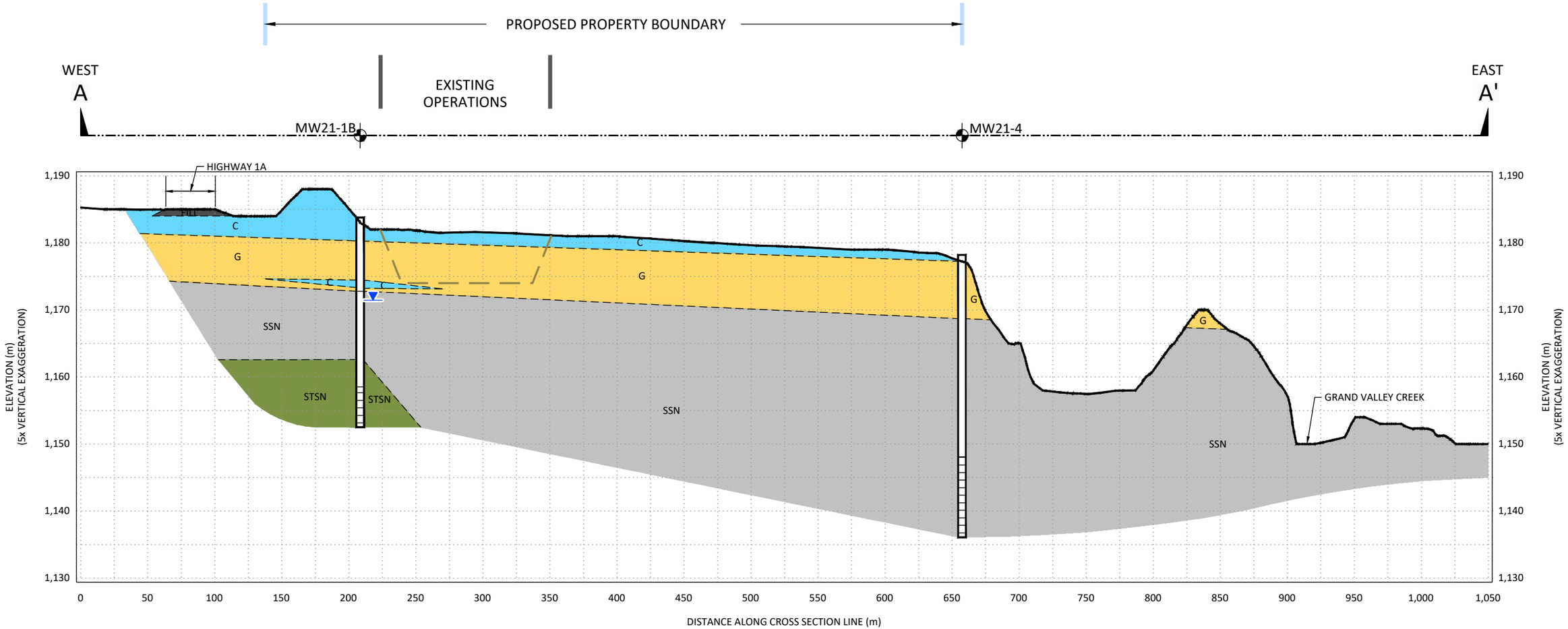
SLR

FIGURE NO: **2**

DATE: December 14, 2022

PROJECT NO: 212.30025.00000

CADFILE NAME: S_212-30025-00000-A2.dwg



LEGEND:

- BOREHOLE LOCATION COMPLETED AS A MONITORING WELL (OTHERS)
- GROUNDWATER ELEVATION
- APPROXIMATE FUTURE EXTRACTION LIMITS
- ASSUMED STRATIGRAPHIC CONTACT
- A — A' STRATIGRAPHIC CROSS SECTION A - A'
- GROUND SURFACE ALONG CROSS SECTION LINE (BASED ON LIDAR DATA)
- FILL — FILL
- C — SILT AND CLAY OVERBURDEN
- G — GRAVEL
- SSN — SANDSTONE
- STSN — SILTSTONE / SANDSTONE INTERBEDS
- WELL
- SCREENED INTERVAL

NOTES:

NOT A LEGAL SURVEY. DO NOT USE FOR CONSTRUCTION.

REFERENCED FROM ABADATA 2.0 CADASTRAL DATA, ALTALIS CADASTRAL DATA, MATRIX SOLUTIONS INC. PROJECT 26388-LP FIGURE 1 TITLED "LOCATION PLAN", TOPOGRAPHICAL DATA AS PROVIDED BY CLIENT FILE NO. "2022-02-02_EG OGL LiDAR 06272018.DWG", NTS MAPS 82 O/01 TITLED "CALGARY", 82 O/02 TITLED "JUMPINGPOUND CREEK", 82 O/07 TITLED "WILDCAT HILLS" AND 82 O/08 TITLED "CROSSFIELD" AND SITE RECONNAISSANCE INFORMATION.

LEGAL DESCRIPTION:
NW 1/4 SEC 13 TWP 026 RGE 05 W5M, N 1/2 SEC 14 TWP 026 RGE 05 W5M, NE 1/4 SEC 15 TWP 026 RGE 05 W5M, E 1/2 SEC 13 TWP 026 RGE 05 W5M, AND S 1/2 & NW 1/4 SEC 18 TWP 026 RGE 04 W5M
CALGARY, ALBERTA

0 25 50 100 150 m
SCALE 1:3,000
WHEN PLOTTED CORRECTLY ON A 11 x 17 PAGE LAYOUT
NAD 1983 UTM Zone 11N

BURNCO ROCK PRODUCTS LTD.
SUITE 200, 5055 11 STREET NE
CALGARY, ALBERTA

SECONDARY WATER RESOURCE ASSESSMENT - WEST COCHRANE GRAVEL PIT

STRATIGRAPHIC CROSS SECTION A - A'

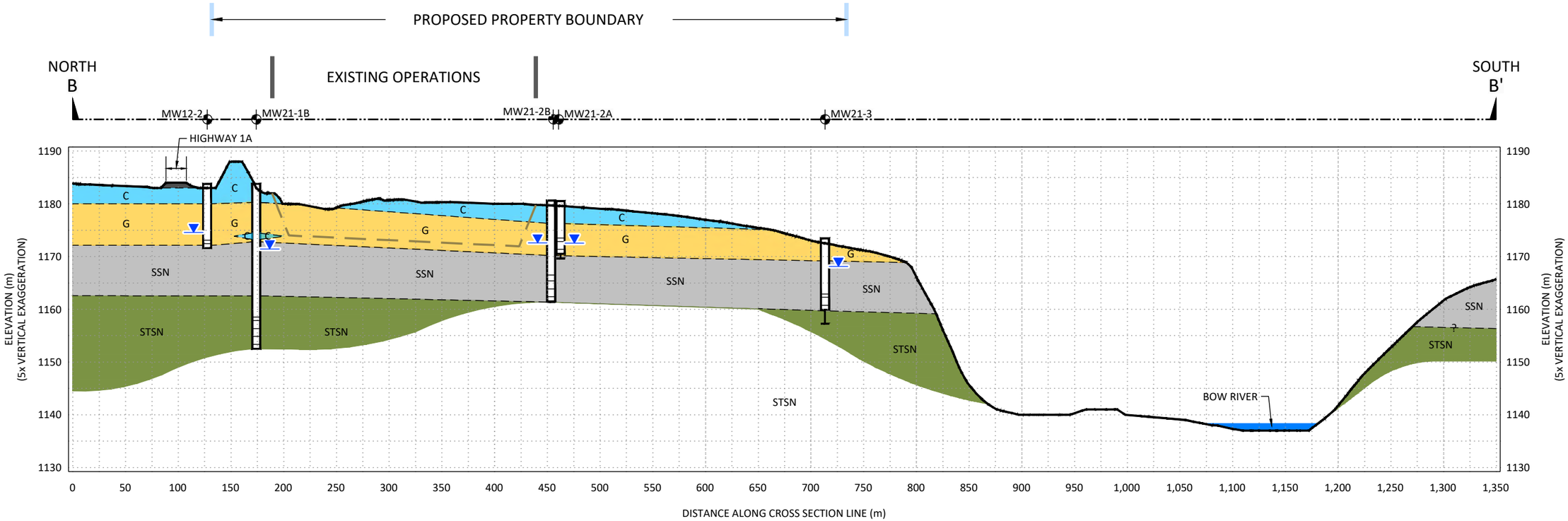
SLR

FIGURE NO:
3

DATE: December 14, 2022

PROJECT NO: 212.30025.00000

CADFILE NAME: S_212-30025-00000-A2.dwg



LEGEND:

- BOREHOLE LOCATION COMPLETED AS A MONITORING WELL (OTHERS)
- GROUNDWATER ELEVATION
- APPROXIMATE FUTURE EXTRACTION LIMITS
- ASSUMED STRATIGRAPHIC CONTACT
- B — B' STRATIGRAPHIC CROSS SECTION B - B'
- GROUND SURFACE ALONG CROSS SECTION LINE (BASED ON LIDAR DATA)
- FILL — FILL
- C — SILT AND CLAY OVERBURDEN
- G — GRAVEL
- SSN — SANDSTONE
- STSN — SILTSTONE / SANDSTONE INTERBEDS
- WELL
- SCREENED INTERVAL
- BOREHOLE OR TESTPIT
- END OF HOLE

NOTES:

NOT A LEGAL SURVEY. DO NOT USE FOR CONSTRUCTION.

REFERENCED FROM ABADATA 2.0 CADASTRAL DATA, ALTALIS CADASTRAL DATA, MATRIX SOLUTIONS INC. PROJECT 26388-LP FIGURE 1 TITLED "LOCATION PLAN", TOPOGRAPHICAL DATA AS PROVIDED BY CLIENT FILE NO. "2022-02-02_EG OGL LiDAR 06272018.DWG", NTS MAPS 82 O/01 TITLED "CALGARY", 82 O/02 TITLED "JUMPINGPOUND CREEK", 82 O/07 TITLED "WILDCAT HILLS" AND 82 O/08 TITLED "CROSSFIELD" AND SITE RECONNAISSANCE INFORMATION.

LEGAL DESCRIPTION:
NW 1/4 SEC 13 TWP 026 RGE 05 W5M, N 1/2 SEC 14 TWP 026 RGE 05 W5M, NE 1/4 SEC 15 TWP 026 RGE 05 W5M, E 1/2 SEC 13 TWP 026 RGE 05 W5M, AND S 1/2 & NW 1/4 SEC 18 TWP 026 RGE 04 W5M
CALGARY, ALBERTA

0 25 50 100 150 200 250 m

SCALE 1:4,000
WHEN PLOTTED CORRECTLY ON A 11 x 17 PAGE LAYOUT
NAD 1983 UTM Zone 11N

BURNCO ROCK PRODUCTS LTD.
SUITE 200, 5055 11 STREET NE
CALGARY, ALBERTA

SECONDARY WATER RESOURCE ASSESSMENT - WEST COCHRANE GRAVEL PIT

STRATIGRAPHIC CROSS SECTION B - B'

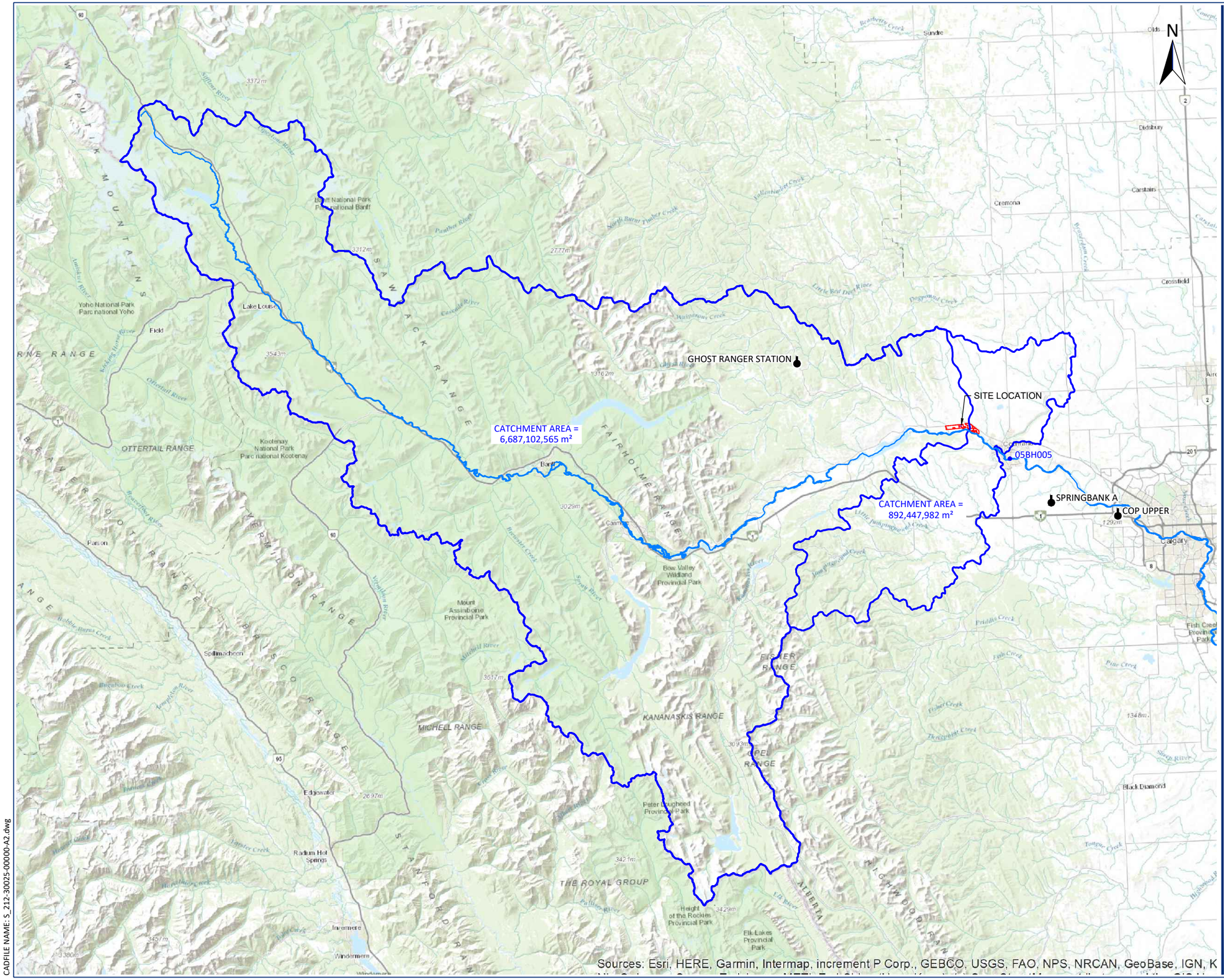
SLR

FIGURE NO: **4**

DATE: December 14, 2022

PROJECT NO: 212.30025.00000

CADFILE NAME: S_212-30025-00000-A2.dwg



LEGEND:

- EXISTING OPERATIONS
- PROPOSED PROPERTY BOUNDARY
- CATCHMENT AREA
- ID — HYDROMETRIC STATION
- ID — CLIMATE STATION
- BOW RIVER

NOTES:

NOT A LEGAL SURVEY. DO NOT USE FOR CONSTRUCTION.

REFERENCED FROM ABACUS DATAGRAPHICS CADASTRAL DATA, ALTALIS CADASTRAL DATA, MATRIX SOLUTIONS INC. PROJECT 26388-LP FIGURE 1 TITLED "LOCATION PLAN", TOPOGRAPHICAL DATA AS PROVIDED BY CLIENT FILE NO. "2022-02-02_EG OGL LiDAR 06272018.DWG", NTS MAPS 82 O/01 TITLED "CALGARY", 82 O/02 TITLED "JUMPINGPOUND CREEK", 82 O/07 TITLED "WILDCAT HILLS" AND 82 O/08 TITLED "CROSSFIELD" AND SITE RECONNAISSANCE INFORMATION.

IMAGERY SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY.
IMAGE DATE: 2020

LEGAL DESCRIPTION:
NW 1/4 SEC 13 TWP 026 RGE 05 W5M, N 1/2 SEC 14 TWP 026 RGE 05 W5M, NE 1/4 SEC 15 TWP 026 RGE 05 W5M, E 1/2 SEC 13 TWP 026 RGE 05 W5M, AND S 1/2 & NW 1/4 SEC 18 TWP 026 RGE 04 W5M
CALGARY, ALBERTA

0 5 10 20 30 km

SCALE 1:600,000
WHEN PLOTTED CORRECTLY ON A 11 x 17 PAGE LAYOUT
NAD 1983 UTM Zone 11N

BURNCO ROCK PRODUCTS LTD.
SUITE 200, 5055 11 STREET NE
CALGARY, ALBERTA

SECONDARY WATER RESOURCE ASSESSMENT - WEST COCHRANE GRAVEL PIT

BOW RIVER CATCHMENT AREA

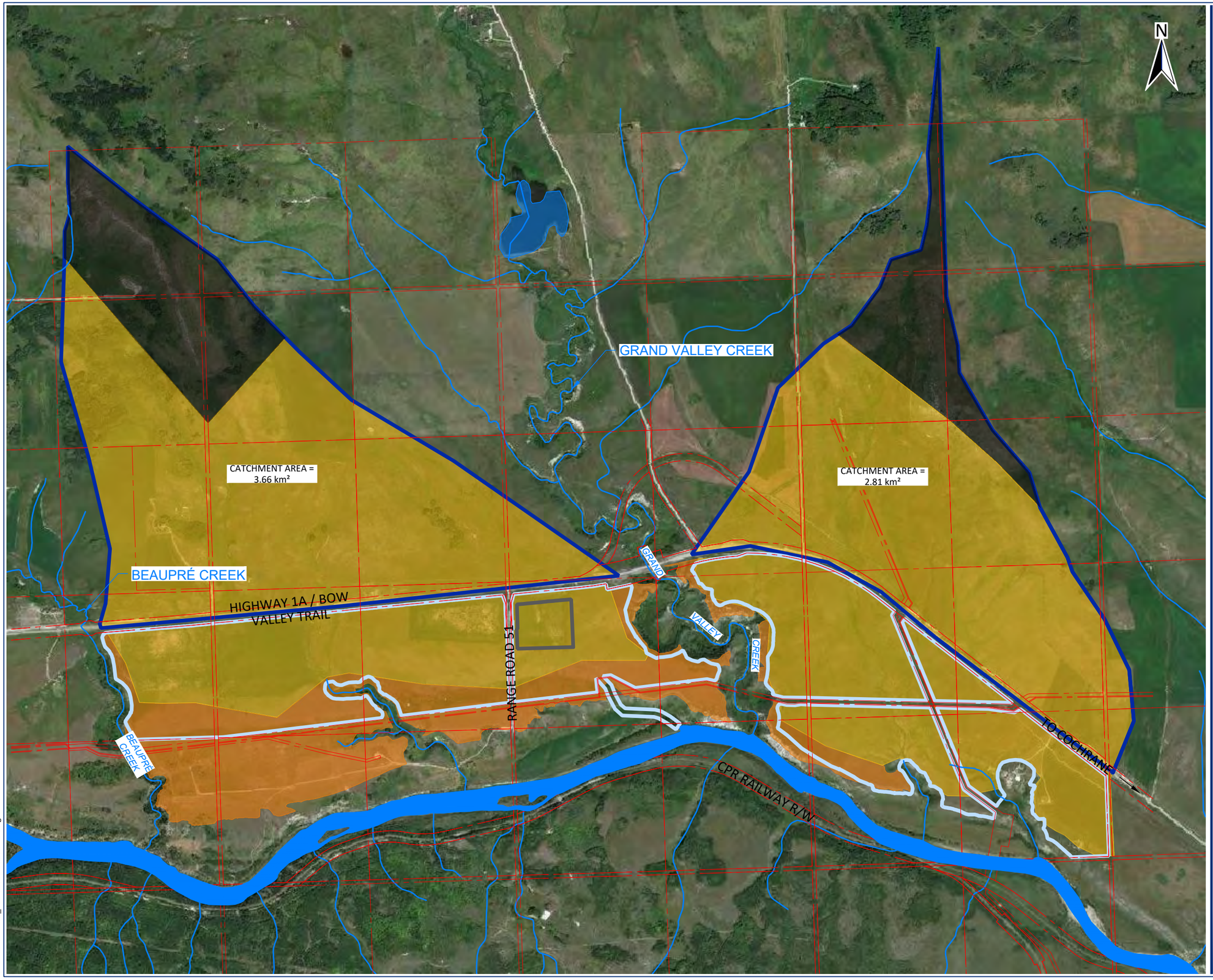
SLR

FIGURE NO: **5**

DATE: December 14, 2022

PROJECT NO: 212.30025.00000

CADFILE NAME: S_212-30025-00000-A2.dwg



LEGEND:

- EXISTING OPERATIONS
- PROPOSED PROPERTY BOUNDARY
- CATCHMENT AREA
- AREA OF SAND AND GRAVEL
- AREA OF SURFICIAL SILT AND CLAY OVERBURDEN
- AREA OF UNDULATING THIN LAYERS OF TILL OVERLYING BEDROCK

NOTES:

NOT A LEGAL SURVEY. DO NOT USE FOR CONSTRUCTION.

REFERENCED FROM ABACUS DATAGRAPHICS CADASTRAL DATA, ALTALIS CADASTRAL DATA, MATRIX SOLUTIONS INC. PROJECT 26388-LP FIGURE 1 TITLED "LOCATION PLAN", TOPOGRAPHICAL DATA AS PROVIDED BY CLIENT FILE NO. "2022-02-02_EG OGL LiDAR 06272018.DWG", NTS MAPS 82 O/01 TITLED "CALGARY", 82 O/02 TITLED "JUMPINGPOUND CREEK", 82 O/07 TITLED "WILDCAT HILLS" AND 82 O/08 TITLED "CROSSFIELD" AND SITE RECONNAISSANCE INFORMATION.

IMAGERY SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY.
IMAGE DATE: 2020

LEGAL DESCRIPTION:
NW 1/4 SEC 13 TWP 026 RGE 05 W5M, N 1/2 SEC 14 TWP 026 RGE 05 W5M, NE 1/4 SEC 15 TWP 026 RGE 05 W5M, E 1/2 SEC 13 TWP 026 RGE 05 W5M, AND S 1/2 & NW 1/4 SEC 18 TWP 026 RGE 04 W5M
CALGARY, ALBERTA

0 0.2 0.4 0.8 1.2 km

SCALE 1:20,000
WHEN PLOTTED CORRECTLY ON A 11 x 17 PAGE LAYOUT
NAD 1983 UTM Zone 11N

BURNCO ROCK PRODUCTS LTD.
SUITE 200, 5055 11 STREET NE
CALGARY, ALBERTA

SECONDARY WATER RESOURCE ASSESSMENT - WEST COCHRANE GRAVEL PIT

SITE CATCHMENT AREA WITH OVERLYING LITHOLOGY

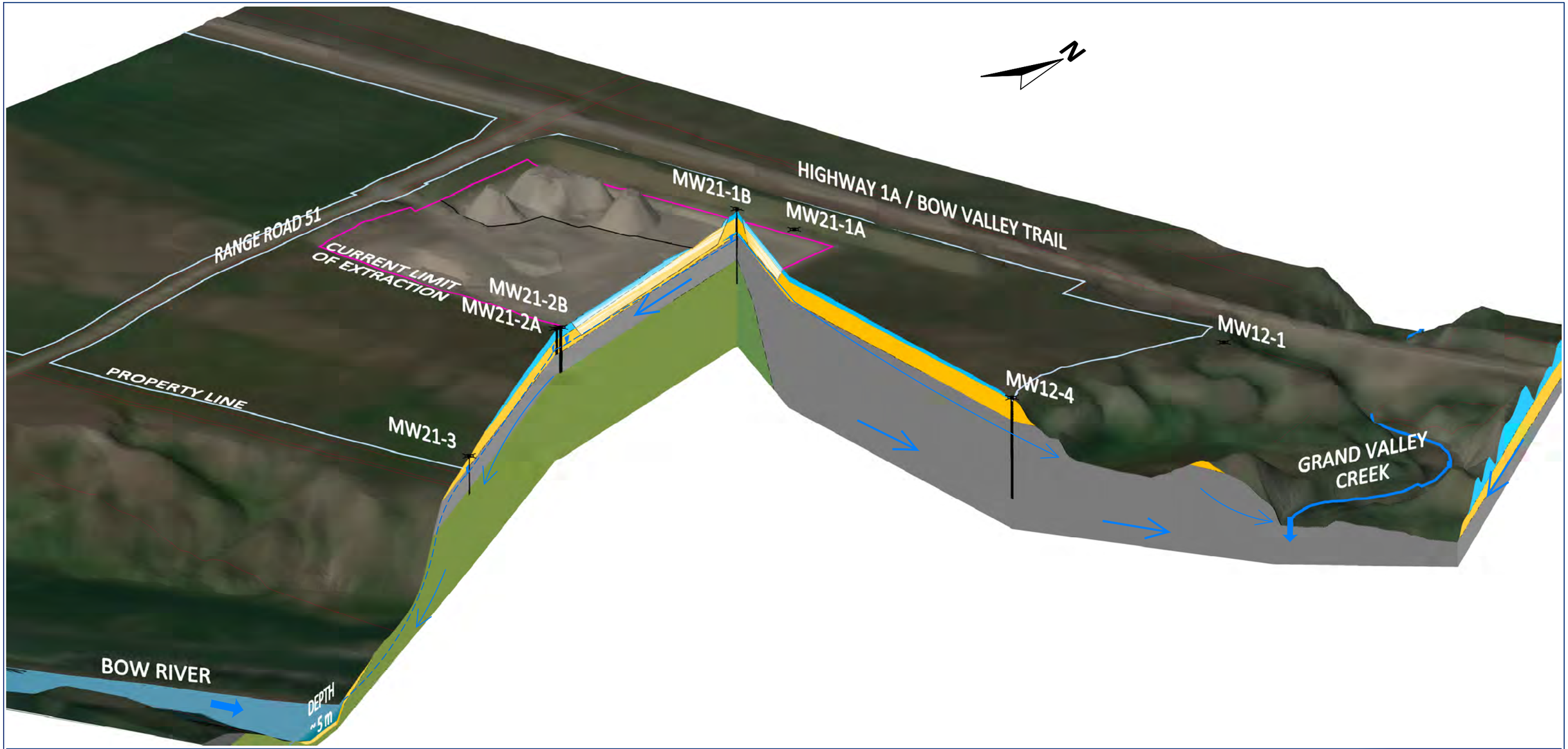
SLR

FIGURE NO: **6**

DATE: December 14, 2022

PROJECT NO: 212.30025.00000

CADFILE NAME: S_212-30025-00000-A2.dwg



LEGEND:

- PROPERTY BOUNDARY
- CURRENT OPERATIONS
- PROPOSED PROPERTY BOUNDARY
- WATER FEATURE - CREEKS
- WATER FEATURE - RIVER OR WATER BODY
- BOREHOLE LOCATION COMPLETED AS A MONITORING WELL (OTHERS)
- GROUNDWATER ELEVATION
- GROUNDWATER FLOW DIRECTION
- SURFACE WATER FLOW DIRECTION
- SILT AND CLAY OVERBURDEN
- GRAVEL
- SANDSTONE
- SILTSTONE / SANDSTONE INTERBEDS

NOTES:

NOT A LEGAL SURVEY. DO NOT USE FOR CONSTRUCTION.

REFERENCED FROM ABADATA 2.0 CADASTRAL DATA, ALTALIS CADASTRAL DATA, MATRIX SOLUTIONS INC. PROJECT 26388-LP FIGURE 1 TITLED "LOCATION PLAN", TOPOGRAPHICAL DATA AS PROVIDED BY CLIENT FILE NO. "2022-02-02_EG OGL LiDAR 06272018.DWG", NTS MAPS 82 O/01 TITLED "CALGARY", 82 O/02 TITLED "JUMPINGPOUND CREEK", 82 O/07 TITLED "WILDCAT HILLS" AND 82 O/08 TITLED "CROSSFIELD" AND SITE RECONNAISSANCE INFORMATION.

IMAGERY SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY.
IMAGE DATE: 2020

LEGAL DESCRIPTION:
NW 1/4 SEC 13 TWP 026 RGE 05 W5M, N 1/2 SEC 14 TWP 026 RGE 05 W5M, NE 1/4 SEC 15 TWP 026 RGE 05 W5M, E 1/2 SEC 13 TWP 026 RGE 05 W5M, AND S 1/2 & NW 1/4 SEC 18 TWP 026 RGE 04 W5M
CALGARY, ALBERTA

BURNCO ROCK PRODUCTS LTD.
SUITE 200, 5055 11 STREET NE
CALGARY, ALBERTA

SECONDARY WATER RESOURCE ASSESSMENT - WEST COCHRANE GRAVEL PIT

CONCEPTUAL SITE MODEL

SLR

FIGURE NO: **7**

DATE: January 12, 2023

PROJECT NO: 212.30025.00000

CADFILE NAME: S_212-30025-00000-A3 CSM.dwg

Appendix A Methodology

Secondary Water Resource Assessment

West Cochrane Gravel Pit

BURNCO Rock Products Ltd.

SLR Project No. 212.30025.00000

January 12, 2023

Appendix A Methodology

A.1 Introduction

The surface water assessment was divided into three main parts, with the first comprising a desktop review of scientific literature and available data collected by BURNCO and Matrix Solutions Inc. (Matrix) as detailed in Section 2.1 of the report. Details of the field program and hydrogeological risk assessment are provided below.

A.2 Field Work

Following the initial information review, field assessments were carried out in accordance with SLR's standard field investigation procedures. This included the following items:

- Bedrock mapping;
- Drive point piezometer and staff gauge installation; and
- Surface water flow measurements and sampling.

The methodology behind these aspects of the field investigation is outlined in the following sections.

A.2.1 Bedrock Mapping

A field survey of bedrock outcrops along the Grand Valley Creek (GVC) valley was conducted by SLR on December 10, 2021. A geological compass was used to measure strike, dip and dip directions along bedding planes, cleavage planes, and fractures at seven bedrock outcrops along the valley. The results of the bedrock survey are shown in Appendix C. Further details are provided in Section 3.4.2.1.

A.2.2 Drive Point Piezometer and Staff Gauge Installation

Drive-point piezometers are economical and non-intrusive devices which measure the surface water level and the groundwater level below the watercourse. In this way the direction of the vertical gradient between the underlying groundwater and overlying surface water is measured. They are simple to install by hand, using a fence post driver.

Two piezometers (MP1 and MP2) were installed approximately 0.9 m and 1.5 m, respectively, below the bed of the Bow River at the downstream surface sample location (BOWDS). A third piezometer (MP3) was installed in GVC between upstream and downstream surface sample locations (GVC US and GVC DS) at a depth of 0.8 m below the creek bed. An interface probe was used to determine relative groundwater and surface water levels using the top of casing at each piezometer.

Given the time of year, water remained frozen in these devices. Consideration should be given to including them in the regular monitoring program over the warmer seasons.

A.2.3 Surface Water Flow Measurements and Sampling

A surface water sampling and stream flow measurement program was conducted by SLR on December 1, 2021. The field work was completed 15 days after a rainfall event to ensure baseflow conditions prevailed in both the Bow River and GVC.

Surface water samples were collected from upstream and downstream locations relative to current aggregate operations in the Bow River and GVC. Water samples were collected using a sampling rod with a plastic sample collection container that was cleaned with Alconox© and a towel and rinsed with sample water three times prior to collecting a sample for analysis. Surface water samples were collected 0.8 m out from the shoreline and from the middle of the water column. Downstream samples were collected first in order to avoid sediment disruption during sampling. One blind field duplicate (DUP21A) was collected at the GVC downstream sample location (GVC DS). Water samples were placed in appropriate sample containers provided by the laboratory and preservative supplied by the laboratory was added to the samples where required. The samples were submitted to AGAT Laboratories of Calgary for testing, which is a Canadian Association for Laboratory Accreditation (CALA) accredited laboratory.

Creek discharge rates were measured in the GVC both upstream and downstream of the aggregate operations at surface water sample locations GVC US and GVC DS respectively. Flow was measured using velocity/area methods, by which a transect was created across the creek and divided into sections based on where velocity and depth measurements were taken. In multiplying the cross-sectional area (width of section x depth) by the velocity, the discharge for each section of the creek was calculated. The total discharge of water from the creek was then calculated as the sum of the discharges from all the sections. Water velocity was measured in the field using a Hach Velocity Flow Meter FH 950 and averaged between ten readings.

A.2.4 Work by Other Consultants

From 2003 to 2005, Sosiak from Alberta Environment and Parks conducted surface water sampling and flow measurements along the GVC. Surface water samples were analyzed for routine parameters, chlorophyll, fecal coliforms, total suspended solids, dissolved oxygen, temperature, pH, and specific conductance (Sosiak 2003, 2006). Sosiak found the flow velocity in GVC ranged from 0.001 m^3/s in mid-July 2003 to 0.091 m^3/s in June 2004, with peak flows of 0.260 to 0.975 m^3/s. Total suspended solids (TSS) concentrations ranged from 3 to 28 mg/L between Highway 1A and the mouth of GVC, with one spike of 58 mg/L in 2004. Overall, the average median TSS concentration from 2003 to 2005 was 11 mg/L for both sample locations. The median pH of the creek ranged from 8.2 to 8.4 (Sosiak 2003, 2006). Sosiak concluded that the sampling data provided sufficient baseline data for conditions in GVC.

In 2014, Levelton Consultants Ltd. (Levelton) completed a hydrogeologic assessment of properties surrounding the proposed West Cochrane Gravel Pit (Levelton 2014). Thirteen groundwater monitoring wells were installed in the overburden to a maximum depth of 11.4 meters below grade (mbg). Levelton completed a groundwater monitoring program at all groundwater monitoring wells and slug tests at four of the wells. The groundwater flow direction was determined to be to the south and east at velocity of approximately 128 m/year. Groundwater samples were collected in March 2012 and May 2013 and analyzed for routine parameters. TDS concentrations in the groundwater ranged from 324 to 641 mg/L (Levelton 2014).

Following the opening of the West Cochrane Gravel Pit in 2016, Matrix installed six groundwater monitoring wells (MW18-01 to MW18-06) at east end of the proposed expansion area in 2018. The groundwater monitoring wells were installed in the overburden to a maximum depth of 17.7 mbg. Groundwater monitoring data suggested a groundwater flow direction to the south to southeast that generally follows topography (BURNCO, 2021a). At the east end of the proposed expansion area, the groundwater flow direction was to the south to southwest. All groundwater monitoring wells were sampled in November 2018 and analyzed for routine parameters, with the exception of seven dry wells.

Groundwater from BH18-02 was also analyzed for benzene, toluene, ethylbenzene, xylenes, and dissolved metals.

In November 2021, Matrix expanded the groundwater monitoring well network surrounding the West Cochrane Gravel Pit, installing six more wells (MW21-1A, MW21-1B, MW21-2A, MW21-2B, MW21-3, MW21-4) in the overburden or bedrock to a maximum depth of 41.2 mbg. Matrix conducted groundwater monitoring and sampling programs for all previously installed groundwater wells in October 2021 and all newly installed wells in November 2021. Five groundwater monitoring wells were dry, and one well was removed (MW12-4). Two positive and negative slug tests were completed for each well at MW18-05 and MW21-2B. Matrix also collected four aggregate samples from the current gravel pit and four streambed samples from Bow River in October 2021. The soil samples were analyzed for salinity, leachable metals, total metals, and petroleum hydrocarbons.

A.2.5 Hydrogeological Synthesis

Groundwater elevations at each groundwater monitoring well were calculated using groundwater monitoring data from the October and November 2021 monitoring events in combination with LiDAR topographical data from BURNCO. Water level measurements collected on December 1, 2021, in GVC were combined with the LiDAR data to calculate surface water elevations along the creek. Groundwater elevations were contoured in order to determine groundwater flow directions and calculate groundwater gradients. It is important to note the quality of these calculations is dependent on the quality of the groundwater measurements. Since groundwater monitoring was completed over a large time scale, it likely that groundwater conditions during the two monitoring events were not the same. Additionally, groundwater depths show evidence that newly installed wells did not fully recover in the three days between drilling and groundwater monitoring.

Groundwater flow direction was compared to bedrock dip and strike measurements collected along GVC as per Section 2.3.1 and assessed relative to regional geological mapping (Pana and Elgr 2013).

A.2.6 Water Budget

To prepare a water budget for each aquifer, the geologic setting and how it influences the groundwater and surface water system was developed first. Using existing climatological information, the availability of water was explored by determining the surplus between precipitation and actual evapotranspiration. This surplus was partitioned into recharge and runoff and is the driving force in each individual water balance. The interaction between aquifers was examined using simplified Darcy flow equations and the pathway geometries (water table, area available for flow, estimated hydraulic conductivity).

Historical precipitation records were collected from Alberta Agriculture and Forestry Alberta Climate Information Service Calgary Springbank A (climate ID 3031109) and Cop Upper (climate ID 3031875) climate stations (Alberta Agriculture and Forestry). The Calgary Springbank A weather station is located at the Springbank Airport, approximately 19.7 kms southwest of the current site. Cop Upper is located approximately 29.9 kms southwest of the current site and was used as a backup for missing Calgary Springbank A climate data. The weather station Ghost Ranger Station was considered due to its location in the Bow River catchment area (see Drawing 3), but the station is farther away from the site than the two above mentioned stations and at an elevation that is not characteristic of the site (1472 masl). The average 30-year temperature and precipitation for each month was calculated in order to determine the surplus between precipitation and actual evapotranspiration. See Appendix C for a technical description of water budget calculations that were used.

Water depth and flow velocity in GVC was determined by combining steam transect measurements on December 1, 2021, and considering historical measurements collected by Sosiak from 2003 to 2005. Historical water level and flow data for the Bow River was collected from Environment and Climate Change Canada Historical Hydrometric Data station #05BH005, in the City of Cochrane (Environment and Climate Change Canada). Recharge was calculated from the terrain and available annual surplus water. Groundwater flow volumes were calculated using Darcy's principle and hydraulic conductivity measurements and then compared to the independently derived recharge values. The groundwater flow was compared to the measured streamflow as well to determine the relative contribution of the site to these watercourses. A conceptual model for the site was constructed using cross sections (prepared from the borehole logs) and topography.

Appendix B Borehole and Monitoring Well Installation Logs

Secondary Water Resource Assessment

West Cochrane Gravel Pit

BURNCO Rock Products Ltd.

SLR Project No. 212.30025.00000

January 12, 2023

LEVELTON CONSULTANTS LTD.

BURNCO Rock Products c/o Twerdoff & Associates Inc.
N 1/2-14, W 1/2-13 and NE-15-26-5 W5M,

MW10-01

Pg 1 of 1

Project No: AB12-0253-00

Depth (ft)	Depth (m)	Description	Symbol	Depth (m)	Sample Number/ ID	Sample Type	Well and Backfill Details	Headspace Vapour Concentration ▲ (ppm_v) ▲ 10 100 1000	Laboratory Analysis /Comments
5	2	Black, silty **TOPSOIL**		1.8					
10	4	**SAND and GRAVEL**, rounded, well sorted, dry							
15	6								
20	6								
25	8								
30				9.1					
		Grey, **SILT**		9.8					
35	10	at 9.8m weathered bedrock (refusal)							
		Bottom of hole at 9.80 meters							
40	12								
45	14								
50	16								
55									
60	18								
65									

Sample Symbols

Backfill Symbols

- Filter Sand
- Bentonite
- Solid Pipe
- Slotted Pipe
- Slough/Cuttings
- Concrete

Soil Symbols

- Organic SILT (Topsoil)
- Sand and Gravel
- SILT

Notes

Logged By	Ken Hugo
Drilled/ Excavated By	
Date Drilled or Excavated	01/05/2010
Elevation (grade)	
Water Level Recorded On	01/05/2010
Drill Method	Solid Stem Auger

HAZMAT R613-1291.GPJ LEVELTON DATA TEMPLATE.GDT 13/10/25

LEVELTON CONSULTANTS LTD.

BURNCO Rock Products c/o Twerdoff & Associates Inc.
N 1/2-14, W 1/2-13 and NE-15-26-5 W5M,

MW10-02

Pg 1 of 1

Project No: AB12-0253-00

Depth (ft)	Depth (m)	Description	Symbol	Depth (m)	Sample Number/ ID	Sample Type	Well and Backfill Details	Headspace Vapour Concentration ▲ (ppm$_v$) ▲ 10 100 1000	Laboratory Analysis /Comments
5	2	**SAND and GRAVEL**, rounded, dry							
10	4								
15	6								
20	6								
25	8			7.6					
		Grey, silty **GRAVEL**		8.5					
30	10	at 8.5 m weathered bedrock (refusal)							
35		Bottom of hole at 8.50 meters							
40	12								
45	14								
50	16								
55									
60	18								
65	20								

Sample Symbols

Backfill Symbols

- Filter Sand
- Bentonite
- Solid Pipe
- Slotted Pipe
- Slough/Cuttings
- Concrete

Soil Symbols

- Sand and Gravel
- Gravel

Notes

Logged By	Ken Hugo
Drilled/ Excavated By	
Date Drilled or Excavated	01/05/2010
Elevation (grade)	
Water Level Recorded On	01/05/2010
Drill Method	Solid Stem Auger

HAZMAT R613-1291.GPJ LEVELTON DATA TEMPLATE.GDT 13/10/25

LEVELTON CONSULTANTS LTD.

BURNCO Rock Products c/o Twerdoff & Associates Inc.
N 1/2-14, W 1/2-13 and NE-15-26-5 W5M,

MW10-03

Pg 1 of 1

Project No: AB12-0253-00

Depth (ft)	Depth (m)	Description	Symbol	Depth (m)	Sample Number/ ID	Sample Type	Well and Backfill Details	Headspace Vapour Concentration ▲ (ppm$_v$) ▲ 10 100 1000	Laboratory Analysis /Comments
5	2	**SAND and GRAVEL**, rounded, dry							
10	4								
15	6								
20	6								
25	8								
30				9.1					
30	10	at 9.1 m dense grey clay, refusal Bottom of hole at 9.10 meters							
35									
40	12								
45	14								
50	16								
55	18								
60									
65	20								

Sample Symbols

Backfill Symbols

- Filter Sand
- Bentonite
- Solid Pipe
- Slotted Pipe
- Slough/Cuttings
- Concrete

Soil Symbols

- Sand and Gravel

Notes

Logged By	Ken Hugo
Drilled/ Excavated By	
Date Drilled or Excavated	01/05/2010
Elevation (grade)	
Water Level Recorded On	01/05/2010
Drill Method	Solid Stem Auger

HAZMAT R613-1291.GPJ LEVELTON DATA TEMPLATE.GDT 13/10/25

Levelton Consultants Ltd.

LEVELTON

Boring/Well Construction Log

Project: McDougall Gravel Pit	Project No.: AB12-0253-00	Boring/Well: **TH12-1**
Location: Northeast Portion of NW-14-26-5 W5M	Logged By: AN	Date Drilled: 03/15/12
Drill Method: Hammer	Drill Co.: Beck Drilling	Water Level read on: N/A
Sample Method: N/A	Rig Type: Becker Hammer	Boring Depth: 8.5 m
Borehole Diameter: 0.17 m	Driller: Nathan Horvath	Well Depth: N/A
Casing Elevation: N/A	Ground Elevation: N/A	Water Table Depth: N/A
		Water Table Elevation: N/A

Depth (m)	Water Level	Graphic Log	Sample Type	Lithological Description of Material	Well Diagram
1			Grain size	**Topsoil** - black, silty, trace sand	No Monitoring Well Installed
2				**Gravel with Sand (10YR 5/3)** - grey, dry, well sorted, trace silt - gravels up to 2 cm in diameter — cobble size below 2.0 m	
3					
4				**Clay Till (10YR 4/1)** - dark grey, very stiff, damp - gravel, iron, sulphate inclusions — rafted bedrock from 5.0 to 5.5 m	
5					
6				— increased gravel contact at ~ 6.6 m, gravels up to 2 cm in diameter	
7				— from 7.5 to 8.5 m very tight and difficult to hammer, no obvious moisture	
8					
9				Backfilled with Cuttings Bentonite Seal Near Surface	
10					
11					
12					**Plate No: 10**

Levelton Consultants Ltd.

LEVELTON

Boring/Well Construction Log

Project: McDougall Gravel Pit	Project No.: AB12-0253-00	Boring/Well: **MW12-1**	
Location: Northeast Portion of NW-13-26-5 W5M	Logged By: AN	Date Drilled: 03/14/12	
Drill Method: Hammer	Drill Co.: Beck Drilling	Water Level read on: 03/28/12	
Sample Method: N/A	Rig Type: Becker Hammer	Boring Depth: 7.64 m	
Borehole Diameter: 0.17 m	Driller: Nathan Horvath	Well Depth: 7.64 m	
Casing Elevation: 1180.48 m	Ground Elevation: 1179.07 m	Water Table Depth: Dry to 7.64 m	
		Water Table Elevation: N/A	

Depth (m)	Water Level	Graphic Log	Sample Type	Lithological Description of Material
0				**Topsoil** - black, silty, trace sand
1				**Silty Clay (10YR 5/3)** - brown, frozen, trace sand
2				**Gravel and Sand (10YR 6/1)** - grey, well sorted, trace silt - dry, gravels approximately 2 cm in diameter
3			Grain size	— cobble size gravels (> 10 cm in diameter) below 2.5 m
4				
5				
6				
7	03/28/2012 Dry to 7.64 m			**Bedrock (10YR 4/1)** - dary grey sandstone, weathered - hard to hammer below 7.4 m, refusal
8				Completed Above-grade Monitoring Well Installed to 7.64 m
9				
10				
11				
12				

Well Diagram

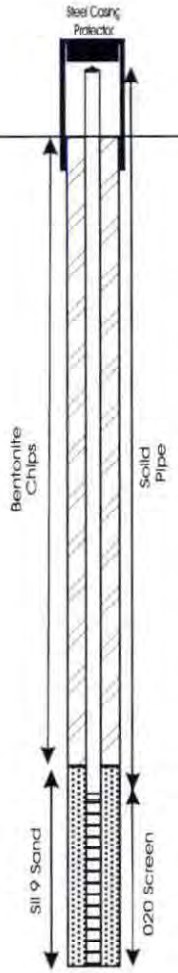


Plate No: 1

Levelton Consultants Ltd.

Boring/Well Construction Log

LEVELTON

Project: McDougall Gravel Pit	Project No.: AB12-0253-00	Boring/Well: **MW12-2**
Location: Northwest Portion of NW-13-26-5 W5M	Logged By: AN	Date Drilled: 03/14/12
Drill Method: Hammer	Drill Co.: Beck Drilling	Water Level read on: 03/28/12
Sample Method: N/A	Rig Type: Becker Hammer	Boring Depth: 11.4 m
Borehole Diameter: 0.17 m	Driller: Nathan Horvath	Well Depth: 11.4 m
Casing Elevation: 1183.67 m	Ground Elevation: 1182.84 m	Water Table Depth: 9.36 m
		Water Table Elevation: 1173.48 m

Depth (m)	Water Level	Graphic Log	Sample Type	Lithological Description of Material
0				**Topsoil** - black, silty, trace sand
1				**Silty Clay (10YR 5/3)** - brown, very stiff, trace fine grained sand - medium plasticity
2				
3				**Gravel and Sand (10YR 6/1)** - grey, trace silt and fine-grained sand, dry - gravels up to 5 cm in diameter, well sorted - approximately 5% 5 to 10 cm in diameter
4			Grain size	
5				
6				
7				
8				
9				— larger gravels 10 to 12 cm in diameter below 9 m
10	03/28/2012 9.36 m			— clay till layers with trace gravel, very dark grey (10YR 3/1) from 10.8 to 11 m, stiff, moist
11				**Bedrock (10YR 4/1)** - sandstone, dark grey, weathered, becomes strong at 11.4 m
12				Completed Above-grade Monitoring Well Installed to 11.4 m

Well Diagram

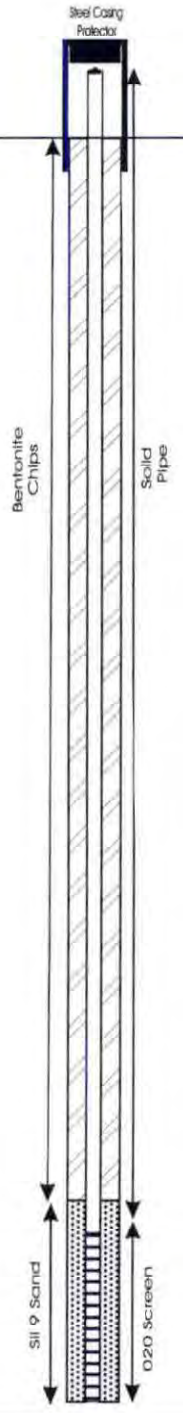


Plate No: 2

Levelton Consultants Ltd.

Boring/Well Construction Log

Project	McDougall Gravel Pit	Project No.	AB12-0253-00	Boring/Well	**MW12-3**
Location	Northeast Portion of NW-13-26-5 W5M	Logged By	AN	Date Drilled	03/14/12
Drill Method	Hammer	Drill Co.	Beck Drilling	Water Level read on	03/28/12
Sample Method	N/A	Rig Type	Becker Hammer	Boring Depth	7.5 m
Borehole Diameter	0.17 m	Driller	Nathan Horvath	Well Depth	7.5 m
Casing Elevation	1177.62 m	Ground Elevation	1176.69 m	Water Table Depth:	7.33 m
				Water Table Elevation:	1169.36 m

Depth (m)	Water Level	Graphic Log	Sample Type	Lithological Description of Material
0				**Topsoil** - black, silty, trace sand
1				**Silty Clay (10YR 5/3)** - brown, trace sand, stiff, medium plasticity, damp
2				**Gravel and Sand (10YR 6/1)** - grey, well sorted, trace silt, dry - gravels up to 3 cm in diameter, well sorted
3			Grain size	--- gravels up to 5 cm in diameter at 3.0 m
4				
5				--- at 4.8 m cobbles up to 14 cm in diameter
6				
7	▼ 03/28/2012 7.33 m			--- damp/wet at 6.5 to 6.75 m, increased sand content --- silty clay layers below 6.75 m - becomes hard to drill at 7.5 m (bedrock)
8				Completed Above-grade Monitoring Well Installed to 7.5 m
9				
10				
11				
12				

Well Diagram

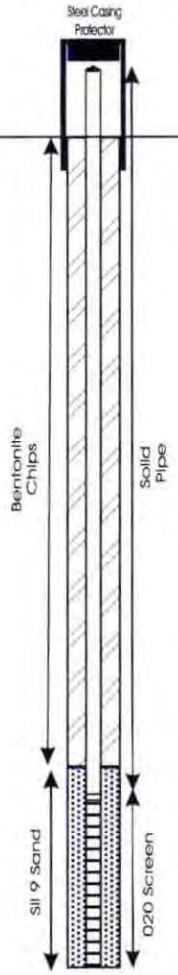


Plate No: 3

Levelton Consultants Ltd.

Boring/Well Construction Log

Project	McDougall Gravel Pit	Project No.	AB12-0253-00	Boring/Well	**MW12-4**
Location	Southwest Portion of NW-13-26-5 W5M	Logged By	AN	Date Drilled	03/15/12
Drill Method	Hammer	Drill Co.	Beck Drilling	Water Level read on	03/28/12
Sample Method	N/A	Rig Type	Becker Hammer	Boring Depth	5.2 m
Borehole Diameter	0.17 m	Driller	Nathan Horvath	Well Depth	5.2 m
Casing Elevation	1172.86 m	Ground Elevation	1171.94 m	Water Table Depth:	Dry to 5.2 m
				Water Table Elevation:	N/A

Depth (m)	Water Level	Graphic Log	Sample Type	Lithological Description of Material
1				**Gravel and Sand (10YR 6/1)** - grey, well sorted, trace silt, dry - gravel up to 2 cm in diameter
2			Grain size	— gravels and cobbles up to 8 cm in diameter below 1.5 m, trace silty sand
3				
4				
5	03/28/2012 Dry to 5.2 m			**Gravel and Sand (10YR 5/2)** - greyish brown sandstone, moist - refusal at 5.2 m
6				Completed Above-grade Monitoring Well Installed to 5.2 m
7				
8				
9				
10				
11				
12				

Well Diagram

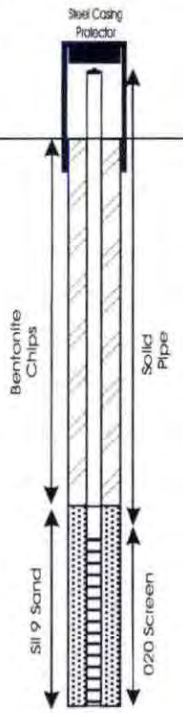


Plate No: 4

Levelton Consultants Ltd.

Boring/Well Construction Log

Project: McDougall Gravel Pit	Project No.: AB12-0253-00	Boring/Well: **MW12-5**
Location: Southeast Portion of NE-14-26-5 W5M	Logged By: AN	Date Drilled: 03/15/12
Drill Method: Hammer	Drill Co.: Beck Drilling	Water Level read on: N/A
Sample Method: N/A	Rig Type: Becker Hammer	Boring Depth: 5.5 m
Borehole Diameter: 0.17 m	Driller: Nathan Horvath	Well Depth: 5.5 m
Casing Elevation: 1173.08 m	Ground Elevation: 1172.19 m	Water Table Depth: Dry to 5.2 m
		Water Table Elevation: N/A

Depth (m)	Water Level	Graphic Log	Sample Type	Lithological Description of Material
0				**Topsoil** - black, silty sand, dry
1				**Gravel with Sand (10YR 6/1)** - grey, well sorted, trace silty - dry - up to 5 cm in dimeter
2				— cobbles up to 12 cm in diameter below 2.0 m
3			Grain size	
4				— moist, silty clay, soft from 4.0 to 4.2 m
5	03/28/2012 Dry to 5.2 m			**Gravel and Sand (10YR 5/2)** - greyish brown sandstone, very hard - refusal at 5.2 m
6				Completed Above-grade Monitoring Well Installed to 5.2 m
7				
8				
9				
10				
11				
12				

Well Diagram

Plate No: 5

Levelton Consultants Ltd.

Boring/Well Construction Log

Project: McDougall Gravel Pit	Project No.: AB12-0253-00	Boring/Well: **MW12-6**
Location: Northwest Portion of NW-13-26-5 W5M	Logged By: AN	Date Drilled: 03/14/12
Drill Method: Hammer	Drill Co.: Beck Drilling	Water Level read on: 03/28/12
Sample Method: N/A	Rig Type: Becker Hammer	Boring Depth: 11.4 m
Borehole Diameter: 0.17 m	Driller: Nathan Horvath	Well Depth: 11.4 m
Casing Elevation: 1186..34 m	Ground Elevation: 1185.49 m	Water Table Depth: 10.2 m
		Water Table Elevation: 1175.29 m

Depth (m)	Water Level	Graphic Log	Sample Type	Lithological Description of Material
0				**Topsoil** - black, silty, trace sand
1				**Silty Clay (10YR 5/3)** - brown, very stiff, firm, damp - medium plasticity
2				
3				
4			Grain size	**Gravel with Sand (10YR 6/1)** - grey, well sorted, dry - gravels up to 2 cm in diameter
5				—below 4.5 m large cobbles > 15 cm in diameter
6				
7				
8				— silty clay layers from 7.0 to 7.5 m — no cobbles, gravels up to 5 cm in diameter
9				
10	▼ 03/28/2012 10.2 m			— 10 to 10.8 m, moist/saturated brown coarse sand (10YR 5/3) with cobbles, well sorted
11				**Clay Till (10YR 3/1)** - very dark grey, trace gravel, firm, moist
12				Completed Above-grade Monitoring Well Installed to 11.4 m

Well Diagram

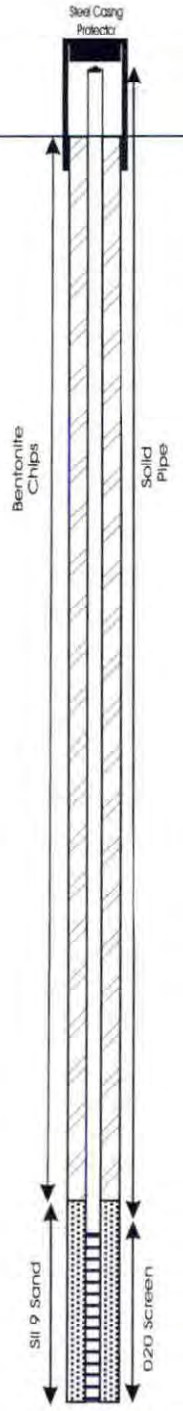


Plate No: 6

Levelton Consultants Ltd.

Boring/Well Construction Log

Project: McDougall Gravel Pit	Project No.: AB12-0253-00	Boring/Well: **MW12-7**
Location: Northeast Portion of NW-14-26-5 W5M	Logged By: AN	Date Drilled: 03/15/12
Drill Method: Hammer	Drill Co.: Beck Drilling	Water Level read on: 03/28/12
Sample Method: N/A	Rig Type: Becker Hammer	Boring Depth: 7.2 m
Borehole Diameter: 0.17 m	Driller: Nathan Horvath	Well Depth: 7.2 m
Casing Elevation: 1180.26 m	Ground Elevation: 1179.34 m	Water Table Depth: 6.82 m
		Water Table Elevation: 1172.52 m

Depth (m)	Water Level	Graphic Log	Sample Type	Lithological Description of Material
0				**Topsoil** - black, silty, trace sand
1				**Gravel with Sand (10YR 6/1)** - grey, well sorted, trace silt - dry, gravels approximately 2 cm in diameter
2				
3				— cobbles > 10 cm in diameter
4			Grain size	
5				
6				— boulders below 5.5 m
7	03/28/2012 6.82 m			**Bedrock (10YR 6/1)** - grey sandstone, strong - refusal at 7.2 m
8				Completed Above-grade Monitoring Well Installed to 7.2 m
9				
10				
11				
12				

Well Diagram

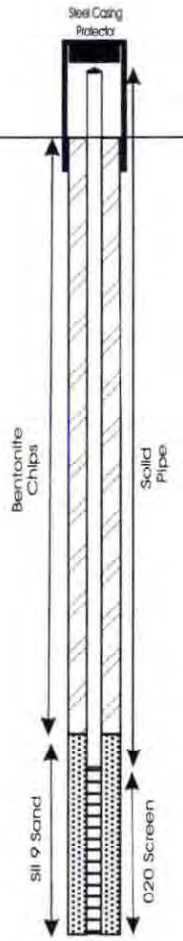


Plate No: 7

Levelton Consultants Ltd.

Boring/Well Construction Log

Project McDougall Gravel Pit	Project No. AB12-0253-00	Boring/Well **MW12-8**
Location Northeast Portion of NW-14-26-5 W5M	Logged By AN	Date Drilled 03/15/12
Drill Method Hammer	Drill Co. Beck Drilling	Water Level read on 04/02/12
Sample Method N/A	Rig Type Becker Hammer	Boring Depth 8.5 m
Borehole Diameter 0.17 m	Driller Nathan Horvath	Well Depth 7.6 m
Casing Elevation 1180.26 m	Ground Elevation 1179.34 m	Water Table Depth: 7.59 m
		Water Table Elevation: 1172.52 m

Depth (m)	Water Level	Graphic Log	Sample Type	Lithological Description of Material
0				**Topsoil** - black, silty, trace sand
1				**Gravel with Sand (10YR 6/1)** - grey, well sorted, trace silt - dry, gravels approximately 2 to 4 cm in diameter, <5% cobbles
2				— layer of coarse sand at 2.0 m
3			Grain size	- increasing cobbles below 3.0 m
4				
5				
6				
7				— moist to wet 6.7 to 6.9 m **Silty Clay(10YR 3/1)** - very dark grey, trace fine grained sand - saturated, medium plasticity - clay till like at 8.0 m with gravel, iron, sulphate inclusions, moist
8	▼ 04/02/2012 7.59 m			
9				Completed Above-grade Monitoring Well Installed to 7.6 m
10				
11				
12				

Well Diagram

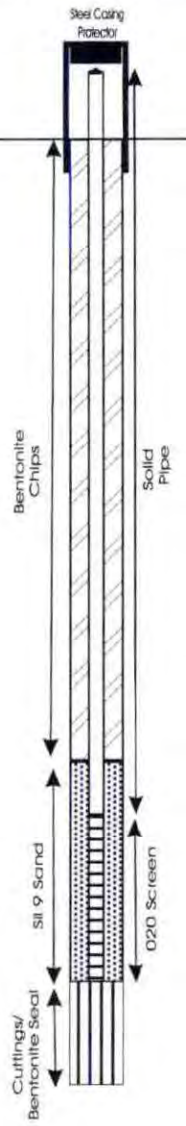


Plate No: 8

Levelton Consultants Ltd.

Boring/Well Construction Log

Project: McDougall Gravel Pit	Project No.: AB12-0253-00	Boring/Well: **MW12-9**
Location: Northeast Portion of NW-14-26-5 W5M	Logged By: AN	Date Drilled: 03/15/12
Drill Method: Hammer	Drill Co.: Beck Drilling	Water Level read on: 04/02/12
Sample Method: N/A	Rig Type: Becker Hammer	Boring Depth: 8.5 m
Borehole Diameter: 0.17 m	Driller: Nathan Horvath	Well Depth: 8.5 m
Casing Elevation: 1185.24 m	Ground Elevation: 1184.46 m	Water Table Depth: 5.72 m
		Water Table Elevation: 1178.74 m

Depth (m)	Water Level	Graphic Log	Sample Type	Lithological Description of Material
0				**Topsoil** - black, silty, trace sand
1				**Gravel with Sand (10YR 5/3)** - brown, well sorted, fine grained sand - gravels from 1 to 3 cm in diameter, dry
2				**Sand with Gravel (10YR 5/3)** - brown, fine to medium grained sand - < 10% gravel, diameter 2 to 3 cm
3				— from ~2.8 to 3.0 m silty clay, wet
4			Grain size	
5				**Gravel with Sand (10YR 6/1)** - grey, trace silt - cobbles up to 10 cm in diameter
6	04/02/2012 5.72 m			
7				— saturated with clay till inclusions from 7.5 to 8.5 m
8				
9				Completed Above-grade Monitoring Well Installed to 8.5 m
10				
11				
12				

Well Diagram

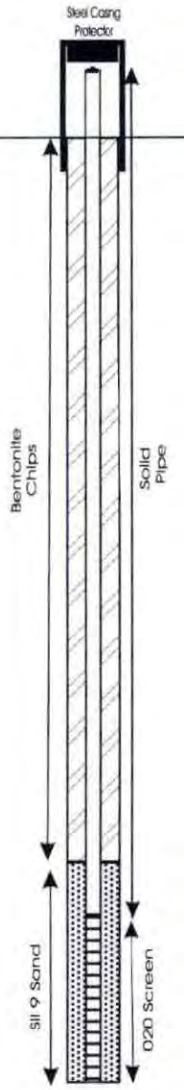


Plate No: 9

Borehole Log - USC

Matrix Solutions Inc.

DRAFT

Project/Site: **26388**

Well/borehole #: **MW18-01 (B1)**

Client: **Burnco Rock Products Ltd.**
Logged By: **R. Killam**
Compiled By: **A. Zhang**
Driller: **Earth Drilling Co. Ltd.**
Drill Equipment: **Sonic-Tracked Rig**

Start Time: **Aug 29, 2018**
Finish Time: **Aug 29, 2018**
Top of Casing: **--**
Ground Elev: **1190.01 m**
Top / Base of Sand Pack: **11.6/15.5 m**

Screened Interval: **12.5-15.5 m**
Slot Size: **0.01 "**
Total Depth: **17.7 m**
Boring Diameter: **0.15 m**
Casing Diameter: **0.05 m**

Legal Location: **SE 24-026-05 W5M**
Relative Location: **--**
Northing: **5677972**
Easting: **669993**
Datum/Zone: **NAD83 / Zone11N**

Well / Borehole Completion Data	Depth (m) / Elevation (relative)	Lithology	Soil Description *LITHOLOGY: texture, plasticity, colour/oxidation, consistency, moisture, primary structure, secondary structure, genesis, remarks.*	Sample Depth *B = Bag* *J = Jar* *V = Vial* Sample No. Prefix: --
	0 / 1190		CLAY: (0-3.0 m) silty, moist, trace sand, brown, firm.	
	-1 / 1189			
	-2 / 1188			
			@ 2.7 m medium plasticity.	
	-3 / 1187		CLAY: (3.0-9.1 m) silty, trace gravel, moist, low to medium plasticity, brown, firm.	
	-4 / 1186			
	-5 / 1185			
Bentonite Chips	-6 / 1184			
	-7 / 1183			
	-8 / 1182			
	-9 / 1181		CLAY: (9.1-12.2 m) gray, medium plasticity, moist, firm.	
	-10 / 1180			

NOTE: Stickup 0.7 m

Borehole Log - USC

Matrix Solutions Inc.

DRAFT

Project/Site: **26388**

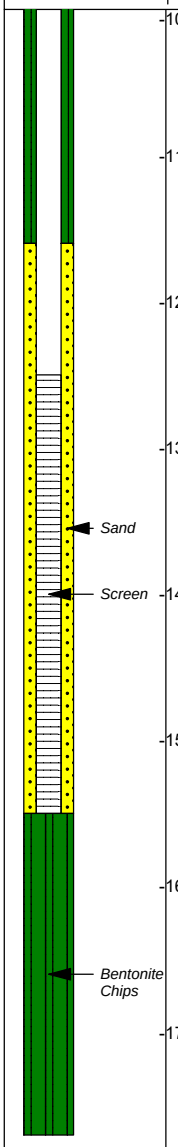
Well/borehole #: **MW18-01 (B1)**

Client: **Burnco Rock Products Ltd.**
Logged By: **R. Killam**
Compiled By: **A. Zhang**
Driller: **Earth Drilling Co. Ltd.**
Drill Equipment: **Sonic-Tracked Rig**

Start Time: **Aug 29, 2018**
Finish Time: **Aug 29, 2018**
Top of Casing: **--**
Ground Elev: **1190.01 m**
Top / Base of Sand Pack: **11.6/15.5 m**

Screened Interval: **12.5-15.5 m**
Slot Size: **0.01 "**
Total Depth: **17.7 m**
Boring Diameter: **0.15 m**
Casing Diameter: **0.05 m**

Legal Location: **SE 24-026-05 W5M**
Relative Location: **--**
Northing: **5677972**
Easting: **669993**
Datum/Zone: **NAD83 / Zone11N**



Depth (m)	Elevation (relative)	Lithology	Soil Description	Sample Depth
10	1180		*LITHOLOGY: texture, plasticity, colour/oxidation, consistency, moisture, primary structure, secondary structure, genesis, remarks.*	*B = Bag* *J = Jar* *V = Vial* Sample No. Prefix: --
11	1179			
12	1178			
			CLAY: (12.2-15.2 m) gray, medium plasticity, moist, firm.	
13	1177			
14	1176			
15	1175			
			SANDSTONE: (15.3-17.4 m) fine to medium grained, dry.	
16	1174			
17	1173			
			Bottom of Hole	
18	1172			
19	1171			
20				

NOTE: Stickup 0.7 m

Borehole Log - USC

Matrix Solutions Inc.

DRAFT

Project/Site: **26388**

Well/borehole #: **MW18-02 (B2)**

Client: **Burnco Rock Products Ltd.**
Logged By: **R. Killam**
Compiled By: **A. Zhang**
Driller: **Earth Drilling Co. Ltd.**
Drill Equipment: **Sonic-Tracked Rig**

Start Time: **Aug 29, 2018**
Finish Time: **Aug 29, 2018**
Top of Casing: **--**
Ground Elev: **1185.46 m**
Top / Base of Sand Pack: **11.0/14.8 m**

Screened Interval: **11.7-14.8 m**
Slot Size: **0.01 "**
Total Depth: **16.8 m**
Boring Diameter: **0.15 m**
Casing Diameter: **0.05 m**

Legal Location: **NW 18-026-04 W5M**
Relative Location: **--**
Northing: **5677699**
Easting: **670817**
Datum/Zone: **NAD83 / Zone11N**

Well / Borehole Completion Data	Depth (m) / Elevation (relative)	Lithology	Soil Description *LITHOLOGY: texture, plasticity, colour/oxidation, consistency, moisture, primary structure, secondary structure, genesis, remarks.*	Sample Depth *B = Bag* *J = Jar* *V = Vial* Sample No. Prefix: --
	0 / 1185 -1 / 1184 -2 / 1183		CLAY: (0-3.0 m) brown, firm, dry to moist, low to medium plasticity.	
	-3 / 1182 -4 / 1181 -5 / 1180		CLAY: (3.0-6.1 m) brown, firm to soft, dry, medium plasticity, trace coarse grained sand.	
Bentonite Chips	-6 / 1179 -7 / 1178 -8 / 1177 -9 / 1176 -10		CLAY: (6.1-9.1 m) brown, firm, dry, medium plasticity. CLAY: (9.1-11.3 m) brown, firm, dry, medium plasticity.	

NOTE: Water Level - 10.83 m bTOC on August 29, 2018 - Stickup 0.7 m

Borehole Log - USC

Matrix Solutions Inc.

DRAFT

Project/Site: **26388**

Well/borehole #: **MW18-02 (B2)**

Client: **Burnco Rock Products Ltd.**
Logged By: **R. Killam**
Compiled By: **A. Zhang**
Driller: **Earth Drilling Co. Ltd.**
Drill Equipment: **Sonic-Tracked Rig**

Start Time: **Aug 29, 2018**
Finish Time: **Aug 29, 2018**
Top of Casing: **--**
Ground Elev: **1185.46 m**
Top / Base of Sand Pack: **11.0/14.8 m**

Screened Interval: **11.7-14.8 m**
Slot Size: **0.01 "**
Total Depth: **16.8 m**
Boring Diameter: **0.15 m**
Casing Diameter: **0.05 m**

Legal Location: **NW 18-026-04 W5M**
Relative Location: **--**
Northing: **5677699**
Easting: **670817**
Datum/Zone: **NAD83 / Zone11N**

Well / Borehole Completion Data	Depth (m)	Elevation (relative)	Lithology	Soil Description *LITHOLOGY: texture, plasticity, colour/oxidation, consistency, moisture, primary structure, secondary structure, genesis, remarks.*	Sample Depth *B = Bag* *J = Jar* *V = Vial* Sample No. Prefix: --
	10	1175			
	11				
		1174		GRAVEL: (11.3-15.2 m) coarse grained, moist to wet, some clay, some sand.	
	12	1173		@ 12.2 m increased gravel content, pebble to cobble, subangular to rounded.	
Sand	13	1172			
Screen					
	14	1171			
Sand	15				
		1170		SANDSTONE: (15.2-16.8 m) weathered, very fine to fine grained.	
Bentonite Chips	16	1169			
	17			Bottom of Hole	
		1168			
	18	1167			
	19				
		1166			
	20				

NOTE: Water Level - 10.83 m bTOC on August 29, 2018 - Stickup 0.7 m

Borehole Log - USC

Matrix Solutions Inc.

DRAFT

Project/Site: **26388**

Well/borehole #: **MW18-03 (B3)**

Client: **Burnco Rock Products Ltd.**
Logged By: **J. Xhemalaj**
Compiled By: **A. Zhang**
Driller: **Earth Drilling Co. Ltd.**
Drill Equipment: **Becker Hammer**

Start Time: **Jul 23, 2018 08:45**
Finish Time: **Jul 23, 2018 11:45**
Top of Casing: **--**
Ground Elev: **1176.36 m**
Top / Base of Sand Pack: **12.8/16.5 m**

Screened Interval: **13.4-16.5 m**
Slot Size: **0.01 "**
Total Depth: **16.8 m**
Boring Diameter: **0.18 m**
Casing Diameter: **0.05 m**

Legal Location: **SE 18-026-04 W5M**
Relative Location: **--**
Northing: **5677045**
Easting: **671656**
Datum/Zone: **NAD83 / Zone11N**

Well / Borehole Completion Data	Depth (m)	Elevation (relative)	Lithology	Soil Description *LITHOLOGY: texture, plasticity, colour/oxidation, consistency, moisture, primary structure, secondary structure, genesis, remarks.*	Sample Depth *B = Bag* *J = Jar* *V = Vial* Sample No. Prefix: --
	0	1176		CLAY: (0-0.8 m) silty, brown, medium plasticity, dry.	
	-1	1175		CLAY: (0.8-1.5 m) silty, some rocks.	
				CLAY: (1.5-2.7 m) silty, brown.	
Bentonite Chips	-2	1174			
	-3	1173		GRAVEL: (2.7-9.1 m) pebble to cobble gravel, some coarse grained sand (includes gray sandstone and mudstone), dry.	
	-4	1172			
	-5	1171			
	-6	1170			
	-7	1169			
Cuttings	-8	1168			
	-9	1167		@ 9.1 m coarse sand, moist.	
	-10			GRAVEL: (9.1-12.2 m) pebble to cobble gravel, some coarse grained sand (includes gray sandstone and mudstone), dry.	

NOTE: Stickup 0.6 m

Borehole Log - USC

Matrix Solutions Inc.

DRAFT

Project/Site: **26388**

Well/borehole #: **MW18-03 (B3)**

Client: **Burnco Rock Products Ltd.**
Logged By: **J. Xhemalaj**
Compiled By: **A. Zhang**
Driller: **Earth Drilling Co. Ltd.**
Drill Equipment: **Becker Hammer**

Start Time: **Jul 23, 2018 08:45**
Finish Time: **Jul 23, 2018 11:45**
Top of Casing: **--**
Ground Elev: **1176.36 m**
Top / Base of Sand Pack: **12.8/16.5 m**

Screened Interval: **13.4-16.5 m**
Slot Size: **0.01 "**
Total Depth: **16.8 m**
Boring Diameter: **0.18 m**
Casing Diameter: **0.05 m**

Legal Location: **SE 18-026-04 W5M**
Relative Location: **--**
Northing: **5677045**
Easting: **671656**
Datum/Zone: **NAD83 / Zone11N**

Well / Borehole Completion Data	Depth (m)	Elevation (relative)	Lithology	Soil Description *LITHOLOGY: texture, plasticity, colour/oxidation, consistency, moisture, primary structure, secondary structure, genesis, remarks.*	Sample Depth *B = Bag* *J = Jar* *V = Vial* Sample No. Prefix: --
Bentonite Chips	10	1166			
	11	1165			
Peltonite	12	1164		GRAVEL: (12.2-16.5 m) well sorted, pebbles to cobbles, some sand (coarse grained).	
	13	1163			
Sand	14	1162			
Screen	15	1161			
	16	1160			
Sand				SANDSTONE: (16.5-16.8 m) fine grained, yellow, dry.	
	17	1159		Bottom of Hole	
	18	1158			
	19	1157			
	20				

NOTE: Stickup 0.6 m

Borehole Log - USC

Matrix Solutions Inc.

DRAFT

Project/Site: **26388**

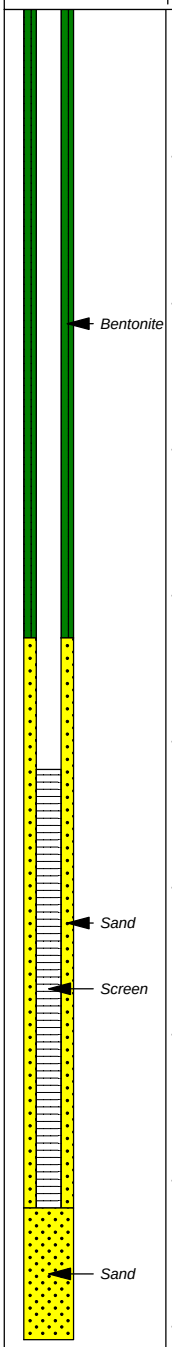
Well/borehole #: **MW18-04 (D3)**

Client: **Burnco Rock Products Ltd.**
Logged By: **R. Killam**
Compiled By: **C. Oliphant**
Driller: **Earth Drilling Co. Ltd.**
Drill Equipment: **Sonic-Tracked Rig**

Start Time: **Aug 30, 2018**
Finish Time: **Aug 30, 2018**
Top of Casing: **--**
Ground Elev: **1170.59 m**
Top / Base of Sand Pack: **4.3/8.2 m**

Screened Interval: **5.2-8.2 m**
Slot Size: **0.01 "**
Total Depth: **9.1 m**
Boring Diameter: **0.15 m**
Casing Diameter: **0.05 m**

Legal Location: **SW 18-026-04 W5M**
Relative Location: **--**
Northing: **5676756**
Easting: **670931**
Datum/Zone: **NAD83 / Zone11N**



Depth (m)	Elevation (relative)	Lithology	Soil Description	Sample Depth
0	1170		TOPSOIL: (0-0.2 m)	
			SAND AND GRAVEL: (0.2-6.7 m) poorly sorted, subangular to rounded clasts, pebble to cobble, fine grained sand.	
-1	1169			
-2	1168			
-3	1167			
-4	1166			
-5	1165			
-6	1164			
-7	1163		SAND AND GRAVEL: (6.7-7.6 m) moist to wet, moderate sorting, subrounded to rounded, fine grained sand, moist to wet could be from drill water.	
-8	1162		SILTSTONE: (7.6-9.1 m) weathered, interbedded sandstone.	
-9	1161		@ 9.1 m Bit getting jammed/hung up.	
-10			Bottom of Hole	

LITHOLOGY: texture, plasticity, colour/oxidation, consistency, moisture, primary structure, secondary structure, genesis, remarks.

B = Bag
J = Jar
V = Vial
Sample No. Prefix: --

NOTE: Stickup at 0.7 m

Borehole Log - USC

Matrix Solutions Inc.

DRAFT

Project/Site: **26388**

Well/borehole #: **MW18-05 (D2)**

Client: **Burnco Rock Products Ltd.**
Logged By: **J. Xhemalaj**
Compiled By: **C. Oliphant**
Driller: **Earth Drilling Co. Ltd.**
Drill Equipment: **Back Hammer**

Start Time: **Jul 23, 2018 13:00**
Finish Time: **Jul 23, 2018 13:30**
Top of Casing: **--**
Ground Elev: **1157.24 m**
Top / Base of Sand Pack: **1.2/4.6 m**

Screened Interval: **1.5-4.6 m**
Slot Size: **0.01 "**
Total Depth: **4.6 m**
Boring Diameter: **0.18 m**
Casing Diameter: **0.05 m**

Legal Location: **SE 18-026-04 W5M**
Relative Location: **--**
Northing: **5676785**
Easting: **671366**
Datum/Zone: **NAD83 / Zone11N**

Well / Borehole Completion Data	Depth (m)	Elevation (relative)	Lithology	Soil Description *LITHOLOGY: texture, plasticity, colour/oxidation, consistency, moisture, primary structure, secondary structure, genesis, remarks.*	Sample Depth *B = Bag* *J = Jar* *V = Vial* Sample No. Prefix: --
Bentonite	0	1157		TOPSOIL: (0-1.2 m) roots, black.	
	-1	1156		CLAY: (1.2-2.3 m) silty, yellow, moist, low to medium plasticity.	
	-2	1155		COAL: (2.3 m-3.1 m)	
Sand Screen	-3	1154		SANDSTONE: (3.1-3.8 m) gray and yellow.	
	-4	1153		SILTSTONE: (3.8-4.6 m) gray and yellow.	
	-5	1152		Bottom of Hole	
	-6	1151			
	-7	1150			
	-8	1149			
	-9	1148			
	-10				

NOTE: Water Level 4.4 m - Stickup 0.6 m

Borehole Log - USC

Matrix Solutions Inc.

DRAFT

Project/Site: **26388**

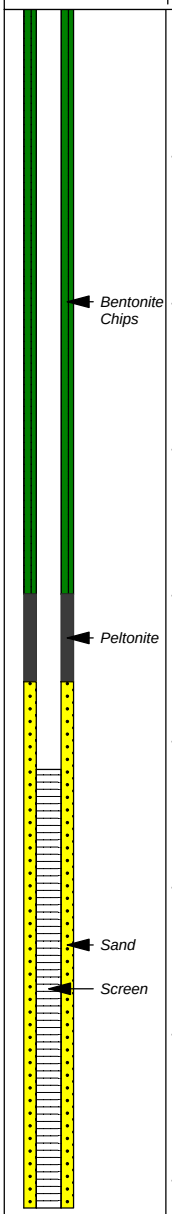
Well/borehole #: **MW18-06 (D1)**

Client: **Burnco Rock Products Ltd.**
Logged By: **J. Xhemalaj**
Compiled By: **C. Oliphant**
Driller: **Earth Drilling Co. Ltd.**
Drill Equipment: **Becker Hammer**

Start Time: **Jul 23, 2018 14:30**
Finish Time: **Jul 23, 2018 16:30**
Top of Casing: **--**
Ground Elev: **1165.67 m**
Top / Base of Sand Pack: **4.6/8.2 m**

Screened Interval: **5.2-8.2 m**
Slot Size: **0.01 "**
Total Depth: **8.2 m**
Boring Diameter: **0.18 m**
Casing Diameter: **0.05 m**

Legal Location: **SE 18-026-04 W5M**
Relative Location: **--**
Northing: **5676368**
Easting: **672001**
Datum/Zone: **NAD83 / Zone11N**



Depth (m)	Elevation (relative)	Lithology	Soil Description	Sample Depth
			LITHOLOGY: texture, plasticity, colour/oxidation, consistency, moisture, primary structure, secondary structure, genesis, remarks.	*B = Bag* *J = Jar* *V = Vial* Sample No. Prefix: --
0			CLAY: (0-2.3 m) silty, yellow, low plasticity, dry.	
-1	1165			
-2	1164			
-3	1163		GRAVEL: (2.3-6.1 m) well sorted, pebble to cobble, some sand, very coarse gravel, dry.	
-4	1162			
-5	1161			
-6	1160			
-7	1159		GRAVEL: (6.1 -7.0 m) coarse sand, moist.	
-8	1158		SHALE: (7.0-8.2 m) yellow to light gray.	
-9	1157		Bottom of Hole	
-10	1156			

NOTE: Sand inside first casing - Stickup 0.6 m

Borehole Log - USC

Matrix Solutions Inc.

DRAFT

Project/Site: **26388**

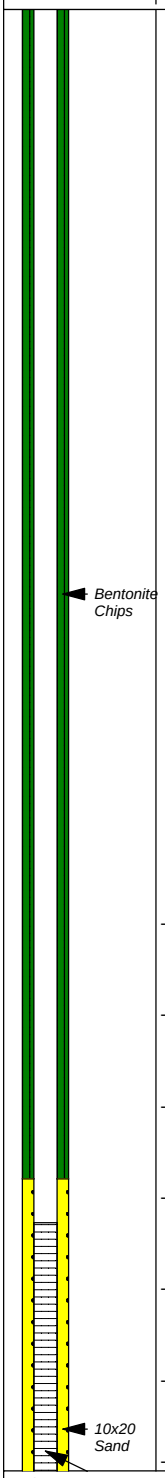
Well/borehole #: **MW21-1a**

Client: **Burnco Rock Products Ltd.**
Logged By: **R. Killam**
Compiled By: **B. Dang**
Driller: **Earth Drilling Co Ltd.**
Drill Equipment: **ODEX**

Start Time: **Nov 22 2021 09:32**
Finish Time: **Nov 22 2021 15:00**
Top of Casing: **--**
Ground Elev: **--**
Top / Base of Sand Pack: **12.8/18.28 m**

Screened Interval: **13.28-18.28 m**
Slot Size: **0.01 "**
Total Depth: **18.59 m**
Boring Diameter: **0.11 m**
Casing Diameter: **0.05 m**

Legal Location: **NW-13-026-05 W5M**
Relative Location: **North of pit**
Northing: **5677740**
Easting: **669058**
Datum/Zone: **NAD83 / Zone11N**



Depth (m)	Elevation (m)	Soil Description	Sample Depth (B = Bag, J = Jar, V = Vial; Sample No. Prefix: --)
0	0	CLAY: (0-2.74 m) some sand (fine to coarse grained), some silt, brown, moist, firm, low plasticity.	
-3	-3	GRAVEL (FINE TO COARSE GRAINED): (2.74-8.54 m) grey, dry, loose, subrounded, well graded.	
-9	-9	CLAY AND SILT: (8.54-9.1 m) grey, moist, firm, medium plasticity.	
-9	-9	GRAVEL (COARSE GRAINED): (9.1-9.76 m) light gray, wet, loose, subrounded, well graded.	
-10	-10	SANDSTONE (FINE TO MEDIUM GRAINED): (9.76-10.0 m) poorly graded, subangular, grey, wet, moderately cemented, water could be from upper gravel.	
-11	-11	SANDSTONE (FINE TO MEDIUM GRAINED): (10.0-18.59 m) some siltstone, poorly graded, subrounded, grey, dry, moderately cemented, silt lenses.	
		@ 10.7-10.71 m moist.	
-12	-12	@ 11.8-11.89 m dry.	
		@ 12.0-12.2 m silty/clay lenses.	

NOTE: ODEX casing 5.5 ODEX hammer bit to 13.72 m Tricone at 13.72 m (4.5) stick up 0.95 m. Ground elevation = 1181 masl

Borehole Log - USC

Matrix Solutions Inc.

DRAFT

Project/Site: **26388**

Well/borehole #: **MW21-1a**

Client: **Burnco Rock Products Ltd.**
Logged By: **R. Killam**
Compiled By: **B. Dang**
Driller: **Earth Drilling Co Ltd.**
Drill Equipment: **ODEX**

Start Time: **Nov 22 2021 09:32**
Finish Time: **Nov 22 2021 15:00**
Top of Casing: **--**
Ground Elev: **--**
Top / Base of Sand Pack: **12.8/18.28 m**

Screened Interval: **13.28-18.28 m**
Slot Size: **0.01 "**
Total Depth: **18.59 m**
Boring Diameter: **0.11 m**
Casing Diameter: **0.05 m**

Legal Location: **NW-13-026-05 W5M**
Relative Location: **North of pit**
Northing: **5677740**
Easting: **669058**
Datum/Zone: **NAD83 / Zone11N**

Well / Borehole Completion Data	Depth (m) / Elevation (m)	Soil / Bedrock	Soil Description	Sample Depth (B = Bag, J = Jar, V = Vial; Sample No. Prefix: --)
Screen	-16 / -16 to -32 / -32		Bottom of Hole	

NOTE: ODEX casing 5.5 ODEX hammer bit to 13.72 m Tricone at 13.72 m (4.5) stick up 0.95 m. Ground elevation = 1181 masl

Borehole Log - USC

Matrix Solutions Inc.

DRAFT

Project/Site: **26388**

Well/borehole #: **MW21-1b**

Client: **Burnco Rock Products Ltd.**
Logged By: **R. Killam**
Compiled By: **B. Dang**
Driller: **Earth Drilling Co Ltd.**
Drill Equipment: **ODEX**

Start Time: **Nov 26 2021 09:29**
Finish Time: **Nov 26 2021 16:00**
Top of Casing: **--**
Ground Elev: **--**
Top / Base of Sand Pack: **23.0/30.49 m**

Screened Interval: **24.49-30.49 m**
Slot Size: **0.01 "**
Total Depth: **30.49 m**
Boring Diameter: **0.11 m**
Casing Diameter: **0.05 m**

Legal Location: **NW-13-026-05 W5M**
Relative Location: **North of pit**
Northing: **5677744**
Easting: **668994**
Datum/Zone: **NAD83 / Zone11N**

Well / Borehole Completion Data	Depth (m) / Elevation (m)	Soil / Bedrock	Soil Description	Sample Depth (B = Bag, J = Jar, V = Vial; Sample No. Prefix: --)
	0 to -16		CLAY: (0-2.74 m) some sand (fine to coarse grained), some silt, brown, moist, firm, low plasticity.	
			GRAVEL (FINE TO COARSE GRAINED): (2.74-8.54 m) grey, dry, loose, subrounded, well graded.	
			CLAY AND SILT: (8.54-9.76 m) grey, moist, firm, medium plasticity.	
			GRAVEL (COARSE GRAINED): (9.76-10.21 m) light gray, wet, loose, subrounded, well graded.	
			SANDSTONE (FINE TO MEDIUM GRAINED): (10.21-10.95 m) well graded, subrounded, grey, moist, poorly cemented, weathered.	
Bentonite Chips			SANDSTONE (FINE TO MEDIUM GRAINED): (10.95-12.2 m) poorly graded, subrounded, grey, dry, moderately cemented.	
			SANDSTONE (FINE TO MEDIUM GRAINED): (12.2-14.94 m) trace siltstone, well graded, subangular, brown and grey, dry, moderately cemented.	
			SANDSTONE (FINE TO MEDIUM GRAINED): (14.94-16.16 m) well graded, subrounded, grey, dry, well cemented.	

NOTE: ODEX casing 5.5 ODEX hammer bit to 10.67 m casing set at 10.67 m Down hole hammer bit to 30.49 m stick up m. Ground elevation = 1181 masl. 2 m NE of MW21-1a

Borehole Log - USC

Matrix Solutions Inc.

DRAFT

Project/Site: **26388**

Well/borehole #: **MW21-1b**

Client: **Burnco Rock Products Ltd.**
Logged By: **R. Killam**
Compiled By: **B. Dang**
Driller: **Earth Drilling Co Ltd.**
Drill Equipment: **ODEX**

Start Time: **Nov 26 2021 09:29**
Finish Time: **Nov 26 2021 16:00**
Top of Casing: **--**
Ground Elev: **--**
Top / Base of Sand Pack: **23.0/30.49 m**

Screened Interval: **24.49-30.49 m**
Slot Size: **0.01 "**
Total Depth: **30.49 m**
Boring Diameter: **0.11 m**
Casing Diameter: **0.05 m**

Legal Location: **NW-13-026-05 W5M**
Relative Location: **North of pit**
Northing: **5677744**
Easting: **668994**
Datum/Zone: **NAD83 / Zone11N**

Well / Borehole Completion Data	Depth (m) / Elevation (m)	Soil / Bedrock	Soil Description	Sample Depth (B = Bag, J = Jar, V = Vial; Sample No. Prefix: --)
	-16 / -16			
	-17 / -17		SANDSTONE (FINE TO MEDIUM GRAINED): (16.16-17.07 m) some siltstone, well graded, subrounded, brown and grey, dry, moderately cemented.	
			SANDSTONE (FINE TO MEDIUM GRAINED): (17.07-17.68 m) well graded, subrounded, grey, wet, moderately cemented.	
	-18 / -18		SANDSTONE (FINE TO MEDIUM GRAINED): (17.68-20.43 m) well graded, subrounded, grey, dry, moderately cemented.	
	-19 / -19			
	-20 / -20			
	-21 / -21		SANDSTONE (FINE TO MEDIUM GRAINED) AND SILTSTONE: (20.43-30.49 m) well graded, subrounded, grey and reddish brown, moist, poorly cemented.	
	-22 / -22			
	-23 / -23			
	-24 / -24			
	-25 / -25		@ 24.7-24.71 m moist returns, possible from upper wet section.	
	-26 / -26			
10x20 Sand	-27 / -27			
Screen				
	-28 / -28			
	-29 / -29			
	-30 / -30			
	-31 / -31		Bottom of Hole	
	-32 / -32			

NOTE: ODEX casing 5.5 ODEX hammer bit to 10.67 m casing set at 10.67 m Down hole hammer bit to 30.49 m stick up m. Ground elevation = 1181 masl. 2 m NE of MW21-1a

Borehole Log - USC

Matrix Solutions Inc.

DRAFT

Project/Site: **26388**

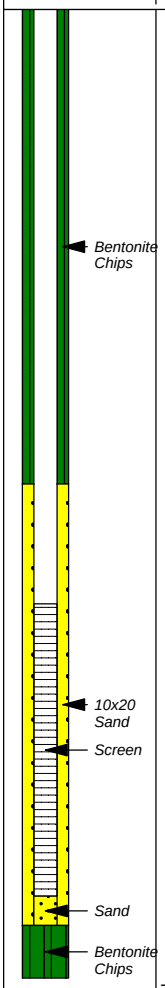
Well/borehole #: **MW21-2a**

Client: **Burnco Rock Products Ltd.**
Logged By: **R. Killam**
Compiled By: **B. Dang**
Driller: **Earth Drilling Co Ltd.**
Drill Equipment: **ODEX**

Start Time: **Nov 22 2021 15:28**
Finish Time: **Nov 23 2021 11:30**
Top of Casing: **--**
Ground Elev: **--**
Top / Base of Sand Pack: **4.87/9.4 m**

Screened Interval: **6.1-9.1 m**
Slot Size: **0.01 "**
Total Depth: **9.94 m**
Boring Diameter: **0.11 m**
Casing Diameter: **0.05 m**

Legal Location: **NW-13-026-05 W5M**
Relative Location: **Adjacent pit**
Northing: **5677465**
Easting: **669058**
Datum/Zone: **NAD83 / Zone11N**



Depth (m) / Elevation (m)	Soil / Bedrock	Soil Description	Sample Depth (B = Bag, J = Jar, V = Vial; Sample No. Prefix: --)
0 / 0		SILT: (0-2.54 m) some sand (fine grained), brown, dry, soft, non-plastic.	
-2.54		GRAVEL (FINE TO COARSE GRAINED): (2.54-3.35 m) some silt, grey, dry, loose, subrounded, well graded.	
-3.35		GRAVEL (FINE TO COARSE GRAINED): (3.35-7.62 m) trace silt, grey, dry, loose, subrounded, poorly graded.	
-6.4		@ 6.4-6.71 m boulder.	
-7.62		GRAVEL (FINE TO COARSE GRAINED): (7.62-7.93 m) trace silt, grey, wet, loose, subrounded, well graded.	
-7.93		GRAVEL (FINE TO COARSE GRAINED): (7.93-9.45 m) grey, moist, loose, subrounded, well graded.	
-9.45		SANDSTONE (FINE GRAINED): (9.45-9.94 m) well graded, subrounded, grey, moist, moderately cemented.	
-9.94		Bottom of Hole	

NOTE: ODEX casing 5.5 ODEX hammer bit 9.94m stick up 0.93 m ground elevation = 1177 masl.

Borehole Log - USC

Matrix Solutions Inc.

DRAFT

Project/Site: **26388**

Well/borehole #: **MW21-2b**

Client: **Burnco Rock Products Ltd.**
Logged By: **R. Killam**
Compiled By: **B. Dang**
Driller: **Earth Drilling Co Ltd.**
Drill Equipment: **ODEX**

Start Time: **Nov 24 2021 10:22**
Finish Time: **Nov 24 2021 16:30**
Top of Casing: **--**
Ground Elev: **--**
Top / Base of Sand Pack: **12.45/18.18 m**

Screened Interval: **13.18-18.18 m**
Slot Size: **0.01 "**
Total Depth: **18.29 m**
Boring Diameter: **0.11 m**
Casing Diameter: **0.05 m**

Legal Location: **NW-13-026-05 W5M**
Relative Location: **Nested with MW21-2a**
Northing: **5677470**
Easting: **669059**
Datum/Zone: **NAD83 / Zone11N**

Depth (m)	Elevation (m)	Soil / Bedrock	Soil Description	Sample Depth (B = Bag, J = Jar, V = Vial; Sample No. Prefix: --)
0	0		SILT: (0-2.44 m) some sand (fine grained), brown, dry, soft, non-plastic.	
-2.44	-2.44		GRAVEL (FINE TO COARSE GRAINED): (2.44-3.35 m) some silt, grey, dry, loose, subrounded, well graded.	
-3.35	-3.35		GRAVEL (FINE TO COARSE GRAINED): (3.35-7.62 m) trace silt, grey, dry, loose, subrounded, well graded.	
-7.32	-7.32		@ 7.32-7.6 m sand lense.	
-7.62	-7.62		GRAVEL (FINE TO COARSE GRAINED): (7.62-7.93 m) trace silt, grey, wet, loose, subrounded, well graded.	
-7.93	-7.93		GRAVEL (FINE TO COARSE GRAINED): (7.93-9.45 m) grey, moist, loose, subrounded, well graded.	
-9.45	-9.45		SANDSTONE (FINE GRAINED): (9.45-10.37 m) well graded, subrounded, grey, moist, poorly cemented, heavily weathered.	
-10.37	-10.37		SANDSTONE (FINE TO MEDIUM GRAINED): (10.37-10.98 m) well graded, subrounded, grey, moist, poorly cemented.	
-10.98	-10.98		SANDSTONE (FINE TO MEDIUM GRAINED): (10.98-16.77 m) well graded, subrounded, grey, dry, poorly cemented.	

NOTE: ODEX casing 5.5 casing set at 10.37 m ODEX hammer bit 10.37 m down hole hammer bit from 10.37 m to 18.29 stick up 0.94 m. Ground elevation = 1177 masl. MW21-2b is 1.8m NE of MW21-2a.

Borehole Log - USC

Matrix Solutions Inc.

DRAFT

Project/Site: **26388**

Well/borehole #: **MW21-2b**

Client: **Burnco Rock Products Ltd.**
Logged By: **R. Killam**
Compiled By: **B. Dang**
Driller: **Earth Drilling Co Ltd.**
Drill Equipment: **ODEX**

Start Time: **Nov 24 2021 10:22**
Finish Time: **Nov 24 2021 16:30**
Top of Casing: **--**
Ground Elev: **--**
Top / Base of Sand Pack: **12.45/18.18 m**

Screened Interval: **13.18-18.18 m**
Slot Size: **0.01 "**
Total Depth: **18.29 m**
Boring Diameter: **0.11 m**
Casing Diameter: **0.05 m**

Legal Location: **NW-13-026-05 W5M**
Relative Location: **Nested with MW21-2a**
Northing: **5677470**
Easting: **669059**
Datum/Zone: **NAD83 / Zone11N**

Well / Borehole Completion Data	Depth (m) / Elevation (m)	Soil / Bedrock	Soil Description	Sample Depth (B = Bag, J = Jar, V = Vial; Sample No. Prefix: --)
10x20 Sand; Screen; Slough	-15 / -15			
	-16 / -16		@ 16.16-16.2 m trace silt, moist.	
	-17 / -17		SANDSTONE (FINE TO MEDIUM GRAINED): (16.77-18.29 m) poorly graded, subrounded, grey, wet, moderately cemented.	
	-18 / -18		@ 17.68-17.7 m hard very fine grained sandstone.	
			Bottom of Hole	
	-19 / -19			
	-20 / -20			
	-21 / -21			
	-22 / -22			
	-23 / -23			
	-24 / -24			
	-25 / -25			
	-26 / -26			
	-27 / -27			
	-28 / -28			
	-29 / -29			
	-30 / -30			

NOTE: ODEX casing 5.5 casing set at 10.37 m ODEX hammer bit 10.37 m down hole hammer bit from 10.37 m to 18.29 stick up 0.94 m. Ground elevation = 1177 masl. MW21-2b is 1.8m NE of MW21-2a.

Borehole Log - USC

Matrix Solutions Inc.

DRAFT

Project/Site: **26388**

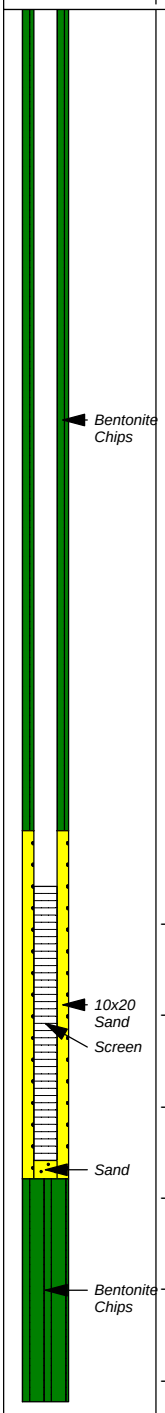
Well/borehole #: **MW21-3**

Client: **Burnco Rock Products Ltd.**
Logged By: **R. Killam**
Compiled By: **B. Dang**
Driller: **Earth Drilling Co Ltd.**
Drill Equipment: **ODEX**

Start Time: **Nov 23 2021 12:00**
Finish Time: **Nov 24 2021 10:00**
Top of Casing: **--**
Ground Elev: **--**
Top / Base of Sand Pack: **8.99/12.8 m**

Screened Interval: **9.6-12.6 m**
Slot Size: **0.01 "**
Total Depth: **15.24 m**
Boring Diameter: **0.11 m**
Casing Diameter: **0.05 m**

Legal Location: **NW-13-026-05 W5M**
Relative Location: **South of pit**
Northing: **5677240**
Easting: **669173**
Datum/Zone: **NAD83 / Zone11N**



Depth (m)	Elevation (m)	Soil / Bedrock	Soil Description	Sample Depth (B = Bag, J = Jar, V = Vial; Sample No. Prefix: --)
0	0		SAND (FINE GRAINED) AND SILT: (0-2.74 m) brown, dry, compact, subrounded, gap graded.	
-3	-3		SAND (FINE TO MEDIUM GRAINED) AND GRAVEL (FINE TO COARSE GRAINED): (2.74-3.35 m) brown, dry, loose, subrounded, well graded.	
-4	-4		SANDSTONE (FINE TO MEDIUM GRAINED): (3.35-4.57 m) trace shale, poorly graded, subrounded, dark grey, dry, poorly cemented, weathered.	
-5	-5		SANDSTONE (FINE TO MEDIUM GRAINED): (4.57-6.1 m) poorly graded, subangular, grey, moist, moderately cemented, moderately weathered, potentially water bearing.	
-6	-6		SANDSTONE (FINE TO MEDIUM GRAINED): (6.1-7.32 m) poorly graded, subrounded, grey, moist.	
-7	-7		@ 7.01-7.02 m siltstone.	
-8	-8		SANDSTONE (FINE GRAINED): (7.32-7.93 m) poorly graded, subrounded, grey, dry, moderately cemented.	
-9	-9		SANDSTONE (FINE TO MEDIUM GRAINED): (7.93-12.8 m) poorly graded, subrounded, grey, moist, poorly cemented.	
			@ 9.15-12.8 m drilling open hole, water producing below casing set at 9.1 m.	
-10	-10		@ 9.76-9.77 m shale lense.	
-12	-12		@ 11.89-12.2 m dry/moist cuttings.	
-13	-13		SILTSTONE: (12.8-15.24 m) dark grey, dry, well cemented.	
-15	-15		Bottom of Hole	
-16	-16			

NOTE: ODEX casing 5.5 ODEX hammer bit to 9.15 casing set at 9.15 m tricone bit from 9.15 to 15.24m TD stick up 0.93 m bolt dropped down at 11.2 m and unable to retrieve. Ground elevation = 1168 masl

Borehole Log - USC

Matrix Solutions Inc.

DRAFT

Project/Site: **26388**

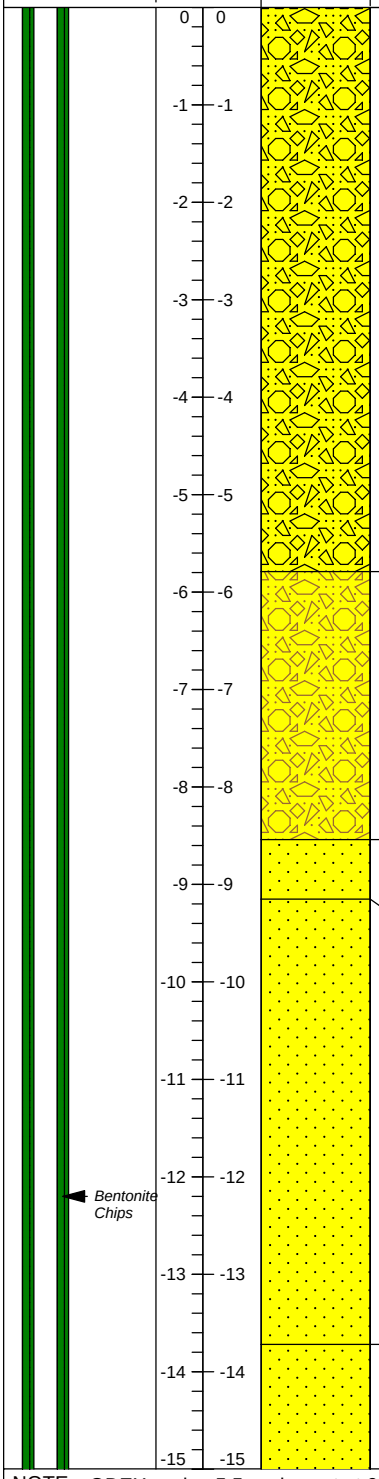
Well/borehole #: **MW21-4**

Client: **Burnco Rock Products Ltd.**
Logged By: **R. Killam**
Compiled By: **B. Dang**
Driller: **Earth Drilling Co Ltd.**
Drill Equipment: **ODEX**

Start Time: **Nov 25 2021 08:58**
Finish Time: **Nov 26 2021 09:00**
Top of Casing: **--**
Ground Elev: **--**
Top / Base of Sand Pack: **24.4/41.15 m**

Screened Interval: **29.15-41.15 m**
Slot Size: **0.01 "**
Total Depth: **41.16 m**
Boring Diameter: **0.11 m**
Casing Diameter: **0.05 m**

Legal Location: **NW-13-026-05 W5M**
Relative Location: **NE of pit**
Northing: **5677603**
Easting: **669415**
Datum/Zone: **NAD83 / Zone11N**



Depth (m) / Elevation (m)	Soil Description	Sample Depth (B = Bag, J = Jar, V = Vial; Sample No. Prefix: --)
0 / 0 to -5.79	GRAVEL (FINE TO COARSE GRAINED): (0-5.79 m) some sand, trace silt, grey, dry, loose, subrounded, well graded.	
-5.79 to -8.54	GRAVEL (FINE TO COARSE GRAINED) AND SAND (FINE TO COARSE GRAINED): (5.79-8.54 m) brown, moist, loose, subrounded, well graded.	
-8.54 to -9.15	SANDSTONE (FINE TO MEDIUM GRAINED): (8.54-9.15 m) well graded, subrounded, grey, dry, poorly cemented, weathered.	
-9.15 to -13.72	SANDSTONE (FINE TO MEDIUM GRAINED): (9.15-13.72 m) poorly graded, subrounded, grey, dry, poorly cemented.	
-13.72 to -20.73	SANDSTONE (FINE GRAINED): (13.72-20.73 m) trace siltstone, poorly graded, subrounded, dark grey, dry, moderately cemented.	

NOTE: ODEX casing 5.5 casing set at 9.15 m ODEX hammer bit 9.15 m down hole hammer bit from 9.15 m to 41.16m stick up 0.95 m. Ground elevation = 1172 masl

Borehole Log - USC

Matrix Solutions Inc.

DRAFT

Project/Site: **26388**

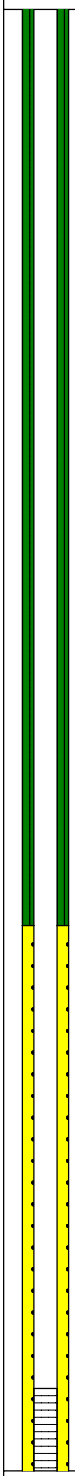
Well/borehole #: **MW21-4**

Client: **Burnco Rock Products Ltd.**
Logged By: **R. Killam**
Compiled By: **B. Dang**
Driller: **Earth Drilling Co Ltd.**
Drill Equipment: **ODEX**

Start Time: **Nov 25 2021 08:58**
Finish Time: **Nov 26 2021 09:00**
Top of Casing: **--**
Ground Elev: **--**
Top / Base of Sand Pack: **24.4/41.15 m**

Screened Interval: **29.15-41.15 m**
Slot Size: **0.01 "**
Total Depth: **41.16 m**
Boring Diameter: **0.11 m**
Casing Diameter: **0.05 m**

Legal Location: **NW-13-026-05 W5M**
Relative Location: **NE of pit**
Northing: **5677603**
Easting: **669415**
Datum/Zone: **NAD83 / Zone11N**

Well / Borehole Completion Data	Depth (m) / Elevation (m)	Soil / Bedrock	Soil Description	Sample Depth (*B = Bag, J = Jar, V = Vial*; Sample No. Prefix: --)
	-15 / -15 to -30 / -30		SANDSTONE (FINE TO MEDIUM GRAINED): (20.73-36.59 m) trace siltstone, poorly graded, subrounded, light brown and dark grey, dry, moderately cemented.	

NOTE: ODEX casing 5.5 casing set at 9.15 m ODEX hammer bit 9.15 m down hole hammer bit from 9.15 m to 41.16m stick up 0.95 m. Ground elevation = 1172 masl

Borehole Log - USC

Matrix Solutions Inc.

DRAFT

Project/Site: **26388**

Well/borehole #: **MW21-4**

Client: **Burnco Rock Products Ltd.**
Logged By: **R. Killam**
Compiled By: **B. Dang**
Driller: **Earth Drilling Co Ltd.**
Drill Equipment: **ODEX**

Start Time: **Nov 25 2021 08:58**
Finish Time: **Nov 26 2021 09:00**
Top of Casing: **--**
Ground Elev: **--**
Top / Base of Sand Pack: **24.4/41.15 m**

Screened Interval: **29.15-41.15 m**
Slot Size: **0.01 "**
Total Depth: **41.16 m**
Boring Diameter: **0.11 m**
Casing Diameter: **0.05 m**

Legal Location: **NW-13-026-05 W5M**
Relative Location: **NE of pit**
Northing: **5677603**
Easting: **669415**
Datum/Zone: **NAD83 / Zone11N**

Well / Borehole Completion Data	Depth (m) / Elevation (m)	Soil / Bedrock	Soil Description	Sample Depth (B = Bag, J = Jar, V = Vial; Sample No. Prefix: --)
10x20 Sand; Screen	-30 to -45		SANDSTONE (FINE TO MEDIUM GRAINED): (36.59-41.16 m) poorly graded, subrounded, light grey, dry, poorly cemented.	
			Bottom of Hole	

NOTE: ODEX casing 5.5 casing set at 9.15 m ODEX hammer bit 9.15 m down hole hammer bit from 9.15 m to 41.16m stick up 0.95 m. Ground elevation = 1172 masl

Appendix C Grand Valley Creek Bedrock Survey Results, Dec 1, 2021

Secondary Water Resource Assessment

West Cochrane Gravel Pit

BURNCO Rock Products Ltd.

SLR Project No. 212.30025.00000

January 12, 2023

Appendix C Grand Valley Creek Bedrock Survey Results, Dec 1, 2021

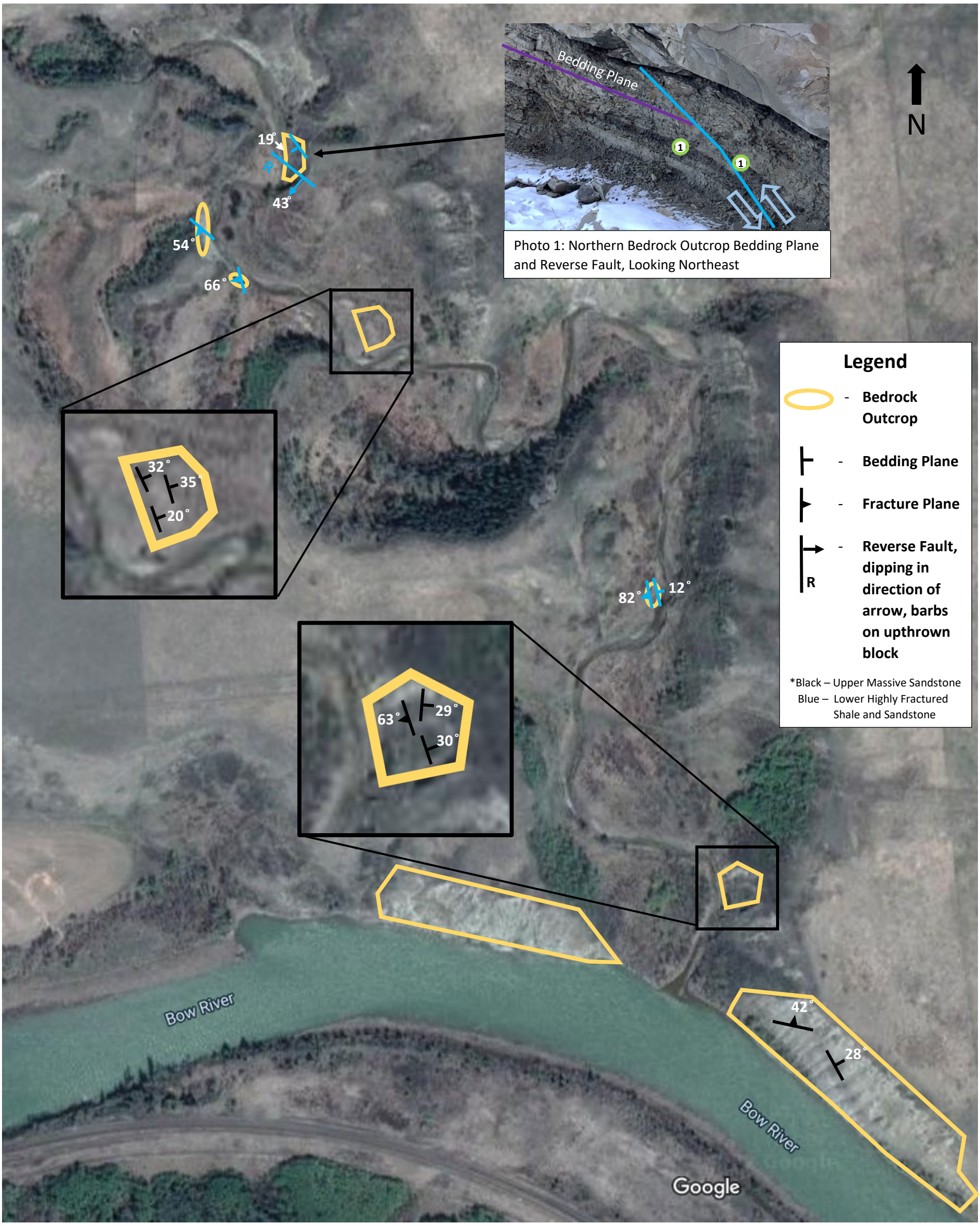


Photo 1: Northern Bedrock Outcrop Bedding Plane and Reverse Fault, Looking Northeast

Appendix D Groundwater Quality Tables

Secondary Water Resource Assessment

West Cochrane Gravel Pit

BURNCO Rock Products Ltd.

SLR Project No. 212.30025.00000

January 12, 2023

Appendix D-1
Groundwater Quality Results - Field Parameters

Geological Unit	Monitoring Well	Sample Date	Field Temp °C	Field pH	Field EC^{25} µS/cm	Field Turbidity NTU
Upgradient / Baseline / Background Wells						
Gravel	MW12-2	07-Nov-18	4.9	8.0	770	
	MW12-2	25-Oct-21	8.2	8.2	820	132
	MW12-6	07-Nov-18	5.3	7.7	670	
	MW12-6	25-Oct-21	7.1	7.8	780	124
	MW12-7	07-Nov-18	4.8	7.8	750	
	MW12-7	25-Oct-21	---	---	---	---
	MW12-8	07-Nov-18	---	---	---	
	MW12-8	25-Oct-21	---	---	---	---
	MW12-9	07-Nov-18	6.0	7.7	550	
	MW12-9	25-Oct-21	4.5	7.95	660	753
	MW18-02 (B2)	30-Aug-18	7.4	7.1	1720	
	MW18-02 (B2)	07-Nov-18	4.4	7.2	1940	
	MW18-02 (B2)	26-Oct-21	6.4	7.51	1370	1000
	MW18-03 (B3)	07-Nov-18	---	---	---	
	MW18-03 (B3)	26-Oct-21	---	---	---	---
	MW18-04 (D3)	07-Nov-18	---	---	---	
	MW18-04 (D3)	26-Oct-21	---	---	---	---
	MW18-06 (D1)	07-Nov-18	4.4	7.8	660	
	MW18-06 (D1)	26-Oct-21	8.9	7.9	620	630
Bedrock	MW18-05 (D2)	07-Nov-18	5.9	7.7	1140	
	MW18-05 (D2)	26-Oct-21	10.1	7.71	950	479
	MW21-1a	29-Nov-21	3.3	***9.3***	1800	740
	MW21-1b	29-Nov-21	3.8	***9.7***	1420	>1000
	Bedrock Well 1	26-Oct-21	---	---	---	---
	Bedrock Well 2	26-Oct-21	11.5	7.5	1297	2.03
	Bedrock Well 3	26-Oct-21	11.8	7.5	1296	0.99
Downgradient Wells						
Gravel	MW10-1	07-Nov-18	5.7	8.2	700	
	MW10-1	25-Oct-21	1.5	8.0	870	503
	MW10-2	07-Nov-18	6.6	7.6	770	
	MW10-2	25-Oct-21	2.5	7.7	830	840
	MW10-3	07-Nov-18	6.9	7.6	520	
	MW10-3	25-Oct-21	5.6	7.8	580	803
	MW12-1	07-Nov-18	---	---	---	
	MW12-1	25-Oct-21	---	---	---	---
	MW12-3	07-Nov-18	5.6	7.8	840	
	MW12-3	25-Oct-21	8.5	7.87	920	495
	MW12-5	07-Nov-18	---	---	---	
	MW12-5	25-Oct-21	---	---	---	---
	MW21-2a	26-Nov-21	8.6	8.0	840	400
Bedrock	MW12-4	07-Nov-18	---	---	---	
	MW12-4	25-Oct-21	---	---	---	---
	MW21-2b	26-Nov-21	7.8	***9.4***	390	288
	MW21-3	29-Nov-21	5.9	***9.6***	---	425
	MW21-4	29-Nov-21	6.8	***8.7***	1550	157
Alberta Tier 1 Guidelines - Natural Areas*			**NS**	**6.5-8.5**	**NS**	**NS**

Notes:

--- - not analyzed
NS - not specified
^{25} - field EC corrected to 25°C
* - *Alberta Tier 1 Soil and Groundwater Remediation Guidelines (AEP 2019)*
Italics - indicates values do not meet applicable guidelines

Appendix D-2
Groundwater Quality Results - General and Inorganic Parameters

Geological Unit	Monitoring Well	Sample Date	Lab pH	Lab EC µS/cm	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	Cl mg/L	SO_4 mg/L	NO_2-N mg/L	NO_3-N mg/L	O_2-N+NO_3- mg/L	T-Alkalinity mg/L	HCO_3 mg/L	Hardness mg/L	Turbidity NTU	TSS mg/L	TDS mg/L
Upgradient / Baseline / Background Wells																			
Gravel	MW12-2	28-Mar-12	8.08	764	39.8	9	126	3.2	10.4	89.4	0.045	0.33	0.375	322	393	140	---	---	471
	MW12-2	13-May-13	8.29	757	28.7	11.8	138	2.9	5.6	61.6	0.005	0.02	0.025	386	471	120	---	---	480
	MW12-2	13-May-13	8.29	753	27.8	11.6	134	2.8	5.3	64.3	<0.005	0.02	0.02	385	470	117	---	---	477
	MW12-2	13-May-13	8.31	756	27.6	11.4	140	2.8	5.2	61.8	<0.005	0.05	0.05	386	470	116	---	---	480
	MW12-2	07-Nov-18	8.14	783	42.7	23.9	98.3	2.8	17.7	79.6	***0.23***	1.03	1.25	313	381	205	---	---	458
	MW12-2	25-Oct-21	7.97	711	34.6	20.1	101	2.7	12.1	59.3	<0.005	0.15	0.15	314	383	169	6	16	418
	MW12-6	02-Apr-12	7.82	714	280	53	31	4.4	27	44	<0.005	0.66	0.66	336	410	917	9740	---	***641***
	MW12-6	13-May-13	8.1	691	60.3	41	33.3	2.6	17.5	36.8	<0.005	0.68	0.68	375	457	319	---	---	416
	MW12-6	13-May-13	8.08	703	59.7	42.3	32.9	2.5	17.7	36.8	<0.005	0.72	0.72	356	435	323	---	---	406
	MW12-6	07-Nov-18	7.95	688	61.2	38	36.8	2.4	10.9	31.9	<0.01	0.33	0.33	355	433	309	---	---	396
	MW12-6	25-Oct-21	7.8	692	60.1	39.4	38.7	2.5	12	35.2	<0.005	0.33	0.33	346	422	312	5870	3220	396
	MW12-7	28-Mar-12	7.88	643	61.2	14.9	56.7	5	23.7	85.6	<0.005	0.81	0.81	222	271	214	---	---	380
	MW12-7	07-Nov-18	7.96	780	68.7	30.3	59.2	3.3	22.9	55.9	<0.01	0.27	0.27	337	411	296	---	---	444
	MW12-9	02-Apr-12	7.97	573	86	20.9	25.4	3.4	8.3	57.8	0.024	0.17	0.194	255	310	301	545	---	355
	MW12-9	13-May-13	8.16	543	60.7	24	25.3	3.1	6.1	39.2	<0.005	0.02	0.02	277	337	250	---	---	324
	MW12-9	13-May-13	8.18	544	59.8	23.6	25.7	3.2	6.7	40.5	<0.005	0.03	0.03	282	344	246	---	---	329
	MW12-9	07-Nov-18	7.98	578	59.2	26.8	25.5	2.8	6.4	37.8	<0.01	<0.02	<0.02	271	330	258	---	---	321
	MW12-9	25-Oct-21	7.86	581	60.6	26.2	25.6	2.7	5.5	46.6	<0.005	0.06	0.06	267	326	259	416	437	328
	MW18-02 (B2)	30-Aug-18	7.88	1880	161	96.6	111	4.6	***140***	326	<0.01	0.3	0.3	523	638	800	---	---	***1150***
	MW18-02 (B2)	07-Nov-18	7.71	2010	140	128	101	3.8	***195***	228	<0.01	<0.02	<0.02	665	811	877	---	---	***1190***
	MW18-02 (B2)	26-Oct-21	7.37	2020	142	143	105	4	***194***	216	<0.020	0.3	0.3	696	848	946	2910	1180	***1220***
	MW18-06 (D1)	07-Nov-18	8.01	680	79.1	37	12.1	6.8	11.1	56.7	0.09	***3.28***	3.36	297	362	350	---	---	396
	MW18-06 (D1)	26-Oct-21	7.89	586	60.2	34.1	9.2	5	12.4	27	<0.005	***4.63***	4.63	260	317	291	4800	3400	305
Bedrock	MW18-05 (D2)	07-Nov-18	8.03	965	49.7	17.6	149	3.2	32.9	110	<0.01	0.03	0.03	359	438	197	---	---	***578***
	MW18-05 (D2)	26-Oct-21	7.96	902	47.6	19.2	130	2.4	25.4	93.4	<0.005	0.11	0.11	360	438	198	703	690	***534***
	MW21-1a	29-Nov-21	***8.69***	1580	12.6	1.9	***388***	3.3	***125***	47.3	<0.005	<0.01	<0.01	606	667	39.3	609	595	***942***
	MW21-1b	29-Nov-21	***9.38***	1610	1.7	<0.2	***354***	2.4	34.7	37.3	0.067	0.19	0.26	737	680	4.2	59300	25700	***872***
	Bedrock Well 2	26-Oct-21	7.65	1240	88	52	129	2.8	4	285	<0.005	0.33	0.33	412	503	434	2.4	4	***808***
	Bedrock Well 3	26-Oct-21	7.62	1260	90.3	54.2	126	2.8	6.7	288	<0.005	0.61	0.61	423	515	449	0.8	<2	***821***
Downgradient Wells																			
Gravel	MW10-1	28-Mar-12	8.08	679	46.8	41.1	40.9	3.9	12.8	59.5	<0.005	1.22	1.22	305	372	286	---	---	388
	MW10-1	07-Nov-18	8.03	752	51.8	39.8	43.7	3.5	16.7	54.8	<0.01	***4.79***	4.79	314	383	293	---	---	420
	MW10-1	25-Oct-21	7.91	777	60.6	45.3	46.2	3	21	54.9	<0.005	***11.5***	11.5	294	358	338	697	563	407
	MW10-2	28-Mar-12	7.96	922	92.5	49.4	31.2	4.1	60.6	193	<0.005	0.01	0.01	230	280	434	---	---	***568***
	MW10-2	07-Nov-18	7.97	796	75.9	40.9	23.2	3.1	40.4	119	<0.01	<0.02	<0.02	256	312	358	---	---	456
	MW10-2	25-Oct-21	7.84	742	73.5	42.2	23.3	3.4	28.5	111	<0.005	0.01	0.01	251	306	357	7740	4220	432
	MW10-3	07-Nov-18	8.07	545	61.9	28.4	18	1.5	6.2	35.6	<0.01	0.42	0.42	253	309	272	---	---	305
	MW10-3	25-Oct-21	7.8	520	55.2	24.7	18.3	1.5	5.1	31.2	<0.005	0.91	0.91	250	305	240	3990	3110	286
	MW12-3	28-Mar-12	7.95	926	91.2	49.1	30.3	4	59.4	196	<0.005	0.02	0.02	230	281	430	---	---	***568***
	MW12-3	07-Nov-18	8.09	877	53.5	32	99.9	3	14.2	135	<0.01	0.03	0.03	325	397	265	---	---	***533***
	MW12-3	25-Oct-21	7.98	791	46.9	27.4	92.2	2.9	12.8	109	<0.005	0.05	0.05	304	371	230	4090	4430	474
	MW12-5	25-Oct-21	7.97	550	26	10.6	81.9	2.8	4.8	62.9	<0.005	***3.77***	3.77	201	245	109	2050	1020	310
	MW21-2a	26-Nov-21	8.12	826	71.7	39.3	68.3	3.8	24	52.2	0.005	2.31	2.32	358	437	341	26800	4340	474
Bedrock	MW21-2b	26-Nov-21	***9.31***	857	1.5	0.3	***202***	0.7	12.3	34.3	0.155	0.05	0.21	442	404	5	5210	2230	***516***
	MW21-3	29-Nov-21	***8.97***	837	1.9	0.3	***202***	1.2	4.3	33.2	0.009	0.07	0.08	421	424	6	7530	4720	495
	MW21-4	29-Nov-21	8.33	1720	33	5.1	***346***	4.8	52.3	276	0.085	0.78	0.87	487	594	103	157	266	***1010***
Alberta Tier 1 Guidelines - Natural Areas*			**6.5-8.5**	**NS**	**NS**	**NS**	**200**	**NS**	**120**	**	***	**3**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**500**

Notes:
--- - not analyzed
NS - not specified
* - *Alberta Tier 1 Soil and Groundwater Remediation Guidelines* (AEP 2019)
** - dependent on hardness value
*** - dependent on chloride value
Italics - indicates values do not meet applicable guidelines

Appendix D-3
Groundwater Quality Results - Dissolved Metals

Geological Unit	Monitoring Well	Sample Date	Al mg/L	Sb mg/L	As mg/L	Ba mg/L	Be mg/L	B mg/L	Cd mg/L	Cr mg/L	Co mg/L	Cu mg/L	Fe mg/L	Pb mg/L	Li mg/L	Mn mg/L	Hg mg/L	Mo mg/L
Upgradient / Baseline / Background Wells																		
Gravel	MW12-2	25-Oct-21	0.003	0.0004	8E-04	0.029	<0.0001	0.069	0.00003	<0.0005	<0.0001	0.002	<0.01	<0.0001	0.021	0.03	<0.000005	0.013
	MW12-6	25-Oct-21	<0.002	<0.0002	2E-04	0.147	<0.0001	0.044	<0.00001	<0.0005	<0.0001	<0.001	<0.01	<0.0001	0.014	<0.005	<0.000005	0.001
	MW12-9	25-Oct-21	<0.002	<0.0002	4E-04	0.082	<0.0001	0.037	0.00004	<0.0005	4E-04	<0.001	0.01	<0.0001	0.007	***0.187***	<0.000005	0.002
	MW18-02 (B2)	30-Aug-18	0.008	0.004	<0.001	<0.05	<0.001	0.08	0.00003	<0.001	0.002	0.003	0.2	<0.0005	0.066	***0.249***	---	0.003
	MW18-02 (B2)	26-Oct-21	***0.669***	<0.0010	<0.0010	0.053	<0.0005	0.1	<0.00005	<0.0020	0.002	<0.005	***1.1***	0.0006	0.087	***0.12***	<0.000005	<0.005
	MW18-06 (D1)	26-Oct-21	0.002	<0.0002	6E-04	0.07	<0.0001	0.033	<0.00001	<0.0005	1E-04	0.002	<0.01	<0.0001	0.022	0.032	<0.000005	0.003
Bedrock	MW18-05 (D2)	26-Oct-21	0.007	<0.0002	0.002	0.037	<0.0001	0.107	0.00001	<0.0005	3E-04	<0.001	0.03	<0.0001	0.019	***0.151***	<0.000005	0.003
	MW21-1a	29-Nov-21	***0.085***	0.0018	0.005	0.081	<0.0001	0.318	0.00004	0.0006	4E-04	0.003	0.11	0.0001	0.049	0.013	<0.000005	0.018
	MW21-1b	29-Nov-21	***0.079***	***0.0166***	***0.099***	0.098	<0.0001	0.276	0.00002	<0.0005	<0.0001	***0.03***	0.01	0.0001	0.039	<0.005	<0.000005	0.068
	Bedrock Well 2	26-Oct-21	<0.002	<0.0002	<0.0002	0.031	<0.0001	0.104	<0.00001	<0.0005	<0.0001	0.005	0.02	<0.0001	0.018	<0.005	<0.000005	0.002
	Bedrock Well 3	26-Oct-21	<0.002	<0.0002	<0.0002	0.033	<0.0001	0.104	0.00001	<0.0005	<0.0001	***0.018***	<0.01	0.0005	0.018	<0.005	<0.000005	0.002
Downgradient Wells																		
Gravel	MW10-1	25-Oct-21	***0.131***	<0.0002	4E-04	0.094	<0.0001	0.042	0.00002	0.0006	3E-04	0.003	0.27	0.0002	0.017	0.016	<0.000005	0.003
	MW10-2	25-Oct-21	0.005	<0.0002	4E-04	0.044	<0.0001	0.037	0.00002	<0.0005	2E-04	<0.001	<0.01	<0.0001	0.016	0.05	<0.000005	0.006
	MW10-3	25-Oct-21	0.019	<0.0002	5E-04	0.09	<0.0001	0.016	<0.00001	<0.0005	4E-04	0.006	0.03	<0.0001	0.009	***0.055***	<0.000005	0.002
	MW12-3	25-Oct-21	0.006	<0.0002	5E-04	0.03	<0.0001	0.036	0.00001	<0.0005	2E-04	0.002	<0.01	<0.0001	0.024	0.033	<0.000005	0.003
	MW21-2a	26-Nov-21	***0.558***	0.0004	0.001	0.141	<0.0001	0.06	0.00006	0.0014	0.002	0.005	***1.3***	0.0012	0.02	***0.094***	<0.000005	0.007
Bedrock	MW21-2b	26-Nov-21	***0.19***	***0.0742***	***0.666***	0.055	<0.0001	0.112	0.00004	<0.0005	2E-04	0.001	0.1	0.0001	0.034	<0.005	<0.000005	0.159
	MW21-3	29-Nov-21	***0.089***	0.0053	***0.084***	0.047	<0.0001	0.188	<0.00001	<0.0005	2E-04	0.007	0.07	0.0001	0.031	<0.005	<0.000005	0.027
	MW21-4	29-Nov-21	0.023	***0.0091***	***0.052***	0.095	<0.0001	0.159	0.00002	<0.0005	4E-04	0.004	0.02	<0.0001	0.034	0.012	<0.000005	0.08
Alberta Tier 1 - Natural Areas*			**0.05**	**0.006**	**0.005**	**1**	**NS**	**1.5**	**	**0.05**	**NS**	**0.007**	**0.3**	**	**NS**	**0.05**	**0.000005**	**NS**

Notes:

--- - not analyzed
NS - not specified
* - *Alberta Tier 1 Soil and Groundwater Remediation Guidelines* (AEP 2019)
** - dependent on hardness value
Italics - indicates values do not meet applicable guidelines

Geological Unit	Monitoring Well	Sample Date	Ni mg/L	Se mg/L	Si mg/L	Ag mg/L	Sr mg/L	Tl mg/L	Sn mg/L	Ti mg/L	U mg/L	V mg/L	Zn mg/L
Upgradient / Baseline / Background Wells													
Gravel	MW12-2	25-Oct-21	0.001	<0.0002	3.72	<0.00001	0.581	<0.0000	<0.001	<0.0005	0.0057	0.0002	0.004
	MW12-6	25-Oct-21	<0.0005	0.0007	4.48	<0.00001	0.818	<0.0000	<0.001	<0.0005	0.0026	<0.0001	<0.001
	MW12-9	25-Oct-21	0.001	<0.0002	4.48	<0.00001	0.77	<0.0000	<0.001	<0.0005	0.0022	0.0002	0.001
	MW18-02 (B2)	30-Aug-18	0.004	<0.0005	4.35	***0.0006***	0.998	<0.0001	<0.0001	0.008	0.009	<0.001	<0.003
	MW18-02 (B2)	26-Oct-21	0.004	<0.0010	6.01	<0.00005	1.11	<0.0003	<0.005	0.014	0.015	0.002	0.006
	MW18-06 (D1)	26-Oct-21	0.001	0.0017	4.86	<0.00001	0.494	<0.0000	<0.001	<0.0005	0.0101	0.0002	0.001
Bedrock	MW18-05 (D2)	26-Oct-21	0.001	<0.0002	3.78	<0.00001	0.694	<0.0000	<0.001	<0.0005	0.0033	0.0002	0.004
	MW21-1a	29-Nov-21	0.004	***0.0054***	2.61	<0.00001	0.103	<0.0000	0.002	0.0025	0.0078	0.001	0.002
	MW21-1b	29-Nov-21	0.001	***0.0102***	2.16	<0.00001	0.087	<0.0000	<0.001	<0.0005	0.0095	0.0098	0.003
	Bedrock Well 2	26-Oct-21	<0.0005	***0.0026***	3.58	<0.00001	1.45	<0.0000	<0.001	<0.0005	0.0042	<0.0001	0.012
	Bedrock Well 3	26-Oct-21	<0.0005	***0.0033***	3.58	<0.00001	1.4	<0.0000	<0.001	<0.0005	0.0046	0.0001	0.025
Downgradient Wells													
Gravel	MW10-1	25-Oct-21	0.002	0.001	4.53	<0.00001	0.82	<0.0000	<0.001	0.0017	0.0033	0.0004	0.005
	MW10-2	25-Oct-21	0.006	<0.0002	3.43	<0.00001	1.01	<0.0000	<0.001	<0.0005	0.0033	0.0002	0.002
	MW10-3	25-Oct-21	8E-04	0.0005	3.67	<0.00001	0.362	<0.0000	<0.001	0.0007	0.002	<0.0001	0.001
	MW12-3	25-Oct-21	0.002	<0.0002	3.71	<0.00001	0.646	<0.0000	<0.001	<0.0005	0.0059	0.0002	0.002
	MW21-2a	26-Nov-21	0.005	0.0014	5.24	<0.00001	0.574	<0.0000	<0.001	0.0076	0.0031	0.0017	0.008
Bedrock	MW21-2b	26-Nov-21	0.004	***0.0853***	2.63	<0.00001	0.038	<0.0000	<0.001	0.0032	0.013	0.009	0.001
	MW21-3	29-Nov-21	0.003	***0.0039***	2.68	<0.00001	0.045	<0.0000	<0.001	0.0024	0.0042	0.0016	0.002
	MW21-4	29-Nov-21	0.009	***0.0079***	3.04	<0.00001	0.258	<0.0000	0.004	<0.0005	0.0149	0.0008	0.002
Alberta Tier 1 - Natural Areas*			**	**0.002**	**NS**	**0.0001**	**NS**	**NS**	**NS**	**NS**	**0.015**	**NS**	**0.03**

Notes:

--- - not analyzed
NS - not specified
* - *Alberta Tier 1 Soil and Groundwater Remediation Guidelines* (AEP 2019)
** - dependent on hardness value
Italics - indicates values do not meet applicable guidelines

Appendix E Surface Water Laboratory Analysis Certificate

Secondary Water Resource Assessment

West Cochrane Gravel Pit

BURNCO Rock Products Ltd.

SLR Project No. 212.30025.00000

January 12, 2023

AGAT Laboratories

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CALGARY, ALBERTA
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CLIENT NAME: SLR CONSULTING
9-6421 APPLECROSS ROAD
NANAIMO, BC V9V1N1
(250) 390-5050
ATTENTION TO: Steve Usher
PROJECT: 212_30025.00000/West Cochrane
AGAT WORK ORDER: 21C839002
WATER ANALYSIS REVIEWED BY: Max Dou, Report Writer
DATE REPORTED: Dec 17, 2021
PAGES (INCLUDING COVER): 14
VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (403) 735-2005

*Notes

Disclaimer:

- *All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.*
- *All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.*
- *AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.*
- *This Certificate shall not be reproduced except in full, without the written approval of the laboratory.*
- *The test results reported herewith relate only to the samples as received by the laboratory.*
- *Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.*
- *All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.*

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Certificate of Analysis

AGAT WORK ORDER: 21C839002

PROJECT: 212_30025.00000/West Cochrane

CLIENT NAME: SLR CONSULTING

ATTENTION TO: Steve Usher

SAMPLING SITE:

SAMPLED BY:RS/CT

Metals - Dissolved - Alberta Tier 1

DATE RECEIVED: 2021-12-02

DATE REPORTED: 2021-12-17

		SAMPLE DESCRIPTION:		BOW US	BOW DS	GVC DS	GVC US	DUP21A
		SAMPLE TYPE:		Water	Water	Water	Water	Water
		DATE SAMPLED:		2021-12-01 12:05	2021-12-01 10:46	2021-12-01 15:46	2021-12-01 16:35	2021-12-01 15:46
Parameter	Unit	G / S	RDL	3285954	3285978	3285979	3285980	3285989
Dissolved Aluminum	mg/L		0.004	0.005	0.005	0.004	0.004	<0.004
Dissolved Antimony	mg/L		0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Dissolved Arsenic	mg/L		0.001	<0.001	<0.001	<0.001	0.001	<0.001
Dissolved Barium	mg/L		0.05	<0.05	<0.05	0.11	0.11	0.11
Dissolved Beryllium	mg/L		0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Dissolved Boron	mg/L		0.01	<0.01	<0.01	0.02	0.02	0.02
Dissolved Cadmium	mg/L		0.000016	<0.000016	<0.000016	<0.000016	<0.000016	<0.000016
Dissolved Chromium	mg/L		0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Dissolved Cobalt	mg/L		0.0009	<0.0009	<0.0009	<0.0009	<0.0009	<0.0009
Dissolved Copper	mg/L		0.0008	<0.0008	0.0026	0.0010	0.0009	0.0018
Dissolved Iron	mg/L		0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dissolved Lead	mg/L		0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Dissolved Manganese	mg/L		0.005	<0.005	<0.005	0.006	<0.005	0.006
Dissolved Molybdenum	mg/L		0.001	<0.001	<0.001	0.002	0.002	0.002
Dissolved Nickel	mg/L		0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Dissolved Selenium	mg/L		0.0005	<0.0005	0.0006	<0.0005	<0.0005	<0.0005
Dissolved Silver	mg/L		0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Dissolved Sodium	mg/L		0.6	3.7	3.7	39.9	33.6	37.5
Dissolved Thallium	mg/L		0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Dissolved Titanium	mg/L		0.001	<0.001	<0.001	<0.001	<0.001	0.001
Dissolved Uranium	mg/L		0.001	<0.001	<0.001	0.001	0.001	0.001
Dissolved Zinc	mg/L		0.005	<0.005	<0.005	<0.005	<0.005	<0.005

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

3285954-3285989 < - Values refer to Report Detection Limit.

Analysis performed at AGAT Calgary (unless marked by *)

Certified By:

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 21C839002

PROJECT: 212_30025.00000/West Cochrane

CLIENT NAME: SLR CONSULTING

ATTENTION TO: Steve Usher

SAMPLING SITE:

SAMPLED BY:RS/CT

Metals - Total - Alberta Tier 1

DATE RECEIVED: 2021-12-02

DATE REPORTED: 2021-12-17

		SAMPLE DESCRIPTION:		BOW US	BOW DS	GVC DS	GVC US	DUP21A
		SAMPLE TYPE:		Water	Water	Water	Water	Water
		DATE SAMPLED:		2021-12-01 12:05	2021-12-01 10:46	2021-12-01 15:46	2021-12-01 16:35	2021-12-01 15:46
Parameter	Unit	G / S	RDL	3285954	3285978	3285979	3285980	3285989
Total Aluminum	mg/L		0.004	0.037	0.044	0.053	0.046	0.055
Total Antimony	mg/L		0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Total Arsenic	mg/L		0.001	<0.001	<0.001	<0.001	0.001	<0.001
Total Barium	mg/L		0.05	<0.05	<0.05	0.12	0.12	0.12
Total Beryllium	mg/L		0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Total Boron	mg/L		0.01	<0.01	<0.01	0.03	0.03	0.02
Total Cadmium	mg/L		0.000016	<0.000016	<0.000016	<0.000016	<0.000016	<0.000016
Total Chromium	mg/L		0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Total Cobalt	mg/L		0.0009	<0.0009	<0.0009	<0.0009	<0.0009	<0.0009
Total Copper	mg/L		0.0008	<0.0008	0.0019	0.0013	0.0012	0.0012
Total Iron	mg/L		0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Lead	mg/L		0.0001	0.0001	<0.0001	0.0001	<0.0001	<0.0001
Total Manganese	mg/L		0.005	<0.005	<0.005	0.008	0.006	0.008
Total Molybdenum	mg/L		0.001	<0.001	<0.001	0.002	0.002	0.002
Total Nickel	mg/L		0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Total Selenium	mg/L		0.0005	<0.0005	0.0005	<0.0005	<0.0005	<0.0005
Total Silver	mg/L		0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Total Sodium	mg/L		0.6	2.2	2.3	38.3	38.5	35.7
Total Thallium	mg/L		0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Total Titanium	mg/L		0.001	0.001	0.001	0.001	0.002	0.002
Total Uranium	mg/L		0.001	<0.001	<0.001	0.001	0.001	0.001
Total Zinc	mg/L		0.004	<0.004	<0.004	<0.004	<0.004	<0.004

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

3285954 < - Values refer to Report Detection Limit.
Note: Metal results (Cu, Pb & Zn) were verified by repeat analysis.

3285978-3285989 < - Values refer to Report Detection Limit.

Analysis performed at AGAT Calgary (unless marked by *)

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 21C839002

PROJECT: 212_30025.00000/West Cochrane

CLIENT NAME: SLR CONSULTING

ATTENTION TO: Steve Usher

SAMPLING SITE:

SAMPLED BY:RS/CT

Routine Chemistry Water Analysis

DATE RECEIVED: 2021-12-02

DATE REPORTED: 2021-12-17

		SAMPLE DESCRIPTION:		BOW US	BOW DS	GVC DS	GVC US	DUP21A
		SAMPLE TYPE:		Water	Water	Water	Water	Water
		DATE SAMPLED:		2021-12-01 12:05	2021-12-01 10:46	2021-12-01 15:46	2021-12-01 16:35	2021-12-01 15:46
Parameter	Unit	G / S	RDL	3285954	3285978	3285979	3285980	3285989
pH	pH Units	7.0-10.5	N/A	8.29	8.23	8.48	8.45	8.43
p - Alkalinity (as CaCO3)	mg/L		5	<5	<5	<5	<5	<5
T - Alkalinity (as CaCO3)	mg/L		5	118	117	242	235	245
Bicarbonate	mg/L		5	144	143	283	276	288
Carbonate	mg/L		5	<5	<5	6	5	6
Hydroxide	mg/L		5	<5	<5	<5	<5	<5
Electrical Conductivity	uS/cm		5	349	347	546	515	544
Chloride	mg/L	(250)	1.0	1.9	1.9	10.1	6.2	9.9
Fluoride	mg/L	1.5	0.01	0.12	0.11	0.12	0.12	0.12
Nitrate	mg/L	45	0.5	0.5	0.5	<0.5	<0.5	<0.5
Nitrate-N	mg/L	10	0.02	0.11	0.11	<0.02	<0.02	<0.02
Nitrite	mg/L	3	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrite-N	mg/L	1	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate+Nitrite - Nitrogen	mg/L		0.02	0.11	0.11	<0.02	<0.02	<0.02
Sulfate	mg/L	(500)	1.0	41.8	41.9	31.2	28.5	31.2
Dissolved Calcium	mg/L		0.3	49.8	50.7	52.3	45.6	50.3
Dissolved Magnesium	mg/L		0.2	13.9	14.2	24.4	19.2	23.4
Dissolved Sodium	mg/L	(200)	0.6	3.7	3.7	39.9	33.6	37.5
Dissolved Potassium	mg/L		0.6	<0.6	<0.6	3.2	2.8	3.0
Dissolved Iron	mg/L	(0.3)	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dissolved Manganese	mg/L	0.12 (0.02)	0.005	<0.005	<0.005	0.006	<0.005	0.006
Sodium Adsorption Ratio				0.12	0.12	1.14	1.05	1.10
Calculated TDS	mg/L		0.6	182	183	306	277	303
Hardness	mg CaCO3/L		1	182	185	231	193	222
Ion Balance	%		1	115	118	111	99	105

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 21C839002

PROJECT: 212_30025.00000/West Cochrane

CLIENT NAME: SLR CONSULTING

ATTENTION TO: Steve Usher

SAMPLING SITE:

SAMPLED BY:RS/CT

Routine Chemistry Water Analysis

DATE RECEIVED: 2021-12-02

DATE REPORTED: 2021-12-17

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to 2020 Canadian Drinking Water Quality MAC (AO)
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

3285954-3285989 < - Values refer to Report Detection Limits.
SAR is a calculated parameter. The calculated parameter is non-accredited. The parameters that are components of the calculation are accredited.
If sodium results in mg/L are less than detection, SAR is non-calculable and is reported as 0.
Ion Balance is a calculated parameter. The calculated parameter is non-accredited. The parameters that are components of the calculation are accredited.
Hardness is a calculated parameter. The calculated parameter is non-accredited. The parameters that are components of the calculation are accredited.
Calculated TDS is a calculated parameter. The calculated parameter is non-accredited. The parameters that are components of the calculation are accredited.

Analysis performed at AGAT Calgary (unless marked by *)

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 21C839002

PROJECT: 212_30025.00000/West Cochrane

CLIENT NAME: SLR CONSULTING

ATTENTION TO: Steve Usher

SAMPLING SITE:

SAMPLED BY:RS/CT

Water Analysis - Ammonia, TDS, TKN, TSS, Turbidity

DATE RECEIVED: 2021-12-02

DATE REPORTED: 2021-12-17

		SAMPLE DESCRIPTION:		BOW US	BOW DS	GVC DS	GVC US	DUP21A
		SAMPLE TYPE:		Water	Water	Water	Water	Water
		DATE SAMPLED:		2021-12-01 12:05	2021-12-01 10:46	2021-12-01 15:46	2021-12-01 16:35	2021-12-01 15:46
Parameter	**Unit**	**G / S**	**RDL**	**3285954**	**3285978**	**3285979**	**3285980**	**3285989**
Ammonia, Total (as N)	mg/L		0.02	<0.02	<0.02	0.02	<0.02	<0.02
Total Dissolved Solids	mg/L		5	223	220	363	327	360
Total Kjeldahl Nitrogen	mg/L		0.1	<0.1	0.12	0.27	0.40	0.33
Total Suspended Solids	mg/L		3	<3	<3	<3	<3	<3
Turbidity	NTU		0.2	2.1	1.8	2.0	2.5	1.9

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Analysis performed at AGAT Calgary (unless marked by *)

Certified By:

AGAT Laboratories

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CANADA T2E 7P7
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Quality Assurance

CLIENT NAME: SLR CONSULTING

AGAT WORK ORDER: 21C839002

PROJECT: 212_30025.00000/West Cochrane

ATTENTION TO: Steve Usher

SAMPLING SITE:

SAMPLED BY:RS/CT

Water Analysis

RPT Date: Dec 17, 2021			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Routine Chemistry Water Analysis															
pH	3293825		8.13	8.16	0.4%	N/A	101%	90%	110%						
p - Alkalinity (as CaCO3)	3293825		<5	<5	NA	< 5	NA	80%	120%						
T - Alkalinity (as CaCO3)	3293825		278	280	0.9%	< 5	92%	80%	120%						
Bicarbonate	3293825		339	342	0.9%	< 5	NA								
Carbonate	3293825		<5	<5	NA	< 5	NA								
Hydroxide	3293825		<5	<5	NA	< 5	NA								
Electrical Conductivity	3293825		744	749	0.7%	< 5	99%	90%	110%						
Chloride	3285979		< 1.0	< 1.0	NA	< 1.0	94%	70%	130%	93%	80%	120%	NA	70%	130%
Fluoride	3285979		< 0.01	< 0.01	NA	< 0.01	96%	70%	130%	105%	80%	120%	NA	70%	130%
Nitrate	3285979		< 0.5	< 0.5	NA	< 0.5	98%	70%	130%	98%	80%	120%	NA	70%	130%
Nitrite	3285979		< 0.05	< 0.05	NA	< 0.05	96%	70%	130%	96%	80%	120%	NA	70%	130%
Sulfate	3285979		< 1.0	< 1.0	NA	< 1.0	95%	70%	130%	94%	80%	120%	NA	70%	130%
Dissolved Calcium	3263813		243	188	25.6%	< 0.3	117%	70%	130%	104%	80%	120%	NA	70%	130%
Dissolved Magnesium	3263813		58.1	42.4	31.3%	< 0.2	107%	70%	130%	97%	80%	120%	NA	70%	130%
Dissolved Sodium	3263813		142	107	28.7%	< 0.6	120%	70%	130%	100%	80%	120%	NA	70%	130%
Dissolved Potassium	3263813		10.4	7.3	34.6%	< 0.6	102%	70%	130%	87%	80%	120%	NA	70%	130%
Dissolved Iron	3263813		<0.1	<0.1	NA	< 0.1	105%	70%	130%	110%	80%	120%	104%	70%	130%
Dissolved Manganese	3263813		0.031	0.032	3.7%	< 0.005	105%	70%	130%	111%	80%	120%	105%	70%	130%

Comments: Matrix spike NA: Spike level < native concentration. Matrix spike acceptance limits do not apply and are not calculated.
Duplicate NA: results are less than 5X the RDL and RDP will not be calculated.

pH has been analyzed past the recommended holding time of 15 minutes from sampling (field measurement ideal if more accurate data required)

Nitrate and Nitrite: The regulatory hold time for the analysis of nitrate and/or nitrite in water is 72 hours.

Metals - Dissolved - Alberta Tier 1															
Dissolved Aluminum	3291890		0.210	0.210	0.2%	< 0.004	107%	70%	130%	109%	80%	120%	106%	70%	130%
Dissolved Antimony	3291890		<0.001	<0.001	NA	< 0.001	99%	70%	130%	92%	80%	120%	93%	70%	130%
Dissolved Arsenic	3291890		<0.001	<0.001	NA	< 0.001	105%	70%	130%	97%	80%	120%	96%	70%	130%
Dissolved Barium	3291890		0.10	0.10	NA	< 0.05	81%	70%	130%	111%	80%	120%	114%	70%	130%
Dissolved Beryllium	3291890		<0.0005	<0.0005	NA	< 0.0005	99%	70%	130%	99%	80%	120%	95%	70%	130%
Dissolved Boron	3291890		<0.01	<0.01	NA	< 0.01	97%	70%	130%	104%	80%	120%	104%	70%	130%
Dissolved Cadmium	3291890		<0.	<0.	NA	< 0.000016	99%	70%	130%	90%	80%	120%	91%	70%	130%
Dissolved Chromium	3291890		<0.0005	<0.0005	NA	< 0.0005	98%	70%	130%	111%	80%	120%	108%	70%	130%
Dissolved Cobalt	3291890		<0.0009	<0.0009	NA	< 0.0009	98%	70%	130%	110%	80%	120%	109%	70%	130%
Dissolved Copper	3291890		0.0009	0.0010	NA	< 0.0008	98%	70%	130%	105%	80%	120%	102%	70%	130%
Dissolved Iron	3263813		<0.1	<0.1	NA	< 0.1	105%	70%	130%	110%	80%	120%	104%	70%	130%
Dissolved Lead	3291890		<0.0002	<0.0002	NA	< 0.0001	86%	70%	130%	88%	80%	120%	87%	70%	130%
Dissolved Manganese	3263813		0.031	0.032	3.7%	< 0.005	105%	70%	130%	111%	80%	120%	105%	70%	130%
Dissolved Molybdenum	3291890		<0.001	<0.001	NA	< 0.001	102%	70%	130%	103%	80%	120%	105%	70%	130%
Dissolved Nickel	3291890		<0.003	<0.003	NA	< 0.003	94%	70%	130%	110%	80%	120%	102%	70%	130%

AGAT Laboratories

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http://www.agatlabs.com

Quality Assurance

CLIENT NAME: SLR CONSULTING

AGAT WORK ORDER: 21C839002

PROJECT: 212_30025.00000/West Cochrane

ATTENTION TO: Steve Usher

SAMPLING SITE:

SAMPLED BY:RS/CT

Water Analysis (Continued)

RPT Date: Dec 17, 2021			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Dissolved Selenium	3291890		0.0083	0.0096	15.4%	< 0.0005	101%	70%	130%	107%	80%	120%	88%	70%	130%
Dissolved Silver	3291890		0.00008	0.00006	NA	< 0.00005	94%	70%	130%	88%	80%	120%	86%	70%	130%
Dissolved Sodium	3263813		142	107	28.7%	< 0.6	120%	70%	130%	100%	80%	120%	NA	70%	130%
Dissolved Thallium	3291890		<0.0001	<0.0001	NA	< 0.0001	101%	70%	130%	103%	80%	120%	102%	70%	130%
Dissolved Titanium	3291890		<0.001	<0.001	NA	< 0.001	101%	70%	130%	101%	80%	120%	98%	70%	130%
Dissolved Uranium	3291890		<0.001	<0.001	NA	< 0.001	105%	70%	130%	100%	80%	120%	100%	70%	130%
Dissolved Zinc	3291890		<0.005	<0.005	NA	< 0.004	99%	70%	130%	94%	80%	120%	90%	70%	130%

Comments: Matrix spike NA: Spike level < native concentration. Matrix spike acceptance limits do not apply and are not calculated.
Duplicate NA: results are less than 5X the RDL and RDP will not be calculated.
With multi element scans it is acceptable for a maximum of 10% (including non-reported elements) of each QC criteria to fail to an absolute maximum of 10%.

Metals - Total - Alberta Tier 1

Total Aluminum	3121837		0.016	0.020	NA	< 0.004	112%	70%	130%	109%	80%	120%	127%	70%	130%
Total Antimony	3121837		<0.001	<0.001	NA	< 0.001	103%	70%	130%	87%	80%	120%	90%	70%	130%
Total Arsenic	3121837		0.006	0.006	6.0%	< 0.001	104%	70%	130%	82%	80%	120%	79%	70%	130%
Total Barium	3121837		0.07	0.07	NA	< 0.05	88%	70%	130%	87%	80%	120%	89%	70%	130%
Total Beryllium	3121837		<0.0005	<0.0005	NA	< 0.0005	111%	70%	130%	92%	80%	120%	99%	70%	130%
Total Boron	3121837		<0.01	<0.01	NA	< 0.01	113%	70%	130%	92%	80%	120%	102%	70%	130%
Total Cadmium	3121837		<0.	<0.	NA	< 0.000016	101%	70%	130%	85%	80%	120%	86%	70%	130%
Total Chromium	3121837		<0.0005	<0.0005	NA	< 0.0005	109%	70%	130%	103%	80%	120%	99%	70%	130%
Total Cobalt	3121837		<0.0009	<0.0009	NA	< 0.0009	110%	70%	130%	109%	80%	120%	103%	70%	130%
Total Copper	3121837		<0.0008	<0.0008	NA	< 0.0008	114%	70%	130%	102%	80%	120%	96%	70%	130%
Total Iron	3121837		0.2	0.3	NA	< 0.1	101%	70%	130%	106%	80%	120%	101%	70%	130%
Total Lead	3121837		<0.0001	0.0001	NA	< 0.0001	84%	70%	130%	80%	80%	120%	79%	70%	130%
Total Manganese	3121837		0.013	0.017	NA	< 0.005	100%	70%	130%	102%	80%	120%	101%	70%	130%
Total Molybdenum	3121837		0.002	0.002	NA	< 0.001	98%	70%	130%	100%	80%	120%	101%	70%	130%
Total Nickel	3121837		<0.003	<0.003	NA	< 0.003	109%	70%	130%	106%	80%	120%	95%	70%	130%
Total Selenium	3121837		0.0083	0.0092	10.8%	< 0.0005	119%	70%	130%	88%	80%	120%	74%	70%	130%
Total Silver	3121837		0.00008	0.00005	NA	< 0.00005	99%	70%	130%	77%	80%	120%	77%	70%	130%
Total Sodium	3121837		30.6	32.9	7.3%	< 0.6	96%	70%	130%	108%	80%	120%	NA	70%	130%
Total Thallium	3121837		<0.0001	<0.0001	NA	< 0.0001	101%	70%	130%	96%	80%	120%	97%	70%	130%
Total Titanium	3121837		0.004	0.004	NA	< 0.001	97%	70%	130%	99%	80%	120%	101%	70%	130%
Total Uranium	3121837		0.001	0.001	NA	< 0.001	101%	70%	130%	98%	80%	120%	100%	70%	130%
Total Zinc	3121837		0.005	0.005	NA	< 0.004	96%	70%	130%	83%	80%	120%	75%	70%	130%

Comments: Matrix spike NA: Spike level < native concentration. Matrix spike acceptance limits do not apply and are not calculated.
Duplicate NA: results are less than 5X the RDL and RDP will not be calculated.
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Water Analysis - Ammonia, TDS, TKN, TSS, Turbidity

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Quality Assurance

CLIENT NAME: SLR CONSULTING

AGAT WORK ORDER: 21C839002

PROJECT: 212_30025.00000/West Cochrane

ATTENTION TO: Steve Usher

SAMPLING SITE:

SAMPLED BY:RS/CT

Water Analysis (Continued)

RPT Date: Dec 17, 2021			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Ammonia, Total (as N)	3284875		1.14	1.14	0.4%	< 0.02	105%	70%	130%	104%	80%	120%	102%	70%	130%
Total Dissolved Solids	3291856		260	247	5.1%	< 5	105%	80%	120%						
Total Kjeldahl Nitrogen	3286871		0.87	0.87	0.0%	< 0.1	90%	70%	130%	87%	80%	120%	94%	70%	130%
Total Suspended Solids	3287270		3	4	NA	< 3	93%	80%	120%						
Turbidity	504	979	20.8	20.7	0.5%	< 0.2	100%	80%	120%						

Comments: Duplicate NA: results are less than 5X the RDL and RDP will not be calculated.

Certified By:

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QC Exceedance

CLIENT NAME: SLR CONSULTING

AGAT WORK ORDER: 21C839002

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ATTENTION TO: Steve Usher

RPT Date: Dec 17, 2021

PARAMETER	Sample Id	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
			Lower	Upper		Lower	Upper		Lower	Upper
Metals - Total - Alberta Tier 1										
Total Silver		99%	70%	130%	77%	80%	120%	77%	70%	130%

Comments: Matrix spike NA: Spike level < native concentration. Matrix spike acceptance limits do not apply and are not calculated.
Duplicate NA: results are less than 5X the RDL and RDP will not be calculated.
With multi element scans it is acceptable for a maximum of 10% (including non-reported elements) of each QC criteria to fail to an absolute maximum of 10%.

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Method Summary

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AGAT WORK ORDER: 21C839002

PROJECT: 212_30025.00000/West Cochrane

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SAMPLED BY:RS/CT

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
Dissolved Aluminum	INST 0141	SM 3125 B	ICP-MS
Dissolved Antimony	INST 0141	SM 3125 B	ICP-MS
Dissolved Arsenic	INST 0141	SM 3125 B	ICP-MS
Dissolved Barium	INST 0141	SM 3125 B	ICP-MS
Dissolved Beryllium	INST 0141	SM 3125 B	ICP-MS
Dissolved Boron	INST 0141	SM 3125 B	ICP-MS
Dissolved Cadmium	INST 0141	SM 3125 B	ICP-MS
Dissolved Chromium	INST 0141	SM 3125 B	ICP-MS
Dissolved Cobalt	INST 0141	SM 3125 B	ICP-MS
Dissolved Copper	INST 0141	SM 3125 B	ICP-MS
Dissolved Iron	INST 0140	SM 3120 B	ICP/OES
Dissolved Lead	INST 0141	SM 3125 B	ICP-MS
Dissolved Manganese	INST 0140	SM 3120 B	ICP/OES
Dissolved Molybdenum		SM 3125 B	ICP-MS
Dissolved Nickel	INST 0141	SM 3125 B	ICP-MS
Dissolved Selenium	INST 0141	SM 3125 B	ICP-MS
Dissolved Silver	INST 0141	SM 3125 B	ICP-MS
Dissolved Sodium	INST 0140	SM 3120 B	ICP/OES
Dissolved Thallium	INST 0141	SM 3125 B	ICP-MS
Dissolved Titanium	INST 0141	SM 3125 B	ICP-MS
Dissolved Uranium	INST 0141	SM 3125 B	ICP-MS
Dissolved Zinc	INST 0141	SM 3125 B	ICP-MS
Total Aluminum	WATR 0200; INST 0141	SM 3030 E; SM 3125 B	ICP-MS
Total Antimony	WATR 0200; INST 0141	SM 3030 E; SM 3125 B	ICP-MS
Total Arsenic	WATR 0200; INST 0141	SM 3030 E; SM 3125 B	ICP-MS
Total Barium	WATR 0200; INST 0141	SM 3030 E; SM 3125 B	ICP-MS
Total Beryllium	WATR 0200; INST 0141	SM 3030 E; SM 3125 B	ICP-MS
Total Boron	WATR 0200; INST 0141	SM 3030 E; SM 3125 B	ICP-MS
Total Cadmium	WATR 0200; INST 0141	SM 3030 E; SM 3125 B	ICP-MS
Total Chromium	WATR 0200; INST 0141	SM 3030 E; SM 3125 B	ICP-MS
Total Cobalt	WATR 0200; INST 0141	SM 3030 E; SM 3125 B	ICP-MS
Total Copper	WATR 0200; INST 0141	SM 3030 E; SM 3125 B	ICP-MS
Total Iron	WATR 0200; INST 0140	SM 3030 E; SM 3120 B	ICP/OES
Total Lead	WATR 0200; INST 0141	SM 3030 E; SM 3125 B	ICP-MS
Total Manganese	WATR 0200; INST 0140	SM 3030 E; SM 3120 B	ICP/OES
Total Molybdenum	WATR 0200; INST 0141	SM 3030 E; SM 3125 B	ICP/MS
Total Nickel	WATR 0200; INST 0141	SM 3030 E; SM 3125 B	ICP-MS
Total Selenium	WATR 0200; INST 0141	SM 3030 E; SM 3125 B	ICP-MS
Total Silver	WATR 0200; INST 0141	SM 3030 E; SM 3125 B	ICP-MS
Total Sodium	WATR 0200; INST 0140	SM 3030 E; SM 3120 B TW	ICP/OES
Total Thallium	WATR 0200; INST 0141	SM 3030 E; SM 3125 B	ICP-MS
Total Titanium	WATR 0200; INST 0141	SM 3030 E; SM 3125 B	ICP-MS
Total Uranium	WATR 0200; INST 0141	SM 3030 E; SM 3125 B	ICP-MS
Total Zinc	WATR 0200; INST 0141	SM 3030 E; SM 3125 B	ICP-MS
pH	INST 0101, INST 0104	SM 4500 H+	PH METER
p - Alkalinity (as CaCO3)	INST-0100, INST-0101	SM 2320 B	TITRATION
T - Alkalinity (as CaCO3)	INST 0101	SM 2320 B	TITRATION
Bicarbonate	INST 0101	SM 2320 B	PC TITRATE
Carbonate	INST 0101	SM 2320 B	PC TITRATE

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Method Summary

CLIENT NAME: SLR CONSULTING

AGAT WORK ORDER: 21C839002

PROJECT: 212_30025.00000/West Cochrane

ATTENTION TO: Steve Usher

SAMPLING SITE:

SAMPLED BY:RS/CT

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Hydroxide	INST 0101	SM 2320 B	PC TITRATE
Electrical Conductivity	INST 0101, INST 0120	SM 2510 B	CONDUCTIVITY METER
Chloride	INST 0150	SM 4110 B	ION CHROMATOGRAPH
Fluoride	INST 0150	SM 4110 B	ION CHROMATOGRAPH
Nitrate	INST 0150	SM 4110 B	ION CHROMATOGRAPH
Nitrate-N	INST 0150	SM 4110 B	CALCULATION
Nitrite	INST 0150	SM 4110 B	ION CHROMATOGRAPH
Nitrite-N	INST 0150	SM 4110 B	CALCULATION
Nitrate+Nitrite - Nitrogen	INST 0150	SM 4110 B	CALCULATION
Sulfate	INST 0150	SM 4110 B	ION CHROMATOGRAPH
Dissolved Calcium	INST 0140	SM 3120B – R	ICP/OES
Dissolved Magnesium	INST 0140	SM 3120B – R	ICP/OES
Dissolved Sodium	INST 0140	SM 3120B – R	ICP/OES
Dissolved Potassium	INST 0140	SM 3120B – R	ICP/OES
Dissolved Iron	INST 0140	SM 3120B – R	ICP/OES
Dissolved Manganese	INST 0140	SM 3120B – R	ICP/OES
Sodium Adsorption Ratio		CARTER & GREGORICH 2007	CALCULATION
Calculated TDS		SM 1030E	CALCULATION
Hardness		SM 2340 B	CALCULATION
Ion Balance		SM 1030E	CALCULATION
Ammonia, Total (as N)	INST 0340	SM 4500-NH3 G	CONTINUOUS FLOW ANALYZER
Total Dissolved Solids	WATR 0610	SM 2540 C	GRAVIMETRIC
Total Kjeldahl Nitrogen	INST-0520	EPA 351.2	DISCRETE ANALYZER
Total Suspended Solids	WATR 0600	SM 2540 D	GRAVIMETRIC
Turbidity	WATR-0500	SM 2130 B	NEPHELOMETER

AGAT Laboratories

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Laboratory Use Only
Arrival Temperature: 1.6°C
AGAT Job Number: 21C839002
Date and Time: 2-DEC '21 AM 8:14

Chain of Custody Record

Emergency Support Services Hotline 1-855-AGAT 245 (1-855-242-8245)

Report Information
Company: SLR Consulting (Canada) Ltd
Contact: Steve Usher
Address: #9 & 6421 Applecross Rd
Nanaimo, BC V9V 1N1
Phone: 250-390-5050 Fax:
LSD: West Cochrane
Client Project #: 212-30025.00000
Sampled By: RS/CT

Report Information
1. Name: Steve Usher
Email: susher@slrconsulting.com
2. Name: Rachelle Sarrazin
Email: rsarrazin@slrconsulting.com
3. Name: Travis Coates
Email: travis.coates@burnco.com

Turnaround Time Required (TAT)
Regular TAT ☒ 5 to 7 Business Days
Rush TAT ☐ <24 Hours (200%) ☐ Two Day / Next Day (100%) ☐ Three Day (50%) ☐ Four Day (25%)
Date Required:

Report Format
☐ Single sample per page
☒ Multiple samples per page
☒ Export

Invoice To Same Yes ☒ / No ☐
Company:
Contact:
Address:
Phone: Fax:
PO/AFE#:
AGAT ID/Quote #:

Requirements *(Selection may impact detection limits)*
☐ CCME ☒ AB Tier 1 ☒ Alberta Surface Water
☐ Agricultural ☐ Agricultural ☒ Chronic
☐ Industrial ☐ Industrial ☒ Acute
☐ Residential/Park ☒ Residential/Park ☐ SK Notice of Site Condition
☐ Commercial ☐ Commercial ☐ Drinking Water
☐ FWAL ☐ Natural Area ☐ Other:
Is this part of the Alberta SRP program? ☐ YES ☐ NO (If yes, please fill below)
Application Number:
Grant Amount:
Well/Facility/Location ID: N/A
UWI:

LABORATORY USE (LAB ID #)	SAMPLE IDENTIFICATION	Sample Time	DEPTH	DATE/TIME SAMPLED	SAMPLE MATRIX	COMMENTS (FILTERED, PRESERVED, HAZARDOUS*) *ADDITIONAL FEE	# OF CONTAINERS: VIALS / JARS	BAGS	BOTTLES
1 (22 8954)	BOW US	12:05		01/12/21	Water	Metals Unpreserved Dissolved was filtered. Ammonia bottles preserved.			8
2 978	BOW DS	10:46							8
3 979	GVC DS	15:46							8
4 980	GVC US	16:35							8
5 989	DUP21A	15:46							8
6									
7									
8									
9									
10									

Detailed Salinity: ☐ AB ☐ SK ☐ BC ☐ D50	☐ CCME/AB : BTEX/F1-F4 ☐ CCME/AB : BTEX /F1-F2	☐ BC: BTEXS/VPH/EPH ☐ BC: LEPH/HEPH	SK: BTEX/TVH/C11-C22, C23-C60	Soil Metals: ☐ HWS-B ☐ SP-B ☐ Hg ☐ Cr^{6+}	Water Metals: ☒ Dissolved ☒ Total ☐ Hg ☐ Cr^{6+}	Routine Water Chemistry	Landfill: ☐ AB Class 2 ☐ BC ☐ SK	Coliforms: ☐ Total ☐ Fecal ☐ E.coli	Particle Size: ☐ Sieve (75µm) ☐ Texture	Total Ammonia	Total Nitrogen (organic)	TDS and TSS	Turbidity			HOLD FOR 30 DAYS NO ANALYSIS (Additional Fee)	HOLD FOR 30 DAYS AFTER ANALYSIS (Additional Fee)
					X	X				X	X	X	X				
					X	X				X	X	X	X				
					X	X				X	X	X	X				
					X	X				X	X	X	X				
					X	X				X	X	X	X				

Samples Relinquished By (Print Name and Sign):	Date/Time	Samples Received By (Print Name and Sign):	Date/Time
Rachelle Sarrazin	01/12/21 16:30	[illegible] @ 8:14 AM	DEC 0 2 2021
Samples Relinquished By (Print Name and Sign):	Date/Time	Samples Received By (Print Name and Sign):	Date/Time
Samples Relinquished By (Print Name and Sign):	Date/Time	Samples Received By (Print Name and Sign):	Date/Time

Pink Copy - Client
Yellow Copy - AGAT
White Copy - AGAT

Page 1 of 1

N°: AB 131753

Document ID: DIV-50-1507.007.

Date Revised: May 14, 2020

AGAT Laboratories

SAMPLE INTEGRITY RECEIPT FORM

RECEIVING BASICS - Shipping

Company/Consultant: SLR

Courier: PO Prepaid Collect

Waybill#: -

Branch: EDM GP FN FM RD VAN LYD FSJ EST SASK Other: C

If multiple sites were submitted at once: Yes (No)

Custody Seal Intact: Yes No (NA)

TAT: <24hr 24-48hr 48-72hr (Reg) Other_____

Cooler Quantity: 1

TIME SENSITIVE ISSUES - Shipping

ALREADY EXCEEDED HOLD TIME? Yes (No)

Inorganic Tests (Please Circle): Mibi , BOD , (Nitrate/Nitrite) , (Turbidity) , Color , Microtox , Ortho PO4 , Tedlar Bag , Residual Chlorine , Chlorophyll* , Chloroamines*

Earliest Expiry: Dec 3, 2021

Hydrocarbons: Earliest Expiry -

SAMPLE INTEGRITY - Shipping

Hazardous Samples: YES (NO) Precaution Taken:_____

Legal Samples: Yes (No)

International Samples: Yes (No)

Tape Sealed: Yes (No)

Coolant Used: (Icepack) Bagged Ice Free Ice Free Water None

Temperature (Bottles/Jars only) N/A if only Soil Bags Received

FROZEN (Please Circle if samples received Frozen)

1 (Bottle/Jar) 1.3 + 1.3 + 2.2 = 1.6 °C 2(Bottle/Jar)___+___+___=____°C

3 (Bottle/Jar)___+___+___=____°C 4 (Bottle/Jar)___+___+___=____°C

5 (Bottle/Jar)___+___+___=____°C 6 (Bottle/Jar)___+___+___=____°C

7 (Bottle/Jar)___+___+___=____°C 8 (Bottle/Jar)___+___+___=____°C

9 (Bottle/Jar)___+___+___=____°C 10 (Bottle/Jar)___+___+___=____°C

(If more than 10 coolers are received use another sheet of paper and attach)

LOGISTICS USE ONLY

Workorder No: 21C839002

Samples Damaged: Yes (No) If YES why?

No Bubble Wrap Frozen Courier

Other:_____

Account Project Manager:_____have they been notified of the above issues: Yes No

Whom spoken to:_____ Date/Time:_____

CPM Initial_____

General Comments:_____

* Subcontracted Analysis (See CPM)

Date issued: March 11, 2020
Document ID: SR-9505.004

Appendix F Aggregate Testing Results

Secondary Water Resource Assessment

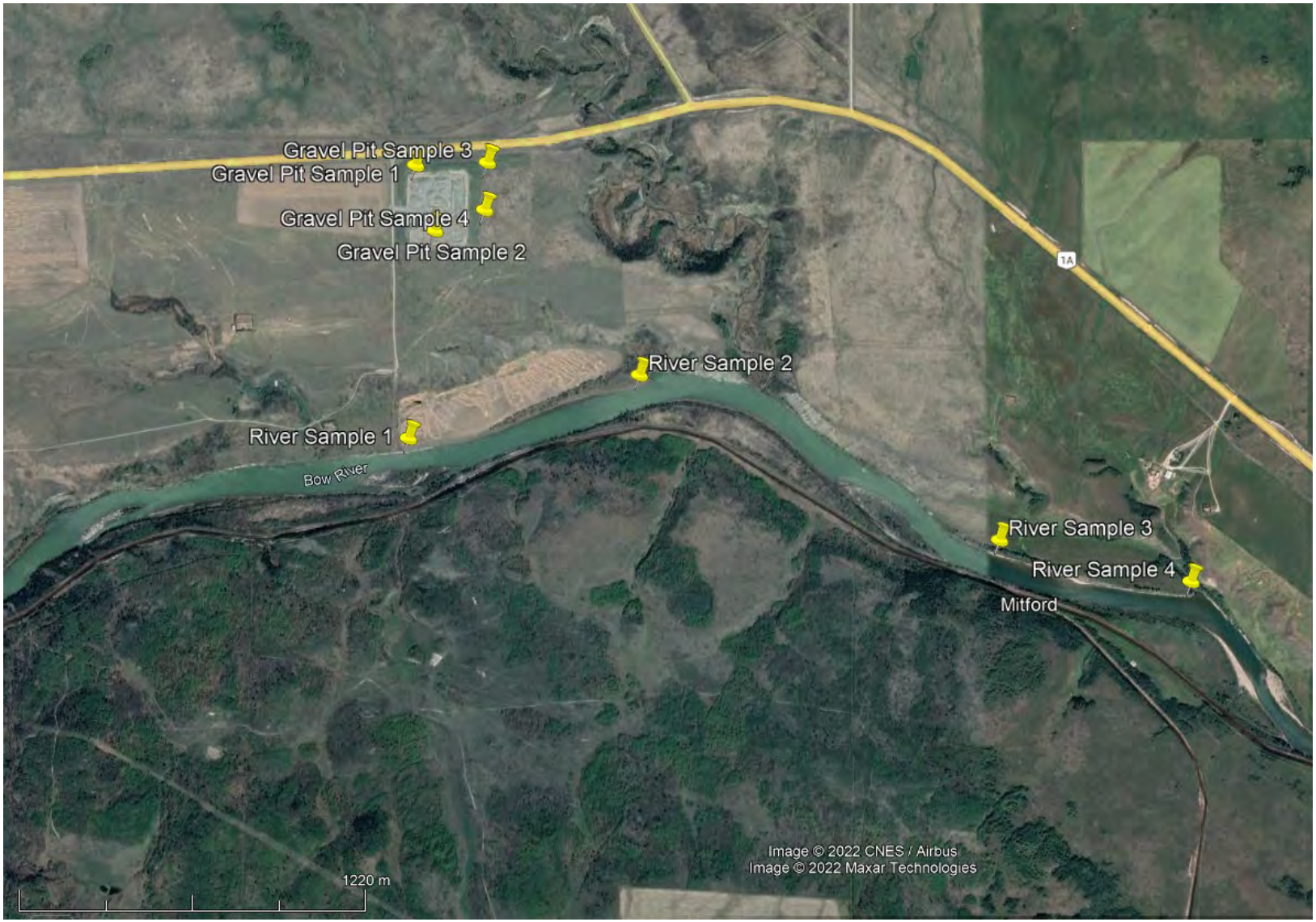
West Cochrane Gravel Pit

BURNCO Rock Products Ltd.

SLR Project No. 212.30025.00000

January 12, 2023

Appendix F Aggregate Sample Locations




Gravel Pit 1


Gravel Pit 2


Gravel Pit 3


Gravel Pit 4


River Sample 1


River Sample 2


River Sample 3

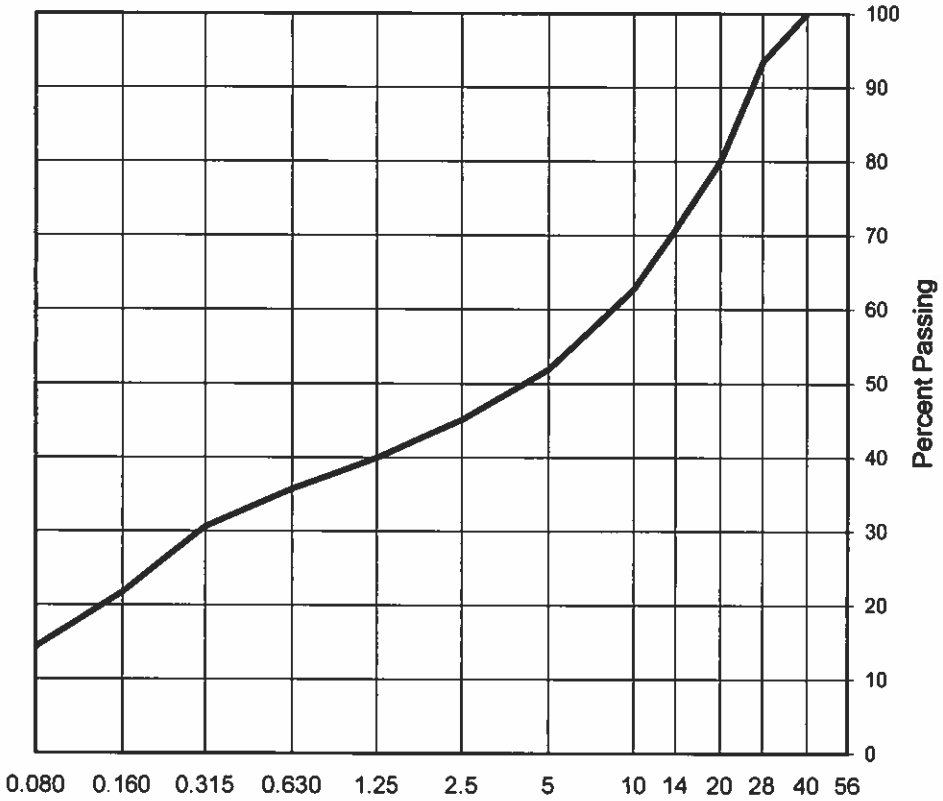

River Sample 4

CONCRETE AGGREGATE ANALYSIS REPORT

CSA A23.2-2A and CSA A23.2-5A

Project No.:	704-ENG.CGEO04230-01.009	**Sample No.:**	L-10
Project:	75 mm Gravel Sieve Test	**Date Received:**	January 28, 2022
Client:	Burnco Rock Products Ltd. c/o SLR Consulting Ltd.	**Date Tested:**	February 1, 2022
Attention:	Steve Usher	**Tested by:**	JB **Office:** Calgary
Email:	susher@slrconsulting.com	**Moisture Content:**	5.2%
Description:	75 mm Gravel	**Colour Plate No.:**	
Source:	River sample 4	**Bulk Relative Density:**	
Location:	Stockpile	**Bulk Relative Density (SSD):**	
Supplier:	Burnco Rock Products Ltd.	**Apparent Relative Density:**	
Specification:		**Absorption:**	

Sieve Sizes	Percent Passing
40	100
28	94
20	80
14	71
10	63
5	52
2.5	45
1.25	40
0.630	36
0.315	31
0.160	22
0.080	14.4



Remarks:

CCIL

Reviewed By: _____ P.Eng.

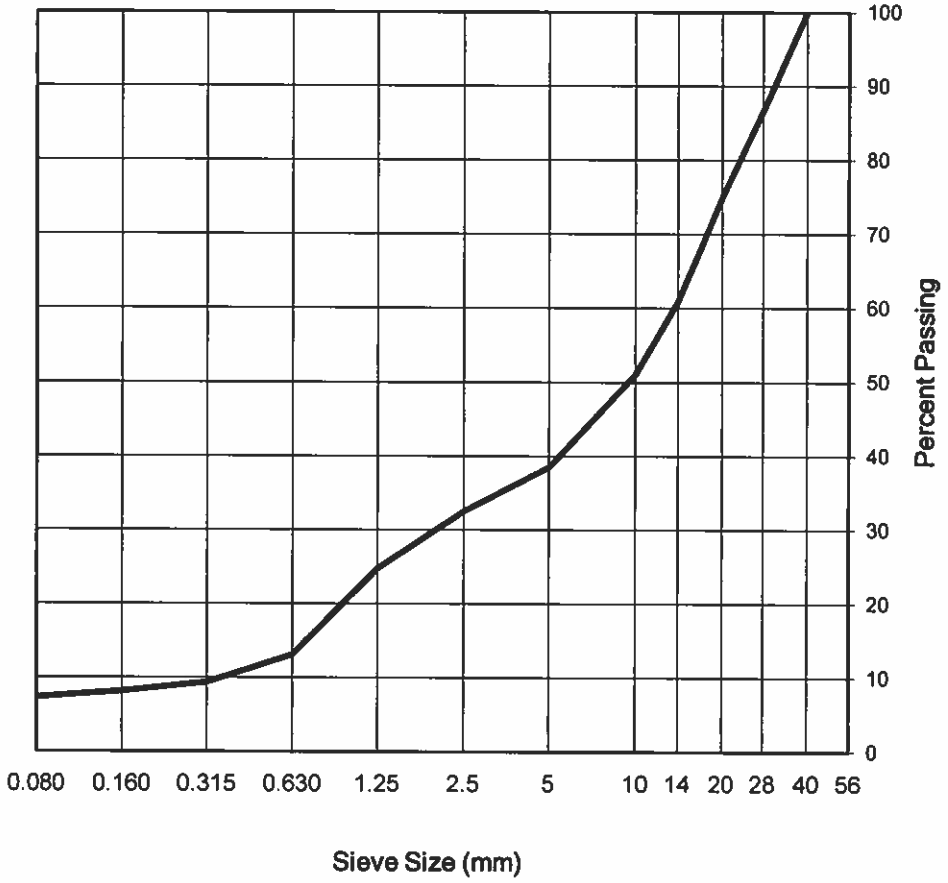
TETRA TECH

CONCRETE AGGREGATE ANALYSIS REPORT

CSA A23.2-2A and CSA A23.2-5A

Project No.:	704-ENG.CGEO04230-01.009	**Sample No.:**	L-9
Project:	75 mm Gravel Sieve Test	**Date Received:**	January 28, 2022
Client:	Burnco Rock Products Ltd. c/o SLR Consulting Ltd.	**Date Tested:**	February 1, 2022
Attention:	Steve Usher	**Tested by:**	JB **Office:** Calgary
Email:	susher@slrconsulting.com	**Moisture Content:**	0.4%
Description:	75 mm Gravel	**Colour Plate No.:**	
Source:	Pit sample 3	**Bulk Relative Density:**	
Location:	Stockpile	**Bulk Relative Density (SSD):**	
Supplier:	Burnco Rock Products Ltd.	**Apparent Relative Density:**	
Specification:		**Absorption:**	

Sieve Sizes	Percent Passing
40	100
28	87
20	75
14	61
10	51
5	38
2.5	32
1.25	25
0.630	13
0.315	9
0.160	8
0.080	7.3



Remarks:

Reviewed By: P.Eng.

TETRA TECH

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CALGARY, ALBERTA
CANADA T2E 7P7
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http://www.agatlabs.com

CLIENT NAME: BURNCO ROCK PRODUCTS LTD.
PO Box 1480, STN T
Calgary, AB T2H 2P9
403-255-2600
ATTENTION TO: ACCOUNTS PAYABLE
PROJECT: Gravel Samples
AGAT WORK ORDER: 21C821381
SOIL ANALYSIS REVIEWED BY: Daniel Reslan, Lab Manager
TRACE ORGANICS REVIEWED BY: Elena Gorobets, Report Writer
DATE REPORTED: Nov 22, 2021
PAGES (INCLUDING COVER): 18
VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (403) 735-2005

*Notes

Disclaimer:

- All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.
- All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.
- AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.
- This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
- The test results reported herewith relate only to the samples as received by the laboratory.
- Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.
- All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.

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Certificate of Analysis

AGAT WORK ORDER: 21C821381

PROJECT: Gravel Samples

CLIENT NAME: BURNCO ROCK PRODUCTS LTD.

ATTENTION TO: ACCOUNTS PAYABLE

SAMPLING SITE:

SAMPLED BY:Thomas Tyler

Soil Analysis - Salinity (pH Calcium Chloride)

DATE RECEIVED: 2021-10-25

DATE REPORTED: 2021-11-22

				Gravel Pit Location 1	Gravel Pit Location 2	Gravel Pit Location 3	Gravel Pit Location 4	River Sample 1	River Sample 2	River Sample 3	River Sample 4
SAMPLE DESCRIPTION:				15cm	15cm	15cm	15cm	15cm	15cm	15cm	15cm
SAMPLE TYPE:				Gravel	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel
DATE SAMPLED:				2021-10-25 12:21	2021-10-25 23:45	2021-10-25 23:20	2021-10-25 12:16	2021-10-25 09:35	2021-10-25 22:20	2021-10-25 13:45	2021-10-25 13:40
Parameter	Unit	G / S	RDL	3132324	3132365	3132366	3132367	3132370	3132371	3132372	3132373
pH (CaCl2 Extraction)	pH Units		N/A	7.23	7.60	7.64	7.61	7.55	7.53	7.41	7.41
Electrical Conductivity (Sat. Paste)	dS/m		0.05	0.40	0.47	0.42	0.60	0.53	0.75	0.61	0.68
Sodium Adsorption Ratio	N/A			0.39	0.25	0.40	1.18	0.35	0.28	0.28	2.79
Saturation Percentage	%		1	39	44	29	66	29	56	48	58
Chloride, Soluble	mg/L		5	26	20	27	65	19	17	14	23
Calcium, Soluble	mg/L		1	33	57	27	33	61	110	83	44
Potassium, Soluble	mg/L		2	10	22	9	15	10	9	7	6
Magnesium, Soluble	mg/L		1	17	12	25	28	18	29	21	14
Sodium, Soluble	mg/L		6	11	8	12	38	12	13	11	83
Sulfur (as Sulfate), Soluble	mg/L		2	36	33	34	62	49	115	85	97
Calcium, Soluble (meq/L)	meq/L		0.05	1.65	2.84	1.35	1.65	3.04	5.49	4.14	2.20
Calcium, Soluble (mg/kg)	mg/kg		1	13	25	8	22	18	62	40	26
Chloride, Soluble (meq/L)	meq/L		0.14	0.73	0.56	0.76	1.83	0.54	0.48	0.39	0.65
Chloride, Soluble (mg/kg)	mg/kg		2	10	9	8	43	6	10	7	13
Magnesium, Soluble (meq/L)	meq/L		0.08	1.40	0.99	2.06	2.30	1.48	2.39	1.73	1.15
Magnesium, Soluble (mg/kg)	mg/kg		1	7	5	7	18	5	16	10	8
Potassium, Soluble (meq/L)	meq/L		0.05	0.26	0.56	0.23	0.38	0.26	0.23	0.18	0.15
Potassium, Soluble (mg/kg)	mg/kg		2	4	10	3	10	3	5	3	3
Sodium, Soluble (meq/L)	meq/L		0.09	0.48	0.35	0.52	1.65	0.52	0.57	0.48	3.61
Sodium, Soluble (mg/kg)	mg/kg		2	4	4	3	25	3	7	5	48
Sulfur (as Sulfate), Soluble (meq/L)	meq/L		0.04	0.75	0.69	0.71	1.29	1.02	2.39	1.77	2.02
Sulfur (as Sulfate), Soluble (mg/kg)	mg/kg		2	14	15	10	41	14	64	41	56
Theoretical Gypsum Requirement	tonnes/ha		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Certified By:

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FAX (403)735-2771
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 21C821381

PROJECT: Gravel Samples

CLIENT NAME: BURNCO ROCK PRODUCTS LTD.

ATTENTION TO: ACCOUNTS PAYABLE

SAMPLING SITE:

SAMPLED BY:Thomas Tyler

Soil Analysis - Salinity (pH Calcium Chloride)

DATE RECEIVED: 2021-10-25

DATE REPORTED: 2021-11-22

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

3132324-3132373 SAR is a calculated parameter. The calculated parameter is non-accredited. The parameters that are components of the calculation are accredited.
If sodium results in mg/L are less than detection, SAR is non-calculable and is reported as 0.
Theoretical Gypsum Requirement is a calculated parameter. The calculated parameter is non-accredited. The parameters that are components of the calculation are accredited. The calculation is from “A Comparison of Methods for Gypsum Requirement of Brine-Contaminated Soils”, Canadian Journal of Soil Science, 1998.

Analysis performed at AGAT Calgary (unless marked by *)

Certified By:

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AGAT WORK ORDER: 21C821381

PROJECT: Gravel Samples

CLIENT NAME: BURNCO ROCK PRODUCTS LTD.

ATTENTION TO: ACCOUNTS PAYABLE

SAMPLING SITE:

SAMPLED BY:Thomas Tyler

T.C.L.P. Leachate 20 Metals

DATE RECEIVED: 2021-10-25

DATE REPORTED: 2021-11-22

Parameter	Unit	G / S	RDL	Gravel Pit North Composite Sample 15cm Gravel 2021-10-25 12:21 3132368	Gravel Pit South Composite Sample 15cm Gravel 2021-10-25 11:45 3132369	River West Composite 15cm Gravel 2021-10-25 10:20 3132374	River East Composite 15cm Gravel 2021-10-25 13:45 3132375
Antimony - Leachate	mg/L		0.5	<0.5	<0.5	<0.5	<0.5
Arsenic - Leachate	mg/L		0.5	<0.5	<0.5	<0.5	<0.5
Barium - Leachate	mg/L		0.5	0.9	<0.5	1.0	0.8
Beryllium - Leachate	mg/L		0.5	<0.5	<0.5	<0.5	<0.5
Boron - Leachate	mg/L		0.5	<0.5	<0.5	<0.5	<0.5
Cadmium - Leachate	mg/L		0.1	<0.1	<0.1	<0.1	<0.1
Chromium - Leachate	mg/L		0.5	<0.5	<0.5	<0.5	<0.5
Cobalt - Leachate	mg/L		0.5	<0.5	<0.5	<0.5	<0.5
Copper - Leachate	mg/L		0.5	<0.5	<0.5	<0.5	<0.5
Iron - Leachate	mg/L		0.5	<0.5	<0.5	<0.5	<0.5
Lead - Leachate	mg/L		0.5	<0.5	<0.5	<0.5	<0.5
Mercury - Leachate	mg/L		0.1	<0.1	<0.1	<0.1	<0.1
Nickel - Leachate	mg/L		0.5	<0.5	<0.5	<0.5	<0.5
Selenium - Leachate	mg/L		0.5	<0.5	<0.5	<0.5	<0.5
Silver - Leachate	mg/L		0.5	<0.5	<0.5	<0.5	<0.5
Thallium - Leachate	mg/L		0.5	<0.5	<0.5	<0.5	<0.5
Uranium - Leachate	mg/L		0.5	<0.5	<0.5	<0.5	<0.5
Vanadium - Leachate	mg/L		0.5	<0.5	<0.5	<0.5	<0.5
Zinc - Leachate	mg/L		0.5	<0.5	<0.5	<0.5	<0.5
Zirconium - Leachate	mg/L		0.5	<0.5	<0.5	<0.5	<0.5

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

3132368-3132375 Analysis based on "as received"

Analysis performed at AGAT Calgary (unless marked by *)

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 21C821381

PROJECT: Gravel Samples

CLIENT NAME: BURNCO ROCK PRODUCTS LTD.

ATTENTION TO: ACCOUNTS PAYABLE

SAMPLING SITE:

SAMPLED BY:Thomas Tyler

Tier 1/SK PNG031, 033 Metals + Hg + Sat Paste B + Cr6 (Soil)

DATE RECEIVED: 2021-10-25

DATE REPORTED: 2021-11-22

				Gravel Pit Location 1	Gravel Pit Location 2	Gravel Pit Location 3	Gravel Pit Location 4	River Sample 1	River Sample 2	River Sample 3	River Sample 4
SAMPLE DESCRIPTION:				15cm	15cm	15cm	15cm	15cm	15cm	15cm	15cm
SAMPLE TYPE:				Gravel	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel
DATE SAMPLED:				2021-10-25 12:21	2021-10-25 23:45	2021-10-25 23:20	2021-10-25 12:16	2021-10-25 09:35	2021-10-25 22:20	2021-10-25 13:45	2021-10-25 13:40
Parameter	Unit	G / S	RDL	3132324	3132365	3132366	3132367	3132370	3132371	3132372	3132373
Antimony	mg/kg		0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Arsenic	mg/kg		1	4	3	3	2	6	7	8	5
Barium	mg/kg		0.5	156	70.0	88.5	72.2	180	143	200	129
Beryllium	mg/kg		0.5	<0.5	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5
Boron (Saturated Paste)	mg/L		0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	mg/kg		0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	mg/kg		0.5	11.3	5.4	7.2	5.6	11.7	9.8	16.6	11.8
Chromium, Hexavalent	mg/L		0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Cobalt	mg/kg		0.5	4.9	2.0	2.6	2.1	7.1	5.4	7.7	5.4
Copper	mg/kg		0.5	9.7	3.5	5.4	3.9	17.4	8.3	12.9	8.2
Lead	mg/kg		0.5	5.9	2.7	3.3	2.6	11.8	7.4	7.8	6.4
Mercury	mg/kg		0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Molybdenum	mg/kg		0.5	0.6	<0.5	0.5	0.5	0.7	0.7	0.6	0.6
Nickel	mg/kg		0.5	14.3	6.7	8.9	7.0	22.6	15.5	22.2	15.5
Selenium	mg/kg		0.5	0.9	0.6	1.0	0.7	0.6	1.0	0.8	0.9
Silver	mg/kg		0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	mg/kg		0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tin	mg/kg		0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Uranium	mg/kg		1	<1	<1	<1	<1	<1	<1	<1	<1
Vanadium	mg/kg		0.5	18.9	9.0	12.5	8.8	17.2	18.0	24.6	18.6
Zinc	mg/kg		1	37	17	24	21	58	48	54	42

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Analysis performed at AGAT Calgary (unless marked by *)

Certified By:

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FAX (403)735-2771
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Certificate of Analysis

AGAT WORK ORDER: 21C821381

PROJECT: Gravel Samples

CLIENT NAME: BURNCO ROCK PRODUCTS LTD.

ATTENTION TO: ACCOUNTS PAYABLE

SAMPLING SITE:

SAMPLED BY:Thomas Tyler

Petroleum Hydrocarbons (BTEX/F1-F4) in Soil (CWS) (Methanol Field Stabilized)

DATE RECEIVED: 2021-10-25

DATE REPORTED: 2021-11-22

				Gravel Pit Location 1	Gravel Pit Location 2	Gravel Pit Location 3	Gravel Pit Location 4	River Sample 1	River Sample 2	River Sample 3	River Sample 4
SAMPLE DESCRIPTION:				15cm	15cm	15cm	15cm	15cm	15cm	15cm	15cm
SAMPLE TYPE:				Gravel	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel
DATE SAMPLED:				2021-10-25 12:21	2021-10-25 23:45	2021-10-25 23:20	2021-10-25 12:16	2021-10-25 09:35	2021-10-25 22:20	2021-10-25 13:45	2021-10-25 13:40
Parameter	Unit	G / S	RDL	3132324	3132365	3132366	3132367	3132370	3132371	3132372	3132373
Benzene	mg/kg		0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Toluene	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ethylbenzene	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Xylenes	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
C6 - C10 (F1)	mg/kg		10	<10	<10	<10	<10	<10	<10	<10	<10
C6 - C10 (F1 minus BTEX)	mg/kg		10	<10	<10	<10	<10	<10	<10	<10	<10
C10 - C16 (F2)	mg/kg		10	<10	<10	<10	<10	<10	<10	<10	<10
C16 - C34 (F3)	mg/kg		10	<10	<10	<10	<10	18	25	12	17
C34 - C50 (F4)	mg/kg		10	<10	<10	<10	<10	<10	<10	<10	<10
Gravimetric Heavy Hydrocarbons	mg/kg		1000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Moisture Content	%		1.00	3.5	3.9	1.9	2.8	6.9	6.5	10	12
Surrogate	Unit	Acceptable Limits									
Toluene-d8 (BTEX)	%	60-140		99	96	95	90	72	128	101	76
o-Terphenyl (F2-F4)	%	60-140		112	110	111	108	110	111	108	110

Certified By: Elena Gorobets

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 21C821381

PROJECT: Gravel Samples

CLIENT NAME: BURNCO ROCK PRODUCTS LTD.

ATTENTION TO: ACCOUNTS PAYABLE

SAMPLING SITE:

SAMPLED BY:Thomas Tyler

Petroleum Hydrocarbons (BTEX/F1-F4) in Soil (CWS) (Methanol Field Stabilized)

DATE RECEIVED: 2021-10-25

DATE REPORTED: 2021-11-22

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

3132324-3132373 Results are based on the dry weight of the sample.
The C6-C10 (F1) fraction is calculated using toluene response factor.
The C10 - C16 (F2), C16 - C34 (F3), and C34 - C50 (F4) fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons (F4g) are not included in and cannot be added to the Total C6-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
Quality control data is available upon request.
Assistance in the interpretation of data is available upon request.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
The chromatogram returned to baseline by the retention time of nC50.
C6 –C10 (F1 minus BTEX) is a calculated parameter. The calculated value is F1 minus BTEX. The calculated parameter is non-accredited. The parameters that are components of the calculation are accredited.
C>10 – C16 (F2- Napthalene) is a calculated parameter. The calculated value is F2 - Napthalene (if requested). The calculated parameter is non-accredited. The parameters that are components of the calculation are accredited.
C>16 - C34 (F3-PAH) is a calculated parameter. The calculated value is F3-PAH (if requested). The calculated parameter is non-accredited. The parameters that are components of the calculation are accredited.
Xylenes is a calculated parameter. The calculated value is the sum of m&p-Xylenes + o-Xylene. The calculated parameter is non-accredited. The parameters that are components of the calculation are accredited.
Extraction and holding times were met for this sample.

Analysis performed at AGAT Calgary (unless marked by *)

Certified By: Elena Gorobets

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Certificate of Analysis

AGAT WORK ORDER: 21C821381

PROJECT: Gravel Samples

CLIENT NAME: BURNCO ROCK PRODUCTS LTD.

ATTENTION TO: ACCOUNTS PAYABLE

SAMPLING SITE:

SAMPLED BY:Thomas Tyler

Polyaromatic Hydrocarbon Analysis - Soil

DATE RECEIVED: 2021-10-25

DATE REPORTED: 2021-11-22

SAMPLE DESCRIPTION:				Gravel Pit Location 1 15cm	Gravel Pit Location 2 15cm	Gravel Pit Location 3 15cm	Gravel Pit Location 4 15cm	River Sample 1 15cm	River Sample 2 15cm	River Sample 3 15cm	River Sample 4 15cm
SAMPLE TYPE:				Gravel	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel
DATE SAMPLED:				2021-10-25 12:21	2021-10-25 23:45	2021-10-25 23:20	2021-10-25 12:16	2021-10-25 09:35	2021-10-25 22:20	2021-10-25 13:45	2021-10-25 13:40
Parameter	Unit	G / S	RDL	3132324	3132365	3132366	3132367	3132370	3132371	3132372	3132373
Acenaphthene	mg/kg		0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.009
Acenaphthylene	mg/kg		0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Anthracene	mg/kg		0.004	<0.004	<0.004	<0.004	<0.004	0.004	0.008	<0.004	0.015
Acridine	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Quinoline	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Naphthalene	mg/kg		0.005	<0.005	<0.005	<0.005	<0.005	0.017	0.019	0.011	0.040
2-Methylnaphthalene	mg/kg		0.005	<0.005	<0.005	<0.005	<0.005	0.036	0.034	0.018	0.040
Fluorene	mg/kg		0.01	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Phenanthrene	mg/kg		0.02	<0.02	<0.02	<0.02	<0.02	0.04	0.06	<0.02	0.08
Fluoranthene	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	0.07	0.04	<0.01	0.05
Pyrene	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	0.06	0.03	<0.01	0.05
Benzo[a]anthracene	mg/kg		0.02	<0.02	<0.02	<0.02	<0.02	0.04	0.02	<0.02	0.02
Chrysene	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo[b+j]fluoranthene	mg/kg		0.03	<0.03	<0.03	<0.03	<0.03	0.07	<0.03	<0.03	<0.03
Benzo[k]fluoranthene	mg/kg		0.02	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.02
Benzo[a]pyrene	mg/kg		0.03	<0.03	<0.03	<0.03	<0.03	0.04	<0.03	<0.03	<0.03
Indeno[1,2,3-cd]pyrene	mg/kg		0.02	<0.02	<0.02	<0.02	<0.02	0.03	<0.02	<0.02	<0.02
Dibenzo[ah]anthracene	mg/kg		0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Benzo[ghi]perylene	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
B[a]P TPE	mg/kg		0.0225	0.0225	0.0225	0.0225	0.0225	0.0590	0.0235	0.0225	0.0235
IACR (Coarse Soil)			0.0136	0.0136	0.0136	0.0136	0.0136	0.0359	0.0145	0.0136	0.0145
IACR (Fine Soil)			0.0259	0.0259	0.0259	0.0259	0.0259	0.0685	0.0275	0.0259	0.0275
Surrogate	Unit	Acceptable Limits									
p-Terphenyl-d14 (PAH)	%	50-140		111	116	117	128	114	103	110	111
p-Naphthalene-d8 (PAH)	%	50-150		95	100	99	116	101	94	94	96
P_Pyrene-d10 (PAH)	%	50-150		103	106	114	124	110	109	108	110

Certified By: Elena Gorobets

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Certificate of Analysis

AGAT WORK ORDER: 21C821381

PROJECT: Gravel Samples

CLIENT NAME: BURNCO ROCK PRODUCTS LTD.

ATTENTION TO: ACCOUNTS PAYABLE

SAMPLING SITE:

SAMPLED BY:Thomas Tyler

Polyaromatic Hydrocarbon Analysis - Soil

DATE RECEIVED: 2021-10-25

DATE REPORTED: 2021-11-22

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

3132324-3132373 Results are based on the dry weight of the sample.
Based on GC/MS target ion analysis.
Isomers Benzo(b)fluoranthene and Benzo(j)fluoranthene have the same GC retention time and are reported as the sum based on the Benzo(b)fluoranthene response.
B[a]P TPE, IACR (Coarse) and IACR (Fine) are calculated parameters. They are calculated according to the Alberta Tier 1 Soil and Groundwater Remediation Guidelines, January 10, 2019. The calculations are not accredited, individual parameters that make up the calculated parameters are accredited. Note that if the analysis returns non-detects for a parameter, ½ the detection limit is entered into the formulas. As per the Guidance Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment Volume 4 Analytical Methods (2016).

Analysis performed at AGAT Calgary (unless marked by *)

Certified By: Elena Gorobets

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Quality Assurance

CLIENT NAME: BURNCO ROCK PRODUCTS LTD.
AGAT WORK ORDER: 21C821381
PROJECT: Gravel Samples
ATTENTION TO: ACCOUNTS PAYABLE
SAMPLING SITE:
SAMPLED BY:Thomas Tyler

Soil Analysis

RPT Date: Nov 22, 2021

PARAMETER	Batch	Sample Id	DUPLICATE			Method Blank	REFERENCE MATERIAL				METHOD BLANK SPIKE			MATRIX SPIKE		
			Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits		
								Lower	Upper		Lower	Upper		Lower	Upper	
Soil Analysis - Salinity (pH Calcium Chloride)																
pH (CaCl2 Extraction)	3132324	3132324	7.23	7.54	4.2%	N/A	90%	90%	110%							
Electrical Conductivity (Sat. Paste)	3132324	3132324	0.40	0.39	2.5%	< 0.05	97%	80%	120%							
Saturation Percentage	3132324	3132324	39	39	1.9%	< 1	101%	80%	120%							
Chloride, Soluble	3132324	3132324	26	25	2.1%	< 5	78%	70%	130%	108%	80%	120%	102%	70%	130%	
Calcium, Soluble	3132324	3132324	33	33	1.8%	< 1	101%	70%	130%							
Potassium, Soluble	3132324	3132324	10	10	1.9%	< 2	90%	70%	130%							
Magnesium, Soluble	3132324	3132324	17	17	1.1%	< 1	99%	70%	130%							
Sodium, Soluble	3132324	3132324	11	11	NA	< 6	96%	70%	130%							
Sulfur (as Sulfate), Soluble	3132324	3132324	36	34	6.0%	< 2	90%	70%	130%							

Comments: Matrix spike NA: Spike level < native concentration. Matrix spike acceptance limits do not apply and are not calculated.
Duplicate NA: results are less than 5X the RDL and RDP will not be calculated.

Tier 1/SK PNG031, 033 Metals + Hg + Sat Paste B + Cr6 (Soil)																
Antimony	3132324	3132324	<0.5	<0.5	NA	< 0.5	104%	70%	130%				113%	70%	130%	
Arsenic	3132324	3132324	4	4	NA	< 1	101%	70%	130%				101%	70%	130%	
Barium	3132324	3132324	156	155	0.6%	< 0.5	92%	70%	130%				104%	70%	130%	
Beryllium	3132324	3132324	<0.5	<0.5	NA	< 0.5	72%	70%	130%				76%	70%	130%	
Boron (Saturated Paste)	3132324	3132324	<0.5	<0.5	NA	< 0.5	89%	70%	130%							
Cadmium	3132324	3132324	<0.5	<0.5	NA	< 0.5	94%	70%	130%				NA	70%	130%	
Chromium	3132324	3132324	11.3	11.9	5.5%	< 0.5	83%	70%	130%				94%	70%	130%	
Chromium, Hexavalent	3125232		<0.3	<0.3	NA	< 0.3	95%	70%	130%	100%	80%	120%	97%	70%	130%	
Cobalt	3132324	3132324	4.9	4.8	1.7%	< 0.5	87%	70%	130%				95%	70%	130%	
Copper	3132324	3132324	9.7	9.8	0.6%	< 0.5	86%	70%	130%				91%	70%	130%	
Lead	3132324	3132324	5.9	5.9	0.2%	< 0.5	84%	70%	130%				95%	70%	130%	
Mercury	3132324	3132324	<0.5	<0.5	NA	< 0.5	117%	70%	130%				128%	70%	130%	
Molybdenum	3132324	3132324	0.6	0.6	NA	< 0.5	94%	70%	130%				97%	70%	130%	
Nickel	3132324	3132324	14.3	14.0	2.4%	< 0.5	90%	70%	130%				95%	70%	130%	
Selenium	3132324	3132324	0.9	1.0	NA	< 0.5	110%	70%	130%				NA	70%	130%	
Silver	3132324	3132324	<0.5	<0.5	NA	< 0.5	86%	70%	130%				90%	70%	130%	
Thallium	3132324	3132324	<0.5	<0.5	NA	< 0.5	77%	70%	130%				100%	70%	130%	
Tin	3132324	3132324	<0.5	<0.5	NA	< 0.5	85%	70%	130%				96%	70%	130%	
Uranium	3132324	3132324	<1	<1	NA	< 1	104%	70%	130%				108%	70%	130%	
Vanadium	3132324	3132324	18.9	18.2	3.9%	< 0.5	71%	70%	130%				95%	70%	130%	
Zinc	3132324	3132324	37	38	1.5%	< 1	91%	70%	130%				92%	70%	130%	

Comments: Matrix spike NA: Spike level < native concentration. Matrix spike acceptance limits do not apply and are not calculated.
Duplicate NA: results are less than 5X the RDL and RDP will not be calculated.

T.C.L.P. Leachate 20 Metals																
Antimony - Leachate	3132375	3132375	<0.5	<0.5	NA	< 0.5	91%	80%	120%	89%	80%	120%	84%	80%	120%	
Arsenic - Leachate	3132375	3132375	<0.5	<0.5	NA	< 0.5	97%	80%	120%	92%	80%	120%	87%	80%	120%	

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Quality Assurance

CLIENT NAME: BURNCO ROCK PRODUCTS LTD.

AGAT WORK ORDER: 21C821381

PROJECT: Gravel Samples

ATTENTION TO: ACCOUNTS PAYABLE

SAMPLING SITE:

SAMPLED BY:Thomas Tyler

Soil Analysis (Continued)

RPT Date: Nov 22, 2021			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Barium - Leachate	3132375	3132375	0.8	0.8	NA	< 0.5	99%	80%	120%	109%	80%	120%	NA	80%	120%
Beryllium - Leachate	3132375	3132375	<0.5	<0.5	NA	< 0.5	97%	80%	120%	100%	80%	120%	98%	80%	120%
Boron - Leachate	3132375	3132375	<0.5	<0.5	NA	< 0.5	98%	80%	120%	116%	80%	120%	102%	80%	120%
Cadmium - Leachate	3132375	3132375	<0.1	<0.1	NA	< 0.1	100%	80%	120%	102%	80%	120%	97%	80%	120%
Chromium - Leachate	3132375	3132375	<0.5	<0.5	NA	< 0.5	113%	80%	120%	113%	80%	120%	111%	80%	120%
Cobalt - Leachate	3132375	3132375	<0.5	<0.5	NA	< 0.5	102%	80%	120%	97%	80%	120%	93%	80%	120%
Copper - Leachate	3132375	3132375	<0.5	<0.5	NA	< 0.5	98%	80%	120%	104%	80%	120%	98%	80%	120%
Iron - Leachate	3132375	3132375	<0.5	<0.5	NA	< 0.5	102%	80%	120%	97%	80%	120%	NA	80%	120%
Lead - Leachate	3132375	3132375	<0.5	<0.5	NA	< 0.5	99%	80%	120%	97%	80%	120%	95%	80%	120%
Mercury - Leachate	3132375	3132375	<0.1	<0.1	NA	< 0.1	95%	80%	120%	93%	80%	120%	93%	80%	120%
Nickel - Leachate	3132375	3132375	<0.5	<0.5	NA	< 0.5	99%	80%	120%	97%	80%	120%	93%	80%	120%
Selenium - Leachate	3132375	3132375	<0.5	<0.5	NA	< 0.5	97%	80%	120%	98%	80%	120%	89%	80%	120%
Silver - Leachate	3132375	3132375	<0.5	<0.5	NA	< 0.5	89%	80%	120%	84%	80%	120%	86%	80%	120%
Thallium - Leachate	3132375	3132375	<0.5	<0.5	NA	< 0.5	98%	80%	120%	82%	80%	120%	90%	80%	120%
Uranium - Leachate	3132375	3132375	<0.5	<0.5	NA	< 0.5	102%	80%	120%	90%	80%	120%	89%	80%	120%
Vanadium - Leachate	3132375	3132375	<0.5	<0.5	NA	< 0.5	96%	80%	120%	91%	80%	120%	89%	80%	120%
Zinc - Leachate	3132375	3132375	<0.5	<0.5	NA	< 0.5	98%	80%	120%	106%	80%	120%	99%	80%	120%
Zirconium - Leachate	3132375	3132375	<0.5	<0.5	NA	< 0.5	100%	80%	120%	99%	80%	120%	104%	80%	120%

Comments: Matrix spike NA: Spike level < native concentration. Matrix spike acceptance limits do not apply and are not calculated.
Duplicate NA: results are less than 5X the RDL and RDP will not be calculated.

Certified By:

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Quality Assurance

CLIENT NAME: BURNCO ROCK PRODUCTS LTD.

AGAT WORK ORDER: 21C821381

PROJECT: Gravel Samples

ATTENTION TO: ACCOUNTS PAYABLE

SAMPLING SITE:

SAMPLED BY:Thomas Tyler

Trace Organics Analysis

RPT Date: Nov 22, 2021			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Petroleum Hydrocarbons (BTEX/F1-F4) in Soil (CWS) (Methanol Field Stabilized)															
Benzene	3591	3132365	<0.005	<0.005	NA	< 0.005	117%	60%	140%	114%	60%	140%	105%	60%	140%
Toluene	3591	3132365	<0.05	<0.05	NA	< 0.05	94%	60%	140%	109%	60%	140%	99%	60%	140%
Ethylbenzene	3591	3132365	<0.01	<0.01	NA	< 0.01	85%	60%	140%	112%	60%	140%	92%	60%	140%
Xylenes	3591	3132365	<0.05	<0.05	NA	< 0.05	93%	60%	140%	120%	60%	140%	95%	60%	140%
C6 - C10 (F1)	3591	3132365	<10	<10	NA	< 10	86%	60%	140%	100%	60%	140%	90%	60%	140%
C10 - C16 (F2)	338	3137213	<10	<10	NA	< 10	88%	60%	140%	97%	60%	140%	100%	60%	140%
C16 - C34 (F3)	338	3137213	23	28	NA	< 10	95%	60%	140%	99%	60%	140%	101%	60%	140%
C34 - C50 (F4)	338	3137213	11	14	NA	< 10	102%	60%	140%	100%	60%	140%	100%	60%	140%

Comments: Duplicate NA: results are less than 5X the RDL and RDP will not be calculated.
The sample spikes and dups are not from the same sample ID.

Polyaromatic Hydrocarbon Analysis - Soil															
Acenaphthene	1066	3132365	<0.005	<0.005	NA	< 0.005	103%	50%	140%	87%	50%	140%	95%	50%	140%
Acenaphthylene	1066	3132365	<0.005	<0.005	NA	< 0.005	101%	50%	140%	79%	50%	140%	89%	50%	140%
Anthracene	1066	3132365	<0.004	<0.004	NA	< 0.004	90%	50%	140%	82%	50%	140%	91%	50%	140%
Acridine	1066	3132365	<0.05	<0.05	NA	< 0.05	95%	50%	140%	96%	50%	140%	97%	50%	140%
Quinoline	1066	3132365	<0.05	<0.05	NA	< 0.05	127%	50%	140%	107%	50%	140%	99%	50%	140%
Naphthalene	1066	3132365	<0.005	<0.005	NA	< 0.005	121%	50%	140%	91%	50%	140%	100%	50%	140%
2-Methylnaphthalene	1066	3132365	<0.005	<0.005	NA	< 0.005	104%	50%	140%	80%	50%	140%	89%	50%	140%
Fluorene	1066	3132365	<0.02	<0.02	NA	< 0.01	112%	50%	140%	84%	50%	140%	96%	50%	140%
Phenanthrene	1066	3132365	<0.02	<0.02	NA	< 0.02	92%	50%	140%	85%	50%	140%	95%	50%	140%
Fluoranthene	1066	3132365	<0.01	<0.01	NA	< 0.01	102%	50%	140%	94%	50%	140%	102%	50%	140%
Pyrene	1066	3132365	<0.01	<0.01	NA	< 0.01	96%	50%	140%	91%	50%	140%	98%	50%	140%
Benzo[a]anthracene	1066	3132365	<0.02	<0.02	NA	< 0.02	94%	50%	140%	85%	50%	140%	90%	50%	140%
Chrysene	1066	3132365	<0.05	<0.05	NA	< 0.05	97%	50%	140%	86%	50%	140%	102%	50%	140%
Benzo[b+j]fluoranthene	1066	3132365	<0.03	<0.03	NA	< 0.03	83%	50%	140%	83%	50%	140%	103%	50%	140%
Benzo[k]fluoranthene	1066	3132365	<0.02	<0.02	NA	< 0.02	104%	50%	140%	103%	50%	140%	112%	50%	140%
Benzo[a]pyrene	1066	3132365	<0.03	<0.03	NA	< 0.03	89%	50%	140%	87%	50%	140%	96%	50%	140%
Indeno[1,2,3-cd]pyrene	1066	3132365	<0.02	<0.02	NA	< 0.02	82%	50%	140%	74%	50%	140%	85%	50%	140%
Dibenzo[ah]anthracene	1066	3132365	<0.005	<0.005	NA	< 0.005	86%	50%	140%	82%	50%	140%	95%	50%	140%
Benzo[ghi]perylene	1066	3132365	<0.05	<0.05	NA	< 0.05	86%	50%	140%	86%	50%	140%	96%	50%	140%

Comments: Duplicate NA: results are less than 5X the RDL and RDP will not be calculated.
The sample spikes and dups are not from the same sample ID.

Certified By: Elena Gorobets

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Method Summary

CLIENT NAME: BURNCO ROCK PRODUCTS LTD.

AGAT WORK ORDER: 21C821381

PROJECT: Gravel Samples

ATTENTION TO: ACCOUNTS PAYABLE

SAMPLING SITE:

SAMPLED BY:Thomas Tyler

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
pH (CaCl2 Extraction)	SOIL-0110; INOR-401-0120; SOIL-0260	SHEPPARD 2007; MILLER 2007; SM 4500 H+	PH METER
Electrical Conductivity (Sat. Paste)	SOIL-0110; INOR-401-0120; SOIL-0140; INST-0120	CARTER & GREGORICH 2007, SM 2510 B	CONDUCTIVITY METER
Sodium Adsorption Ratio		CARTER & GREGORICH 2007-SAR	CALCULATION
Saturation Percentage	SOIL-0140; INOR-401-0120; SOIL-0120	CARTER & GREGORICH 2007	GRAVIMETRIC
Chloride, Soluble	SOIL-0110; INOR-401-0120; SOIL-0140; INST-0500	Carter & Gregorich 2007; SM 4500-Cl-E	COLORIMETER
Calcium, Soluble	SOIL-0110; INOR-401-0120; SOIL-0140; INST-0140	CARTER & GREGORICH 2007, SM 3120B	ICP/OES
Potassium, Soluble	SOIL-0110; INOR-401-0120; SOIL-0140; INST-0140	CARTER & GREGORICH 2007, SM 3120B	ICP/OES
Magnesium, Soluble	SOIL-0110; INOR-401-0120; SOIL-0140; INST-0140	CARTER & GREGORICH 2007, SM 3120B	ICP/OES
Sodium, Soluble	SOIL-0110; INOR-401-0120; SOIL-0140; INST-0140	CARTER & GREGORICH 2007, SM 3120B	ICP/OES
Sulfur (as Sulfate), Soluble	SOIL-0110; INOR-401-0120; SOIL-0140; INST-0140	CARTER & GREGORICH 2007, SM 3120B	ICP/OES
Antimony - Leachate	SOIL 0420; INST 0140	In-House Leachate; SM 3120B	ICP/OES
Arsenic - Leachate	SOIL 0420; INST 0140	In-House Leachate; SM 3120B	ICP/OES
Barium - Leachate	SOIL 0420; INST 0140	In-House Leachate; SM 3120B	ICP/OES
Beryllium - Leachate	SOIL 0420; INST 0140	In-House Leachate; SM 3120B	ICP/OES
Boron - Leachate	SOIL 0420; INST 0140	In-House Leachate; SM 3120B	ICP/OES
Cadmium - Leachate	SOIL 0420; INST 0140	In-House Leachate; SM 3120B	ICP/OES
Chromium - Leachate	SOIL 0420; INST 0140	In-House Leachate; SM 3120B	ICP/OES
Cobalt - Leachate	SOIL 0420; INST 0140	In-House Leachate; SM 3120B	ICP/OES
Copper - Leachate	SOIL 0420; INST 0140	In-House Leachate; SM 3120B	ICP/OES
Iron - Leachate	SOIL 0420; INST 0140	In-House Leachate; SM 3120B	ICP/OES
Lead - Leachate	SOIL 0420; INST 0140	In-House Leachate; SM 3120B	ICP/OES
Mercury - Leachate	SOIL 0420; INST 0140	In-House Leachate; SM 3120B	ICP/OES
Nickel - Leachate	SOIL 0420; INS 0140	In-House Leachate; SM 3120B	ICP/OES
Selenium - Leachate	SOIL 0420; INS 0140	In-House Leachate; SM 3120B	ICP/OES
Silver - Leachate	SOIL 0420; INS 0140	In-House Leachate; SM 3120B	ICP/OES
Thallium - Leachate	SOIL 0420; INST 0140	In-House Leachate; SM 3120B	ICP/OES
Uranium - Leachate	SOIL 0420; INST 0140	In-House Leachate; SM 3120B	ICP/OES
Vanadium - Leachate	SOIL 0420; INS 0140	In-House Leachate; SM 3120B	ICP/OES
Zinc - Leachate	SOIL 0420; INST 0140	In-House Leachate; SM 3120B	ICP/OES
Zirconium - Leachate	SOIL 0420; INST 0140	In-House Leachate; SM 3120B	ICP/OES
Antimony	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Arsenic	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Barium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Beryllium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Boron (Saturated Paste)	SOIL-0110; INOR-401-0120; SOIL-0140; INST-0140	CARTER & GREGORICH 2007, SM 3120 B	ICP/OES
Cadmium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Chromium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP/MS

2910 12TH STREET NE
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Method Summary

CLIENT NAME: BURNCO ROCK PRODUCTS LTD.

AGAT WORK ORDER: 21C821381

PROJECT: Gravel Samples

ATTENTION TO: ACCOUNTS PAYABLE

SAMPLING SITE:

SAMPLED BY:Thomas Tyler

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Chromium, Hexavalent	SOIL 0600	BARTLETT, R.J., JAMES, B.R. (1996) S	SPECTROPHOTOMETER
Cobalt	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Copper	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Lead	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Mercury	SOIL-0110; INOR-401-0120; SOIL-0390; INST-0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Molybdenum	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Nickel	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Selenium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Silver	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Thallium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Tin	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Uranium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Vanadium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Zinc	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS

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CLIENT NAME: BURNCO ROCK PRODUCTS LTD.

AGAT WORK ORDER: 21C821381

PROJECT: Gravel Samples

ATTENTION TO: ACCOUNTS PAYABLE

SAMPLING SITE:

SAMPLED BY:Thomas Tyler

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Benzene	TO-0543	EPA SW-846 5021 & 8260	GC/MS
Toluene	TO-0543	EPA SW-846 5021 & 8260	GC/MS
Ethylbenzene	TO-0543	EPA SW-846 5021 & 8260	GC/MS
Xylenes	TO-0543	EPA SW-846 5021 & 8260	GC/MS
C6 - C10 (F1)	TO-0543	CCME Tier 1 Method	GC/FID
C6 - C10 (F1 minus BTEX)	TO-0543	CCME Tier 1 Method	GC/FID
C10 - C16 (F2)	TO-0560	CCME Tier 1 Method	GC/FID
C16 - C34 (F3)	TO-0560	CCME Tier 1 Method	GC/FID
C34 - C50 (F4)	TO-0560	CCME Tier 1 Method	GC/FID
Gravimetric Heavy Hydrocarbons	TO-0560	CCME Tier 1 Method	GC/FID
Moisture Content	TO-0560	CCME Tier 1 Method	GC/FID
Toluene-d8 (BTEX)	TO-0543	EPA SW-846 5021 & 8260	GC/MS
o-Terphenyl (F2-F4)	TO 0560	CCME Tier 1 Method	GC/FID
Acenaphthene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Acenaphthylene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Anthracene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Acridine	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Quinoline	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Naphthalene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
2-Methylnaphthalene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Fluorene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Phenanthrene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Fluoranthene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Pyrene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Benzo[a]anthracene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Chrysene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Benzo[b+j]fluoranthene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Benzo[k]fluoranthene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Benzo[a]pyrene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Indeno[1,2,3-cd]pyrene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Dibenzo[ah]anthracene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Benzo[ghi]perylene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
p-Terphenyl-d14 (PAH)	TO 0210	EPA SW-846 3570 & 8270	GC/MS
p-Naphthalene-d8 (PAH)	TO-0210	EPA SW-846 3570 & 8270	GC/MS
P_Pyrene-d10 (PAH)	TO-0210	EPA SW-846 3570 & 8270	GC/MS
B[a]P TPE		CCME	GC/MS
IACR (Coarse Soil)		CCME	GC/MS
IACR (Fine Soil)		CCME	GC/MS

AGAT Laboratories

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Calgary, Alberta T2E 7P7
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Laboratory Use Only
Arrival Temperature: 12.5 C
AGAT Job Number: 25-OCT '21 PM 3:31
Date and Time: 21C821381

Chain of Custody Record

Emergency Support Services Hotline 1-855-AGAT 245 (1-855-242-8245)

Report Information
Company: Burnco Rock Products Ltd.
Contact: Travis Coates
Address: Main Floor, 155 Glendeer Circle SE Box 1480, Station T
Calgary, AB, Canada T2H 2P9
Phone: 403-640-9217 Fax:
LSD:
Client Project #:
Sampled By: Thomas Tyler

Report Information
1. Name: Travis Coates
Email: travis.coates@burnco.com
2. Name: Maverick Lam
Email: maverick.lam@burnco.com
3. Name:
Email:

Turnaround Time Required (TAT)
Regular TAT ☑ 5 to 7 Business Days
Rush TAT ☐ <24 Hours (200%) ☐ Two Day / Next Day (100%) ☐ Three Day (50%) ☐ Four Day (25%)
Date Required:

Report Format
☐ Single sample per page
☑ Multiple samples per page
Export EDD to Excel

Invoice To Same Yes ☑ / No ☐
Company:
Contact:
Address:
Phone: Fax:
PO/AFE#:
AGAT ID/Quote #:

Requirements (Selection may impact data deliverables)
☐ CCME ☑ AB Tier 1 ☐ Alberta Surface Water
☐ Agricultural ☐ Agricultural ☐ Chronic
☐ Industrial ☐ Industrial ☐ Acute
☐ Residential/Park ☐ Residential/Park ☐ SK Notice of Site Condition
☐ Commercial ☐ Commercial ☐ Drinking Water
☐ FWAL ☐ Natural Area ☐ Other:
Is this part of the Alberta SRP program? ☐ YES ☐ NO (If yes, please fill below)
Application Number:
Grant Amount:
Well/Facility/Location ID:
UWI:

LABORATORY USE (LAB ID #)	SAMPLE IDENTIFICATION	DEPTH	DATE/TIME SAMPLED	SAMPLE MATRIX	COMMENTS (FILTERED, PRESERVED, HAZARDOUS*) *ADDITIONAL FEE	# OF CONTAINERS VIALS / JARS	BAGS	BOTTLES	Detailed Salinity: ☑ AB ☐ SK ☐ BC ☐ D50	☑ CCME/AB : BTEX/F1-F4 ☐ CCME/AB : BTEX/F1-F2	☐ BC: BTEXS/VPH/EPH ☐ BC: LEPH/HEPH	SK: BTEX/TVH/C11-C22, C23-C60	Soil Metals: ☐ HWS-B ☐ SP-B ☐ Hg ☐ Cr^{6+}	Water Metals: ☐ Dissolved ☐ Total ☐ Hg ☐ Cr^{6+}	Routine Water Chemistry	Landfill: ☐ AB Class 2 ☐ BC ☐ SK	Coliforms: ☐ Total ☐ Fecal ☐ E.coli	Particle Size: ☐ Sieve (75µm) ☐ Texture	Alberta Tier 1 Metals Extended	PAHs in Soil Tier 1	Strong ACid/Base Accounting (Modified Sobek)	TCLP Leachable Metals, Class 2			HOLD FOR 30 DAYS NO ANALYSIS (Additional Fee)	HOLD FOR 30 DAYS AFTER ANALYSIS (Additional Fee)
31 32324	Gravel Pit Location 1	15 cm	Oct. 25 12:[illegible]	Gravel		2/2	2		☑	☑									☑	☑						
2 365	Gravel Pit Location 2	15 cm	Oct. 25 11:45	Gravel		2/2	2		☑	☑									☑	☑						
3 366	Gravel Pit Location 3	15 cm	Oct. 25 11:20	Gravel		2/2	2		☑	☑									☑	☑						
4 367	Gravel Pit Location 4	15 cm	Oct. 25 11:10	Gravel		2/2	2		☑	☑									☑	☑						
5 368	Gravel Pit North Composite Sample	15 cm	Oct. 25 12:21	Gravel			2														☑	☑				
6 369	Gravel Pit South Composite Sample	15 cm	Oct. 25 11:45	Gravel			2														☑	☑				
7																										
8																										
9																										
10																										

Samples Relinquished By (Print Name and Sign)	Date/Time	Samples Received By (Print Name and Sign)	Date/Time
Thomas Tyler	Oct 25, 2021	Anthony	25 Oct 2021

Pink Copy - Client
Yellow Copy - AC
White Copy- AG

Page 1 of 2

C 63885

25-OCT '21 PM 3:31

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webearth.agatlabs.com

Chain of Custody Record

Emergency Support Services Hotline 1-855-AGAT 245 (1-855-242-8245)

Report to:

Company: Burnco Rock Products ltd,

Same as COC#:

	LABORATORY USE (LAB ID #)	SAMPLE IDENTIFICATION	DEPTH	DATE/TIME SAMPLED	SAMPLE MATRIX	COMMENTS (FILTERED, PRESERVED, HAZARDOUS*) *ADDITIONAL FEE	# OF CONTAINERS VIALS / JARS	# OF CONTAINERS BAGS	# OF CONTAINERS BOTTLES
1	32370	River Sample 1	15 cm	Oct. 25 9:35	Gravel		2/2	2	
2	371	River Sample 2	15 cm	Oct. 25 10:20	Gravel		2/2	2	
3	372	River Sample 3	15 cm	Oct. 25 13:45	Gravel		2/2	2	
4	373	River Sample 4	15 cm	Oct. 25 15:40	Gravel		2/2	2	
5	374	River West Composite	15 cm	Oct. 25 10:30	Gravel			2	
6	375	River East Composite	15 cm	Oct. 25 13:45	Gravel			2	
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
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20									
21									
22									
23									
24									
25									

	Detailed Salinity: ☑ AB ☐ SK ☐ BC ☐ D50	CCME/AB : BTEX/F1-F4 ☐ CCME/AB : BTEX/F1-F2	BC: BTEXS/VPH/EPH ☐ BC: LEPH/HEPH	SK: BTEX/TVH/C11-C22, C23-C60	Soil Metals: ☐ HWS-B ☐ SP-B ☐ Hg ☐ Cr^{6+}	Water Metals: ☐ Dissolved ☐ Total ☐ Hg ☐ Cr^{6+}	Routine Water Chemistry	Landfill: ☐ AB Class 2 ☐ BC ☐ SK	Coliforms: ☐ Total ☐ Fecal ☐ E.coli	Particle Size: ☐ Sieve (75µm) ☐ Texture	Alberta Tier 1 Metals Extended	PAHs in Soil Tier 1	Strong Acid/Base Accounting (Modified Sobek)	TCLP Leacable Metals, Class 2	HOLD FOR 30 DAYS NO ANALYSIS (Additional Fee)	HOLD FOR 30 DAYS AFTER ANALYSIS (Additional Fee)
1	☑	☑									☑	☑				
2	☑	☑									☑	☑				
3	☑	☑									☑	☑				
4	☑	☑									☑	☑				
5											☑	☑				
6													☑	☑		
7													☑	☑		

Samples Relinquished By (Print Name and Sign)	Date/Time	Samples Received By (Print Name and Sign)	Date/Time
Thomas Tyler	Oct 25/21		25 Oct. 2021
Samples Relinquished By (Print Name and Sign)	Date/Time	Samples Received By (Print Name and Sign)	Date/Time
Samples Relinquished By (Print Name and Sign)	Date/Time	Samples Received By (Print Name and Sign)	Date/Time

Pink Copy - Client
Yellow Copy - AGAT
White Copy- AGAT

Page 2 of 2

C 63886

AGAT Laboratories

SAMPLE INTEGRITY RECEIPT FORM

RECEIVING BASICS - Shipping

Company/Consultant: Burnco Rock

Courier: DO Prepaid Collect

Waybill#

Branch: EDM GP FN FM RD VAN LYD FSJ EST SASK Other: C

If multiple sites were submitted at once: Yes (No)

Custody Seal Intact: Yes No (NA)

TAT: <24hr 24-48hr 48-72hr (Reg) Other

Cooler Quantity: 2

TIME SENSITIVE ISSUES - Shipping

ALREADY EXCEEDED HOLD TIME? Yes No

Inorganic Tests (Please Circle): Mibi , BOD , Nitrate/Nitrite , Turbidity , Color , Microtox , Ortho PO4 , Tedlar Bag , Residual Chlorine , Chlorophyll* , Chloroamines*

Earliest Expiry:

Hydrocarbons: Earliest Expiry w/ methanol vials

SAMPLE INTEGRITY - Shipping

Hazardous Samples: YES (NO) Precaution Taken:

Legal Samples: Yes (No)

International Samples: Yes (No)

Tape Sealed: Yes (No)

Coolant Used: Icepack Bagged Ice Free Ice Free Water (None)

Temperature (Bottles/Jars only) N/A if only Soil Bags Received

FROZEN (Please Circle if samples received Frozen)

1 (Bottle/Jar) 12 + 12.5 + 13 = 12.5 °C 2(Bottle/Jar)___+___+___=___°C

3 (Bottle/Jar)___+___+___=___°C 4 (Bottle/Jar)___+___+___=___°C

5 (Bottle/Jar)___+___+___=___°C 6 (Bottle/Jar)___+___+___=___°C

7 (Bottle/Jar)___+___+___=___°C 8 (Bottle/Jar)___+___+___=___°C

9 (Bottle/Jar)___+___+___=___°C 10 (Bottle/Jar)___+___+___=___°C

(If more than 10 coolers are received use another sheet of paper and attach)

LOGISTICS USE ONLY

Workorder No: 21C82138

Samples Damaged: Yes (No) If YES why?

No Bubble Wrap Frozen Courier

Other:

Account Project Manager: _____ have they been notified of the above issues: Yes No

Whom spoken to: _____ Date/Time: _____

CPM Initial_____

General Comments:

* Subcontracted Analysis (See CPM)

Date issued: March 11, 2020
Document ID: SR-9505.004

Appendix G Turbidity Discussion

Secondary Water Resource Assessment

West Cochrane Gravel Pit

BURNCO Rock Products Ltd.

SLR Project No. 212.30025.00000

January 12, 2023

Appendix G Turbidity Discussion

It has been our long experience that turbidity is not generally an issue in groundwater around sand and gravel excavations. For the following discussion we assume that the aggregate is removed down to 1 m above bedrock and remains saturated below the floor of the pit. When one examines the physics of the settling of particulate matter, it becomes apparent why this observation is valid. There are two directions of movement: downward under the force of gravity; and horizontally as the groundwater moves through the sand and gravel under the excavation (pit) area and beyond. The net result of these two directions describes what will occur.

In the case of vertical movement particulate matter will fall through the water under the force of gravity, as slowed by the fluid drag on the particles. Smaller particles fall more slowly than bigger particles, all of which is described by Stoke's Law. Using Stoke's law (see appended calculation at the end of this discussion) and a particulate diameter of 0.4 µm representative of the bottom end of the range for silt, a settlement velocity of 1.3 cm/day may be determined. (For the sake of comparison, the upper range of size of silt particles (12 µm) was considered and the corresponding settling rate was much higher at 11.7 m/day.) These are the rate and time of settlement in an unimpeded water column. The water column, however, winds through the porous medium that is sand and gravel and to assess the effect of that one employs the concept of tortuosity. Tortuosity has been estimated to be 1.5 for these materials. Thus, a settlement velocity of 1.3 ÷ 1.5 = 0.87 cm/day. For 1 m of saturated aquifer below the base of the pit, this infers a settling time of 115 days.

With respect to the horizontal movement, the water will follow the lateral movement of groundwater in the saturated sand and gravel. It is convenient to picture the water column described above moving laterally. So, by the time the particle settles out, it will happen at the point that particular unit reaches after 115 days. (For the sake of comparison, the upper range of silt particles will settle in under a day.) To do this, a reasonable estimate of the average linear groundwater velocity is needed.

The average linear groundwater velocity (V) in the sand and gravel can be calculated from:

$$V = K\, i / n_e$$

Where **K** is the geometric mean hydraulic conductivity (11.6 m/day), **i** is the average horizontal hydraulic gradient (0.009 m/m) and **n** is the effective porosity. Without site specific measurements of porosity, the sand and gravel soils are estimated to have an effective porosity of approximately 0.3 m^3/m^3 based on the average effective porosity (30%) of a gravel.

Therefore, **V** = (11.6 x 0.009) / 0.3 = **0.35 m/day**

The migration distance can be determined by multiplying the downward travel time (115 days) by this average lateral velocity of 0.35 m/day. Based on this, the smallest particle would settle by about 40 metres from the edge of the excavation (pit) area. The reader should be reminded that outside the edge of the excavation (pit) area there is a constant addition of clear water from above which, even if there was turbid water entering the groundwater from the excavation (pit) area, would suppress and further dilute this turbidity. Based on the foregoing, it is clear that turbid water does not travel far from the excavation (pit) area and the Bow River, which is 150 m away at its nearest point, Grand Valley Creek, which is about 100 m away or Beaupre Creek, which is around 70 m away should be protected.

The above calculations, including the average linear velocity, rely on average conditions. A heavy rainfall event on clean sand and gravel will generate little turbidity, but for the sake of discussion, we conservatively assume here it will. Given the very high hydraulic conductivity of the sand and gravel, there will not be a very significant rise in driving head so the measured site hydraulic gradients will remain about the same, and thus the downgradient migration rate will also be about the same.

Based on the above calculations, we conclude that a short turbidity plume of declining concentration could be created by a high rainfall event. We estimate it would migrate just over 40 m away from the edge of the excavation. Given that the nearest receptors (rivers and creeks) are over 70 m away, there are no potential receptors that could be impacted.

References

G.1 References

BURNCO Rock Products Ltd. 2021a. *Master Site Development Plan, West Cochrane Gravel Pit, NE 15-26-05 W5M (Title # 141P219), N/2 14-26-05 W5M (Title # 151 199 374), W/2 13-26-05 W5M (Title # 151 199 374 +1), NE 13-26-05 W5M, SE 24-26-05 W5M (Title # 141 167 388), SE 13-26-05 W5M (Title # 141 167 387), W 18-26-04 W5M (Title 141 167 389), NW 18-26-04 W5M, SW 19-26-04 W5M (Title # 141 167 390), SE 18-26-04 W5M, NE 18-26-04 W5M (Title # 141 167 053)*. June 2020 v.3, Revised May 2021.

BURNCO Rock Products Ltd. 2021b. *Water Act Approval Application, West Cochrane Gravel Pit, NE 15-26-05 W5M (Title # 141P219), N/2 14-26-05 W5M (Title # 151 199 374), W/2 13-26-05 W5M (Title # 151 199 374 +1), NE 13-26-05 W5M, SE 24-26-05 W5M (Title # 141 167 388), SE 13-26-05 W5M (Title # 141 167 387), W 18-26-04 W5M (Title 141 167 389), NW 18-26-04 W5M, SW 19-26-04 W5M (Title # 141 167 390)*.

Fennell, J. 2021. *Re: West Cochrane Pit soil column flushing experiment*. Rocky View Gravel Watch. https://www.rockyviewgravelwatch.com/_files/ugd/1ab202_a248dc9d5d7c42b6b9f698ace7286b85.pdf. Accessed January 5, 2022.

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