SCREENING LEVEL ASSESSMENT OF TWO SUMAS MOUNTAIN QUARRIES

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LIST OF ACRONYMS

BBS	Bianchini Biological Services
BCCDC	British Columbia Conservation Data Centre
BMP	Best Management Practices
CoA	City of Abbotsford
CoA SPB	City of Abbotsford's Streamside Protection Bylaw No. 1465-2005
CGPVT	Cleared/Gravel Pit Vegetation Type
CWD	Coarse Woody Debris
DFO	Fisheries and Oceans Canada
EMCP	Environmental Mitigation and Compensation Plan
FVC	Fraser Valley Conservancy
Gpm	gallons per minute
HADD	Harmful Alteration, Disruption or Destruction of fish habitat
L.S. 13	Sec 28, Twn 19, Plan L.S. 13
L.S. 16	Sec 29, Twn 19, Plan L.S. 16
532470 BC	A Numbered Company – operator of quarries
Levelton	Levelton Consultants Ltd.
Lot 2	Lot 2, Sec 29, Twn 19, Plan BCP03736
Lot S1/2	Lot S1/2, Sec 32, Twn 19, Plan SE1/4
M	Metre
MFLNRO	Ministry of Forests, Lands and Natural Resource Operations
MMFVT	Mature Mixed Forest Vegetation Type
MOE	Ministry of Environment
Jamieson	Jamieson Quarries Ltd.
MB	McKay Brook
OCP	Official Community Plan
QEP	Qualified Environmental Professional
SARA	Species at Risk Act
SMEA	Sumas Mountain Elegibility Area
SMP	Stormwater Management Plan
SPEA	Streamside Protection and Enhancement Area

SRDP	Soil Removal and Deposit Permit
SRS	Scott Resource Services Inc.
TOB	Top of Bank
WC	Watercourse
YDFVT	Young Deciduous Forest Vegetation Type

1. INTRODUCTION

This document provides a screening level assessment of two quarries operating at Sumas Mountain: the Summit Quarry operated by 532470 BC Ltd. (532470 BC) and the Jamieson Quarry operated by Jamieson Quarries Ltd. (Jamieson). The operators retained Levelton Consultants Ltd. (Levelton) to manage the environmental component and Levelton retained Scott Resource Services Inc. (SRS) in association with Bianchini Biological Services to undertake an Environmental Assessment (EA) of the aggregate quarries located on Sumas Mountain, Abbotsford, B.C.

The two operators currently have permits for aggregate extraction down to the 200 m elevation. They are now seeking approval to expand their operations for aggregate removal from the 200 m elevation down to the 170 m elevation. The two operators are requesting an amendment to their existing Soil Removal and Deposit Permits (SRDPs) for aggregate extraction within the Sumas Mountain Eligibility Area. The quarry operators plan to coordinate operations to lower the elevation of the working surfaces within the quarry footprints, from 200 m to 170 m. The overall footprint of the quarries will increase by approximately 20% (rounded to the nearest 5%). Each operator will submit their own application for the amendment for the Notice of Work, but for efficiency the EA covers both projects.

The original draft of the EA was prepared when it was expected that the City of Abbotsford's (CoA) Streamside Protection Bylaw would have to be applied. However, after discussions with the CoA, approval was given to follow the BC Ministry of Environment Riparian Areas Regulation (RAR) instead of the Abbotsford bylaw. Upon completion of negotiations with environmental regulators, the proponent's Qualified Environmental Professional will prepare an Environmental Mitigation and Compensation Plan (EMCP). The EMCP will provide options for offsite habitat compensation in order to achieve no net loss to the productive capacity of the watershed.

This summary report is based on:

- SRS's assessments of fish and wildlife habitat, and ecological communities that could be affected by the proposed mining activity,
- Levelton's desktop hydrological assessment, and
- Levelton's overview study of the Sumas Mountain aggregate resource mining and reclamation plan.

2. PROJECT OBJECTIVES AND JUSTIFICATION

In 2009 Levelton, under contract to CoA, conducted an overview study of the mining operations located on the south side of Sumas Mountain. The overview assessment was conducted in order to determine the feasibility of mining from the 200 m elevation down to 170 m and amending the former Official Community Plan (OCP) Bylaw (1483-2005) to reflect this. CoA Council has since approved OCP Bylaw, 2005, Amendment Bylaw No. 10-01 (No. 1957-2010) and has included the Sumas Mountain Eligibility Area (SMEA) into the OCP. This allows the CoA to review proposals to the 170 m elevation within the SMEA (CoA, 2010).

Aggregate resources in the Lower Mainland are in great demand and it makes sense from an economic and environmental standpoint to extract and haul these resources locally. By expanding the aggregate removal to the 170 m floor elevation, mining operations would be expected to continue for approximately 30 to 40 additional years (Levelton, 2009). This will inject money into the local economy and reduce fuel consumption and greenhouse gas emissions by keeping extraction and hauling operations local. The plan is to mine the area flat down to the 170 m level in

those areas where the 170 m contour is within quarry property. In other words the mine will be a plateau day lighted to the 170 m level.

As an alternative to expanding the existing quarry sites, new quarries could be developed in other regions of the Lower Mainland. However, this would have a larger ecological footprint as additional roads would need to be constructed and potentially undisturbed and intact habitat areas would be impacted.

In addition, future land use planning supports development within the SMEA. The groundwork will be laid out for such development to occur upon completion of mining to the proposed 170 m elevation. Utilities, transportation, sustainable stormwater management features, and protected areas will already be established.

3. GENERAL PROJECT DESCRIPTION

3.1 SITE DESCRIPTION

532470 BC and Jamieson have existing approvals to mine down to the 200 m elevation for the quarries on the southern slope of Sumas Mountain, Abbotsford, B.C. (Figures 1 and 3). The total area of the two quarries is approximately 83 hectares and the zoning is One Unit Rural Residential and Resource Use Zone with the exception of Lot 1, Sec 32, Twn 19, Plan 64443 which is zoned One Unit Rural Residential Zone (RR2) and is presently not being used for any mining operations (CoA Web map, 2011).

Over half of the total area is being actively mined under existing permits for aggregate extraction to the 200 m floor elevation (yellow contour line in Figure 2). The forested areas of the site are primarily second growth, dominated by mature deciduous trees and shrubs and provide quality vegetation and wildlife habitat. The site maintains several groundwater seepages that ultimately discharge to the Sumas River. Residential properties to the north and east, mining quarries to the south, and a mining quarry and Kinder Morgan Canada Tank Farm to the west surround the site.

The study area for this assessment, therefore consists of the land within the property boundaries shown in Figures 2 and 3 plus any vegetation, habitat or water courses that are within 50 m of the property and which may be impacted by the quarry activities.

3.1.1 532470 BC

There are three properties currently being mined that are operated by 532470 BC within the Summit Quarry: Lot 2, Sec 29, Twn 19, Plan BCP03736 (Lot 2); Sec 29, Twn 19, Plan L.S. 16 (L.S. 16); and, Sec 28, Twn 19, Plan L.S. 13 (L.S. 13) (Figure 2). Access to the quarry is via Ward Road. The geology of this quarry consists mainly of igneous granitic rock (Levelton, 2009).

The Summit Quarry has an existing permit for extraction down to the 200 m floor elevation. 532470 BC estimates that mining down to the 200 m elevation will continue for approximately four more years.

The southern half of Lot 2 and east 2/3 of L.S. 13 have not been disturbed. Four groundwater seepages drain from the north and east side of the property into McKay Brook (MB), which drains through the northeast corner of the property and one unnamed tributary (WC19) transects properties L.S. 16 and Lot 2. For everything between the 200 m and the 170 m elevation that will be cleared, habitat compensation is proposed for impacts to this watercourse.

3.1.2 Jamieson Quarries

Three properties currently being mined are operated by Jamieson namely the Jamieson, Friesen and Emmerson lands. The respective properties include Lot S1/2, Sec 32, Twn 19, Plan SE1/4; Lot 2, Sec 32, Twn 19, Plan 64443; and, Lot 3, Sec 32, Twn 19, Plan 64444. Access to the quarries is via Ward Road. The geology of these properties consists mainly of igneous granitic rock (Levelton, 2009).

The quarries have existing permits for extraction down to the 200 m floor elevation. Jamieson estimates that mining to the 200 m elevation will continue for another ten to fifteen years.

The north and east perimeters of quarry operations slope into a ravine which has been relatively undisturbed. MB drains southeast through the ravine and across the northeast corner of the quarry. Five groundwater seepages drain from the north and east side of the proposed site towards MB. Three watercourses (WC 7, 12 and 18) and one pond (Pond 1) exist between the 200 and 170 m elevations. Between these contours, Pond 1, WC 7 and WC 12 will be removed and replaced with offsite compensation. WC 18 will remain in place with a 10m buffer zone. Pond 2 (above 200 m) will remain accessible per the current approved mining plan for clean-out of sediment from its storm water retention function.

4. PROJECT OVERVIEW AND SCOPE

4.1 PROPOSED ACTIVITIES

532470 BC and Jamieson are proposing to mine the existing quarries on the south slope of Sumas Mountain down from the 200 m elevation to the 170 m elevation. This will require clearing, extracting, and reclaiming the area while maintaining base flows to the two main watercourses draining the site, McKay Brook and Kilgard Creek.

4.1.1 Clearing and removal of overburden materials

The undisturbed forested areas will require clearing down to the 170 m elevation. Clearing will be conducted between August 16th and March 14th to avoid nesting birds. If clearing is essential during the nesting period, a detailed raptor survey and bird nesting survey will be required prior to any clearing activities. If nesting birds are detected, clearing activities will require management plans with appropriate avoidance buffers and monitoring in order to protect and monitor the nesting birds while the works commence, or clearing will need to be avoided in affected areas until the birds have fledged. Timber resources will be harvested and overburden materials removed immediately after clearing. Overburden materials will be sorted by type and stockpiled in a location where they can be accessed and reused during reclamation upon completion of mining (Levelton, 2009).

4.1.2 Quarry operations

The quarry operations consist of blasting, gravel crushing and screening, and hauling. The quarries will mine in approximate 15 m layers until mining is complete (Levelton, 2009). Blasting will continue as currently approved to the 200 m elevation. No additional facilities will be required for gravel crushing operations or for maintenance and fuel storage.

Transportation corridors already exist for hauling aggregates extracted down to the 200 m elevation. Both quarries utilize the Truck Route to link Ward Road with Atkinson Road and Highway 1. The Truck Route is a statutory right-of-way with a 10-year lease period (Levelton, 2009). All truck traffic exits via Ward Road to the truck route.

4.1.3 Post-mining activities

Upon completion of mining, soil and substrate engineering may be required to provide infiltration and detention of groundwater seepages to maintain flows to downstream watercourses in order to mimic pre-existing flow rates, water quality, and watercourse features and functions.

4.2 FUTURE LAND USE

Future land use is ultimately contingent on the CoA's OCP Bylaw No. 1957-2010. Before the OCP Bylaw amendment, the future land use designations for the quarries were designated as a mix of Suburban Residential and Resource Conservation (Levelton, 2009). These designations may change before mining is finished, but in any event, future use will be based OCP requirements.

4.3 TIMELINE AND PHASING

Extraction to the proposed 170 m floor elevation will occur over 30 to 40 years. Therefore, works will be conducted gradually. Operations will continue in the same manner as currently approved to the 200 m elevation. Post-mining activities including any remedial works required will be conducted upon completion of mining down to the 170 m elevation.

5. REGULATORY FRAMEWORK

The regulatory framework and processes applicable to the project are outlined within the Levelton overview assessment prepared for the CoA in 2009. In 2010, since the overview assessment was prepared, OCP Bylaw No. 1957-2010 came into force allowing proposals within the SMEA to be reviewed by the CoA down to the 170 m elevation. Also in 2010, the CoA introduced the Erosion and Sediment Control Bylaw No. 1989-2010, which prohibits the discharge of sediment or sediment-laden water into any watercourse.

Specific to fish habitat as outlined in this assessment, the Provincial RAR provides the definition of fish habitat and outlines the SPEA widths for watercourses that are classified as streams providing fish habitat.

Subsection 35(1) of the federal *Fisheries Act* prohibits any harmful alteration, disruption or destruction of fish habitat (HADD) from occurring, unless otherwise authorized under Subsection 35(2). Subsection 36(3) of the *Fisheries Act* prohibits the release of deleterious substances either directly or indirectly into any fish bearing water.

Section 9 of the provincial *Water Act* requires that any changes in or about a stream be conducted under an approval in accordance with Part 7 of the provincial Water Regulation.

6. DESCRIPTION OF THE ENVIRONMENT

6.1 HYDROGEOLOGICAL ASSESSMENT

6.1.1 Background

This section is based on Levelton's desktop hydrogeological assessment for the above-referenced properties and is provided in the accompanying documentation.

The quarries have been developed in predominantly Lower Jurassic[1] massive volcanic rocks of the Harrison Lake Formation, starting at elevations ranging from 220 to 250 m asl. The BC Geological Survey[2] has mapped the bedrock as intermediate, light coloured flows and pyroclastic[3] rock. There are small inclusions of fine-grained sediment and conglomerate present within the volcanic host rock. As the volcanic rock mass cooled, following its emplacement, an interconnected series of joints, faults and fractures developed.

The bedrock west of the quarries consists of Eocene aged[4], undivided sedimentary rock of the Kitsilano Formation and includes conglomerate, sandstone, shale with lesser basalt flows and minor pyroclastics. The sedimentary rock inclusions within the Lower Jurassic volcanics are likely pieces of the Kitsilano Formation rocks.

The surficial deposits consist of Sumas Drift of varying thickness and locally developed colluvial and organic based soils. Sumas Drift includes glacial till, glacio-fluvial outwash sand and gravel and ice-contact sediments, deposited during the last Ice Age, between roughly 10,000 and 11,500 years ago. The surficial material did not form a continuous cover and has been stripped to facilitate the quarrying of bedrock.

Levelton conducted a visit in late January 2011 to review site conditions and to familiarize staff with the local geology and the hydrogeological setting. During inspections of the Jamieson Quarry, the Summit Quarry and the Western Rock Products Quarry on LS 9, our field observations of the geology matched the mapping described above.

6.1.2 Hydrogeological Setting

The quarries are located within a groundwater recharge area. Given the quarries' elevation and the surrounding topography, the only source of recharge for groundwater on Upper Sumas Mountain is precipitation. Rainfall records for Mission West and the Abbotsford Airport revealed that an average of 1,875 mm and 1,573 mm of precipitation falls annually at these stations, respectively. However, the precipitation on the top of Sumas Mountain may be as much as 25 to 40% higher than that recorded at lower elevations, due to orographic influences[5]. Although the majority of the precipitation falls between October and March, there is a significant portion of the annual precipitation that falls during the remainder of the year.

A portion of the precipitation falling on Sumas Mountain will return to the atmosphere via evapotranspiration. The remainder will initially be retained in the either unsaturated areas in the soil or within shallow, weathered and fractured bedrock. Some of the precipitation that recharges the unsaturated zone will flow through the subsurface towards local topographically low areas and discharge after a brief travel time[6]. The remaining precipitation will migrate vertically downwards through the unsaturated material and act as recharge to the shallow and deep groundwater flow systems.

Shallow groundwater and interflow may also be discharged as seepages in rock faces, where fractures 'daylight'. During the visit, Levelton staff noted seepage in the northeast corner of LS 9 and the central area of the Makara lot. We were unable to determine if this was shallow

1 The Jurassic period ranged from 213 to 144 million years ago.
2 BC Geological Survey Open File 1994-17, K. Bellefontaine, D. Alldrick and P.J. Desjardins.
3 Pyroclastic rocks consist of fragmented particles, caused by volcanic explosions.
4 The Eocene epoch ranged from 55 to 38 million years ago. Geologically, an epoch is a subdivision of a period.
5 As moist air rises and cools over a mountain, precipitation is produced.
6 Subsurface water that migrates through the unsaturated zone prior to discharge is not considered groundwater (which only occurs under fully saturated conditions) but is termed interflow.

groundwater or interflow. However, our site guide indicated that the flow tends to cease after prolonged periods in the summer with no precipitation, indicating that the flow is likely shallow seasonal groundwater.

Precipitation that falls on exposed bedrock will infiltrate directly, and then migrate deeper into the groundwater flow system under the influence of gravity, along faults, fractures and joints in the bedrock. The fracture system is likely complex and consists of both interconnected and discontinuous fractures of varying lengths, widths and continuity. The shallow and deep groundwater flow systems likely exhibit seasonal, and possibly annual, fluctuations in water levels, depending on the seasonal variability of precipitation.

There are two potential aquifers on Sumas Mountain. The first is a shallow, unconfined aquifer hosted in the surficial Sumas Drift deposits. Unconfined shallow aquifers tend to be hosted in sand and gravel deposited either by flowing water or glacial ice. Typically shallow aquifers dry up in summer after periods of minimal precipitation and during periods of high evapotranspiration. Because the water is present under fully saturated conditions, even if only for part of the year, it is considered groundwater and is commonly called a perched or seasonal water table.

The second aquifer is hosted deep within the bedrock. Groundwater flow through the massive bedrock tends to be complex and is typically controlled by the geometry and connectivity of fractures, faults and jointing. Well yields in bedrock aquifers, while suitable for domestic use, tend to be low, depending on the number and spacing of fractures intercepted during well drilling.

A thorough understanding of groundwater flow in bedrock aquifers requires detailed study and numerical modeling. This type of study has not been completed in the Sumas Mountain area. For the purposes of this report, groundwater flow is assumed to largely follow surface topography and move south towards the Fraser Valley under the influence of gravity

6.1.3 Water Quality

Levelton was unable to review any water quality data for local wells, as none was listed in the *BC Water Resources Atlas*. However, we expect that the shallow groundwater surrounding the quarries is of high quality, as it is derived from precipitation and has short residence times as both surface and groundwater flow. Locally, the surficial deposits may have high organic content that may contribute to elevated concentrations of iron, manganese, tannins and lignins. Levelton expects these areas are small and uncommon on Sumas Mountain.

The deeper groundwater is likely also high quality, as the predominantly volcanic rocks are resistant to weathering and groundwater residence time is also relatively short.

6.1.4 Water Well Records

Levelton reviewed water well and aquifer information contained in the *BC Water Resources Atlas*, an on-line database maintained by the Ministry of Environment (MOE). This database was populated with well logs that were submitted on a voluntary basis by water well drillers or well owners. Well logs were not subjected to quality checks and frequently use different terms when referring to the same deposit. Nevertheless, they form a valuable database for assessing hydrogeological settings. Aquifers that are presented in the database were mapped largely on the basis of water well records, surficial geology mapping and topographic or physical features.

There were no aquifers identified on Sumas Mountain by the MOE, as there are too few water wells to allow complete aquifer mapping. However, numerous water well records submitted to the database show essentially two main types of wells – shallow dug wells that are developed in the surficial deposits and deeper, drilled bedrock wells. The well logs reviewed by Levelton are

presented in Appendix 1 of the attached hydrogeological assessment. Well tag numbers match those presented in Figure 6.

As shown in Figure 6, there are numerous water wells located on Keeping Road to the north of the existing quarries, on Sumas Mountain Road to the west, and on Ward Road to the south. There may be additional wells in the area that are not listed in the database as well drillers and owners are not required to submit well records. The locations of the wells in the database are approximate and their status and use are unknown.

A summary of the information in the *BC Water Resources Atlas* for the shallow wells, dug in surficial deposits shows that well yields are generally very low (Table 1 – well numbers correspond to those shown in Figure 6) and numerous well logs contain comments related to the well drying up or being inadequate during summer months. It is likely that these shallow wells were developed into a perched water table that contains enough groundwater for domestic use for most of the year, but dries up in late summer.

Table 1: Summary of Shallow Well Information near Sumas Mountain Quarries.

Well Number	Location	Depth (m)	Material	Driller Estimated Well Yield (gpm)
6628	Keeping Rd	3.65	Glacial clay	0
6684	Keeping Rd	3.65	Glacial hardpan	0 (Insufficient in dry season)
6686	Sumas Mtn Rd	4.57	Glacial	0 (Insufficient in dry season)
6642	Sumas Mtn Rd	5.49	Glacial	0
6777	Sumas Mtn Rd	3.05	Glacial quicksand	0 (Insufficient in dry season)
6710	Sumas Mtn Rd	6.40	Glacial	0 (Insufficient)

Although there are no records of shallow wells along Ward Road, Levelton is aware of one shallow, dug well located at 37316 Ward Road[7]. The well is roughly 8 m (25 feet) deep and is located in the unnamed watercourse that originates within the Summit Quarry at 37403 Ward Road. According to the previous property owner, the unnamed watercourse tends to dry up in late summer; however, this well has been able to supply the three residences located at 37314 and 37316 Ward Road. Levelton has been unable to assess the validity of this observation.

Figure 6 also shows the approximate locations of several deep, bedrock wells, including four wells drilled on properties located on Ward Road. There does not appear to be any pattern to the location or depths of the wells. The well records indicate that the wells ranged from 60 to 160 m in depth and that yields were generally low, which is typical of bedrock wells. One well on Keeping

[7] *Overview Study, Sumas Mountain Aggregate Resource Mining and Reclamation Plan*; Levelton File Number FV08-0434. June 2009.

Road had an estimated yield of 1.9 L/s (30 gpm), which is high for a well drilled in bedrock. This well likely was drilled into an area where a number of fractures intercepted or into a local fault zone. A summary of well information for bedrock well logs in the *BC Water Resources Atlas* is listed in Table 2. The wells along Ward Road ranged from 60 to 65 m deep and reported yields were low.

Table 2: Summary of Deep Well Information near Sumas Mountain Quarries.

Well Number	Location	Depth (m)	Material	Driller Estimated Well Yield (gpm)
101305	Keeping Rd	129.5	Shale	1
101306	Keeping Rd	99	Shale	1.25
67529	Keeping Rd	160	Bedrock	30
100947	Sumas Mtn Rd	61	Grey sandstone	3
1177	Ward Rd	67	Shale, bedrock, granite	0
47355	Ward Rd	67	Green bedrock, granite	0
52147	Ward Rd	61.5	Green granite, black shale quartz, some limestone	0.5
52102	Ward Rd	61.5	Black shale, green granite	1

Figure 6 indicates a well on the property north of Ward Road (Well 75552), which appears to be within the Makara lot. The well record shows that it was drilled for Mr. Jamieson in 1984 and the well yield was 0 gallons per minute (gpm). No other information regarding well depth, water level or whether this well is bedrock or shallow, dug well is listed. Levelton is of the opinion that the indicated location of this well is likely inaccurate and that it is located near the former Jamieson residences, north of its indicated location.

However, there is likely at least one well serving the residence located just west of the Makara lot, near the intersection of Ward Road and Sumas Mountain Road. Levelton was unable to find any well records for wells on this property in the *BC Water Resources Atlas.*

6.1.5 Potential Recharge Impacts

6.1.5.1 Unnamed Creek (WC 19)

Levelton understands that the unnamed creek currently flows virtually year round, although anecdotal information from both the former owner of 37316 Ward Road and Levelton's site guide indicated that the flow slows considerably or dries up completely during late summer, depending on the severity of the summer. During our site visit, Levelton observed an area of undisturbed overburden on both sides and upslope of the unnamed creek. The surficial deposits, as well as the sedimentation ponds observed on the Summit Quarry, likely serve as a source of recharge to the

unnamed creek during periods of non-precipitation and provide base flow to the creek on a year round basis.

Currently the water in the unnamed watercourse is derived from a combination of overland (surficial) flow, interflow and shallow groundwater during wet winter months and primarily from shallow groundwater during dry parts of the year. Winter precipitation saturates the surficial deposits, which discharge base flow into the unnamed watercourse during periods of low or no precipitation. The unnamed watercourse is a local groundwater discharge zone.

Based on Levelton's field visit and background information review, Levelton understands that the lowering of the pit floors to elevation 170 m, from elevation 200 m will involve:

1. removal of soil cover and vegetation surrounding the unnamed creek;
2. flattening the overall site topography; and
3. effectively eliminating any surficial deposits within the quarry footprints.

Any area where drilling and blasting occurred, the resulting fractured rock will likely allow winter precipitation to infiltrate and recharge the unnamed creek.

Removal of the surficial deposits will likely have a direct impact on the unnamed creek and the shallow well discussed above that has supplied the three residences on Ward Road. The removal of the surficial deposits surrounding the unnamed watercourse and the lowering of the quarries to elevation 170 m will essentially eliminate the storage of shallow groundwater within the surficial deposits and disrupt the area that contributes recharge into the watercourse. Disruption of the recharge may reduce or eliminate both interflow and the flow of shallow groundwater into this well and may cause either periodic or permanent water shortages for the well users. It may be possible to mitigate this loss of recharge water by developing a series of large sedimentation ponds on the upstream portions of the Makara property or the Summit Quarry.

6.1.5.2 Nearby Shallow Wells

As discussed, lowering the pit floors to elevation 170 m will involve removing the soil cover and vegetation (if present) and flattening the overall site topography. Recharge of the bedrock aquifer will be via direct infiltration. Discussions with the quarry operators indicate that drilling and blasting tends to fracture the rock below the excavation level. As a result, water is not observed to accumulate in the quarries, but instead percolates into the subsurface. The impacts to nearby offsite, shallow wells due to the removal of glacial, deposits within the quarry footprints is likely negligible.

6.1.5.3 Bedrock Wells

Depending on the slope and configuration of the working areas within the quarry footprints, recharging precipitation may infiltrate the bedrock more quickly and may enhance the groundwater levels and volumes within the bedrock aquifer. However, faster runoff times and shorter runoff distances may offset the increased recharge, as precipitation flows across the working surface into engineered catchment areas or towards the property boundaries.

The blasting associated with lowering the quarry floors may also impact well water quality or quantity. The property owner at 37314 Ward Road reported that the well deteriorated following blasting and that the well was abandoned as a result. In addition, the well owner at 37226 Keeping

Road (Well 101305) has experienced silt or sand in the well since 1995[8]. Whether the problems with silt and sand were related to blasting was not discussed in the background reports that Levelton reviewed.

Levelton is familiar with changes in groundwater quality and quantity elsewhere in BC due to blasting vibrations being transmitted through bedrock. Impacts may include changes in water chemistry as well as increases in turbidity and sand content. Occasionally increases or decreases in yield have also been noted by well users, as blasting has either opened fractures or caused them to close. Given the distances between the bedrock wells and the quarries, and given the well depths, Levelton is of the opinion that impacts on the bedrock wells will be negligible.

6.2 DESCRIPTION OF BIOPHYSICAL ENVIRONMENT

6.2.1 Surface Water

As noted in the previous section based on the hydrogeology of the area, precipitation infiltrates into the overburden and is retained within the fractures of the bedrock until seeping out at a lower elevation, becoming a surface flowing watercourse. Flow measurements were collected previously by SRS at three different locations along WC19. It was noted that flows increased as they moved downstream suggesting that there is a "continuous and increasing input of groundwater" seeping out of the bedrock (SRS, 2008).

In active mining areas within the proposed site the infiltration capacity is temporarily removed until blasting commences and new fractures are produced to capture the surface runoff. The surficial runoff of stormwater will be directed towards drainage ditches and sediment detention ponds for infiltration. The sediment detention ponds also improve the quality of the water by removing suspended solids prior to being released to the environment.

6.2.2 Fish and Fish Habitat

SRS conducted the fish habitat assessment of the watercourses that would be potentially impacted by the proposed mining expansion. The assessment was conducted on February 1, 2 and March 16, 17, 23 and 31, 2011 by Selena Shay (BSc), Ryan Anaka (MSc, BA Geog.) and Remi Masson (BSc, Dipl.Tech.) of SRS. Quality assurance of the field assessment was conducted by Patrick Ehnes (R.B.Tech., AScT) on October 31, 2011 to confirm findings of the fieldwork.

Watercourses were classified using the RAR. The functions, features and conditions within and adjacent to each watercourse are summarized below and described in detail in the attached report and Appendices. Watercourse locations have been professionally surveyed.

6.2.2.1 Watercourses Within the Proposed Site

Three watercourses, a pond, and a wetland that offered poor to marginal fish habitat conditions and occurred within the subject properties between the 200 m and 170 m elevations (Table 3 and see also Attachment 4 in Appendix 2 of the SRS assessment report) were noted. The proposed works will permanently affect these watercourses.

[8] *Hydrogeological Report 37124 Keep Road, Sumas Mountain, Abbotsford BC.* Morrow Environmental Consultants File V0-948, February 2001.

Table 3: Classification of watercourses within the subject properties and between the 200 m to 170 m elevations.

Watercourse identifier	Description	Classification (RAR)	Stream (Y/N) per RAR
WC1	Not a stream; discharges towards MB when flowing	Non-permanent, non-fish bearing	N
WC2	Not a stream; discharges towards MB when flowing	Non-permanent, non-fish bearing	N
WC4	Not a stream; discharges towards MB when flowing	Non-permanent, non-fish bearing	N
WC6	Not a stream; terminates to ground	Non-permanent, non-fish bearing	N
WC7	Discharges from Pond 1 and is a tributary directly connected to MB	Permanent stream, non-fish bearing	Y
WC8	Not a stream; discharges into WC7 when flowing	Non-permanent, non-fish bearing	N
WC12	Tributary directly connected to MB	Non-permanent, non-fish bearing	Y
WC17	Not a stream; terminates to ground	Non-permanent non-fish bearing stream	N
WC18	Discharges from Pond 2 and is a tributary directly connected to MB	Permanent non-fish bearing stream	Y
WC19	Tributary to the Sumas River	Permanent fish bearing stream	Y
Pond 1	Tributary directly connected to WC7	Permanent stream, non-fish bearing	Y
Wetland 1	Tributary directly connected to WC19	Permanent non-fish bearing stream	Y

6.2.2.2 Watercourses Adjacent to the Subject Properties and/or Outside of the 170 m to 200 m Elevation

Watercourses within the immediate area and outside of the property boundaries were also assessed. Eleven watercourses offering poor to marginal fish habitat conditions were located

adjacent to the subject properties and/or outside of the 170 m to 200 m elevation (SRS assessment report). Classifications of the watercourses are per the RAR.

Table 4: Classification of watercourses adjacent to the subject properties and/or outside of the 170 m to 200 m elevation.

Watercourse identifier	Description	Classification (RAR)	Stream (Y/N) RAR
MB	Tributary to the Sumas River	Permanent fish bearing stream	Y
Kilgard Creek	Tributary directly connected to the Sumas River	Permanent fish bearing stream	Y
WC3	Tributary directly connected to MB	Permanent non-fish bearing stream	Y
WC5	Tributary directly connected to MB	Permanent non-fish bearing stream	Y
WC9	Not a stream; terminates to ground	Non-permanent, non-fish bearing	N
WC10	Tributary directly connected to MB	Non-permanent, non-fish bearing	Y
WC11	Tributary directly connected to MB	Permanent non-fish bearing stream	Y
WC13	Tributary directly connected to MB	Permanent stream, potentially fish accessible	Y
WC14	Tributary directly connected to WC13	Permanent non-fish bearing stream	Y
WC15	Tributary directly connected to WC13	Permanent non-fish bearing stream	Y
WC16	Tributary directly connected to WC13	Permanent non-fish bearing stream	Y
Pond 2	Tributary directly connected to WC18	Permanent non-fish bearing stream	Y

6.3 VEGETATION AND WILDLIFE

6.3.1 BACKGROUND

SRS requested Bianchini Biological Services (BBS) to conduct a site assessment of the subject properties. BBS undertook a preliminary site assessment of the study area on September 8, 2009, a winter assessment in February 4, 2010 and spring assessments on May 5, 2010 and May 19, 2011.

The site was assessed for occurrences of species listed under the Federal *Species at Risk Act* (SARA), provincially Red and Blue-listed species and for general wildlife and vegetation species as well as raptor/heron nests and current wildlife use. As per the CoA's Wildlife Assessment Report Guidelines (April 2010), a wildlife habitat report was also requested from the Fraser Valley Conservancy (FVC).

The study area fell within the Georgia Depression Ecoprovince, Lower Mainland Ecoregion, and Fraser Lowland Ecosection. The study area was situated in the Dry Maritime Coastal Western Hemlock Biogeoclimatic subzone.

6.3.2 METHODS

Prior to the field assessment, a literature search was conducted covering the Sumas Mountain area of Abbotsford, including British Columbia Conservation Data Centre (BCCDC) searches, Wildlife Tree Stewardship Program, FVC wildlife report and local knowledge. The CoA and provincial web mapping services were also reviewed to obtain the most current aerial imagery. Area calculations were obtained using online mapping tools. The BCCDC website was searched for all species listed under SARA, the Committee on the Status of Endangered Wildlife in Canada, Provincial Identified Wildlife and the Provincial *Wildlife Act* that are suspected to occur within habitats identified within the study area. In addition, species listed as Red and Blue-listed by the BCCDC but not specifically covered under legislation were also included. Data was also requested from the BCCDC for all records within 2 km of the study area.

Random transects were surveyed through all habitats identified during the site assessment. Vegetation species within each site were identified and recorded. In addition, the presence of coarse woody debris (CWD), wildlife trees, dens, burrows and other habitat features were also recorded. All wildlife trees were classified according to methodologies identified by Backhouse (1993) and Fenger et al. (2006).

Pacific water shrew habitat was assessed following methodologies described by Craig and Vennesland 2008. Potential raptor/heron nest trees were scanned visually with binoculars. All wildlife and wildlife sign encountered was recorded.

6.3.3 FEDERALLY AND PROVINCIALLY LISTED SPECIES OF CONCERN

Thirteen federally and/or provincially listed species whose geographic range overlap the subject properties and preferred habitats may occur within the Summit Quarry and Jamieson Quarry study area. These species are listed in Table 5.

Table 5 Federally and/or provincially listed species that occur or may occur in the study area based on BCCDC records, FVC mapping, and local knowledge (SARA 2011, BCCDC 20111, FVC 2011). Likelihood of occurrence within the study area based on the field assessment results is also indicated.

Species	Federal/Provincial Status	Legislation	Site Occurrence

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Species	Federal/Provincial Status		Legislation			Site Occurrence
Common/Scientific Name	COSEWIC/SARA Status	BCCDC Status*	SARA	Provincial Identified Wildlife	Provincial Wildlife Act	Expected Onsite Habitat Use

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6.3.4 RESULTS

6.3.4.1 Vegetation Overview

Three vegetation types were identified within the study area:

1. Mature Mixed Forest Vegetation Type

2. Young Deciduous Forest Vegetation Type

3. Cleared/Gravel Pit Vegetation Type

The location of each of these vegetation types, representative photographs of and a list of observed vegetation species in each type were provided by BBS. The three vegetation types located within the subject area are described below.

Mature Mixed Forest Vegetation Type

The Mature Mixed Forest Vegetation Type (MMFVT) occurred within the northeast portions of LS 13 and Lot S1/2. This generally steep (~40 - 80%), northeast facing (~028^{o} - 055^{o}) forested area was dominated by mature big leaf maple (*Acer macrophyllum*) with western redcedar (*Thuja plicata*), red alder (*Alnus rubra*), western hemlock (*Tsuga heterophylla*) and occasional Douglas-fir (*Pseudotsuga menziesii*), paper birch (*Betula papyrifera*) and black cottonwood (*Populus balsamifera trichocarpa*). The patchy shrub layer was dominated by sparse to dense areas of salmonberry (*Rubus spectabilis*) and snowberry (*Symphoricarpos albus*). The herb layer was dominated by sword fern (*Polystichum munitum*) and youth-on-age (*Tolmiea menziesii*). MB occurred within this vegetation type. In addition, a number of small watercourses, seepages and ephemeral drainages also occurred within this vegetation type (Figure 4).

Young Deciduous Forest Vegetation Type

The Young Deciduous Forest Vegetation Type (YDFVT) was mainly situated within Lot 2 and LS 16 and occurred along an intermittent, unnamed watercourse (WC19). Portions of WC19 appeared to have been mechanically trenched. A road also bisected this drainage with no evidence of a culvert connecting the headwaters (eastern end) to the downstream portion. This vegetation type was dominated by young red alder with salmonberry and thimbleberry (*Rubus parviflorus*). The herb layer was dominated by abundant cover of lady fern (*Athyrium filix-femina*) with occasional bracken fern (*Pteridium aquilinum*), stinging nettle (*Urtica dioica*), youth-on-age, common horsetail (*Equisetum arvense*) and bleeding heart (*Dicentra formosa*).

Two moderate-sized (~10m x 6m) ponds formed a riparian complex and occurred within Lot 2 with the upper pond likely created by the bisecting of the drainage by an access road. The vegetation surrounding these ponds were dominated by willow (*Salix* spp.), red alder with patches of skunk cabbage (*Lysichiton americanus*), gramanoids and aquatic obligates.

A smaller (~3m x 5m) anthropogenic pond occurred at the eastern tip of the YDFVTA. This shallow (<50 cm deep) pond was likely created by the side broadcast of material from the surrounding gravel extraction operation. Young red alder dominated the edge of the gravel bank surrounding the pond. The shrub and herb layer was very sparse and a large algae bloom was evident. No CWD was observed within or adjacent to the pond.

Cleared/Gravel Pit Vegetation Type

The Cleared/Gravel Pit Vegetation Type (CGPVT) was situated throughout most of the study area. This habitat was heavily disturbed with recent clearing occurring at the southwest portion of Lot S1/2 and northern portions of Lot 2 and LS 16 and southwest portion of Lot S1/2. Active gravel extraction occurred in most of Lot S1/2, LS 13 and LS 16.

6.3.4.2 Wildlife Trees

A wildlife tree is any standing dead or living tree with special features that provides present or future important habitats for the maintenance or enhancement of wildlife. There are nine classifications of coniferous and six classes of deciduous wildlife trees in various successions from live and healthy with no decay, to stumps and debris (Fenger et al. 2006). All of these wildlife tree stages provide important habitat, and are known to support more than 90 animal species in British Columbia, including cavity nesting birds and mammals (Backhouse 1993). Some of the uses include nesting, feeding, territoriality (i.e. bear mark trees, bird singing sites, etc.), roosting, shelter, and overwintering (Backhouse 1993).

There are nine decay classes of coniferous trees and six decay classes of deciduous trees within British Columbia (Fenger et al. 2006). Most of the trees observed in the study area were identified as Class 1 wildlife trees. Class 1 wildlife trees are described as live healthy trees with no decay. Class 2 to 7 wildlife trees were also identified within the study area. Most of the decayed trees were situated in the mature portion of the MMFVT.

No active nests were observed within the study area during the field program. Nest cavities (likely from this breeding season) were detected in many of the wildlife trees observed. A number of old cavities were also observed in many of the wildlife trees encountered. These trees also provided habitat for many bird and mammal species including songbirds, squirrels and bats.

6.3.4.3 Coarse Woody Debris

CWD is typically described as woody debris greater than 0.3 m in diameter. CWD provides important foraging, nesting, and cover components in the forested ecosystem for small mammals (Anonymous 1991). Many insectivorous small mammals, birds, and black bears feed on insects found in decomposing woody material. CWD provides a safe, moist environment in which species such as salamanders and shrews can forage and seek shelter.

Limited CWD cover (<1%) was recorded within the MMFVT. Moderate cover of CWD (1-10%) was recorded in portions of the YDFVT. No CWD was observed in the CGPVT.

6.3.4.4 Potential Vegetation Species and Ecological Communities with Special Federal/Provincial Status that May Occur in the Study Area

Pacific Waterleaf

No Pacific waterleaf was detected within the study area during the field program. The Pacific waterleaf has been Red-listed by the BCCDC (20111). This species is typically found in lowland moist forests and streambanks (Klinkenberg 2006). Within BC it has been found on southern Vancouver Island and the lower Fraser Valley. No BCCDC records for this species occurred within 2 km of the study area.

Phantom Orchid

No phantom orchid plants were detected within the study area during the field program. The phantom orchid has been listed as threatened by SARA and is on the provincial Red List. In Canada, it is found only in the extreme southwest of British Columbia with populations on the

Saanich Peninsula of Vancouver Island, Saltspring Island, and the lower Fraser Valley on the mainland. While suitable habitat exists throughout the Fraser Valley and additional locations may turn up in the future, the overall range of the species is unlikely to change. This plant has a very restricted distribution in Canada. The phantom orchid is known to have occurred at twelve sites in Canada, but it now occurs at only eight of these. There are few individuals at each site for a grand total for all sites of probably less than 100 individuals (EC1 2011). The phantom orchid grows in the humus litter in coniferous forests with little or sparse ground cover, but at one site, it grows on limestone tailings from a quarry. It is often found at the base of mature birch trees. The species prefers low mountains or hills, where it usually occurs on south or west facing slopes (EC1 2010).

Tall Bugbane

Tall bugbane was not detected during the field program. It has been listed as endangered by SARA and is on the provincial Red List. This plant grows west of the Cascade Mountains from Oregon to Washington, and north to southern British Columbia where it is confined to the Chilliwack Valley. No BCCDC records for this species occurred within 2 km of the study area. This species grows in deciduous and mixed wood forests, mainly composed of bigleaf maple, red alder, Douglas-fir, and western redcedar. Preferred habitat characteristics include small gaps in the forest canopy resulting from windthrow, fire or the death of older trees, as they allow sufficient light to penetrate the understorey. Tall bugbane is also found in disturbed habitats, along road-cuts and in recently logged areas, where plentiful light favours its growth. However, on these artificially open sites it is quickly out-competed by species more adapted to open habitats (Fontaine and Douglas 1999).

Ecological Communities

The BCCDC defines listed ecological communities as ecosystems identified in a Sensitive Ecosystems Inventory. These sites are generally old growth stands that are generally 500 m2 or greater. These ecosystems are often the remnants of the natural ecosystems that once occupied a much larger area. Typically, mature and old growth upland ecological communities are of concern to the BCCDC. In addition, all listed riparian, wetland and estuarine communities at any growth stage are also of concern to the BCCDC (K.A. McIntosh pers. comm.). The listed ecological communities are classified using methodologies and nomenclature developed by Green and Klinka (1994).

The forested portions within the study area were second to third growth stands. The upper and midslopes of the MMFVT were classified as the Blue-listed Western Redcedar / Sword Fern Dry Maritime (Site Series 05) and the riparian area of Lot S1/2 and LS 13 was classified as the Bluelisted Western Redcedar - Foamflower (Site Series 07) ecological communities.

6.3.4.5 General Wildlife Observations

Wildlife sign and activity was recorded throughout the study area. Songbirds were observed flying and feeding in vegetation throughout the site. Columbian black-tailed deer (*Odocoileus hemionus columbianus*) trails, beds and pellets were also observed. The SARA and provincially listed Oregon forestsnail and red-legged frog were detected during the field program. In addition, active dens of the SARA and provincially listed mountain beaver were observed within LS 13 and adjacent to the study area; approximately 85 m north of Lot S1/2.

6.3.4.6 Wildlife Habitat Assessment

Habitats were assessed for the ten wildlife species listed in Table 5. The following are the results of the habitat assessment for each of the ten species.

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6.3.4.7 Wildlife Corridors

Moderately used wildlife trails, attributed to Columbian black-tailed deer, were detected within the study area. These animals appeared to travel through the site to adjacent properties not impacted by gravel extraction.

6.3.5 CONCLUSIONS AND DISCUSSION

6.3.5.1 General Summary

Given the extreme modification of the topography in the proposed mine site (200m down to 170m) there will be no opportunity to retain vegetation communities or wildlife habitats within the proposed mining area. There is a significant amount of offsite habitat compensation that is being implemented to address fish habitat impacts due to the mine. The fish habitat that is being created as compensation will include areas of riparian habitat that will also benefit the wildlife species that may have utilized habitats in the proposed mine site.

6.3.5.2 Vegetation and Ecological Communities

No SARA listed vegetation species were detected during the field program. The Blue-listed Western Redcedar / Sword Fern Dry Maritime (Site Series 05) and the Blue-listed Western Redcedar - Foamflower (Site Series 07) ecological communities were observed within the study area. No Best Management Practices (BMP's) currently exist for ecological communities. These ecosystems are important to many wildlife species and are of special concern due to development pressures.

6.3.5.3 Wildlife Trees

Most wildlife trees in the study area were identified as Class 1 wildlife trees. Class 2-7 wildlife trees occurred within the YDFVT and MMFVT. Wildlife trees provide important habitat for cavity nesting birds and roosting bats. Currently, no BMP exists for wildlife trees. Coarse Woody Debris

Limited CWD cover was recorded within the MMFVT. Moderate cover of CWD was recorded in portions of the YDFVT. No CWD was observed in the CGPVT. CWD is important for many small mammals, amphibians, reptiles and invertebrates. Currently, no BMPs exist for wildlife CWD.

6.3.5.4 Wildlife

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Signs of deer, woodpecker and passerines were also detected within the study area. The treed portions within the forested sections of the study area provided potential breeding/roosting habitat for passerines, woodpeckers and a number of bat species.

6.3.5.5 Wildlife Corridors

Moderately used wildlife corridors were observed throughout the MMFVT during the field survey. Well-defined trails were particularly evident along the riparian area of MB. These trails appeared to be used by deer accessing various habitats surrounding the study area. These wildlife corridors provided connectivity to adjacent feeding areas and alternate security habitats for many wildlife species. Wildlife corridors also provide important links and ensure the integrity of ecosystems. Wildlife corridors adjacent to the study area will be maintained.

6.3.5.6 Legislation

Under the Provincial *Wildlife Act* all native wildlife species listed in the Act are protected. Under SARA all listed wildlife are protected. In addition, defined critical habitats on Federal lands are also protected. Although SARA protects defined critical habitats on Federal lands the “Safety Net” clause gives local governments the first opportunity to prevent the up-listing of any species listed in the Act. If local governments do not prevent the up-listing of a species then the Minister of Environment may order that the provisions of Sections 32 and 33 of SARA apply to the species of concern. To date no critical habitats have been defined for the above mentioned species, although management options are suggested in the most recent BMPs available for each species.

6.4 Effects on Biophysical Environment

6.4.1 Surface water

Surface water runoff will be collected from hard surface areas including roads and directed to stormwater retention/recharge areas for treatment and infiltration to ground. This will allow treated surface water to recharge the groundwater aquifers and maintain flow paths and flow rates to the seepage watercourses draining the site. A stormwater management plan (SMP) will be prepared consistent with the BC Ministry of Environment’s regulatory requirements.

6.4.2 Fish habitat component

Three streams, a wetland, and one pond providing fish habitat will be impacted by mining down to the 170 m elevation including: WC7; WC12; WC19, Wetland 1, and Pond 1. All other watercourses are either located outside of the property boundaries, located outside the 170 m to 200 m elevation, or are not considered streams under the RAR. Per the RAR, WC7, WC12, WC18, and WC19

would require a 10 m wide SPEA from the high water mark (HWM). Pond 1 and Wetland 1 will require a 15 m wide SPEA on the west, north, and east sides, and a 30 m wide SPEA on the south side. As Wetland 1 is on the southern boundary of Lot 2, only impacts that will occur on the subject property will be compensated for. Fish habitat impacts have been calculated using the RAR SPEA designations and surveyed watercourse locations. A professional survey of watercourses has been conducted. The fish habitat impacts are shown the watercourse and fish habitat assessment and are summarized in Table 6 below.

Table 6: Instream and riparian habitat impacts associated with the proposed works.

Feature	Habitat Impacts (m²)
Wetland 1	9,561.5
Pond 1	2,478.7
WC7	2,580.7
WC12	673.0
WC19	2,355.5
Total habitat loss	**17,649.4**

Approximately 17,650 m^2 of fish habitat will be impacted during the proposed works. These impacts will result in a HADD and will require Authorization under Subsection 35(2) of the federal *Fisheries Act*. These impacts will also result in changes in and about a stream and will require Approval under Section 9 of the provincial *Water Act*.

6.4.3 Fish habitat impacts

The proposed mining activities between the 200 m elevation and the 170 m elevation will result in a loss of approximately 17,650 m² of fish habitat.

6.4.4 DISCUSSION AND CONCLUSIONS

The proposed expansion of mining operations will permanently impact fish, vegetation and wildlife habitat. The environmental consultants understand that the proposed mining operations will result in a HADD and will require Authorization under Subsection 35(2) of the federal *Fisheries Act*. Approximately 17,650 m^2 of fish habitat will be impacted during the proposed mining expansion. Offsite fish habitat compensation has been negotiated with DFO to address the impacts from the first phase of mining down to the 200m elevation. DFO has authorized the HADD for Phase 1. The proponents are currently negotiating an addendum to the Authorization to address the Phase 2 (down to 170m) impacts. The proposed mining operations will also result in changes in and about a stream and will require Approval under Section 9 of the provincial *Water Act*.

Levelton has indicated that the proposed mining expansion is favoured over mining new areas within the Lower Mainland. The existing quarries have already significantly altered the landscape, and the infrastructure to support current mining operations already exists. Levelton also noted that many of the socio-economic impacts in this area have already been addressed.

The CoA has already given approval in concept to further mining in this area and is allowing proposals to be reviewed for mining down to the 170 m elevation within the SMEA which was recently adapted into the amended OCP. An EMCP will be prepared with the following objectives:

- maintain base flows to McKay Brook and lower reaches of WC19;
- maintain water quality;
- minimize impacts to fish, vegetation, and wildlife habitat; and,
- compensate for impacts to fish, vegetation, and wildlife habitat at an offsite location.

By implementing mitigation measures and providing appropriate habitat compensation, the proposed project should achieve the goal of no net loss of fish habitat to the productive capacity of the Fraser River watershed.

6.5 ARCHAEOLOGY

Per information provided by BC's Ministry of Forests, Lands and Natural Resource Operations (MFLNRO) Sumas Mountain is a historically and culturally significant area for the Sumas Aboriginals who would use the area for hunting, trapping, fishing, picking berries, and harvesting plants for medicinal purposes.

Sumas Lake was historically located at the base of Sumas Mountain. However, it was drained in the early 1900's via the Sumas and Vedder Canals to provide fertile farming land in which is now known as the Sumas Prairie (Chilliwack Museum, 2011).

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The project site has changed dramatically as the total area has been logged and mining has been conducted to the 200 m elevation. For continuing operations the operators will train staff to remain vigilant and to follow protocol if archaeological artefacts are found.

7. SUMMARY AND RECOMMENDATIONS

532470 BC and Jamieson Quarries Ltd. currently have permits for aggregate extraction down to the 200 m elevation level. They are now seeking approval to extend their operations for aggregate removal down to the 170 m elevation. The operators of quarries on Sumas Mountain plan to coordinate final designs to lower the elevation of the working surfaces within the quarry footprints from 200 m to 170 m.

The operators intend to apply to the CoA for amendments to their soil removal permits to allow extraction down to 170 m. The CoA has agreed to allow the operators to follow the BC RAR instead of the guidelines set out in the CoA Bylaw. This may allow the 170 m surface of quarries that lie along MB to extend to the edge of the bank along that waterway. In any event, upon completion of negotiations with environmental regulators, the proponents Qualified Environmental Professional will prepare and Environmental Mitigation and Compensation Plan. With regard to the EMCP, DFO has indicated that offsite compensation may be considered in lieu of any fish habitat lost to because of quarry operations.

Hydrology

Although there are likely to be minimal to negligible impacts on local wells, with the exception of the well in the unnamed watercourse, there are mitigation measures that could be considered if required for the area around the Sumas Mountain quarries, including:

- Installing a series of suitably sized sedimentation ponds on the Makara property or in the Summit Quarry may mitigate the loss of storage for recharge water (and the resultant base flow) into the unnamed creek.
- As noted previously, fracturing caused by drilling and blasting appears to limit water accumulation on the floor of the quarries. Although the requirement for additional control measures are unlikely, if the situation arises controlling offsite runoff of precipitation through the construction of water routing and retention structures and settlement ponds would assist in reducing runoff effects and help maintain shallow offsite groundwater quality and quantity.
- Refuelling and fuel storage areas should continue to have controls to ensure inadvertent spills are confined.
- Spill response kits and personnel will continue to be on-site, in the event of inadvertent spills.
- No storage of explosives on site and using explosives in such a manner that limits or minimizes exposure to precipitation and runoff will continue.
- Sloping the quarry working surfaces to allow for drainage and to minimize ponding water within the quarries, as necessary. It is noted that ponding has not been an issue.
- Monitoring impacts to unnamed watercourse and the dug well within the watercourse as the surficial deposits are stripped from the Summit Quarry.
- Ensuring that domestic water supply is available for local residents that are impacted by the lowering of the quarries to 170 m elevation, if required.

Surface Water

- 532470 BC, Jamieson and their engineers should commit to the design and preparation of an integrated SMP that will satisfy CoA targets as they relate to Ministry of Forest, Lands and Natural Resource Operations and DFO guidelines. The SMP will incorporate strategies for infiltrating water to ground (where viable), detaining or retaining stormwater and for treatment of water collected from hard surface areas including roads to improve water quality and contribute to onsite productivity.
- Mitigation measures should be included in a detailed EMCP prepared by a QEP to protect MB and any adjacent watercourses located outside the proposed mining area.
- Base flow will be maintained to McKay Brook and WC19 through the duration of the project. Flow measurements will be conducted prior to the expansion to obtain a baseline of flow readings. Flow rates will be monitored through the duration of the project.
- Water quality must be maintained within streams through the duration of the project. Water quality monitoring should be conducted prior to the expansion and through the duration of

the project to verify that water quality is not being negatively affected by non-permitted quarrying activities.

Vegetation and Wildlife

The following recommendations, if required, should be implemented by a QEP.

Vegetation and Ecological Communities

The following recommendations should be implemented to protect habitat for sensitive vegetation species and ecosystems:

- Where possible protect the Blue-listed Western Redcedar / Sword Fern Dry Maritime (Site Series 05) and the Blue-listed Western Redcedar – Foamflower (Site Series 07) of the MMFVT and provide a buffer (RAR setback to McKay Brook will be utlized), agreed to with the regulatory agencies, from MB to protect the vegetation and ecosystem values. Since retention of ecological community is not possible within the mine site, habitat compensation will be afforded in conjunction with the fish habitat compensation.

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- Ensure that any cleared trees or vegetation are felled away from all setback areas in order to protect the setback areas from disturbance.

Terrestrial Wildlife

The following recommendations should be implemented if required, to protect and improve habitat for the above mentioned species as well as all other terrestrial wildlife species:

- Conduct a follow-up survey for mountain beavers and their dens prior to clearing or mining. If active dens are detected prior to planned clearing and mining activities then a mountain beaver management plan may be required. The management plan should follow the practices agreed to with the regulatory agencies. If active dens are detected and a 50 m buffer cannot be implemented due to project constraints then, upon discussion with officials from MFLNRO, investigate the potential of mountain beaver relocation to suitable, offsite, habitats.

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- Place CWD, where practical, to improve habitat for many wildlife species within all setback areas.

- Install fencing where practical and as required by regulatory agencies to prevent access into the setback areas to protect vegetation and habitat values.

Birds and Bats

Within the subject area the following recommendations should be implemented to protect and improve habitat for the above mentioned species as well as other bird species:

- A stewardship initiative to install wildlife trees within setback areas to improve habitat for cavity nesting birds and roosting bats would be desirable. The installation of bird and bat boxes will also improve habitat for many other bird and bat species.

- Avoid vegetation removal in all vegetation types during the breeding season (April 1-July 31) to protect breeding birds and roosting bats and to avoid contravention of Section 34 of the *Wildlife Act*.

- Conduct a raptor nest survey prior to any clearing.

Monitoring

- Seasonal monitoring should be conducted to ensure objectives in Sections 6.4.4 and 7 and any requirements of the mining permit are respected.

Fish Habitat Compensation

As mentioned, offsite fish habitat compensation has been negotiated with DFO to address the impacts from the first phase of mining down to the 200m elevation. DFO has authorized the HADD for Phase 1. The proponents are currently negotiating an addendum to the Authorization to address Phase 2 (down to 170m) impacts. The addendum will address the 17,650 m² of fish habitat impact associated with Phase 2 of the project, to achieve no net loss to the productive capacity of the watershed.

8. FIGURES

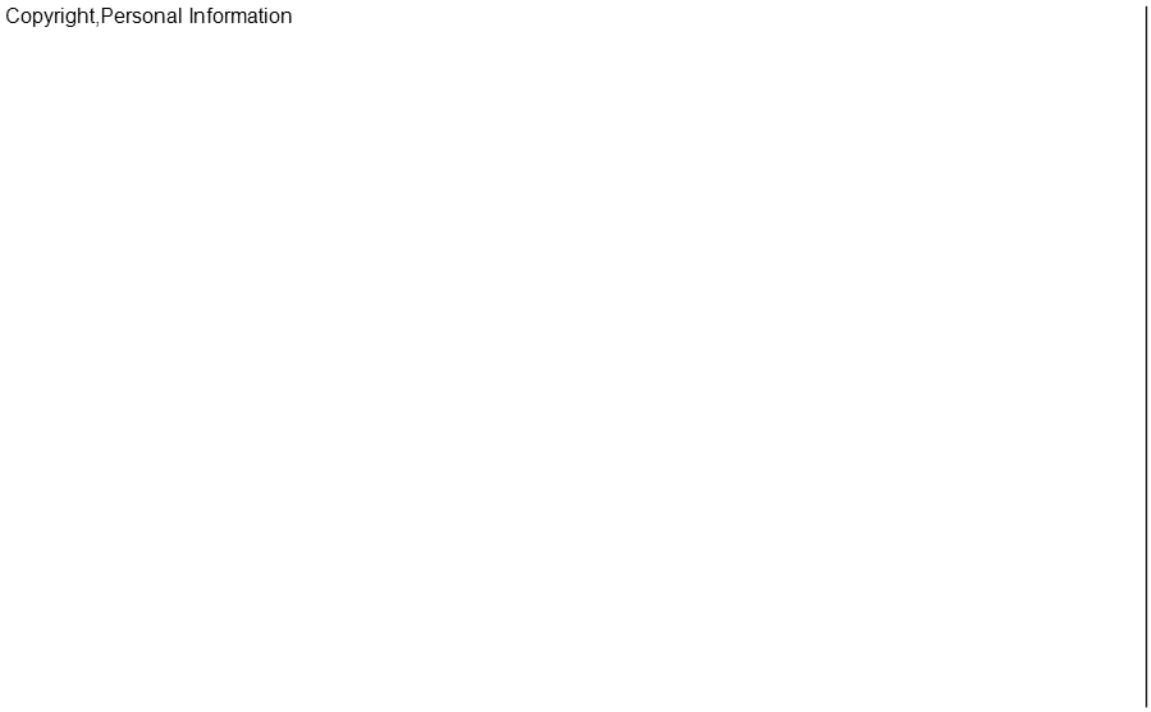

Figure 1 Map of the assessment location (from Appendix 1 of SRS assessment, images from Google Earth & Google Map, 2011).

Figure 2 Property boundaries showing the assessment location (from Appendix 1 of SRS assessment, image from City of Abbotsford Webmap, 2011).

Figure 3 Locations of the subject quarries (from Appendix 1 of SRS assessment, image from City of Abbotsford Webmap, 2011).

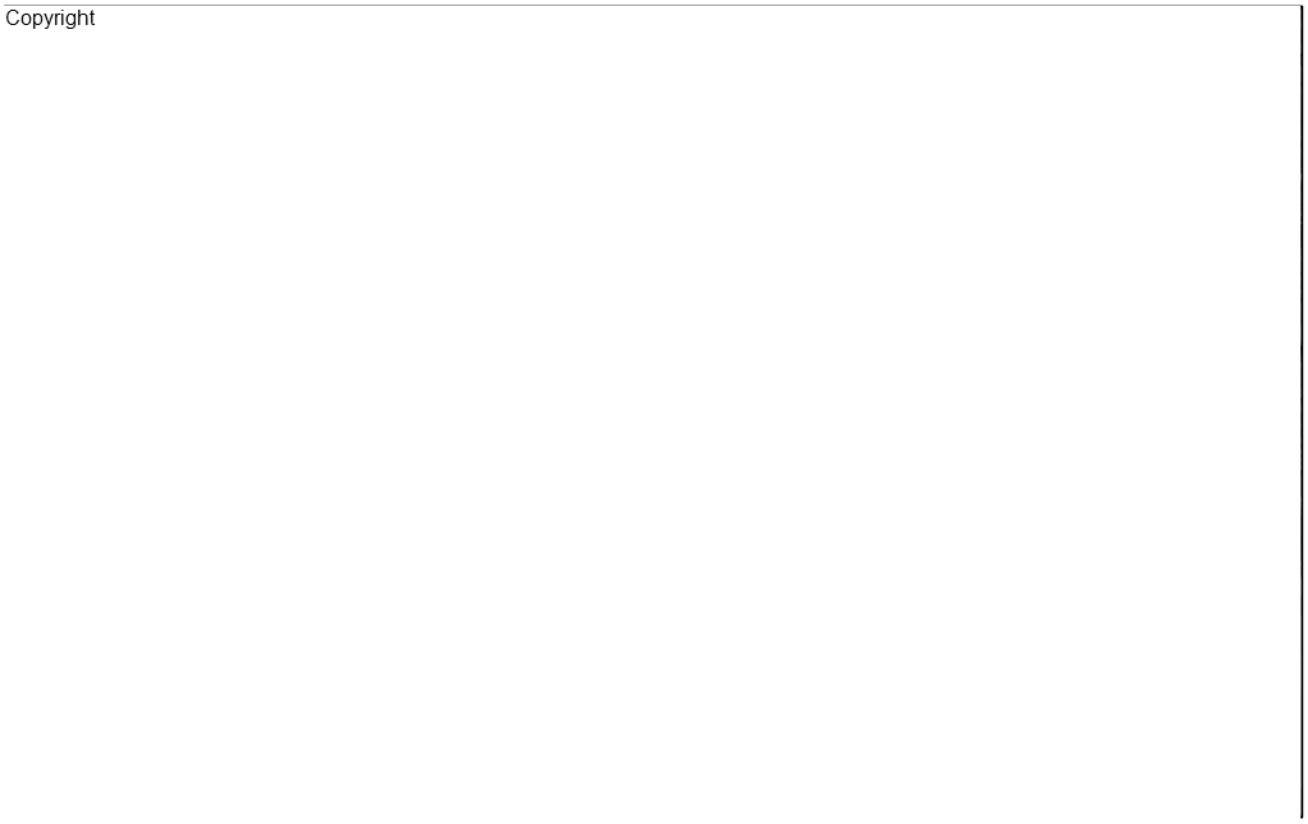

Figure 4 Approximate locations of watercourses (from attachment 4 of SRS assessment, image from City of Abbotsford Webmap, 2011).

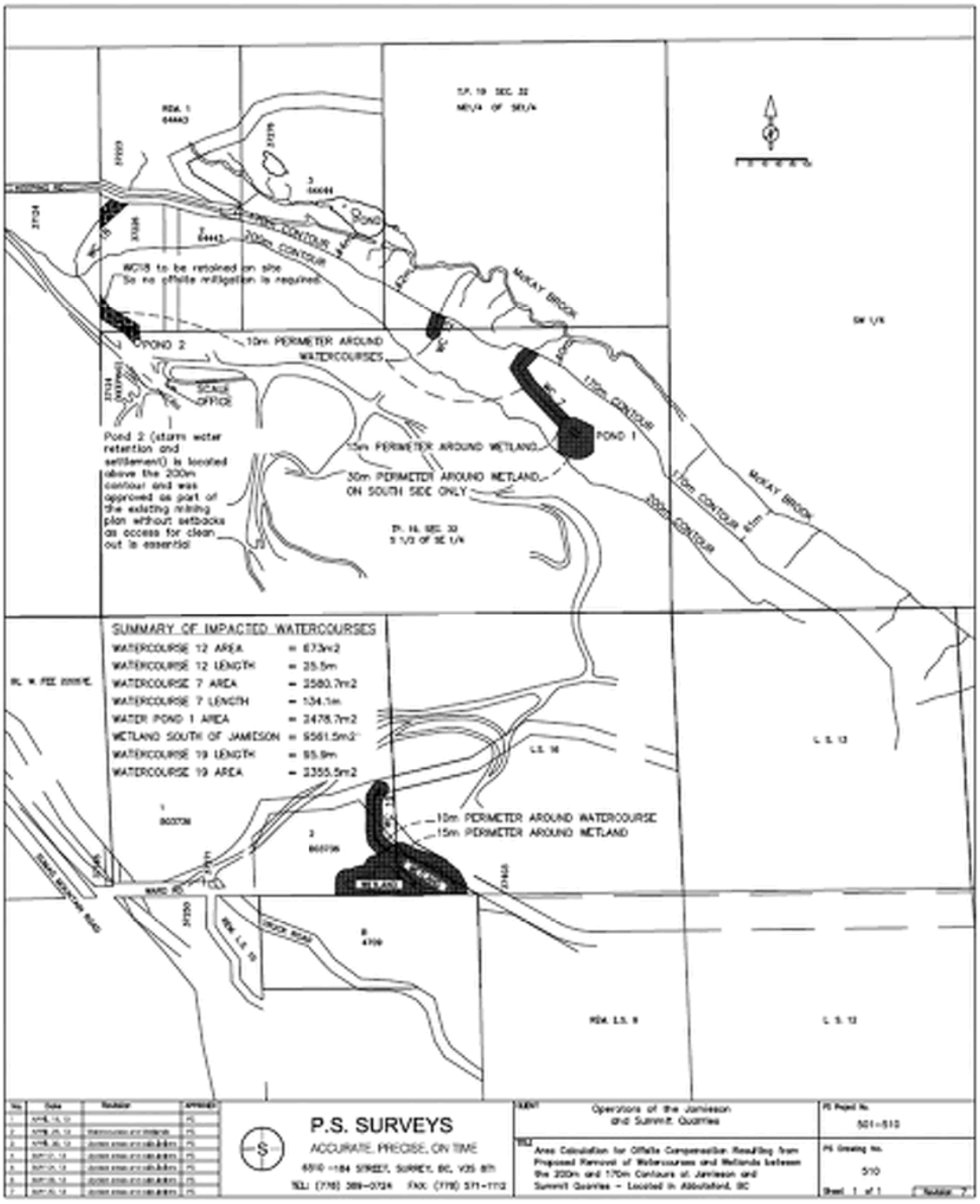

Figure 5 Approximate of fish habitat impacts (from SRS assessment).

Figure 6 **Water Well Location Plan (from Levelton's desktop hydrogeological assessment).**

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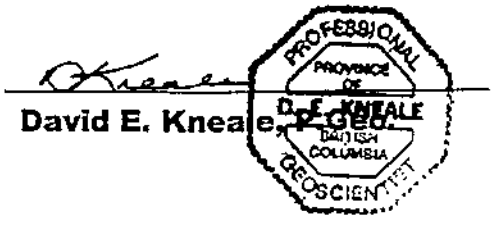
HYDROGEOLOGICAL REPORT

37124 Keeping Road
SUMAS MOUNTAIN
Abbotsford, BC

Prepared for:

Jamieson Quarries Limited

Prepared By:



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APPENDICES

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1. INTRODUCTION

On behalf of Jamieson Quarries Limited, Morrow Environmental Consultants Inc. (MECI) submits this hydrogeological report to the City of Abbotsford in support of an application to obtain a permit to operate a rock quarry at 37124 Keeping Road on Sumas Mountain. The purpose of this report is to assess the present site hydrology and hydrogeology, determine if any impacts would occur from quarrying and recommend mitigation measures to limit any impacts.

2. SCOPE OF WORK

MECI has formulated the following scope of work for the project:

Hydrology/Hydrogeology

- Carry out a surficial mapping exercise to locate potential groundwater seepage zones.
- Research available data to identify geology, climate surface drainage patterns, both locally and regionally.
- Determine the groundwater resource use in the area by searching the provincial water well database.
- Complete a well survey for those groundwater wells not listed in the provincial database.
- Develop a conceptual hydrogeological model for the existing and post mining conditions.
- Assess any potential impacts on the water resources and to provide mitigation measures to limit impacts, if any were identified.

3. REGIONAL SETTING

3.1. Physiography

The proposed quarry is located on Sumas Mountain at the western extremity of the Fraser Valley Regional District as shown on the key plan (Drawing V0-948-001).

Sumas Mountain rises to a maximum of 440 m above sea level (asl). It is bordered on the north by the Fraser River, the west, east and south by the Central Fraser Lowlands. The topography varies from near vertical rock faces on the south and north to a more undulating setting in the central interior.

Surface drainage is away from the topographic high of the mountain in all directions.

3.2. Geology

Sumas Mountain is formed of pre-tertiary rock consisting of sedimentary, volcanic, granitic and metamorphic rock and tertiary rock consisting of basalt, sandstone, siltstone, shale and conglomerate. Tertiary rock is prevalent at the south and east portion of the mountain. Portions of this formation, known as clay-shales, have been selectively mined for over 100 years.

The pre-tertiary rock consists of massive andesite and dacite porphyries. Numerous southwest-northeast trending lineations consisting of cliff faces and deep incised depressions are indicative of the presence of large joints and/or faults. These large depressions exert significant controls on the drainage patterns of Sumas Mountain. Quarrying pre-tertiary rock has occurred in the last half of this century.

Quarternary sediments (colluvial and aeolian) generally overly bedrock although bedrock outcrops are very prevalent throughout the Mountain. The higher elevations and deeper slopes are mantled by 50 cm to 100 cm of colluvium. Flatter areas formed by local depressions consist of up to 6 m of unconsolidated sand, silt and gravel (Sumas Drift) and till.

3.3. Climate

Sumas Mountain receives approximately 1,640 mm average annual precipitation. On average, about 80% of the total annual precipitation falls between October and April. It is characterized as a west coast climate, with moderate year-round temperatures, with heavy precipitation between December and March. The Frost Free Period (FFP) is about 150 days.

Evapotranspiration is estimated between 400 mm and 500 mm annually, the majority of which will occur in the summer months.

3.4. Hydrology

Sumas Mountain is divided into several main surface water catchments. The main drainages located near the proposed quarry are shown on Drawing V0-948-001.

The higher elevations are characterized as having bedrock outcrops with a thin veneer of soil cover generally less than one metre in thickness. The lower elevations (bowls) on the mountain, such as Straiton subdivision may contain up to 6 m of unconsolidated sediments overyling bedrock.

The higher elevations are zones of groundwater recharge which exhibit steep downward hydraulic gradients. The majority of the bedrock wells exhibit an unsaturated zone below the surface of the bedrock, which is indicative of a recharge area.

The lower elevations (relative to the surrounding topography) or bowls are recharged by groundwater infiltration from the upper elevations as well as emergent streams. These areas generally have a high water table (less than 2 m below ground surface). Wells are generally dug and are less than 7 m in depth in these areas. Groundwater springs also occur in these lower lying areas.

Sumas Mountain is entirely recharged by precipitation falling within the catchment. Waterways, shallow wells and bedrock wells are subject to seasonal water level fluctuations depending on the amount of precipitation received.

4. LOCAL SETTING

4.1 Mine Plan

It is proposed that quarrying will commence on the eastern portion of the property and will extend down to elevation 200 m as shown on the attached Site Plan (Drawing V0-948-002). The ultimate pit floor will be developed with a flat grade and daylight at the 200 m level. No disturbance of the land below the 200 m level is anticipated. An approximate 150m buffer (no disturbance zone) will remain between the lowest extent of the quarry and McKay Creek. Overall, slopes below the 200 m level vary between 40 and 45 percent.

The proposed pit has an estimated volume of 5,000,000 tonnes. The rate of removal is estimated at about 250,000 tonnes annually, with an expected life of 20 years. Processing will include blasting, crushing and screening operations. Washing of aggregate is not anticipated.

4.1. Physiography

The proposed quarry is located on a hill which rises to approximately 270 m in elevation at its highest point (Drawing V0-948-002). The hill forms part of a northwest-southeast trending ridge. The upper portions of the hill are undulating and slope steeply downward between 55% and 67% to the northeast towards McKay Creek. Numerous bedrock outcrops are present. An existing quarry operation is present in the northwest corner of the site. The ground surface in the area of the existing quarry slopes downward to the west-northwest.

A gravel access road enters the property from Keeping Road in the northwest corner. The upper portions of the site are generally cleared as pasture while the steeper slopes in the surrounding area are heavily wooded. The subject property has two residences and several out-buildings and is currently used for animal husbandry. A pond is located in the south-central area of the site. It is reportedly lined with clay. An aerial photograph of the site is shown on Drawing V0-948-003.

4.2. Geology

Bedrock on the site consists of pre-tertiary Chehalis Volcanics (Roddick, 1956). Outcrops in the existing quarry show significant jointing in the upper few metres due to weathering, becoming increasingly massive with depth.

Quaternary deposits consist of generally less than 0.5 m of colluvium overlying bedrock. Some site fills (thickness unknown) are present to the east and west of the pond which are used as pasture. Numerous bedrock outcrops are present throughout the site. Bedrock exposures exhibit moderate jointing due to weathering near the surface that becomes more massive with depth.

4.3. Hydrology

The property is located within the McKay Creek drainage. The eastern portion of the site slopes down to the northeast while the western portion slopes westward. Drawing V0-948-002 shows the local catchment area for the property. The topographic high on the property which trends northwest-southeast is a local drainage divide but all surface drainage from the property eventually discharges into McKay Creek except for a small portion of the southwest corner of the site.

A mapping exercise to identify areas of surface runoff and/or springs was carried out in January 2001. Two existing springs were identified and are shown on Drawing V0-948-002. The southern-most spring (No. 1) appears to be persistent year round and is located within the limits of the proposed quarry area. Spring No.2 is located below the 200 m (lowest point of proposed quarry workings). Water from this spring ponds in a small depression. There is some evidence of runoff from the pond, although no runoff was observed at the time of the inspection. An erosion gully is present near the northeast corner of the proposed quarry and is likely related to surface drainage from the switchback road in this area of steep terrain. The pond located west of the proposed quarry, is likely maintained with surface and subsurface flow of water. The water level reportedly fluctuates less than 0.6 m throughout the year.

4.3.1. Conceptual Model

Precipitation (1,640 mm) falling within the catchment will disperse along the well vegetated slopes. A portion will be lost to the atmosphere by evapotranspiration (estimated at 500 mm annually). The remaining portion (1,140 mm) likely infiltrates the shallow soil cover and upper zone of fractured bedrock and emerge at lower elevations. A much smaller portion infiltrates into the deep bedrock flow system. The following presents a breakdown of the relative contributions of the hydrological components:

% Contribution	Hydrological Components
30	Evapotranspiration
<10	Soil Moisture Deficit
30 - 50	Runoff
10 - 30	Recharged to Bedrock

The estimates above are not based on detailed hydrological calculations, but are given to provide a range of relative importance of each of the hydrologic components.

The estimate of infiltration to bedrock is based on the moderate bedrock fracturing observed in the existing quarry and the limited evidence of surface runoff and springs in area, although the terrain is very steep in some areas and soil cover is minimal.

4.4. Groundwater

Groundwater usage was identified immediately surrounding the proposed quarry site by a search of the provincial water well data base and a well survey by telephone to augment the existing records. In addition well survey information obtained by Levelton Associates Ltd. Report in 1995 was also used. MECI was authorized by our client through Westcoast Aggregates Ltd. to rely on this information.

A total of 12 wells were identified in the immediate area of the property. Details of the wells are included in Table 1 attached and are summarized below:

Well Type	Number
Bedrock	6
Dug Well	6

The wells listed may not represent all of the wells in the area because the provincial well data base is not complete. Well construction generally accompanied residential development on the mountain beginning in the 1950s with continued growth from 1970 onward to as recent as 1999. The vast majority of wells are used for domestic water supply with a few used for irrigation and community purposes.

The distribution of well type (bedrock, dug or flowing artesian) does not follow a pattern except that shallow wells tend to be located at lower elevations relative to the surrounding area. These areas are generally located near streams and are characterized as having up to 8 m of

unconsolidated sediment overlying bedrock. Water levels tend to be shallow and can vary from the ground surface to as much as 7 m below. The shallow wells are subject to seasonal water table fluctuations in response to precipitation. Several residents have commented that shallow well production will vary throughout the year.

No springs used for water supply were identified in the immediate area. Bedrock completed wells vary in depth from about 61 m to 120 m. Shallow wells vary in depth from 2 to 8 m.

The wells closest to the proposed quarry include 37124 (on the subject property), 37226 (adjacent the north boundary of the property), and 37276 Keeping Road (north side of McKay creek). The well at 37124 supplies both residences on the property, and the Owner, s.22 s.22 reports no problems with the well. The well at 37226 Keeping Roac s.22 is near the existing quarry and is 120 m deep. s.22 notes at times he has experienced some problems with silt and/or sand in the well water since about 1995. The well at 37276 Keeping Roac s.22 is a shallow dug well located near McKay Creek and he has not experienced any concerns with the well.

5. POTENTIAL QUARRY IMPACTS AND MITIGATION MEASURES

5.1. Hydrology

The quarry is located in a recharge zone characterized by strong downward gradients. Based on the topography, vegetation and geology, it is estimated that 30 to 50% of the total precipitation falling within the property is available to recharge streams and shallow aquifers in the immediate vicinity of the site.

Removal of rock above 200 m asl will result in removal of vegetation and soil cover and flattening of the topography. Removal of vegetation will reduce transpiration of moisture to the atmosphere as well as increasing the infiltration capacity by flattening of the slopes. Removal of soil will also reduce that amount of precipitation used for the soil moisture deficit. This moisture will therefore be available for evaporation losses to the atmosphere or infiltration into the bedrock. The most significant result is that more precipitation would be available to recharge the shallow flow system year round including the drier summer months. The same conditions will occur during the winter rainy season although the total effect on peak surface flows is unclear. Lowering the elevation would generally increase peak flows because of a loss of soil/bedrock/vegetation storage but these impacts may be offset slightly since reducing the elevation also reduces the hydraulic head or driving force. Removal of rock will also reduce the travel time of infiltration entering the bedrock allowing quicker recharge of the bedrock aquifer throughout the year.

The proposed quarry site will straddle a local surface drainage divide. The ultimate pit floor at 200 m asl is approximately the elevation of the emergent stream (Spring No. 1). The area of the catchment that will be modified north of the spring is approximately 3 ha. While this likely represents a very small portion of the catchment overall some changes in local drainage patterns can be expected, although, at the anticipated annual rate of removal, variations in flow characteristics will be slow to occur.

The existing quarry operation in the northwest corner of the site has been in operation for 8 years with an estimated total volume of removal of 380,000 tonnes. A visual inspection of the site in January/2001 indicates there are no surface drainage impoundments. The site appears to have adequate subsurface drainage with limited surface drainage controls. Surface drainage

in this area is towards a local topographic low towards the northwest corner of the existing quarry.

5.2. Drainage Control

Clearing vegetation and stripping of overburden in wet weather may result in siltation of McKay Creek. To mitigate those impacts, we propose to avoid clearing and stripping in wet weather whenever possible and avoid working in large areas. Stripping of overburden should be carried out in the drier summer months. If handled in a sequential manner and limited to 1 ha of disturbed area at any one time, drainage and siltation control can be easily handled by sloping the bedrock inwards towards the slope, and not allowing runoff over the bank.

Drainage within the quarry, during and post mining, can be accomplished by over blasting and fracturing the remaining rock to increase storage or provide detention ponds for temporary storage to reduce peak flows.

Upon completion of quarrying in the area of Spring No. 1, it is recommended that the pit floor be backsloped at approximately one per cent grade towards the spring location to re-establish pre-mining drainage patterns.

5.3. Blasting

Rock blasting in general has the potential to cause visual and noise impacts, fly rock damage, effect water quality as well as impair well production. Some of the quarry operations will be visible from 37276 Keeping Road and possibly some residences on Dawson Road.

Noise impacts will likely be minimal since the site is located at least 50 m above the nearest residence. Noise will tend to rise above the blast as opposed to travel down the mountain.

Fly rock and fugitive dust from blasting can affect the surrounding area. This can be mitigated by limiting the powder factor and having smaller, more frequent blasts. Larger blasts may require the use of blast mats. The closest house to the site at 37226 Keeping Road is approximately 120 m northwest of the existing quarry. Since blasting will commence east of the existing quarry, the main quarry operation will direct fly rock away from the residence but towards the residence at 37276 Keeping Road. This residence however is approximately 200 m away from the nearest blast location and some 50 m in elevation below the lowest point of

the pit floor (200 m). A recommended blast design "theoretically" allows homes to be within 255 m of the blast.[1] Reduced powder factors such as those used elsewhere on Sumas Mountain with the appropriate delays will reduce flyrock, fugitive dust and vibration.

Vibrations from blasting can be transmitted significant distances in bedrock. If large enough, vibrations may collapse shallow wells that are unsupported or result in slope instability where springs emerge from the hillside. Wells completed in the massive bedrock are unlikely to be affected since the overburden is cased off with the casing seated in the bedrock. The shallow wells identified appear to be completed in a similar fashion with large diameter concrete rings, some with drain rock surrounding the concrete casings. This type of well construction is unlikely to be affected. However, Mr. Friesen at 37226 has commented on siltation concerns within the bedrock well at his residence. We do not know the root cause of this problem, but it is possible that vibrations from blasting may allow silt to migrate into the well. Since the majority of blasting will be further away from this well, it is likely that if blasting impacts now exist, these will be lessened somewhat with the increased distance from the main blast area. It is recommended that vibration monitoring of the first two blasts be carried out to assess if there is a potential for blasting to impact this well. In addition, baseline water quality data should be collected for comparison, if future concerns arise. Should concerns over well quality or production arise, alternatives such as lining the well with a PVC liner or drilling the well deeper may mitigate these impacts as well as reducing the powder factor in subsequent blasts if required.

The use of nitrogen based explosives has the potential to impair water quality due to the toxicity of nitrogen compounds (nitrate, nitrite, and ammonia) and their ability to promote algal growth. Nitrate is the primary contaminant of concern since the reduced, more toxic form of nitrogen (nitrite and ammonia) are generally quickly converted to nitrate in the unsaturated zone. The influence of explosives on water quality is governed mainly by the annual hydrologic cycle and hydrology rather than seasonal variations in explosives use.[2] Factors to be considered in minimizing nitrogen losses include the following.

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[1] SRK Robinson, *Recommendations of a Production Blast Design, Proposed Upon Sumas Mountain Road Quarry, Abbotsford, BC*, 1994 12 15.

[2] BC Ministry of Environment, Lands and Parks, *The Effect on Water Quality of Explosives Use in Surface Mining, Volume 1, Nitrogen Sources, Water Quality and Production and Management of Impacts*, MOE Technical Report, L.W. Pommen, May 1983.

1) Dewatering of blasting areas and/or removing water from blast holes. Nitrogen compounds are extremely water soluble and reduced contact time will reduce nitrogen losses.

2) Minimize the time explosives are in contact with water by reducing the time from the loading to blasting.

3) Use more water resistant slurries.

4) Spill control and good housekeeping should be carried out at explosives blending, handling and storage facilities. An explosives handling and spill prevention plan should be submitted.

5) Explosives storage and handling facility location should be located well away from any water sources.

6) Avoid wet blasting to reduce the amount of undetonated explosives. If spoil contains substantial residual nitrogen, surface drainage should be diverted away from the spoil pile.

6. GENERAL LIMITATIONS AND CONFIDENTIALITY

This report has been prepared by Morrow Environmental Consultants Inc. (MECI) for the exclusive use of Jamieson Quarries Limited and the City of Abbotsford, who have been party to the development of the scope of work for this project and understands its limitations.

This report is intended to provide information to Jamieson Quarries Limited to complete permit requirements for the City of Abbotsford. MECI is not a party to the various considerations underlying any other requirements, and does not make recommendations regarding such requirements. In providing this report, MECI accepts no liability or responsibility in respect of the site described in this report or for any business decisions or other requirements relating to the site, including decisions in respect of the purchase, sale or investment in the site.

Any use, reliance on, or decision made by a third party based on this report is the sole responsibility of such third party. MECI accepts no liability or responsibility for any damages that may be suffered or incurred by any third party as a result of the use of, reliance on, or any decision made based on this report.

The findings, conclusions and recommendations in this report have been developed in a manner consistent with the level of skill normally exercised by environmental professionals currently practising under similar conditions in the area. The findings contained in this report are based, in part, upon information provided by others. If any of the information is inaccurate, modifications to the findings, conclusions and recommendations may be necessary.

The findings, conclusions and recommendations presented by MECI in this report reflect MECI's best judgment based on the site conditions at the time of the site inspection on the dates set out in this report and on information available at the time of preparation of this report. They have been prepared for specific application to this site and are based, in part, upon visual observation of the site, subsurface investigation at discrete locations and depths, and specific analysis of specific materials as described in this report during a specific time interval. The findings cannot be extended to previous or future site conditions or to portions of the site which were unavailable for direct observation, subsurface locations which were not investigated directly, or materials or analysis which were not specified.

If site conditions change or if any additional information becomes available at a future date, modifications to the findings, conclusions and recommendations may be necessary.

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TABLE 1

Well Log Data Summary

TABLE 1: Well Log Data Summary

Address	Type of Wall Construction	Depth of Well (m)	Depth to Water	Year of Construction	Comments on Notes on Well Records
37314 Ward Road[1]	Drilled and cased	61.5	0.6 m	1983	• Estimated flow 2 gpm from 55 m
37316 Ward Road[1]	Supplied by the above well				
37353 Ward Road[1]	Dug, concrete rings	3	n/a	n/a	• Insufficient in dry season additional. Dug well noted on property.
37335 Ward Road[1]	Drilled and cased	67	n/a	81	• Pump set at 61 m.
2nd Well on Property[1]	Dug	3.3	1.8	n/a	• Close to brook.
37271 Ward Road[1]	Dug	4.5	n/a	n/a	
37195 Ward Road[1]	Drilled	n/a	n/a	n/a	• n/a
37171 Ward Road[1]	Dug	4	n/a	n/a	• Insufficient in dry season.
37124 Keeping Road[1]	Dug	2.4	n/a	n/a	• 30 m from Hunters Brook.
37223 Keeping Road[1]	Drilled	n/a	n/a	n/a	
37226 Keeping Road	Drilled	120 m		n/a	• Supply limited in dry summer months. Some sand and debris in water - started about 1995.
37276 Keeping Road	Dug	8 m	n/a	n/a	• No Problem With Supply. Close To McKay Creek.
37124 Keeping Road	Drilled	100 m	n/a	n/a	• No problems with supply.

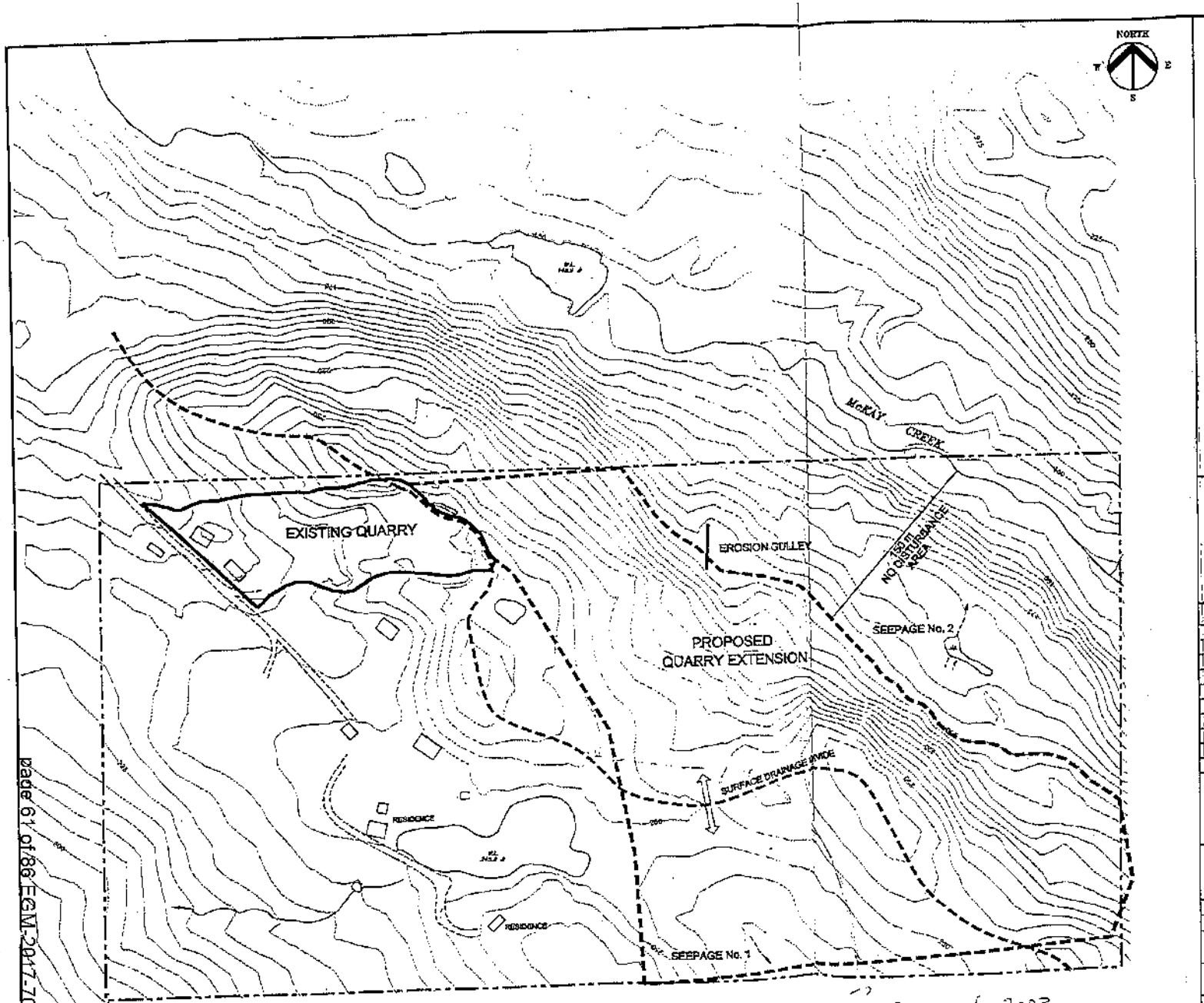
[1]Hydrogeological Study Proposed Quarry off of Ward Sumas Mountain, BC. Levelton Associates File 894-324, January 19, 1995.

APPENDIX I

Drawings

V0-948-001 - Key Plan
V0-948-002 - Aerial Photograph
V0-948-003 - Site Plan


EXISTING QUARRY WORKINGS
200m CONTOUR
Bench #1
13m Ht
10m Wide
100m
QUARRY EXTENSION FLOOR AT 200m ELEVATION
Pond W.L. 246
20 acres



LEGEND

- PROPERTY BOUNDARY
- BUILDING
- ROAD – GRAVEL
- GROUND SURFACE CONTOURS (CONTOUR INTERVAL 5 m)
- SEEPAGE
- EXISTING QUARRY OUTLINE
- PROPOSED QUARRY OUTLINE

NOTES

REVISIONS

REV.	DATE	DESCRIPTION	BY	CHK
0	01-02-02	ISSUED TO CLIENT	DRT	DEK

10 0 100

MORROW ENVIRONMENTAL CONSULTANTS INC.

SCALE: 1:3000	APPROVED BY:	DRAWN BY: DRT
DATE: 2001-02-02	MEGS	CLIENT:	CHECKED: DEK
DRAWING NAME: JAMIESON QUARRIES		PROJECT LOCATION: KEEPING ROAD ABBOTSFORD, BC	

SITE PLAN

CADFILE: VQ948R00 | PLOTTED: 20010184525 | DWG No: VQ-948-003 REV.: 0

Planned 2003

LEGEND

- PROPERTY BOUNDARY
- BUILDING
- ROAD — GRAVEL
- GROUND SURFACE CONTOURS (CONTOUR INTERVAL 5 m)
- SEEPAGE
- EXISTING QUARRY OUTLINE
- PROPOSED QUARRY OUTLINE

NOTES

REVISIONS

REV.	DATE	DESCRIPTION	BY	CHK
0	01-02-02	ISSUED TO CLIENT	DRT	DEK

MORROW ENVIRONMENTAL CONSULTANTS INC.

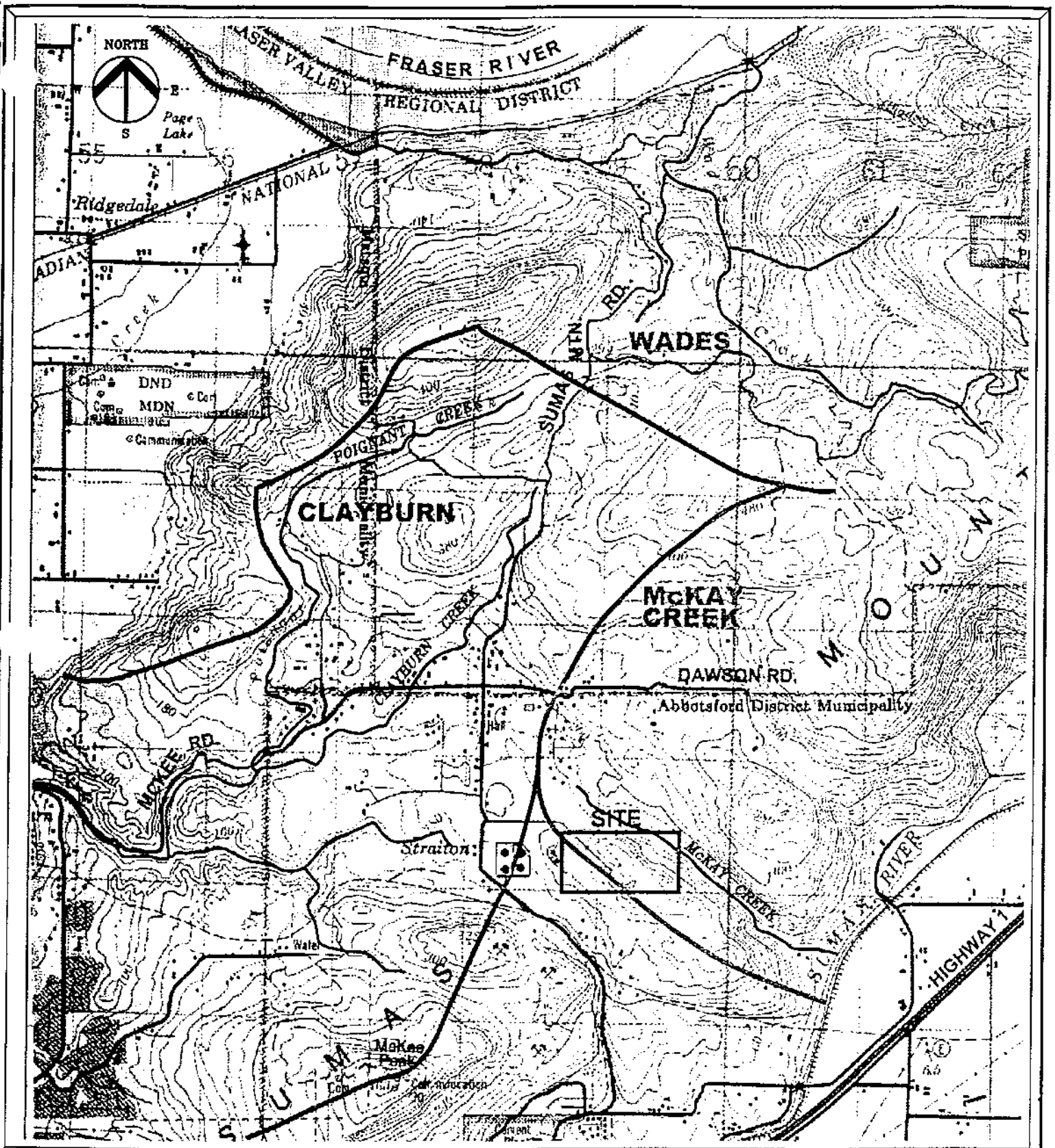
SCALE: 1:2500	APPROVED BY: MDDK	CLIENT:	DRAWN BY: DRT
DATE: 2001-02-02			CHECKED: DEK

CLIENT NAME: JAMIESON QUARRIES

PROJECT LOCATION: KEEPING ROAD ABBOTSFORD, BC

AIR PHOTO

CADFILE: V0948RC0 | PLOTTED: 20010103



LEGEND

- CREEK
- CATCHMENT BOUNDARY
- MAIN ACCESS ROAD
- SITE LOCATION

REVISIONS

REV.	DATE	DESCRIPTION	BY	CHK
0	01 02 02	ISSUED TO CLIENT	DRT	DEK

MORROW ENVIRONMENTAL CONSULTANTS INC.

SCALE: 1:40,000 | APPROVED BY: | DRAWN BY: DRT
DATE: 2001-02-01 | MECE: | CLIENT: | CHECKED: DEK

CLIENT NAME: JAMIESON QUARRIES

PROJECT LOCATION: KEEPING ROAD ABBOTSFORD, BC

KEY PLAN

CADFILE: V0948001 | PLOTTED: 1999100511658 | DWG No: V0-948-001 | REV: 0

APPENDIX II

Provincial Well Log Survey

WELL Search

FAR N.

Ministry of Environment, Lands and Parks Groundwater Database System
Water Well Data by BCGS Number

Information Disclaimer
The Province disclaims all responsibility for the accuracy of information provided. Information provided should not be used as a basis for making financial or any other commitments.

BCGS 092G010333 # 1

WTN 00000000650(s.22 St. Area Land Dist. 37 Dist. Lot Plan Lot Twp. 19 Sect. 33 Range IR Mer. Block Qtr. NW Island Const. Date 19500101 DUG Depth 50.0 ft. Dia. 36.0 in. 0

BCGS 092G010333 # 2

WTN 000000042364 s.22 St. 37138 DAWSON RD. Area ABBOTSFORD Land Dist. 37 Dist. Lot Plan 57303 Lot 18 Twp. 19 Sect. 32 Range IR Mer. Block Qtr. Island Const. Date 19790521 DRI Depth 125.0 ft. Dia. 6.0 in. 1 GPM

BCGS 092G010333 # 3

WTN 000000058196 s.22 St. DAWSON RD Area SUMAS Land Dist. 37 Dist. Lot Plan Lot Twp. 20 Sect. 5 Range IR Mer. Block Qtr. Island Const. Date 19880607 DRI Depth 405.0 ft. Dia. 6.0 in. 1.5 GPM 0

WELL Search

FAR SE

Ministry of Environment, Lands and Parks Groundwater Database System
Water Well Data by BCGS Number

Information Disclaimer
The Province disclaims all responsibility for the accuracy of information provided. Information provided should not be used as a basis for making financial or any other commitments.

BCGS 092G010314 # 1

WTN 00000000642(s.22 St. Area Land Dist. 37 Dist. Lot Plan Lot Twp. 19 Sect. 28 Range IR Mer. Block Qtr. SE Island Const. Date 19500101 OTH Depth 5.0 ft. Dia. 1.5 in. 0

BCGS 092G010314 # 2

WTN 00000003574_ ---- s.22 . ELDRIDGE RD. Area ABBOTSFORD Land Dist. 37 Dist. Lot Plan Lot 14 Twp. 19 Sect. 28 Range IR Mer. Block Qtr. Island Const. Date 19760927 DRI Depth 60.0 ft. Dia. 6.0 in. 15 GPM

BCGS 092G010314 # 3

WTN 00000005121(s.22 St. 3699 ELDRIDGE RD. Area ABBOTSFORD Land Dist. 37 Dist. Lot 225 Plan 59059 Lot 17 Twp. 19 Sect. 28 Range IR Mer. Block Qtr. Island Const. Date 19821025 DRI Depth 125.0 ft. Dia. 6.0 in. 0

BCGS 092G010314 # 4

WTN 00000001501_ ---- s.22 St. MCDERMOT RD. Area Land Dist. 37 Dist. Lot Plan 13382 Lot 1 Twp. 19 Sect. 27 Range IR Mer. Block Qtr. SW Island Const. Date 19570101 DRI Depth 39.0 ft. Dia. 10.0 in. 51 GPM 0

WELL Search

Far NE

Ministry of Environment, Lands and Parks Groundwater Database System
Water Well Data by BCGS Number

Information Disclaimer
The Province disclaims all responsibility for the accuracy of information provided. Information provided should not be used as a basis for making financial or any other commitments.

BCGS 092G010332 # 1

WTN 00000003377 s.22 St. MCDERMOT RD. Area ABBOTSFORD
Land Dist. 37 Dist. Lot Plan Lot 8 Twp. 19 Sect. 33 Range IR Mer. Block Qtr. SE Island Const. Date 19751030 OTH Depth 19.0 ft. Dia. 6.0 in. 10 GPM

WELL Search

FAR NW.

Ministry of Environment, Lands and Parks Groundwater Database System
Water Well Data by BCGS Number

Information Disclaimer
The Province disclaims all responsibility for the accuracy of information provided. Information provided should not be used as a basis for making financial or any other commitments.

BCGS 092G009442 # 1

WTN 00000000667[s.22] SR St. Area Land Dist. 37 Dist. Lot Plan Lot Twp. 19 Sect. 31 Range IR Mer. Block Qtr. SE Island Const. Date 19500101 DUG Depth 21.0 ft. Dia. 0.0 in. 0

BCGS 092G009442 # 2

WTN 00000000668[s.22] St. Area Land Dist. 37 Dist. Lot Plan Lot Twp. 19 Sect. 32 Range IR Mer. Block Qtr. SW Island Const. Date 19500101 DUG Depth 16.0 ft. Dia. 0.0 in. 0

BCGS 092G009442 # 3

WTN 000000006622[s.22] Area Land Dist. 37 Dist. Lot Plan Lot Twp. 19 Sect. 31 Range IR Mer. Block Qtr. NE Island Const. Date 19500101 DUG Depth 20.0 ft. Dia. 0.0 in. 0

BCGS 092G009442 # 4

WTN 000000025370[s.22] St. 36376 FARINA RD. Area Land Dist. 37 Dist. Lot Plan Lot Twp. 19 Sect. 31 Range IR Mer. Block Qtr. SW Island Const. Date 19710901 DRI Depth 100.0 ft. Dia. 0.0 in. 0

BCGS 092G009442 # 5

WTN 000000024544[s.22] [redacted] STRAITON RD. Area Land Dist. 37 Dist. Lot Plan 10300 Lot 2 Twp. 19 Sect. 31 Range IR Mer. Block Qtr. NE Island Const. Date 19710208 DRI Depth 29.0 ft. Dia. 0.0 in. 0

BCGS 092G009442 # 6

WTN 000000036145[s.22] St. 4390 SUMAS MOUNTAIN RD. Area Land Dist. 37 Dist. Lot Plan 16829 Lot 8 Twp. 19 Sect. 32 Range IR Mer. Block Qtr. Island Const. Date 19761213 DRI Depth 49.0 ft. Dia. 6.0 in. 10 GPM

BCGS 092G009442 # 7

WTN 000000055851[s.22] St. 36621 FARINA RD. Area ABBOTSFORD Land Dist. 37 Dist. Lot Plan 69592 Lot 20 Twp. 19 Sect. 31 Range IR Mer. Block Qtr. NE Island Const. Date 19860331 DRI Depth 165.0 ft. Dia. 6.0 in. 10 GPM 0

BCGS 092G009442 # 8

WELL Search

WTN 000000055847 [s.22] t. 36621 FARINA RD. Area ABBOTSFORD Land Dist. 37 Dist. Lot Plan 69592 Lot 20 Twp. 19 Sect. 31 Range IR Mer. Block Qtr. Island Const. Date 19860331 DRI Depth 0.0 ft. Dia. 0.0 in. 0 0 8 rows selected.

-WELL Search

Immediately SW/S/SE

Ministry of Environment, Lands and Parks Groundwater Database System
Water Well Data by BCGS Number

Information Disclaimer
The Province disclaims all responsibility for the accuracy of information provided. Information provided should not be used as a basis for making financial or any other commitments.

BCGS 092G010313 # 1

WTN 000000006513 s.22 St. Area Land Dist. 37 Dist. Lot Plan Lot Twp. 19 Sect. 29 Range IR Mer. Block Qtr. SW Island Const. Date 19500101 OTH Depth 17.0 ft. Dia. 1.5 in. 0

BCGS 092G010313 # 2

WTN 000000006710 s.22 St. Area Land Dist. 37 Dist. Lot Plan Lot Twp. 19 Sect. 29 Range IR Mer. Block Qtr. SE Island Const. Date 19500101 DUG Depth 21.0 ft. Dia. 36.0 in. 0

BCGS 092G010313 # 3

WTN 000000006777 s.22 St. Area Land Dist. 37 Dist. Lot Plan Lot Twp. 19 Sect. 29 Range IR Mer. Block Qtr. NE Island Const. Date 19500101 DUG Depth 10.0 ft. Dia. 0.0 in. 0

BCGS 092G010313 # 4

WTN 000000006422 s.22 St. Area Land Dist. 37 Dist. Lot Plan Lot Twp. 19 Sect. 29 Range IR Mer. Block Qtr. NW Island Const. Date 19500101 DUG Depth 18.0 ft. Dia. 36.0 in. 0

BCGS 092G010313 # 5

WTN 000000047355 s.22 St. 37335 WARD RD. Area ABBOTSFORD Land Dist. 37 Dist. Lot Plan 4709 Lot 9 Twp. 19 Sect. 29 Range IR Mer. Block Qtr. Island Const. Date 19810307 OTH Depth 220.0 ft. Dia. 8.0 in. 0

BCGS 092G010313 # 6

WTN 000000052147 s.22 St. 37314 WARD RD. Area ABBOTSFORD Land Dist. 37 Dist. Lot Plan 64729 Lot 1 Twp. 19 Sect. 29 Range IR Mer. Block Qtr. Island Const. Date 19830511 DRI Depth 202.0 ft. Dia. 6.0 in. .5 GPM

BCGS 092G010313 # 7

WTN 000000001171 s.22 St. 37335 WARD RD. Area ABBOTSFORD Land Dist. 37 Dist. Lot Plan 4709 Lot PTSB Twp. 29 Sect. 29 Range 19 IR Mer. Block Qtr. Island Const. Date 19010101 DRI Depth 220.0 ft. Dia. 215.0 in. 0 0

BCGS 092G010313 # 8

WTN 000000052102 s.22 St. 37314 WARD RD. Area ABBOTSFORD Land Dist. 37

WELL Search

Dist. Lot Plan 64729 Lot 1 Twp. 19 Sect. 29 Range IR Mer. Block Qtr. Island Const. Date 19830501
DRI Depth 202.0 ft. Dia. 0.6 in. 1 GPM 0 8 rows selected.

Immediately. NW / N / NE

Ministry of Environment, Lands and Parks Groundwater Database System
Water Well Data by BCGS Number

Information Disclaimer
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BCGS 092G010331 # 5 - NOT LISTED.

WTN 00000001646 s.22 St. Area Land Dist. 37 Dist. Lot Plan Lot Twp. 19 Sect. 32 Range IR Mer. Block Qtr. NW Island Const. Date 19600101 DRI Depth 20.0 ft. Dia. 0.0 in. 0 0

BCGS 092G010331 # 1 - WEST

WTN 000000006628 s.22 St. Area Land Dist. 37 Dist. Lot Plan Lot Twp. 19 Sect. 32 Range IR Mer. Block Qtr. SW Island Const. Date 19500101 DUG Depth 12.0 ft. Dia. 0.0 in. 0

BCGS 092G010331 # 2 - ADJACENT ?

WTN 000000006684 s.22 St. Area Land Dist. 37 Dist. Lot Plan Lot Twp. 19 Sect. 32 Range IR Mer. Block Qtr. SE Island Const. Date 19500101 DUG Depth 12.0 ft. Dia. 0.0 in. 0

BCGS 092G010331 # 3 - NORTH, across creek

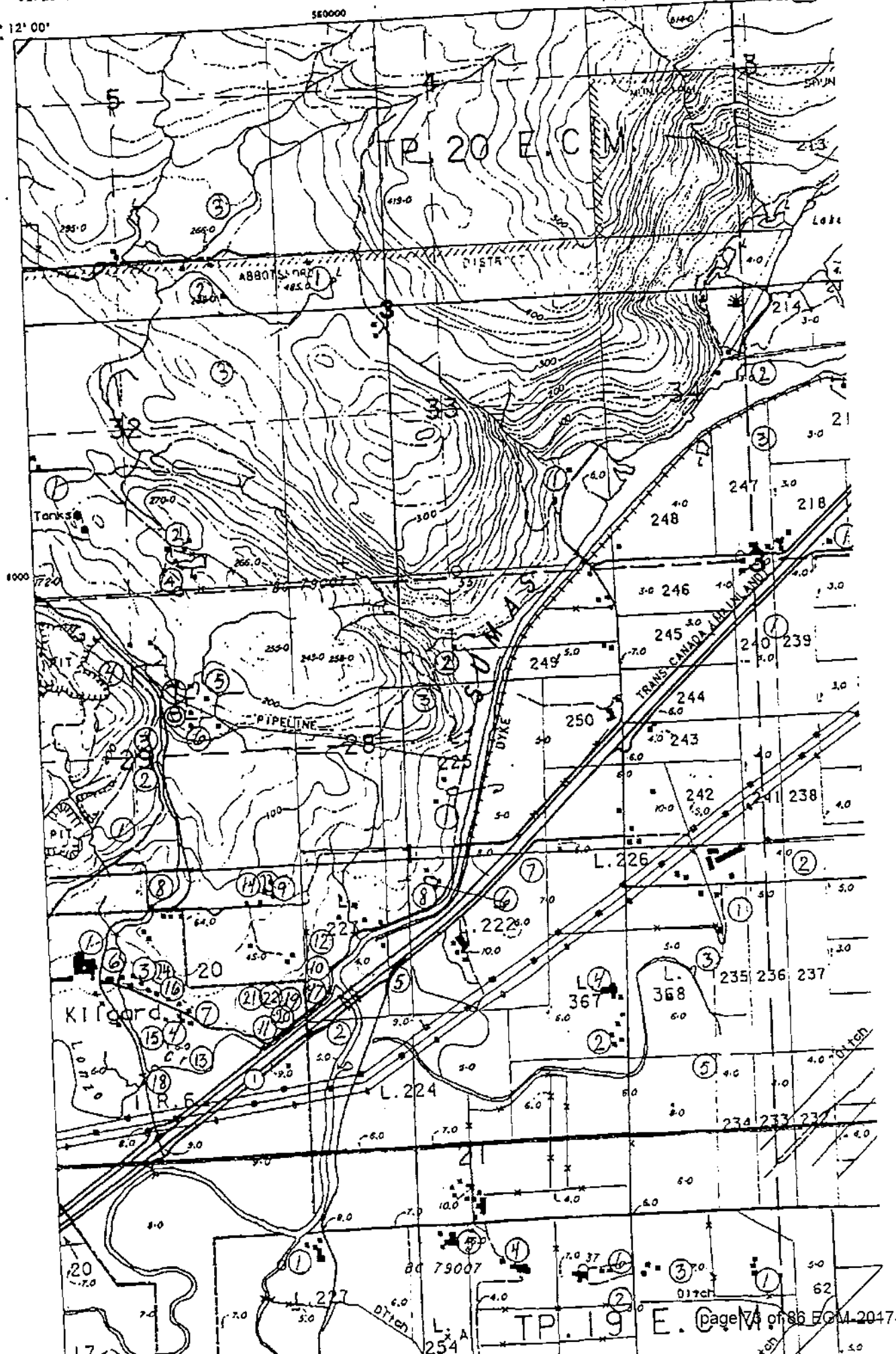
WTN 000000057430 s.22 . 37088 DAWSON RD. Area SUMAS Land Dist. 37 Dist. Lot Plan 69371 Lot 1 Twp. 19 Sect. 32 Range IR Mer. Block Qtr. Island Const. Date 19870903 DRI Depth 2452.0 ft. Dia. 0.0 in. 7 GPM 0

BCGS 092G010331 # 4 ADJACENT ?

WTN 000000075552 H. s.22 . 37124 KEEPING ROAD Area ABBOTSFORD Land Dist. 37 Dist. Lot Plan Lot Twp. 19 Sect. 32 Range IR Mer. Block Qtr. SE Island Const. Date 19851113 Depth ft. Dia. in. 0 0

AREA INDICATED BY GREEN OUTLINE

926·010 Scale 1:20000m



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PRELIMINARY ENVIRONMENTAL REVIEW

of

LAND LEVELLING, ACCESS ROAD CONSTRUCTION

for

QUALITY INDUSTRIAL MINERAL & SUPPLY INC.
37195 Ward Road, R.R.#4
Box 12, Abbotsford, B. C.
V2S 4N4

PEGASUS EARTH SENSING CORP.

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North Vancouver, B.C.
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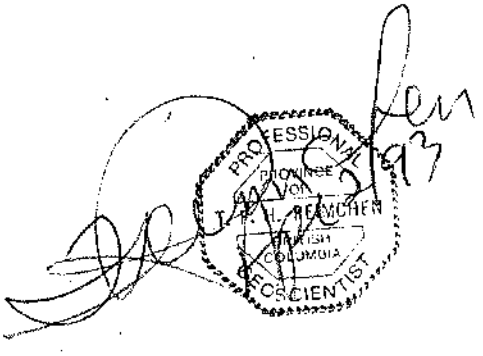

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Walter E. Bergmann

Barrister and Solicitor

MINISTRY OF ENERGY, MINES AND PETROLEUM RESOURCES
REC'D JUN 07 1993
NANAIMO, B.C.

FACSIMILE TRANSMISSION

TO: MINISTRY OF ENERGY, MINES & PETROLEUM RESOURCES
NANAIMO, B.C.
Attn: W.E. Beresford, P.Eng.
District Manager & Engineer,
Environmental Impact Management

FAX NO.: 1-755-2474

Number of pages, including cover page: 14

COMMENTS OR SPECIAL INSTRUCTIONS:

Preliminary Environmental Review

FROM: WALTER E. BERGMANN

OPERATOR: MARY

RE: QUALITY INDUSTRIAL MINERAL & SUPPLY INC, & JAMESON'S QUARRY

FILE NO.:

FAX NO.: 298-8216

DATED: 7th June, 1993

TABLE OF CONTENTS

INTRODUCTION

PEGASUS EARTH SENSING CORPORATION was requested by Jack Lee of Quality Industrial Mineral and Supply Inc. to review the geology and comment on the environmental impact of a proposed access road construction and levelling on 80 acres of privately owned land on Sumas Mountain (Figure 1). On March 30, 1993 Ted H. F. Reimchen P. Geol., P. Geo. reviewed the property.

The area, formerly forested, now consists of steeply rolling partly treed terrain ranging up to 275 M. above sea level. Farm buildings are nestled on the edge of a grass and shrub covered plateau at 250 m. looking south over the Fraser River valley. The steeply rolling relatively inaccessible terrain to the east has several excellent future building sites with panoramic view of the Fraser Valley and surrounding mountains.

Quality Industrial Mineral and Supply Inc is planning to access these eastern areas by blasting out year round access roads with proper grades. The waste rock will be crushed to proper size and removed from the site. The occasional shrubs and trees affected will be cut, trimmed and removed. All disturbed areas will be reclaimed by replacing top soil where needed and planted with local agronomic grass species.

GEOLOGY

Roddick (1956) first mapped this area as being part of the Chehalis Volcanics. He indicated that the rock present consisted of massive andesite and dacite porphyries with phenocrysts of plagioclase feldspar. Granodiorite of the Coast Range Batholith is present on the east side of Sumas Mountain. Quaternary sediments, mainly alluvium cover lower elevations.

Property Geology:

Based on the March 30th site visit the volcanic rocks are medium-grained, grey to green in colour, highly jointed and fractured and break readily into resistant angular fragments. The volcanics are massive andesites and dacitic porphyries often characterized by phenocrysts of plagioclase and other feldspars.

Surficial Geology

The area was last glaciated by ice moving from the northeast to the southwest judging by striations in the local rock bosses. The surficial materials consist of remnants of a washed glacial till composed of angular to well-rounded granitic and volcanic boulders derived locally as well brought from the nearby coastal mountains.

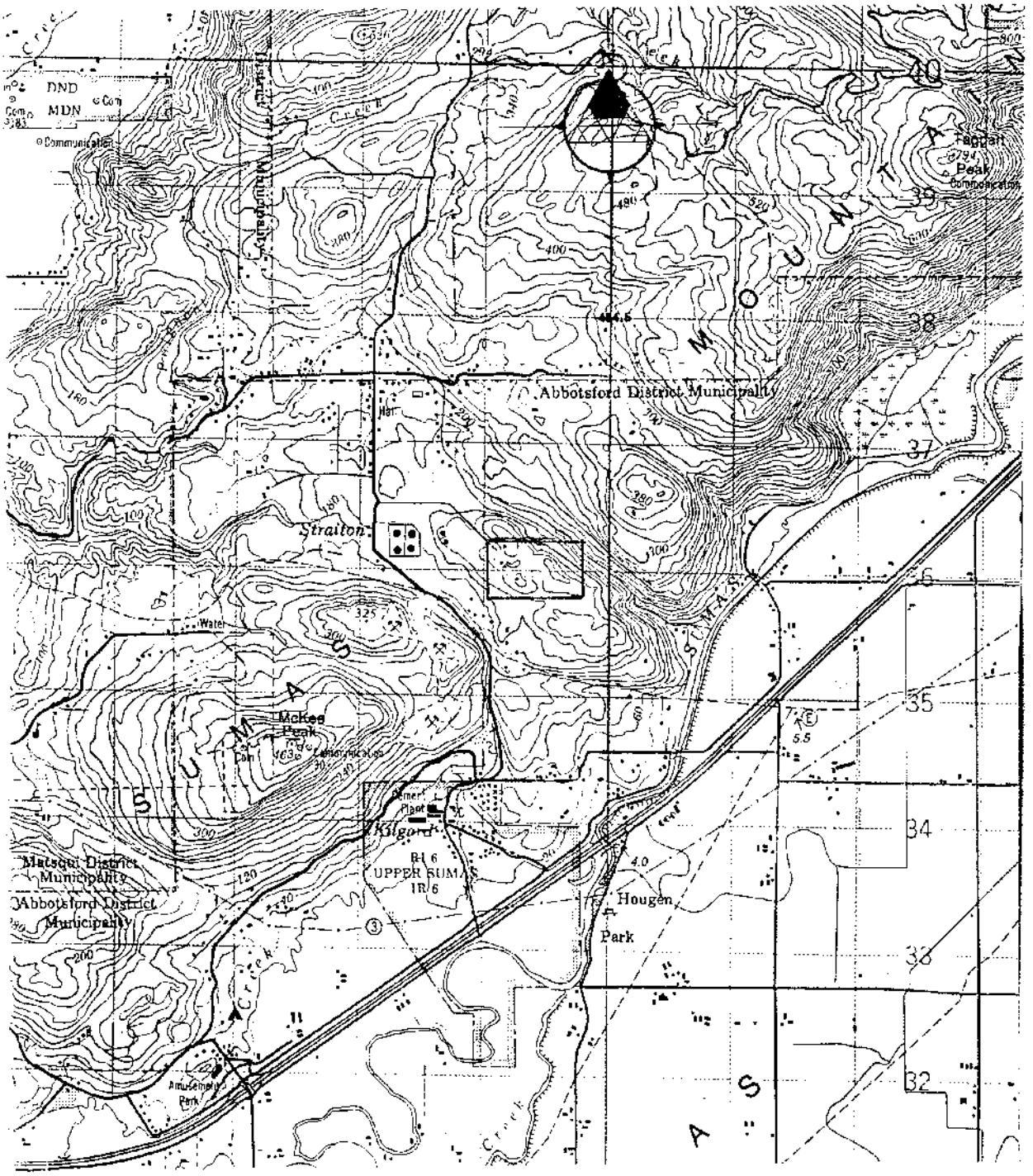
In addition, very angular coarse to medium sand consisting mainly of feldspathic and quartz fragments comprise 60% of the fines. Much of the area is partly exposed rock with a thin soil forming the surficial cover.

The terrain is formerly glaciated with the glacier cutting into the rocks creating steep slopes and isolated rock bosses. The soils are variable in thickness to 3 meters but average less than one meter in thickness.

PROJECT SETTING

The 80 acres are located on the east side of the Sumas Mountain. Access to the area is presently gained off Lower Sumas Mountain Road and Keeping Road by following a constricted narrow (not to safe standard) access road along the perimeter of land belong to Trans Mountain Pipeline. The access road leads into the southwestern cornor of the 80 acres. The closest main population centre is Abbotsford. The local community is termed Straiton, one kilometer to the east and 500 meters north along Lower Sumas Mountain Road (Figure 1).

A large 4-tank farm belonging to the Trans Mountain Pipeline is located about one kilometre west of the 80 acres. The nearest active industry involving blasting and crushing--Clayburn Brick and Tile Products is 500 meters to the southwest as evidenced by the mine symbols on Figure 1. Clayburn Industries and its predecessors have been in operation for nearly 100 years without any known interference to surrounding properties.



QUALITY INDUSTRIAL MINERAL & SUPPLY INC.

TO ACCOMPANY REPORT BY

PEGASUS EARTH SENSING CORPORATION

SCALE 1:50,000	DATE March 93
FILE 211-03	FIGURE 1
DRAWN TR	CHKD

On the north side of Sumas Mountain, near the Fraser River; Mainland Sand and Gravel Ltd. drill, blast and crush rock, operate two shifts (15 hours) for five days a week. Ninety percent of the material is barged down the Fraser River, the remainder is trucked to local markets.

Soil cover is thin, usually less than 40 cm. to absent, exposing bare rock in colours from grey to black. Drainage of the eastern side of the area is via McKay Creek to the Sumas Canal. Two ponds collect runoff and seepage water and nest in natural and man-made hollows on the property.

Logging of first and second growth hemlock and fir has removed most of the evergreen trees. At present several isolated birch and maple trees are present. Alder of various heights has reforested some of the area.

The dark colored volcanic rocks are hard non-toxic with a neutral ph. and the crushing operation will not release any toxic metals or deleterious chemicals into the surrounding environment. The road building and levelling operation will entail drilling, blasting, crushing. Rock will be trucked from the site.

The project will consist of a weigh scale on the edge of the property with road access to stockpiles beside the crusher. Rock will be drilled and blasted from the hillside cuts, transported to the crusher site by front end loader. The resulting product will move by loader to a stockpile and loaded onto trucks as needed.

The ultimate production flow chart will approximate the following:

Quarry
↓
Primary Crusher
↓
Coarse Rock Storage Pile
↓
Crusher
↓
Product Storage
↓
Weigh Scale

The slopes of the roads will be backgraded to acceptable standards, top soil removed and stockpiled initially, will be replaced and the disturbed areas replanted so as to minimize erosion. Culverts will be placed where necessary, ponds created for visual aspect and also for water retention.

There is practically no overburden on the deposit as several alpine glaciers scoured the top of Sumas mountain removing previous weathered soil and rubble. Numerous outcrops of rock can be seen on the surface. The rock will be drilled using a tracked 30 ton excavator mounted with a Tamrock-Dp 438 rotary hammer rig.

The drilling pattern will depend on the structure and geology of the rock but benches will be created to ensure a high degree of safety. In general holes will be 9 cm wide and drilled on a 2 x 2 meter pattern using explosives for separation. A front end loader (Cat 988 -20 tons) will place the pit-run into the crusher. A 25 ton D-7 Caterpillar, will be used to construct local access roads and assist in the clearing.

Production blasting will be done once or twice a week to supply sufficient material to the crusher. Blasting will be controlled to mitigate against noise and ground vibration.

Crushing Plant

Pit-run ore is discharged into a surface bin feeding a 35 ton jaw crusher to reduce rock to -15 cm.(6"). The material is then stored. Crushing will be performed on a one shift per day basis.

Loading Facilities

Small stockpiles of various crushed sizes will be produced. Loading will be done with the 988 CAT. A weigh scale will exist on the edge of the property.

Waste Management/Pollution Control/Power Requirements

A 440 volt generator will be used as the initial power supply later supplanted by a 3 phase B.C. Hydro 440 voltage line which will probably be routed from Sumas Mountain Road. Fuel tanks at the site will be bermed for safety and accidental spillage. Garbage will be removed. A chemical toilet will be used. No permanent camp is necessary except facilities for a night watchmen.

No tailings will be produced. Water sprays will be used at the crusher to minimize dust when needed. Every effort will be made to maximize the collection and minimize the loss of fines.

The access roads will be ditched to capture any silt laden water channelling it to natural-filtered drains for eventual release. The discharge will be monitored according to the Pollution Control Objectives.

Dustfall emission will be measured in a form (mg/(dm^2 d)) and manner specified by the Director of Pollution Control for the Province of British Columbia. Water sprays will be installed at dust generation points.

ENVIRONMENTAL CONSIDERATIONS

Present Aspect

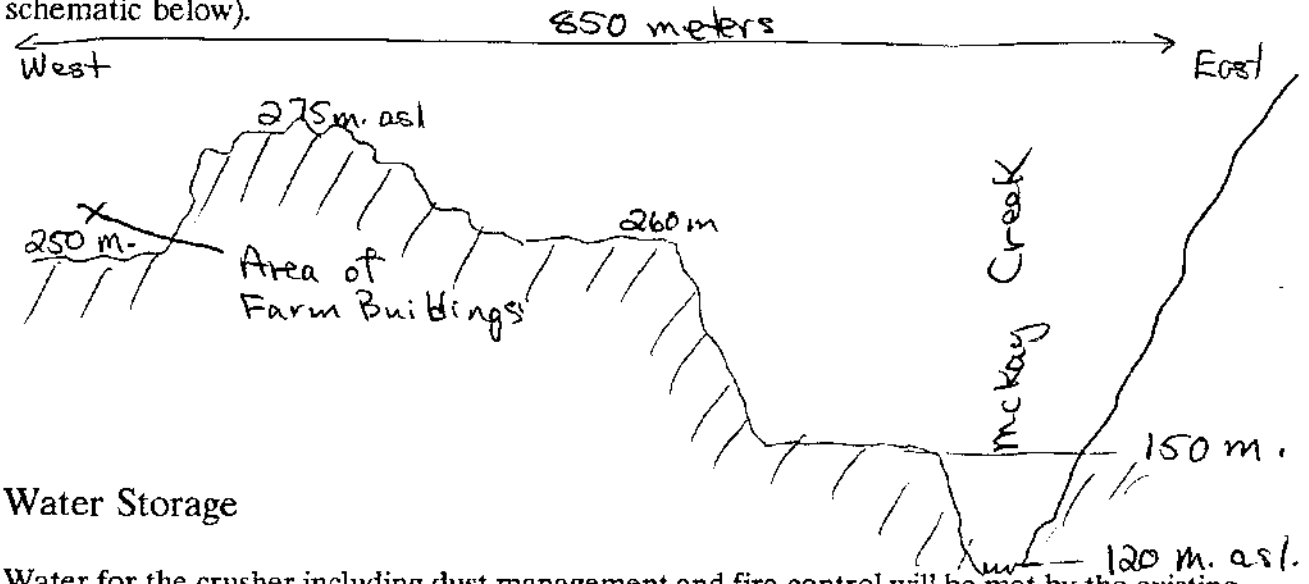
In consideration of the fact that the area is now partially exposed rock, covered by a thin soil cover disturbed by two sessions of logging (early 1900's and 1980's) it would appear that very little further surface disturbance is possible. The area is and has been burned in many places, which has destroyed much of the pre-existing moss, mulch cover and organic material in the soils. Grass now occupys these areas but growth is slow due to low nutrients. Now burned and bare rock is common throughout the claim block.

The rock exposed on the surface (highest elevation at 275 - 250 M. asl) is heavily fractured. It breaks readily upon a minimum of blasting into 'orange to grapefruit' size materials. Glacial overburden averages less than one meter in thickness except in small closed depressions. Only in the central part, in some of the depressions, do glacial materials thicken, ranging up to 3 meters in depth.

Drainage

The area is dissected by natural faults which have been gouged out by glaciation. A NE-SW drainage divide crosses the mid point of the property. Several small unconnected closed depressions collect drainage from the outcrops. The extreme northeastern part is drained by McKay Creek.

At the present moment access to McKay creek is impossible. The Creek has incised itself into a steep sided narrow canyon more than 30 meters deep at the 120 m. contour. A flattened rock terrace some 100 meters wide is present at the top of the canyon. The terrace ends abruptly at the base of the steep slope which rises about 120 meters to the grass covered rolling terrain on which the building sites and access roads will be cut (See schematic below).



Water Storage

Water for the crusher including dust management and fire control will be met by the existing storage pond located in a glacially gouged depression. The pond contains about 13,500,000 litres (3,000,000 gallons).

Climate/Precipitation

The west coast climate of Sumas Mountain is characterized by moderate temperatures year round with heavy precipitation during the months of December to March. An annual range of temperature of 15°C. with about 1950 sunshine hours characterizes the claims area.
As a result of temperature and pressure gradients created in the land/sea interface in the Georgia Strait, wind directions reverse during the year. For much of the winter, the land is colder than the water resulting in the flow of air towards the Georgia Strait. Winds are altered by the topography and blow from a northeast direction across the claims. This flow reverses in summer when the gradient turns in the opposite direction with wind movement from the southwest.

Winter temperatures are moderate with occasional slight frost penetration in the upper layers. The Frost Free Period (FFP) is about 150 days.

Total annual precipitation on the site is projected at 1800-2200 mm.(71 - 86 inches). About 80% of the total annual precipitation falls during the period of October to April. A mean monthly deficit (actual evapotranspiration) of 26 mm. (Abbotsford Airport), occurs in the

months of June - September, using a soil moisture storage capacity of 100 mm. of water in the A and B horizons. The soil storage is zero in the bare exposed rock of existing terrain.

The soil moisture regime is Class Subaquic or saturated for short periods of time in the winter months. The soil temperature is mild mesic with a MAT (Mean Annual Soil Temperature) of 8°C. to less than 15°C. degrees and a growing season ranging from 200 to 220 days for temperatures over 5°C.

Hydrology/Groundwater

The 80 acre area does not support any known sustainable aquifers. Since 'tight' bedrock is exposed on the surface or near surface, precipitation does not have an opportunity to collect except in small depressions. Surface ponding is evident by the presence of two storage areas.

All of the upland soils are extremely coarse textured with rapid water infiltration and downward movement. Since the water holding capacity is low, there is no need for special drainage provisions as natural soil drainage is most effective.

Soils/Land Use

Weakly developed soils are present throughout the property. The soil profiles, depending on the drainage and aspect, most closely approximate Brunisols and Humo-Ferric Podzols (Bhf horizon) in low lying areas. Dystric Brunisols commonly occur where there is little weathering (on tops and sides of the exposed rock outcrops). They are characterized by acidic soils and little translocation of soil materials. Humo-Ferric Podzols occur near the base of the rock outcrops and grade laterally into Gleysols soils which form bogs in the closed depressions.

Much of the land in this area has limited capability for agriculture. The Canadian Land Capability Classification for Agriculture states that limitations are due to general steepness of terrain, low nutrients and water holding capacity, stoniness, and shallow profile.

> "land in this class is non-arable...to no capability for arable culture or sustained grazing.." with 'T' equating to steepness of topography and 'R' to rockiness or shallow bedrock.

Erosion Potential

Although slopes are steep, nearly vertical in some places, the erosion potential is extremely low as the soils are very permeable. Numerous patches of bare rock are readily evident No hazardous areas exist.

Forestry/Vegetation

Although the area has been logged the surrounding forests belong to the Coastal Western Hemlock Biogeoclimatic Zone. Characteristic climax trees in this surrounding zone are Western Hemlock Tsuga heterophylla and coastal Douglas-fir, Pseudotsuga menziesii.

In the logged off area the thin soil commonly supports shrubs and deciduous trees such as alder (Alnus rubra) and birch (Betula paprifera?). Other shrubs (in full sunny areas) growing on the claim block, are blueberries (Vaccinium membranaceum), salmonberry (Rubus spectablis), elderberry (Sambucus racemosa),huckleberry Vaccinium occidentalis and false azaelas (Menziesia ferruginea).

In better drained areas the grass redtop (Agrostis alba), grows in profusion.

In poorly drained areas near the depression are willows (Salix sp.), soft rush (Juncus effusius), cattail (Typha latifolia), creeping buttercup (Ranunculus repens) and even some skunk cabbage (Lysichitum americanum).

Wildlife

Sumas Mountain falls under the jurisdiction of Management Unit 2-4 where shooting is not allowed. Lack of tree cover combined with low soil moisture retention has created arid conditions in summer. This has held growth to a minimum except for the profusion of grass species. Lack of suitable cover or habitat has restricted wildlife activities to relatively sparse populations.

Birdlife is notable for conspicuous omissions. Scarce populations of spruce/willow (Franklin) grouse (Canachites canadensis F.), crows (Corvus brachyrhynchos?) and an occasional whisky jack or Canada jay (Perisoreus canadensis) was observed. In the pond semi-wild mallard ducks (Anas platyrhynchos) were seen feeding.

A high (exceeding 20 meters) waterfall (Hole in the Wall), precludes the incursion and establishment of salmonoid populations on McKay Creeks.

Pollution

No tailings are generated from the proposed operation. If dust or fines from the crushing operation were to be accidentally discharged into the drainage no harm would be done. The reason for this is that the specific gravity of the fines is similar to quartz and the particles would settle rapidly into the bed of the stream. In addition, since **no deleterious/hazardous minerals are present in this rock type the habitat would not be adversely affected.**

CORPORATE INFORMATION

QUALITY INDUSTRIAL MINERAL & SUPPLY INC.(QUIMS) is a small private British Columbia company that has raised all its capital by private stock placement. The following director and technical consultants are involved in developing this project:

JACK D. LEE (1931-) President and Director of QUIMS, 37195 Ward Road, Abbotsford, Straiton Area, B.C., V2S 4N4; resident of Sumas Mountain since 1978, businessman and prospector since 1957, President of LeeBilt General Contractors since 1960 and Sparton Equipment Ltd. since 1976. Jack has developed a sought after expertise in supplying and installing remote microwave tower foundations and anchors. He has gained his experience with B.C. Telephone having worked on nearly every Microwave site in British Columbia and with RKTG Consulting Engineers. He is a innovator/inventer having developed several practical improvements and refinements for drilling using a Warner Swaisy 30 ton excavator mounted with a Tamrock-Dp 438 rotary hammer rig.

JOHN H. INGLIS, C.G.A. (1928-) of 4550 East Hastings Street, North Burnaby, B.C. V5C 2K4 is the Corporate Accountant for QUIMS.

TORONTO DOMINION BANK on Hastings and Rosser, North Burnaby is the corporate bank for QUIMS.

TED H.F.REIMCHEN, P. Geol., P. Geo., (1941-) **Expertise: NATURAL SCIENTIST** President of Pegasus is a Professional Geoscientist and Geologist with 26 years of post-graduate experience in mineral exploration for placer minerals, gemstones, speciality and mineral sands to REO'S(rare earths) to industrial minerals and potable water. He is intimately familiar with property evaluation and geological mapping, drilling, tunnelling, sampling, and ore reserve calculations separating MINEABLE from GEOLOGICAL reserves for these minerals.

His experience and interests range from aerial photograph interpretation, erosion potential and hazard prediction to geobotanical prospecting and environmental assessments, wetland delineations to remote sensing, to engineering geology, and archaeology to seismic risk studies. He has involved himself with placer evaluation, mine design and running day to day operations of several large open pit mines in jungles to tundra in several areas of the earth. He has prepared numerous Professional Reports on geological prospects in 36 countries.