



Development Permit

DP2407J (Benson Oil Ltd.)

Date: April 17, 2024

Issued pursuant to Section 490 and 491 of the *Local Government Act*

1. This Development Permit is issued to 0889922 B.C. LTD., INC.NO. BC0889922 of Castlegar, BC as the registered owner (hereinafter called the "Permittee") and shall only apply to those lands within the Regional District of Central Kootenay, in the Province of British Columbia legally described as LOT 2 DISTRICT LOT 237 KOOTENAY DISTRICT PLAN EPP71075 (PID 030-632-439) as shown on the attached Schedules 1, 2, 3 and 4, forming part of this Permit, referred to hereafter as the "said lands".
2. This Development Permit is issued subject to compliance with all of the bylaws of the Regional District of Central Kootenay applicable thereto, except as specifically varied or supplemented by this Permit.
3. This Development Permit shall not have the effect of varying the use or density of land as specified in the applicable Zoning Bylaw of the Regional District of Central Kootenay, nor a Floodplain Specification under Section 524 of the Local Government Act.
4. The said lands have been designated 'Industrial (I)' and are located within a Development Permit Area pursuant to the *Kootenay-Columbia Rivers Official Community Plan Bylaw No. 1157, 1996* as amended.
5. The Permittee has applied to the Regional District of Central Kootenay to authorize the development of a "card lock" style fueling station on 0.4 ha portion of the subject property. Pursuant to this Development Permit and subject to the terms and conditions herein contained, as well as all other applicable Regional District Bylaws, the Regional District of Central Kootenay hereby authorizes the use of the said lands for this purpose.
6. The Permittee is required to obtain approval in writing from the Regional District of Central Kootenay prior to the construction any new buildings, external additions to existing buildings or for any deviation from the development authorized under Section 5 of this Development Permit. Furthermore, the Permittee is hereby advised of the following requirements:
 - 6.1 The Regional District of Central Kootenay Building Department requires that the Permittee obtain a demolition permit and/or building permit prior to the removal of any existing buildings and structures, the renovation, expansion or alteration of any existing building and the construction of any new building.
 - 6.2 Unless otherwise stated all buildings and structures shall comply with the site coverage, building height and building setback requirements of the 'Light Industrial' (M1) zone of the Regional District of Central Kootenay Zoning Bylaw No. 1675, 2004 as amended.
 - 6.3 In accordance with Resolution 112/25 of the Board of Directors of the RDCK as carried on February 20, 2025, the permittee is granted variances from the Regional District of Central Kootenay Zoning Bylaw No. 1675, 2004 to the extent specified in Section 6.3.1 below:
 - 6.3.1 Sections 611.1, 611.2, 611.13 and 621.3 of RDCK Zoning Bylaw No. 1675, 2004 are varied for the following purposes:

- 611.1 and 611.2: Reduction of required parking spaces based on “Operation Area” from 11 to 2;
- 611.13: Reduction of area to be surfaced with concrete or asphalt to an area measuring 775 m²;
- 621.3: Reduction of landscape screen along the front property line to accommodate a wider driveway access for large commercial vehicles;

Subject to:

1. The following measures to control and mitigate dust being implemented:
 - a. Surfacing the non-paved portions of the site with a low dust alternative such as road base gravel;
 - b. Regular application of dust control treatment (e.g. water, calcium chloride or other suitable treatment) on non-paved portions of the site.
- 6.4 So as to form a continuous landscape buffer, the Permittee shall be required to install new landscape planting consisting of trees, shrubs or fencing to supplement the existing landscaping along the northern and southern property lines and in accordance with “Schedule 3: Landscape Plan (Revision 1) prepared by Morrow Engineering Ltd., dated November 5, 2024”.
- 6.5 Trees and shrubs associated with this Landscape/Planting Plan (Schedule 3) shall be planted in accordance with the applicable regulations in Sections 620 and 621 of Zoning Bylaw No. 1675.
- 6.6 All landscape planting shall be installed and inspected by Regional District of Central Kootenay staff prior to April 22, 2027. Furthermore, subject to Section 7, the Permittee shall be required to provide a Letter of Credit in the amount of \$33,726 to allow the Regional District to complete the required landscaping, if necessary.
- 6.7 All yard lighting shall be unobtrusive and in scale with the surroundings.
- 6.8 All parking spaces shall be designed in accordance with the requirements of Section 611 of Zoning Bylaw No. 1675, 2004 and are subject to the following:
- 6.8.1 Each parking space shall have a length of not less than 5.8 metres and a width of not less than 2.6 metres and a height of not less than 2.2 metres.
 - 6.8.2 In all parking areas containing more than five (5) parking spaces, every off-street parking space must have curbs, or wheel stops, to prevent vehicles from overhanging parcel lines, landscaped areas or walking corridors.
- 6.9 In accordance with Section 4.1.3.10 of the Kootenay-Columbia Rivers OCP Bylaw No. 1157 an aquifer assessment was prepared by LEGACY Environmental, dated February 20, 2025 (File # 0342.01.02) in support of this Development Permit Application. The report is attached to this permit as Schedule 4. All recommendations and considerations included in this report shall be implemented through the construction period and throughout the ongoing operation of the proposed card lock fueling station on the subject property.
- 6.10 A building permit shall be required prior to any construction involving land in this location at which time the Permittee shall be required to address sewage disposal issues to the

satisfaction of the Interior Health Authority and Regional District of Central Kootenay Senior Building Official.

7. As a condition of the issuance of this Permit, the Regional District shall hold an irrevocable Letter of Credit submitted by the Permittee in the amount of \$33,726 to ensure the landscaping requirements as set forth in Section 6 are completed and in accordance with the following provisions:
 - 7.1 A condition of the posting of the Letter of Credit is that should the Permittee fail to carry out the landscaping as herein above stated, according to terms and conditions of this permit within the time provided, the Regional District may use the Letter of Credit to complete the landscaping by servants, agents or contractors, and any surplus shall be paid over to the Permittee. If the amount of funds is insufficient to cover the actual cost of completing the works, then the Permittee shall pay such deficiency to the Regional District immediately upon receipt of the Regional District's bill for same.
 - 7.2 The Permittee shall complete the landscaping works required by this Permit prior to April 9, 2027. Within this time period the required landscaping must be inspected and approved by the Regional District.
 - 7.3 If the landscaping is not approved within this time period, the Regional District has the option of continuing to renew the Letter of Credit until the required landscaping is completed or has the option of drawing from the Letter of Credit to complete the required landscaping. In this event, the Regional District or its agents have the irrevocable right to enter into the property to undertake the required landscaping for which the Letter of Credit was submitted.
 - 7.4 If the landscaping is approved within this time period without the Regional District having to draw on the Letter of Credit, 90% of the original amount of the Letter of Credit shall be returned to the Permittee.
 - 7.5 A hold back of 10% of the original amount of the Letter of Credit shall be retained until a final inspection is undertaken within 12 months of the date of the original inspection and approval was given to the landscaping. If the landscaping receives approval at final inspection, the 10% hold back will be returned to the Permittee. If after the final inspection, approval of the landscaping is not given, the Regional District has the option of continuing to renew the Letter of Credit until the required landscaping is approved or has the option of drawing on the Letter of Credit the funds to complete the required landscaping. In this event, the Regional District or its agents have the irrevocable right to enter onto the property to undertake the required landscaping for which the Letter of Credit was submitted.
8. The said lands shall be developed strictly in accordance with the terms and conditions of this Development Permit and the requirements of all applicable Regional District Bylaws as well as any plans and specifications which may, from time to time, be attached to this Permit shall form a part thereof.
9. In accordance with the Local Government Act, if the development authorized by this Development Permit is not commenced within two years of the date of this Permit, this Permit shall lapse.
10. In accordance with the Local Government Act, 'Notice' shall be filed in the Land Title Office that the said lands are subject to this Development Permit.
11. The terms of this Development Permit including subsequent amendments, are binding on all persons who acquire an interest in the said lands associated with this Permit.

12. It is understood and agreed that the Regional District has made no representations, covenants, warranties, guarantees, promises, or agreement (verbal or otherwise) with the Permittee other than those in this Development Permit. It is solely the responsibility of the Permittee to ensure that the requirements of all other applicable government agencies are satisfied.
13. This Development Permit does not constitute a building permit.
14. This Development Permit shall come into force and effect 14 days after the date of issuance unless a Waiver of Appeal is received from the Permittee at which time the Development Permit shall be deemed to be issued upon receipt of the Waiver of Appeal. OR If a Notice of Appeal is received the Development Permit shall be suspended until such time as the Board of the Regional District of Central Kootenay has decided the Appeal.

S Sudan

Sangita Sudan, General Manager of Development and Community Sustainability Services

April 17, 2025

Date of Approval (date of review and approval)

April 23, 2025

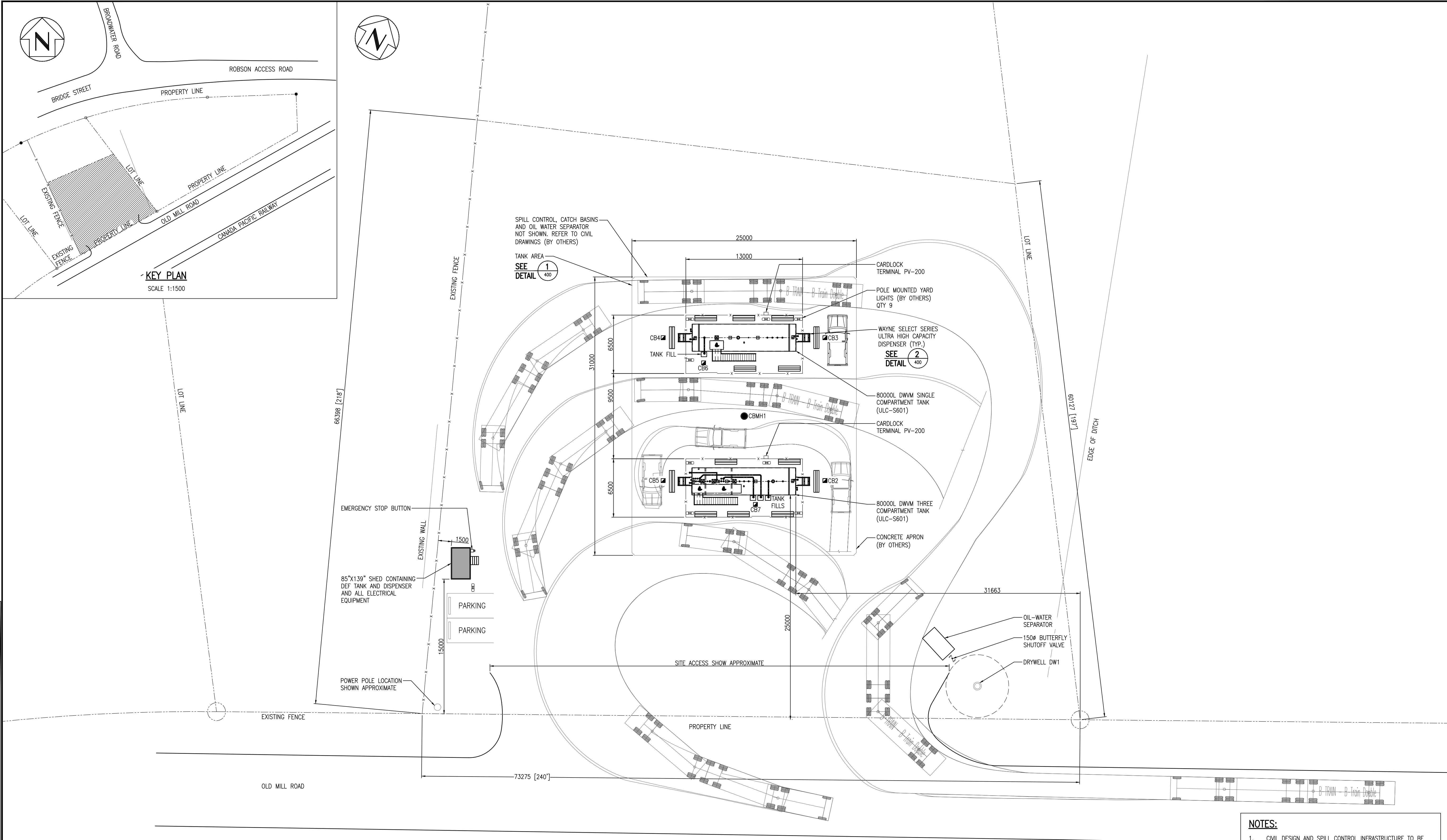
Date of Issuance (pending receipt of securities)

Schedule 1: Subject Property



Schedule 2: Site Plan

(Full size drawing on following page)



MECHANICAL SITE PLAN

SCALE 1:200

PROFESSIONAL SEAL

MORROW ENGINEERING
NOT FOR CONSTRUCTION



Morrow Engineering Ltd.
CONSULTING ENGINEERS
NORTH VANCOUVER, B.C.

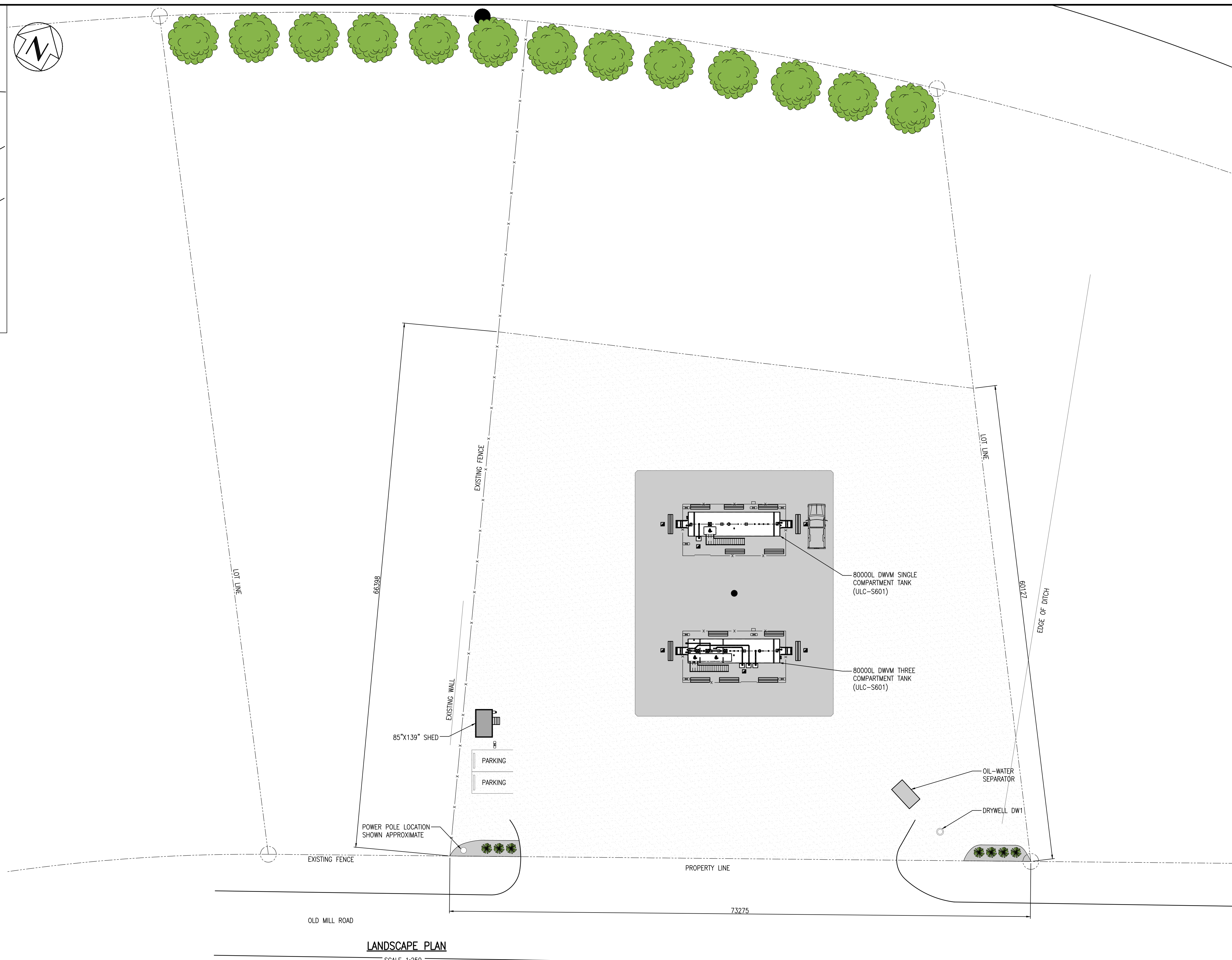
BENSON OIL
NEW CARDLOCK FUEL SYSTEM
50 OLD MILL ROAD, CASTLEGAR BC
MECHANICAL SITE PLAN

DRAWING NUMBER
54-123-100

REV	DATE (MM.DD.YY)	REVISION DESCRIPTION	DRAWN	DESIGNED	CHECKED
1	10.29.24	ISSUED FOR CLIENT REVIEW	SL	DW	DW
0	05.29.24	ISSUED FOR CLIENT REVIEW	SL	DW	DW

Schedule 3: Landscape Plan

(Full size drawing on following page)



MORROW ENGINEERING
NOT FOR CONSTRUCTION

PROFESSIONAL SEAL

1	11.05.24	RE-ISSUED FOR CLIENT REVIEW	SL	DW	DW
0	10.29.24	ISSUED FOR CLIENT REVIEW	SL	DW	DW
REV	DATE (MM.DD.YY)	REVISION DESCRIPTION	DRAWN	DESIGNED	CHECKED



Morrow Engineering Ltd.

CONSULTING ENGINEERS

NORTH VANCOUVER, B.C.

BENSON OIL

NEW CARDLOCK FUEL SYSTEM

50 OLD MILL ROAD, CASTLEGAR BC

LANDSCAPE PLAN

DRAWING NUMBER

54-123-200

Schedule 4: Aquifer Assessment prepared by Legacy Environmental, dated February 20, 2025
(Complete report on following pages)



February 20, 2025

File # 0342.01.02

B.A. Benson & Son Ltd.
PO Box 368
Trail, BC V1R 4L6

RE: Proposed Card Lock Aquifer Assessment, 50 Old Mill Road, Castlegar, BC

1 INTRODUCTION

Legacy Environmental Ltd. ("LEGACY") is pleased to provide this Letter Report for an aquifer assessment for the proposed card lock at the property located at 50 Old Mill Road, Castlegar, BC (the "Site"). We understand this letter was required to address comments from the Regional District of Central Kootenay (RDCK) during a Development Variance Permit application. Specifically, RDCK raised concerns regarding the potential impacts to aquifers and nearby receptors that could result from spills or leaks from the aboveground storage tanks (ASTs) that will be installed at the proposed card lock.

1.1 Objective and Scope of Work

As part of this assessment, LEGACY conducted the following:

- Completed a high-level review of the proposed design for capture of spills or leaks that may occur, to assess the likelihood of identifying contamination before it migrates to a receptor.
- Reviewed the reported on-Site water well installation details, nearby water wells, geology maps and local aquifer characteristics to assess the potential for migration to potential receptors.
- Prepared this opinion letter regarding the potential environmental risk posed to aquifers underlying the Site by the proposed card lock development.

An evaluation of the AST construction and adequacy of the early spill detection monitoring and alarms has not been conducted and is outside the scope of this assessment.

2 BACKGROUND

LEGACY was provided with the following plans for review:

- *Mechanical Site Plan, Drawing No 54-123-100, Rev. 1, New Carlock Fuel System, 50 Old Mill Road, Castlegar, BC, prepared by Morrow Engineering Ltd., dated November 5, 2024.*
- *Landscape Plan, Drawing No 54-123-200, Rev. 1, New Carlock Fuel System, 50 Old Mill Road, Castlegar, BC, prepared by Morrow Engineering Ltd., dated November 5, 2024.*
- *Site Plan & Drywell Detail, Drawing No C01, Rev. PB, Card Lock Facility, 50 Old Mill Road, Castlegar, BC, prepared by McElhanney, dated June 18, 2024.*

The proposed card lock includes the installation of two 80,000 litre ASTs located centrally on the property, one of which includes three internal compartments. The ASTs will be installed on a concrete apron that slopes towards a central catch basin and manhole that flows to an oil water separator and discharges to a drywell that will be located on the eastern corner of the property, adjacent to Old Mill Road. Six catch basins are planned to be installed in the concrete apron in case of surficial spills from the ASTs or dispensers, which will also flow to the central catch basin. The plan includes a shut-off valve to stop flow from the oil water separator to the drywell. The proposed drywell will be precast concrete installed within a sloped excavation 3 metres (m) at the base, backfilled with 50 to 200 millimetre drain rock with a filter fabric installed along the sloped excavation walls. An electrical shed will be located on the western side of the Site which will include an externally accessible emergency stop button and an internal diesel exhaust fluid (DEF) tank and dispenser.

Generally, the environmental risk posed by ASTs is reduced when compared to underground storage tanks, it is less likely for small leaks to go undetected for long durations as they are visible at grade, and spill and leaks can be more easily be directed to on-site drainage structures with included capture devices (e.g., oil water separators).

3 AQUIFER AND WELL DETAILS

The surficial geology, topography, and inferred groundwater flow direction are presented in the table below. The general surficial geology and topography is based on Geological Survey of Canada and Surficial Geology Maps. Where available, Site or area specific geology was confirmed with borehole logs and well records available in iMapBC.

Physical Setting

Surficial Geology	Terrace Deposit (T), dominantly sand, some gravel; benches above the level of surrounding floodplain.
Site Topography	Relatively flat, sloping to the south
Regional Topography	Gently sloping to the south, with steeper gradients northeast and northwest of the Site, at the valley edges
Inferred Groundwater Flow Direction	South
Closest Water Bodies	Columbia River, approximately 180 m southwest of the Site.

The BC Water Resources Atlas was searched through iMapBC for known aquifers beneath the Site and water wells and licenses within 500 m of the Site.

Four aquifers were identified beneath the Site: aquifer numbers 501, 504, 513 and 990. Overburden aquifers 504 and 501 overlie deeper bedrock aquifers 513 and 990.

Aquifer 504 is a shallow partially confined aquifer occupying the slope of the valley floor, bounded by the Columbia River to the south. This aquifer is present within sand and gravel in the floodplain areas and likely hydraulically connected to the Columbia River. In some areas this aquifer is overlain by a confining layer, ranging in thickness from 1.5 to 33.5 m, and the vulnerability is considered moderate. In the vicinity of the Site, it is unlikely that there is a substantial overlying confining layer. Depth to groundwater ranges from 4.3 to 36 m, and groundwater flow likely follows topography to the south towards the Columbia River. A total of 30 wells are correlated to this aquifer.

Aquifer 501 is a deep confined aquifer along the Columbia River that is comprised of alluvial and glaciofluvial deposits. This aquifer is present within sand and gravel deposits, that are overlain with clay, till and fines with an average thickness of 19.6 m. In some areas, sand and gravel is present from ground surface resulting in areas of locally high vulnerability, but overall vulnerability is considered moderate. Most wells are deep and the average depth to water is 25.0 m. Groundwater flow is noted to likely follow topography towards the south with the slope of the valley and is likely hydraulically connected to the Columbia River and underlying bedrock aquifers. A total of 164 wells are correlated to this aquifer.

Aquifer 513 is a fractured bedrock aquifer (primarily granitic and granodioritic), present along the Kootenay and Columbia Rivers, often present below the regional overburden aquifers. The depth to the bedrock ranges from between 0.3 to 148 m, with an average depth of 18.5 m, though bedrock outcrops are noted to be present in high elevation areas. The aquifer is generally confined in the valley floor with moderate vulnerability, and unconfined at higher elevations where vulnerability is considered high. Near the Site, this aquifer is overlain by Aquifers 504 and 501, with a least 21 m of overburden, and the likelihood of surficial contamination reaching this aquifer was considered low. A total of 336 wells are correlated to this aquifer and the median depth to water is 24.5 m.

Aquifer 990 is a fractured bedrock aquifer (various igneous and metamorphic types), present along the north shore of the Columbia River, often present below the regional overburden aquifers. The depth to the bedrock ranges from between 2.7 to 37.5 m, with an average depth of 22.9 m. The aquifer is present within the valley floor, is partially confined, with moderate vulnerability. Near the Site, this aquifer is overlain by Aquifers 504 and 501, with a least 21 m of overburden, and the likelihood of surficial contamination reaching this aquifer was considered low. A total of 5 wells are correlated to this aquifer and the depth to water ranged from 10.7 to 30.5 m, based on two readings.

A total of 23 water wells were identified within 500 m of the Site, one of which (well number 87816) was located at the Site. Soil lithology in the on-Site well was primarily sand or sand and gravel in the upper 17 m, overlying till at depth. The on-Site well was constructed in 2007, with a screen from 14 to 15.2 m depth, and a reported static water level of 4.9 m. A copy of the well installation log is included in **Appendix A**.

All identified off-Site wells were in upgradient areas with primarily domestic water uses reported, though irrigation and 'other' were also listed. All identified water wells were correlated to aquifer 501. The minimum finished depth of a water well within 200 m of the Site was 12 m (well number 82189) with most finished at depths around 20 m or more.

Search results including well mapping, a summary of well details, and aquifer information sheets are included in **Appendix A**.

4 DISCUSSION

LEGACY reviewed the local geology, aquifers present below the Site, nearby water wells and uses including on-Site well 87816. While the proposed use as a cardlock introduces the potential for surficial contamination at the Site, hydrocarbon contaminants are less dense than water and are, therefore, only likely to impact shallow aquifer 504. There are no known receptors using aquifer 504 in the vicinity of the Site, and there is a low risk of potential contaminant migration to the nearest aquatic receptor. All other identified aquifers are at a depth such that contamination reaching potential receptors is considered unlikely.

A summary of the characteristics and risk presented by the proposed card lock to each aquifer is provided in the following table.

Summary of Aquifer Findings

Aquifer No. / Type	Risk	Rationale
504 – Shallow unconfined overburden	Low	There are no known current water wells near the Site in aquifer 504, and therefore no receptors are present that could be impacted if contamination were to occur. Groundwater flow is expected to be towards the Columbia River, south of the Site, and away from potential receptors in this aquifer. Any hydrocarbon contamination resulting from spills or leaks would be quickly contained and product recovered. As such, only residual dissolved concentrations have the potential to reach the aquifer and migrate laterally along with the shallow groundwater flow. The Columbia River is located more than 220 m from the Site. Considering the distance between the Site and Columbia River, and the presence of City of Castlegar wastewater treatment ponds, migration and discharge of residual contaminated groundwater to the Columbia River is unlikely. Migration of residual petroleum hydrocarbons over such distances is rare, due to the aerobic biodegradation that occurs as contaminants migrate away from the source area. This typically results in a steady-state plume that would extend over a much shorter distance. Furthermore, the open wastewater treatment ponds present along the migration pathway would likely act as barriers, either preventing shallow groundwater flow, or discharging to the ponds, resulting in potentially accelerated biodegradation due to aeration within the treatment pond. Based on the above, the risk of a spill or leak reaching the aquatic environment in the Columbia River was considered low.
501 – Deep partially confined overburden	Low	All water wells near the Site were associated with aquifer 501, a primarily confined aquifer with typical water intakes at depths around 20 m. All off-Site water wells within 500 m were in upgradient locations with respect to the inferred groundwater flow direction. Vertical migration to the depth of typical water intakes in this aquifer was considered unlikely considering potential contaminants, and no downgradient potential receptors were identified. Based on the above, the risk was considered low.
513 – Fractured Bedrock	Low	Considering the minimum overburden thickness of 21 m at the Site, potential risk of contamination to the deep bedrock aquifer was considered low.
990 – Fractured Bedrock	Low	Considering the minimum overburden thickness of 21 m at the Site, potential risk of contamination to the deep bedrock aquifer was considered low.

Based on the above analysis, it is LEGACY's opinion that the proposed use as a cardlock presents a low risk to aquifers underlying the Site, as any potential contamination that occurred is not likely to impact any receptors.

LEGACY understands that there is no current use of the on-Site water well as a drinking water supply, and as such, there is a low risk posed by the potential use of the Site as a card lock. If at a future date the on-Site water well is used as a drinking water source, a more detailed analysis of the well location in relation to the fueling infrastructure and/or need for regular monitoring or water quality testing should be conducted. Consistent with the *Water Sustainability Act*, and its Groundwater Protection Regulation, any water wells that are no longer in use, or planned to be used in the future, should be properly decommissioned.

5 CLOSURE

We appreciate your business! Should you have any questions or concerns please do not hesitate to contact the undersigned.

Prepared by LEGACY:



Dan D'Angelo, P.Ag., CSAP
Senior Project Manager
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Reviewed by LEGACY:



Karey Dow, P.Ag., PMP
Principal, Contaminated Sites Specialist
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kdow@legacyenv.ca

6 STATEMENT OF LIMITATIONS

LEGACY completed this Report for B.A. Benson & Son Ltd. (Client) in a manner consistent with the level of care and skill normally exercised by environmental science professionals practicing under similar conditions in BC at the time the Report was completed. No warranty, expressed or implied, is given concerning the presence, absence, type or level of contamination at the Site. The evaluation and interpretation of the information contained in this Report is based on the actual data obtained at the time under the conditions encountered during the performance of the work and may vary, despite the use of due professional care. Any conclusions and recommendations provided are based upon applicable legislation existing at the time the Report was completed. Any changes in the legislation may alter the conclusions and/or recommendations made by LEGACY.

This Report shall not create any rights or benefits to parties other than Client and LEGACY. No third party shall have the right to rely on LEGACY opinions rendered in connection with this Report without LEGACY's written consent. Any use that a third party makes of these opinions, or any reliance on or decision made based on this Report, will be at such third party's sole risk without liability to LEGACY. LEGACY accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report or opinions.

APPENDIX A

WATER WELL AND AQUIFER DETAILS



Table A1 - Well Details

Well Tag Number	Well Class	Intended Water Use	Street Address	Finished Well Depth (m bgl)	Aquifer ID
98982	Water Supply	Irrigation	PASS CREEK ROAD	18.29	501
120737	Water Supply	Private Domestic	1037 raspberry road	14.63	501
123740	Water Supply	Private Domestic	1111 Raspberry Rd,	28.35	501
20077	Unknown	Not Applicable	RASPBERRY VILLAGE	43.59	501
97716	Water Supply	Private Domestic	19 RASPBERRY ROAD	36.58	501
20116	Unknown	Unknown Well Use	OLD RASPBERRY	17.37	501
88321	Water Supply	Private Domestic	LOT 1 RASPBERRY ROAD	22.56	501
74636	Water Supply	Private Domestic	1104 WILD ROSE RD	24.38	501
87816	Water Supply	Private Domestic	OLD MILLS ROAD	15.24	501
38587	Unknown	Unknown Well Use	PASS CREEK	21.34	501
82189	Water Supply	Private Domestic	962 WALDIE ROAD	12.19	501
365	Water Supply	Private Domestic	WALDIES FLATS	23.77	501
13954	Unknown	Unknown Well Use	NOT LISTED	20.12	501
90328	Water Supply	Private Domestic	2133 BAYVIEW ROAD	24.38	501
19411	Unknown	Unknown Well Use	NOT LISTED	18.59	501
80237	Unknown	Other	NORNS CREEK AND HWY 3	8.84	501
80240	Unknown	Not Applicable	NORNS CREEK	18.59	501
80239	Unknown	Not Applicable	NORNS CREEK AND HWY 3	14.63	501
34532	Unknown	Unknown Well Use	ROSEBERRY VILLAGE	50.90	501
80238	Unknown	Not Applicable	NORNS CREEK AND HWY 3	14.63	501
57872	Water Supply	Private Domestic	BROADWATER RD.@ PASS CR.PARK	23.16	501
66350	Water Supply	Private Domestic	2045 RASPBERRY ROAD	26.21	501
82190	Water Supply	Private Domestic	1086 WILD ROSE	24.08	501



iMapBC Mapping

Legend

Groundwater Wells - All

ARTESIAN_COND

- Reported Artesian Well
- Well

0 0.20 0.41 km

1: 10,000

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Datum: NAD83

Projection: WGS_1984_Web_Mercator_Auxiliary_Sphere

Key Map of British Columbia

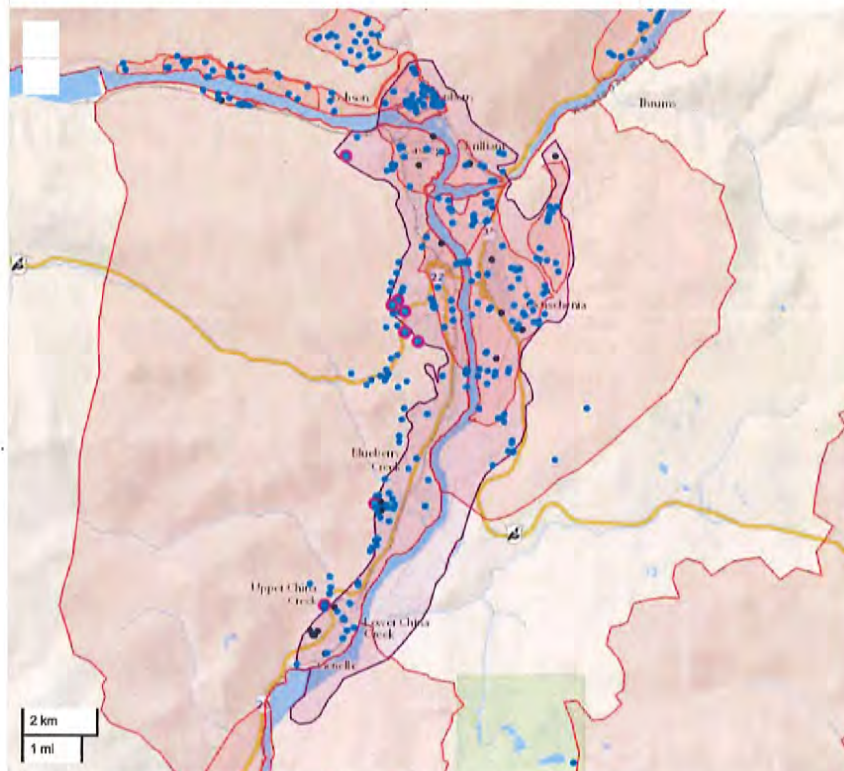




Aquifer Search / Aquifer Summary

Aquifer 501 Summary

Aquifer number	501
Year of mapping	2024
Aquifer name	Castlegar Overburden
Litho stratigraphic unit	Late Wisconsinan glaciofluvial sand and gravel
Descriptive location	Along the Columbia River, northern extent confluence of Columbia and Kootenay rivers.
Vulnerability	Moderate
Material type	Sand and Gravel
Subtype	Confined sand and gravel - glacial
Quality concerns	
Productivity	Moderate
Size (km ²)	46.5
Calculated well density	Moderate



- ☒ Cadastrals
- ☐ EcoCat
- ☐ Surface water licences
- ☐ Groundwater licences
- ☒ Wells
- ☒ Wells - aquifer parameters
- ☐ Observation wells
- ☐ EMS wells
- ☐ Uncorrelated wells

Legend

- Wells – all
- Wells – artesian
- Wells – closed/abandoned

MapBox | Government of British Columbia, DataBC, GeoBC

Well Information

Number of wells correlated to the aquifer	164
Number of uncorrelated wells within mapped aquifer extent	12

Documentation

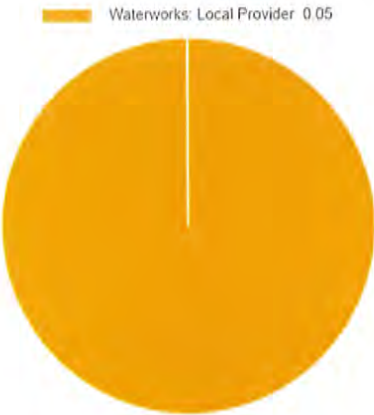
- AQ_00501_Aquifer_Mapping_Report0501.pdf

Licensing Information

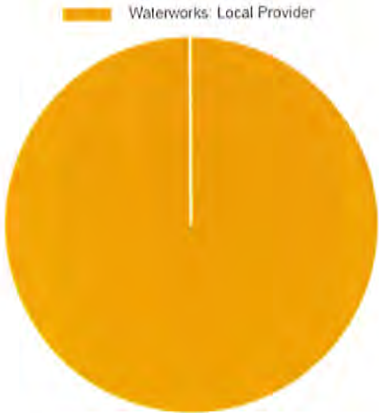
The licensing summaries should be considered estimates. Total volume is likely more than what is indicated in charts due to domestic use and unprocessed licence applications. Due to complexities in the structure of the licensing data, reported values should be confirmed through the [e-licensing portal \(https://1200.gov.bc.ca/pub/ams/Default.aspx?PossePresentation=AMSPublic&PosseObjectDef=o_ATIS_DocumentSearch&PosseMenuName=WS_Main\)](https://1200.gov.bc.ca/pub/ams/Default.aspx?PossePresentation=AMSPublic&PosseObjectDef=o_ATIS_DocumentSearch&PosseMenuName=WS_Main).

Number of groundwater licences	1
Water withdrawal volume (annual)	54576 cubic metres

Licensed volume by purpose (millions of cubic meters)



Number of licences by purpose



Licence Number	Well Tag Numbers In Licence
504563	19471, 126735

Licence info last updated 1/8/2025

Licensing information is obtained from the [Water Rights Licence - Public data layer \(https://catalogue.data.gov.bc.ca/dataset/water-rights-licences-public\)](https://catalogue.data.gov.bc.ca/dataset/water-rights-licences-public).

Unique licenses are counted once for each aquifer that they are associated with.

The total licensed volume is counted once for each licence (the total volume may be shared between wells if there are multiple wells in a licence). In cases where specific volumes are licensed for multiple purposes, individual volumes are summed.

Knowledge Indicators

Advanced mapping	◦ Mapping Report (2024) (https://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=63036)
Drilling & operation advisory	No information available.
Observation wells	Active ◦ 074 (https://governmentofbc.maps.arcgis.com/apps/webappviewer/index.html?id=b53cb0bf3f6848e79d66ffd09b74f00d&find=OBS WELL 074)
Numerical Model	No information available.
Aquifer notations	No notation currently assigned.
Water Budget	No information available.
Water quality information	4 wells with an EMS ID
Hydraulically connected (screening level)	See Guidance on Determining Likelihood of Hydraulic Connection
Groundwater Surface Water Interactions	No information available.
Other information	No information available.

Aquifer Name: Castlegar Overburden Aquifer

Aquifer Number: 0501

Date of Mapping: February 2nd, 2023

Authors: Tibor Lengyel, M.Sc., P.Geo., Simrat Verma, M.Sc., and Andrew Hinnell, Ph.D., P.Geo.

A. AQUIFER DESCRIPTION FOR AQUIFER 0501

A.1 CONCEPTUAL UNDERSTANDING OF HYDROSTRATIGRAPHY

A.1.1 AQUIFER EXTENTS

Aquifer 0501 is located along the Columbia River in the vicinity of Castlegar, British Columbia (see Figure 1; Lengyel et al. 2024). The east and west extents of the aquifer were delineated based on surficial geological mapping in the area and they coincide with the extent of mapped alluvial and glaciofluvial sediments (Fulton et al. 1984). To the south, aquifer 0501 is separated from aquifer 0483 by inferred bedrock outcrops which interrupt the glaciofluvial sediments in the Columbia River valley. Similarly, the northern boundary is separated from aquifer 1117 (located on the Kootenay River) by bedrock outcrop.

A.1.2 GEOLOGIC FORMATION (OVERLYING MATERIALS)

Borehole records indicate deposits overlying the aquifer are comprised of interlayered sands and gravels with clay, hardpan (interpreted as till), and fines (described as silt and clay). Permeable sands and gravels exist at ground surface in some regions. Silt, gravelly silt, boulders, till and clay zones exist in 89 well records with an average thickness of 19.6 m.

Most wells are deep (>30 m) and have been completed within glaciofluvial deposits.

A.1.3 GEOLOGIC FORMATION (AQUIFER) – SUBTYPE: 4B – CONFINED GLACIOFLUVIAL

Surficial mapping (Fulton et al. 1984) indicates that aquifer 0501 is comprised primarily of medium to coarse glaciofluvial deposits.

A.1.4 VULNERABILITY - MODERATE

While the permeability of the aquifer has not been tested, it is expected to be high based on the type of aquifer material (alluvial and glaciofluvial sand and gravel). Depth to groundwater is shallow to deep with an average depth to water of 25.0 m. Well records indicate that the aquifer is generally confined by thick sequences of till, silt, and/or clay. However, there are some regions of the aquifer (e.g., in the southwest, and in the Castlegar region in the north) that have permeable material (sand and gravel) present from the ground surface resulting in local areas of high vulnerability. The aquifer has been classified as a mixed aquifer (i.e., confined and unconfined), and the overall vulnerability of the aquifer has been assessed as moderate.

A.2 CONCEPTUAL UNDERSTANDING OF FLOW DYNAMICS

A.2.1 GROUNDWATER LEVELS AND FLOW DIRECTION

Static groundwater levels recorded in the provincial groundwater wells database (GWELLS) range from shallow (2.7 m) to deep (78.6 m). There is one provincial observation well (OW-074) within the aquifer. There are no artesian wells within the aquifer extents.

The Province has managed observation well 074 located in this aquifer since 1966. A maximum groundwater level of 26.3 m below ground level and a minimum groundwater level of 28.7 m below ground level was recorded in 2021.

The groundwater surface is interpreted to be a subdued representation of the topography, based on regional interpolation of groundwater surface elevations. Groundwater is interpreted to follow the topographic gradient and flow from high elevations near the edges of the aquifer to low elevations near the Columbia River with a southerly component influenced by the regional slope of the river valley.

A.2.2 RECHARGE

Recharge to the aquifer is likely from distributed infiltration of precipitation, snowmelt, slow downward leakage, and/or surface water features including the Columbia River and its tributaries. The infiltration of precipitation and snowmelt is expected to focus on areas where the overlying materials are thinner or coarse-grained. The aquifer may also be recharged by deep groundwater flow associated with mountain block recharge in adjacent mountain ranges via the underlying bedrock aquifers (0500, 0513, and 1283).

A.2.3 POTENTIAL FOR HYDRAULIC CONNECTION

Groundwater is inferred to be hydraulically connected to the Columbia and Kootenay rivers. The aquifer may also be hydraulically connected to the underlying bedrock aquifers (0500, 0513, and 1283). While inferred bedrock outcrops separate them, aquifers 0483, 0484, 0501, and 1117 are part of the same group of overburden aquifers along the Columbia and Kootenay Rivers.

A.3 WATER MANAGEMENT

A.3.1 ADDITIONAL INFORMATION ON WATER USE AND MANAGEMENT

Reported well yields for 113 of 163 (excluding 50 wells that were dry or had no reported well yield) wells within the aquifer range between 0.006 L/s and 139 L/s with a geometric mean of 2.1 L/s, indicating an aquifer with moderate productivity with localized zones of low and high productivity. No water quality or quantity concerns were noted in the water quality comments of the GWELLS database.

There is a mix of domestic and commercial/industrial, and production wells (Golf Course, Ootischenia Improvement District, and Village of Kinnard) based on land use and well records.

A.3.2 ADDITIONAL ASSESSMENTS OR MANAGEMENT ACTIONS

No water availability or water budget studies have been completed in the area.

A.4 AQUIFER REFERENCES

Berardinucci J. and K. Ronneseth, 2002. Guide to Using the BC Aquifer Classification Maps for the Protection and Management of Groundwater. BC Ministry of Water, Land and Air Protection, Water Air and Climate Change Branch, Water Protection Section.

Geographic datasets from the BC Data Catalogue, accessed December 2022 <https://data.gov.bc.ca/>.

Groundwater Level datasets for Provincial Groundwater Observation Well Network from the Government of BC, accessed February 2023,
<https://governmentofbc.maps.arcgis.com/apps/webappviewer/index.html?id=b53cb0bf3f6848e79d66ffd09b74f00d>

Fulton, R.J., Shetsen, I., and Rutter, N.W., 1984. Surficial geology, Kootenay Lake, British Columbia-Alberta. Geological Survey of Canada, Open File 1084, 1:1,000,000 scale.

Lengyel, T., Verma, S., Deri-Takacs, J., and Hinnell, A. 2024. Aquifer Mapping in the Kootenay/Boundary Region of British Columbia: Creston, Rossland, Castlegar, and Salmo. Water Science Series, WSS2024-05. Prov. B.C., Victoria B.C.

A.5 REVISION HISTORY

Date	Version	Revision Class	Comments	Author
20020308	1	Major	Initial mapping of aquifer	N/A
20221230	1	Major	Remapping and consolidation of aquifers	Tibor Lengyel, M.Sc., P.Geo., Simrat Verma, M.Sc., and Andrew Hinnell, Ph.D., P.Geo.

Note: Author of first mapping not available



Aquifer Description (Mapping Report - 2012):

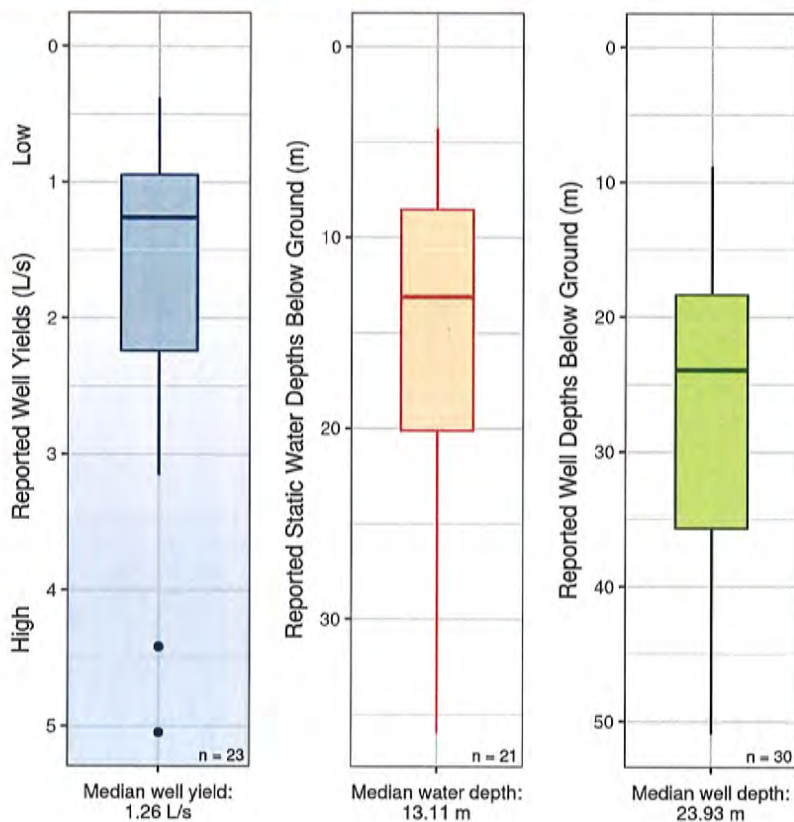
Unconfined glacio-fluvial outwash or ice contact sand and gravel aquifers generally formed near or at the end of the last period of glaciation (sub-type = 4a).

Aquifer Details

Region	Kootenay
Water District	Nelson
Aquifer Area	1.6 km ²
No. Wells Correlated	30
Vulnerability to Contamination	Moderate
Productivity	Moderate
Aquifer Classification	IIB
Hydraulic Conductivity *	Unknown
Transmissivity *	Unknown
Storativity *	Unknown
No. Water Licences Issued to Wells	Unknown
Observation Wells (Active, Inactive)	None

* min - max

For Hydraulic Connection see [guidance document](#)



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Detailed methods for all figures are described in the companion document ([Aquifer Factsheet - Companion Document.pdf](#)).

Factsheet generated: 2022-07-27. Aquifers online: <https://apps.nrs.gov.bc.ca/gwells/aquifers>.

AQUIFER CLASSIFICATION WORKSHEET

DATE: March 31, 2012
AQUIFER REFERENCE NUMBER: 504
DESCRIPTIVE LOCATION OF AQUIFER: Raspberry Village, north of Castlegar, north of Columbia River
NTS MAP SHEET: 082J05
BCGS MAP SHEET: 082f032

CLASSIFICATION: IIB

RANKING: 10

Aquifer Size: 1.6 km²

Aquifer Boundaries:

The southern aquifer boundary follows the shoreline of the Columbia River. The remainder of the aquifer boundary follows the break in slope of the valley floor and valley sides, generally along the 500 m above sea level topographic contour interval. Solid lines have been used for boundaries having a high degree of certainty while dash lines indicate a lesser degree of certainty.

Aquifer Sub-type: 1b

Characterized as aquifers found along rivers of moderate stream order with the potential to be hydraulically influenced by the river.

Aquifer Priority Rating for Observation Wells: 38.63

Geologic Formation (overlying materials):

Lithology information indicates overlying deposits of primarily clay, silt, as well sands and fines. A few wells have highly permeable sediments from surface.

Geologic Formation (aquifer): Sand and Gravel

Post glacial floodplain. The aquifer is likely hydraulically connected to the Columbia River and potentially locally hydraulically connected to Norns Creek.

Confined/Partially Confined/Unconfined: Partially Confined

Vulnerability:

Moderate - B

A majority of wells with lithology information have a confining unit overlying the aquifer ranging in thickness from 1.52 to 33.53 m with a median of 13.05 m and an average of 13.85 m. The depth to the bottom of the primary confining layer ranges from 1.83 to 47.24 m with a median of 18.29 m and an average of 22.16 m. Only a medium degree of confinement is provided by some deposits (i.e., sand & fines) and there may be windows of highly permeable sediments in the confining layer. Based on the above, the aquifer vulnerability is considered moderate.

Productivity:

Moderate – Geomean 1.47 L/s

Reported well yields range widely between 0.38 to 5.05 L/s with a median of 1.26 L/s and an average of 1.89 L/s based on 23 records. Productivity is considered moderate based on a geometric mean of 1.47 L/s.

Depth to Water:

Moderately Shallow – Average 16.34 m

The depth to static water level ranges from 4.27 to 35.97 m with a median of 13.11 m and an average of 16.34 m based on 21 records.

Direction of Groundwater Flow:

Groundwater likely follows the topographic gradient from high elevation to low elevation towards the Columbia River.

Recharge:

Recharge to the aquifer is likely from direct infiltration of precipitation, slow downward leakage, surface water features, and/or lateral inflows into the valley.

Domestic Well Density:

Moderate – 16.3 wells/km²

The level of density was calculated at 16.3 wells/km² using wells identified for domestic and unknown uses and is considered to be moderate.

Type of Water Use:

Multiple Uses

Groundwater is used for private domestic, water supply system, and irrigation purposes based on a review of well records.

Reliance on Source:

Conjunctive. There are water licenses along local springs that are also used to meet local water demands. A reservoir is also located within the aquifer area.

Conflicts between Users:

None documented.

Quantity Concerns:

One well reportedly goes dry occasionally.

Quality Concerns:

Some iron reported at a few wells. This is an aesthetic issue.

Comments:

References:

Bernardinucci J. and K Ronneseth, 2002. Guide to Using the BC Aquifer Classification Maps for the Protection and Management of Groundwater. BC Ministry of Water, Land and Air Protection, Water Air and Climate Change Branch, Water Protection Section.

Little, H.W. 1960. Geology, Nelson (West Half), Kootenay and Similkameen Districts, British Columbia, Geological Survey of Canada, Map 1090A, scale 1:253,440.

AQUIFER CLASSIFICATION AND RANKING

AQUIFER LOCATION: Raspberry Village, north of Castlegar, north of Columbia River

AQUIFER REFERENCE NUMBER: 504

AQUIFER SUB-TYPE: 1b

AQUIFER PRIORITY RATING FOR OBSERVATION: 38.63

CLASSIFICATION: IIB RANKING: 10

Classification Component:

Level of Development: Aquifer productivity is considered moderate based on well yield. Demand is considered moderate (see below). There is a moderate level of development in relation to aquifer productivity.

Level of Vulnerability: Moderate level of vulnerability to surface contamination.

Ranking Component: Ranking Value:

Productivity: 2

Vulnerability: 2

Size: 1

Demand*: 2

Type Of Use: 3

Quality:

Quantity:

Total: 10

** Demand has been assessed subjectively. Demand is based on domestic well density as well as general knowledge of well use and land use in the area. Demand assumes that the reported well capacity is the amount of water used, which can be misleading. The reported well capacity is often higher than actual use.*

Statistical Summary of Well Data for Aquifer # 504

Total number of wells available for statistical analysis:

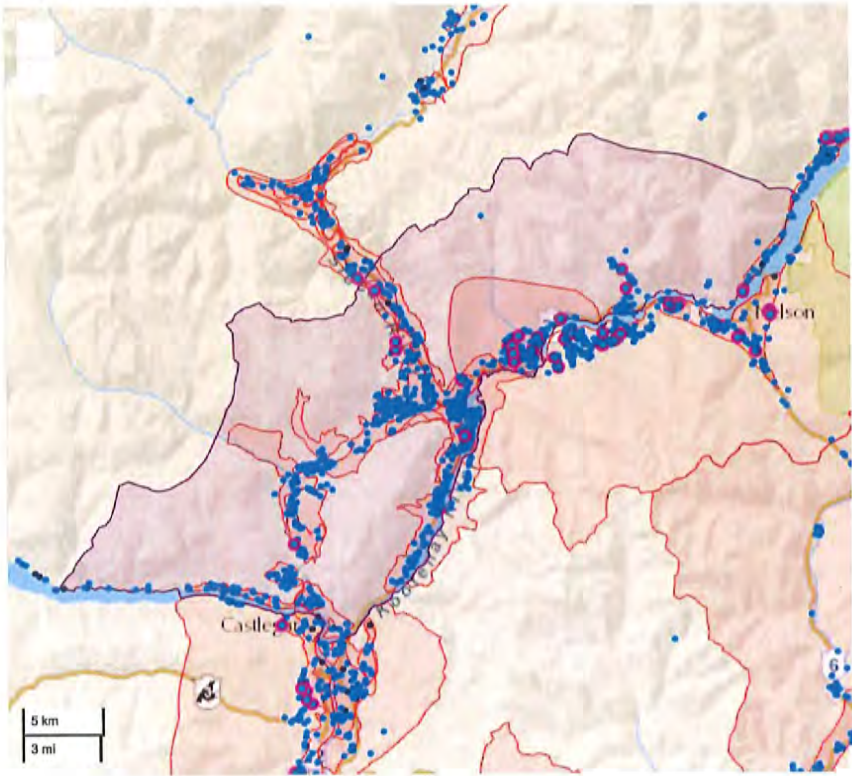
	Depth to Bedrock (m bgs)	Well Depth (m bgs)	Depth to Water (m bgs)	Reported Est. Well Yield (L/s)	Est. Thickness of Confining Materials (m)
Number of Wells	0	28	21	23	24
Minimum	-	12.19	4.27	0.38	1.52
Maximum	-	50.90	35.97	5.05	33.53
Median	-	24.23	13.11	1.26	13.05
Average	-	27.98	16.34	1.89	13.85
Geometric Mean	-	25.90	13.58	1.47	10.58



Aquifer Search / Aquifer Summary

Aquifer 513 Summary

Aquifer number	513
Year of mapping	2024
Aquifer name	North Castlegar Bedrock
Litho stratigraphic unit	Fractured crystalline Mesozoic & Cenozoic. Some metamorphic Paleozoic & sedimentary Mesozoic
Descriptive location	North of the confluence of the Kootenay and Columbia rivers
Vulnerability	High
Material type	Bedrock
Subtype	Fractured crystalline bedrock
Quality concerns	Isolated
Productivity	Moderate
Size (km²)	513.2
Calculated well density	Low



- ☒ Cadastrals
- ☐ EcoCat
- ☐ Surface water licences
- ☐ Groundwater licences
- ☒ Wells
- ☒ Wells - aquifer parameters
- ☐ Observation wells
- ☐ EMS wells
- ☐ Uncorrelated wells

- Legend
- Wells – all
 - Wells – artesian
 - Wells – closed/abandoned

MapBox | Government of British Columbia, DataBC, GeoBC

Well Information

Number of wells correlated to the aquifer	336
Number of uncorrelated wells within mapped aquifer extent	75

Documentation

- AQ_00513_Aquifer_Mapping_Report0513.pdf

Licensing Information

The licensing summaries should be considered estimates. Total volume is likely more than what is indicated in charts due to domestic use and unprocessed licence applications. Due to complexities in the structure of the licensing data, reported values should be confirmed through the [e-licensing portal \(https://200.gov.bc.ca/pub/ams/Default.aspx?PossePresentation=AMSPublic&PosseObjectDef=o_ATIS_DocumentSearch&PosseMenuName=WS_Main\)](https://200.gov.bc.ca/pub/ams/Default.aspx?PossePresentation=AMSPublic&PosseObjectDef=o_ATIS_DocumentSearch&PosseMenuName=WS_Main).

Number of groundwater licences	0
Water withdrawal volume (annual)	No information available.

Licensing Information is obtained from the [Water Rights Licence - Public data layer \(https://catalogue.data.gov.bc.ca/dataset/water-rights-licences-public\)](https://catalogue.data.gov.bc.ca/dataset/water-rights-licences-public).

Unique licenses are counted once for each aquifer that they are associated with.

The total licensed volume is counted once for each licence (the total volume may be shared between wells if there are multiple wells in a licence). In cases where specific volumes are licensed for multiple purposes, individual volumes are summed.

Knowledge Indicators

Advanced mapping	◦ Mapping Report (2024) (https://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=63036)
Drilling & operation advisory	No information available.
Observation wells	No information available.
Numerical Model	No information available.
Aquifer notations	No notation currently assigned.
Water Budget	No information available.
Water quality information	0 wells with an EMS ID
Hydraulically connected (screening level)	See Guidance on Determining Likelihood of Hydraulic Connection
Groundwater Surface Water Interactions	No information available.
Other information	No information available.

Aquifer Name: North Castlegar Bedrock Aquifer

Aquifer Number: 0513

Date of Mapping: February 2nd, 2023

Authors: Tibor Lengyel, M.Sc., P.Geo., Simrat Verma, M.Sc., and Andrew Hinnell, Ph.D., P.Geo.

A. AQUIFER DESCRIPTION FOR AQUIFER 0513

A.1 CONCEPTUAL UNDERSTANDING OF HYDROSTRATIGRAPHY

A.1.1 AQUIFER EXTENTS

The aquifer is north of the Columbia and Kootenay rivers (see Figure 1; Lengyel et al. 2024). The aquifer is a bedrock aquifer. Bedrock forms a regionally extensive geological/hydrostratigraphic unit. The extent of the aquifer is defined based on topography, major surface water features, and water licensing watershed boundaries. The aquifer is bounded by Upper Arrow Lake and the Columbia and Kootenay rivers, and the West Arm of Kootenay Lake in the south and the east. The rest of the aquifer boundaries were delineated based on inferred groundwater divides (ridges) drawn using surface licensing watershed boundaries. The aquifer was mapped outside the extent of well development; thus, uncertainty exists with aquifer properties.

A.1.2 GEOLOGIC FORMATION (OVERLYING MATERIALS)

Fulton et al. (1984) described the area of the aquifer to be overlain by sandy till, alluvium, glaciolacustrine silt, clay, and sand, and glaciofluvial sand and gravel. Aquifer 0513 may be locally overlain by the sediments of overburden aquifers 0501, 1117, and 1276. Depth to bedrock ranges from 0.3 to 147.8 m. The average depth to bedrock is 18.5 m. Bedrock outcrops at higher elevations.

A.1.3 GEOLOGIC FORMATION (AQUIFER) – SUBTYPE: 6B – FRACTURED CRYSTALLINE ROCK

Aquifer 0513 is composed primarily of fractured igneous intrusive rock (granite and granodioritic) of the Cenozoic and Mesozoic eras. There is a portion of granite and metamorphic rock (gneiss) that is of the Paleozoic Era, and a small section of sedimentary rock of the Mesozoic Era (Cui et al. 2017).

As the bedrock has been faulted and fractured throughout the area of the aquifer and surrounding region, and well yields change over short distances and do not appear to be correlated with bedrock type, secondary permeability is expected to be dominant in all types of bedrock; and as such, all these rocks may act as aquifers. Accordingly, bedrock aquifers are expected to extend across lithological boundaries.

A.1.4 VULNERABILITY - MODERATE

The bedrock aquifer is composed of fractured rock. Depth to groundwater varies from shallow to deep. The average depth to water is 24.5 m and average depth to bedrock is 18.5 m. The aquifer is generally confined, however, some areas throughout the aquifer show higher vulnerability (i.e., where permeable deposits are overlying the aquifer, overlying material is thin, and at higher elevations where the aquifer outcrops). There are artesian wells within the aquifer.

Vulnerability across the aquifer ranges from moderate along the floodplain of the Columbia River (where the aquifer is confined by overlying sediments [and where most of the development is expected to occur] and where the risk of contamination from land use is expected to be higher) to high further away from the river (in areas of topographical high where bedrock outcrops and overlying material is thin). The overall vulnerability of the aquifer to surface contamination has been qualitatively assessed to be moderate.

A.2 CONCEPTUAL UNDERSTANDING OF FLOW DYNAMICS

A.2.1 GROUNDWATER LEVELS AND FLOW DIRECTION

Static water levels recorded in the provincial groundwater wells database (GWELLS) range from artesian to deep (139.6 m). There are 24 wells with artesian groundwater conditions within the aquifer, located along the Kootenay River. There are no provincial observation wells within the aquifer.

The groundwater surface is interpreted to be a subdued representation of the topography based on regional interpolation of groundwater surface elevations. Groundwater is interpreted to flow along the topographic gradient from higher elevation in the north/northwest to lower elevation towards the south/southeast along the Columbia and Kootenay rivers.

No information has been identified on the primary porosity and permeability of the bedrock unit. Based on the type of material (primarily igneous intrusive rocks) and the large variation of reported well yields over short distances, flow is expected to occur primarily through fractures.

No information is available on how faults impact groundwater flow in the area. Fracturing associated with the faults is interpreted to enhance (and possibly be the main source) permeability.

A.2.2 RECHARGE

Recharge to the aquifer varies depending on depth to bedrock. In areas where the overburden is thick, surficial recharge to the aquifer is likely limited. The infiltration of precipitation and snowmelt is expected to focus on areas where fine-grained overburden is thinner and in areas of higher topographic elevations where overburden is absent, and the bedrock outcrops at surface (Fulton et al. 1984). Much of the recharge is expected to occur in the spring associated with snowmelt. Recharge may occur through the overlying overburden aquifers 1117 and 1276. The aquifer may also be recharged by overlying tributaries of the Columbia and Kootenay rivers where the intervening overburden is thin; however, spatial and temporal understanding of this recharge mechanism is uncertain and further investigation is required to confirm these hydraulic connections.

A.2.3 POTENTIAL FOR HYDRAULIC CONNECTION

Hydraulic connection to various surface water bodies (primarily the Columbia and Kootenay rivers and their minor tributaries, Upper Arrow and Kootenay lakes which form the southern and eastern boundaries of aquifer 0513) is expected. As the bedrock has been faulted and fractured throughout the Study Area, hydraulic connection to other aquifers (including the overlying overburden aquifers 0501, 1117 and 1276) is inferred; however, the extent of the fracture network and its continuity requires further study. Hydraulic connection with overburden aquifers may be limited should low permeability layers separate them.

A.3 WATER MANAGEMENT

A.3.1 ADDITIONAL INFORMATION ON WATER USE AND MANAGEMENT

Based on the water quality comments of the GWELLS database, two wells indicated an elevated water hardness as water quality concerns. Well yields for 325 out of 336 (excluding eleven wells that were dry or had no reported well yield) wells within the aquifer range between 0.02 L/s and 6.3 L/s with a geometric mean of 0.5 L/s, indicating an aquifer with generally moderate productivity with localized zones of low and high productivity.

There is a mix of domestic and commercial wells within aquifer 0513 based on well purpose recorded in GWELLS.

A.3.2 ADDITIONAL ASSESSMENTS OR MANAGEMENT ACTIONS

No water availability or water budget studies have been completed in the area.

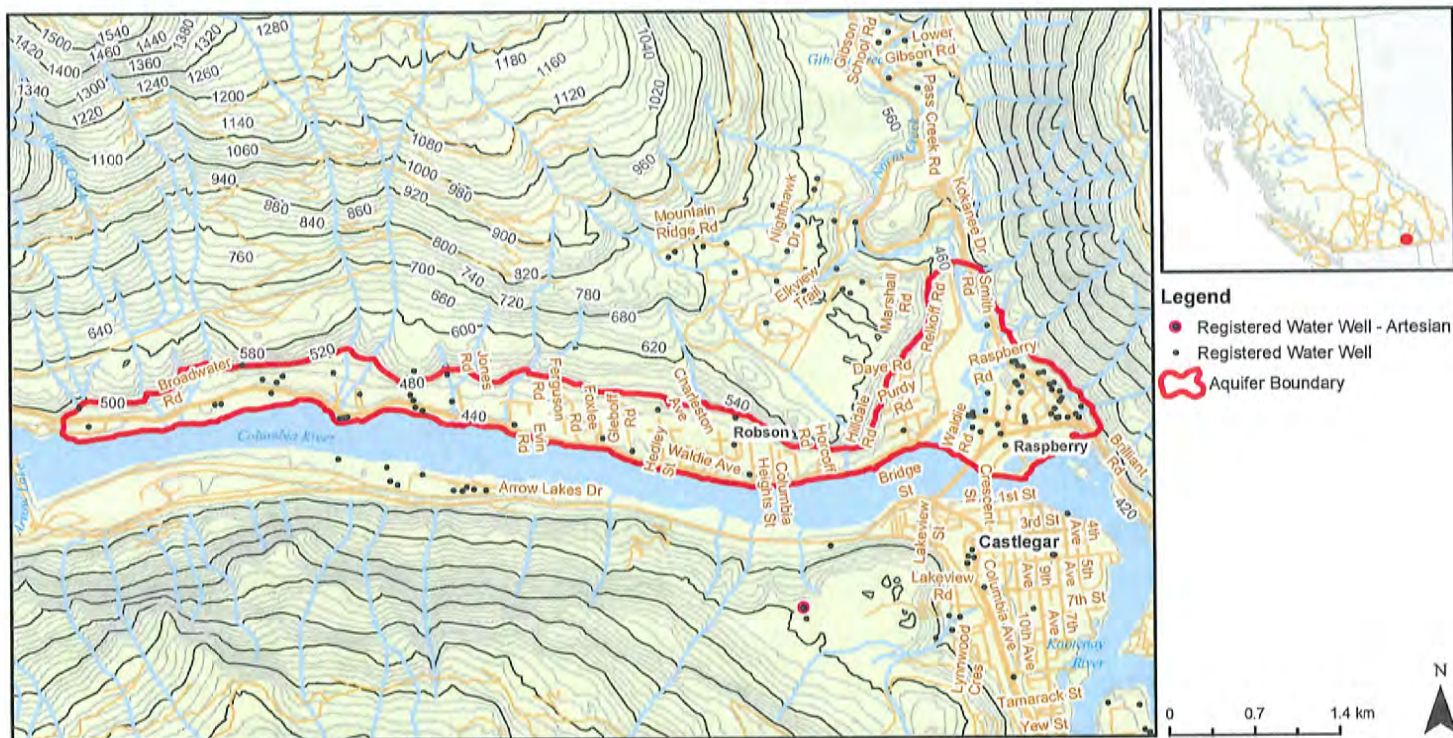
A.4 AQUIFER REFERENCES

- Berardinucci J. and K. Ronneseth, 2002. Guide to Using the BC Aquifer Classification Maps for the Protection and Management of Groundwater. BC Ministry of Water, Land and Air Protection, Water Air and Climate Change Branch, Water Protection Section.
- Cui, Y., Miller, D., Schiarizza, P., and Diakow, L.J. 2017. British Columbia Digital Geology. BC Ministry of Energy Mines and Petroleum Resources, BC Geological Survey Open File 2017-8, 9p. Data Version 2019-12-19.
- Fulton, R.J., Shetsen, I., and Rutter, N.W., 1984. Surficial geology, Kootenay Lake, British Columbia-Alberta. Geological Survey of Canada, Open File 1084, 1:1,000,000 scale.
- Geographic datasets from the BC Data Catalogue, accessed December 2022 <https://data.gov.bc.ca/>.
- Lengyel, T., Verma, S., Deri-Takacs, J., and Hinnell, A. 2024. Aquifer Mapping in the Kootenay/Boundary Region of British Columbia: Creston, Rossland, Castlegar, and Salmo. Water Science Series, WSS2024-05. Prov. B.C., Victoria B.C.

A.5 REVISION HISTORY

Date	Version	Revision Class	Comments	Author
20020322	1	Major	Initial mapping of aquifer	N/A
20160426	2	Minor	Revision of aquifer	Lowen Hydrogeology Consulting Ltd.
20230202	3	Major	Remapping and consolidation of aquifers	Tibor Lengyel, M.Sc., P.Geo., Simrat Verma, M.Sc., and Andrew Hinnell, PhD, P.Geo.

Author of first mapping not available



Aquifer Description (Mapping Report - 2012):

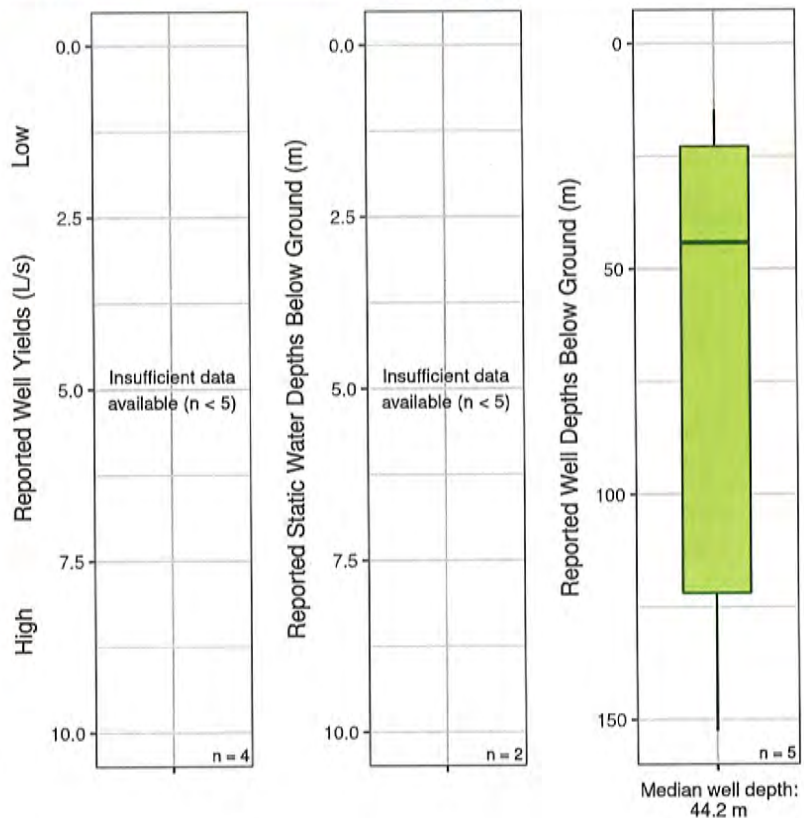
Fractured crystalline (igneous intrusive or meta-morphic, meta-sedimentary, meta-volcanic, volcanic) rock aquifer (subtype = 6b).

Aquifer Details

Region	Kootenay
Water District	Nelson
Aquifer Area	4.5 km ²
No. Wells Correlated	5
Vulnerability to Contamination	Moderate
Productivity	Moderate
Aquifer Classification	IIIB
Hydraulic Conductivity *	Unknown
Transmissivity *	Unknown
Storativity *	Unknown
No. Water Licences Issued to Wells	Unknown
Observation Wells (Active, Inactive)	None

* min - max

For Hydraulic Connection see [guidance document](#)



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Detailed methods for all figures are described in the companion document ([Aquifer Factsheet - Companion Document.pdf](#)).

Factsheet generated: 2022-07-27. Aquifers online: <https://apps.nrs.gov.bc.ca/gwells/aquifers>.

AQUIFER CLASSIFICATION WORKSHEET

DATE: March 31, 2012

AQUIFER REFERENCE NUMBER: 990

DESCRIPTIVE LOCATION OF AQUIFER: Northern shoreline of the Columbia River, west of
Lower Arrow Lake

NTS MAP SHEET: 092H06

BCGS MAP SHEET: 092h033

CLASSIFICATION: IIIB

RANKING: 8

Aquifer Size:

4.5 km²

Aquifer Boundaries:

The aquifer boundary was delineated using topography and the extent of well development. The aquifer is located in the valley bottom. Solid lines have been used for boundaries having a high degree of certainty while dash lines indicate a lesser degree of certainty.

Aquifer Sub-type:

6b

Characterized as fractured crystalline (igneous intrusive or metamorphic, meta-sedimentary, meta-volcanic, volcanic) rock aquifers.

Aquifer Priority Rating for Observation Wells:

21.90

Geologic Formation (overlying materials):

Lithology information indicates overlying deposits of primarily clay or highly permeable sand and gravel deposits. The depth of unconsolidated material overlying the bedrock ranges from 2.74 to 37.49 m with a median of 22.86 m and an average of 21.21 m based on only 5 well records.

Geologic Formation (aquifer):

Intrusive/Metamorphic Rocks

Primarily intrusive rocks belonging to the Greenwood, Wallace Creek Plutons, Kinnaird Gneiss formation from the Mesozoic era. Some wells are instrumented in metamorphic rocks from the Paleozoic era. The shallow bedrock wells may be hydraulically connected to overlying unconsolidated deposits.

Confined/Partially Confined/Unconfined:

Partially Confined

Vulnerability:

Moderate - B

The thickness of the confining unit ranges from 8.53 to 12.81 m with an average of 11.18 m based on three well records. There are two wells that have highly permeable sediments overlying the bedrock unit. Lithology information for overlying Aquifer No. 502 and Aquifer No. 504 suggests some overlying confining materials only provide a medium degree of confinement and there may be windows of highly permeable sediments in the confining layer. Based on the above, the aquifer vulnerability is considered moderate.

Productivity:

Moderate – Geomean 0.35 L/s

Reported well yields range between 0.13 to 0.95 L/s with an average of 0.54 L/s based on 4 records. Productivity is considered moderate based on a geometric mean of 0.35 L/s.

Depth to Water:

Moderately Shallow – Average 20.57 m

Two depth to static water levels of 10.67 m and 30.48 m were reported.

Direction of Groundwater Flow:

Groundwater likely flows to the south ignoring geologic complexities in the fractured bedrock and assuming groundwater will follow the topographic gradient from high elevation to low elevation.

Recharge:

Recharge to the aquifer is likely from direct infiltration of precipitation, slow downward leakage, and/or local surface water features.

Domestic Well Density:

Low – 1.1 wells/km²

The level of density was calculated at 1.1 wells/km² using wells identified for domestic uses and is considered to be moderate.

Type of Water Use:

Drinking Water

Groundwater is used for private domestic purposes based on a review of well record information.

Reliance on Source:

Conjunctive. There are water licenses along local creeks and springs that are also used to meet water demands. Wells are also instrumented in overlying Aquifer No. 502 and Aquifer No. 504.

Conflicts between Users:

None documented.

Quantity Concerns:

None documented.

Quality Concerns:

None documented.

Comments:

References:

Bernardinucci J. and K Ronneseth, 2002. Guide to Using the BC Aquifer Classification Maps for the Protection and Management of Groundwater. BC Ministry of Water, Land and Air Protection, Water Air and Climate Change Branch, Water Protection Section.

AQUIFER CLASSIFICATION AND RANKING

AQUIFER LOCATION: Northern shoreline of the Columbia River, west of Lower Arrow Lake

AQUIFER REFERENCE NUMBER: 990

AQUIFER SUB-TYPE: 6b

AQUIFER PRIORITY RATING FOR OBSERVATION: 21.90

CLASSIFICATION: IIIB RANKING: 8

Classification Component:

Level of Development: Aquifer productivity is considered moderate based on well yield. Demand is considered low (see below). There is a light level of development in relation to aquifer productivity.

Level of Vulnerability: Moderate level of vulnerability to surface contamination.

Ranking Component: Ranking Value:

Productivity: 2

Vulnerability: 2

Size: 1

Demand*: 1

Type Of Use: 2

Quality:

Quantity:

Total: 8

** Demand has been assessed subjectively. Demand is based on domestic well density as well as general knowledge of well use and land use in the area. Demand assumes that the reported well capacity is the amount of water used, which can be misleading. The reported well capacity is often higher than actual use.*

Statistical Summary of Well Data for Aquifer # 990

Total number of wells available for statistical analysis:

	Depth to Bedrock (m bgs)	Well Depth (m bgs)	Depth to Water (m bgs)	Reported Est. Well Yield (L/s)	Est. Thickness of Confining Materials (m)
Number of Wells	5	5	2	4	3
Minimum	2.74	14.63	10.67	0.13	8.53
Maximum	37.49	152.40	30.48	0.95	12.81
Median	22.86	44.20	20.57	0.54	12.19
Average	21.21	71.20	20.57	0.54	11.18
Geometric Mean	15.66	48.73	18.03	0.35	11.00

white: Customer copy
canary: Driller copy
pink: Ministry copy

Sheet _____ of _____

General

1. Requirements for well construction and well closure reports are found in Part 5 of the *Water Act* and the Ground Water Protection Regulation. Part 5 of the act and regulation are available at: <http://www.env.gov.bc.ca/wat/gws/index.html>.
2. The current Ministry standard datum for mapping and geodetic use is the North American Datum of 1983 (NAD 83). To determine GPS coordinates using a Global Positioning System (GPS), set the datum to NAD 83.
3. For latitude and longitude coordinates, provide coordinates either in degree, minutes and seconds (e.g., 50° 2' 21.037") or decimal degrees (e.g., 50.039175°).
4. For the method of determining ground elevation, enter: GPS, differential GPS, level, altimeter, 1:50,000 map, 1:20,000 map, 1:10,000 map or 1:5,000 map.
5. The classes and sub-classes of wells are shown below:

Class	Sub-class (if applicable)
Water supply	Domestic; Non-domestic
Monitoring	Temporary; Permanent
Recharge or injection	
Dewatering or drainage	Temporary; Permanent
Remediation	Temporary; Permanent
Geotechnical.....	Borehole; Test pit; Special type of hole; Closed loop geothermal
6. Well reports submitted to the Deputy Comptroller, or retained by the person responsible, as required under the *Water Act* and the Ground Water Protection Regulation, shall be considered part of the Provincial Government records and is subject to the *Freedom of Information and Protection of Privacy Act*.

How to Fill Out the Lithologic Description Table

7. Each row in the lithologic description table represents either a depth interval or depth in the well.
8. A row could represent a depth interval (e.g., from 0 feet to 12 feet), such as for a geologic stratum or a specific depth (e.g., 120 feet), such as for a depth location of a water-bearing fracture.
9. For a depth interval, enter the relative hardness of the material in the column "Relative Hardness," if applicable: Very Hard (VH), Hard (H), Dense (D), Stiff (ST), Medium (M), Loose (L), Soft (S), Very Soft (VS).
10. For a depth interval, enter the letter for the overall colour of the geologic material in the column "Colour," if applicable: White (W), Grey (Gy), Blue (Bl), Green (G), Yellow (Y), Brown (Br), Red (R), Tan (T), Black (Bk).
11. For each depth interval, enter the description of the geologic materials encountered during drilling in the column "Material Description." Material descriptions should be chosen from the following recommended list of materials:

Surficial materials (approximate range of particle size)

boulders (greater than 10 inches)
 cobbles (2 1/2 inches to 10 inches)
 gravel (80 slot to 2 1/2 inches)
 coarse sand (25 slot to 80 slot)
 medium sand (10 slot to 25 slot)
 fine sand (2 slot to 10 slot)
 silt (less than 2 slot)
 clay (much less than 2 slot)
 till (variable particle size)
 organics (e.g., top soil, wood, peat)

Bedrock materials

conglomerate
 sandstone
 shale
 siltstone
 limestone
 crystalline
 granite
 basalt
 volcanic
 bedrock

12. In describing the material, list the material in order from greatest to least and indicate what materials occur in trace (less than 5%) amounts. The word "and" means both materials occur in approximately equal amounts (e.g., "gravel and coarse sand, trace silt").
13. Under the column "Water-bearing Estimated Flow (USgpm)," use "D" for "dry," "W" for "wet," or enter the estimated flow in USgpm.
14. If a water-bearing fracture is encountered, the depth of the fracture should be recorded in a row and the estimated flow of water in the fracture can be entered in the column "Water-bearing Estimated Flow (USgpm)."

How to Fill Out the Closure Description Table and the Well Closure Information Section

15. Each row in the closure description table represents either a depth interval (e.g., from 0 feet to 12 feet) or depth (e.g., 120 feet) in the well.
16. For a depth interval, enter the type of backfill or sealant material(s) in the column "Material Description."
17. Indicate in "Details of closure" whether casing(s) or screen(s) were pulled or left in place. If casing(s) were left in place, indicate whether it was perforated or ripped.

Screen Details

18. "Type" includes riser pipe, K-packer, screen, screen blank, or tail pipe.

Well Driller

19. Fill in the name of the driller who constructed the well.

Registration Number of Driller Responsible

20. Fill in the registration number on the Qualified Well Driller identification card. If the work was completed by a driller who is not registered as a Qualified Well Driller, the Qualified Well Driller who is directly supervising the work should fill in their registration number on their Qualified Well Driller identification card. The Qualified Well Driller signs the form.

Definitions of Abbreviations

aslabove sea level	ftfeet	PIDParcel Identifier	USgpm...US gallons per minute
bglbelow ground level	hrshours	RgRange	UTMUniversal Transverse
blocbelow top of casing	ininches	SecSection	Mercator Grid
DiaDiameter	NAD 83 ..North American	SWLstatic water level	
D.L.District Lot	Datum (1983)	TwpTownship	

updated: Feb. 7, 2006

0	8	2	F	•	0	3	2	•	2	•	3	•	2
---	---	---	---	---	---	---	---	---	---	---	---	---	---

0	0	0	0	8	7	8	1	6
---	---	---	---	---	---	---	---	---

WELL NO. 023

P10. 020-063-294		WATER WELL RECORD		ID plate = 17805	
MINISTRY OF WATER, LAND AND AIR PROTECTION				VICTORIA, BRITISH COLUMBIA	
LEGAL DESCRIPTION: LOT C SEC. TP. R. D.L. 237 LAND DISTRICT Kootenay PLAN 20129				Z X Y NO. E N	
DESCRIPTIVE LOCATION Old Mills Road Castlegar				LICENCE NO. DATE	
OWNER'S NAME D. Christensen				ADDRESS	
DRILLER'S NAME J.R. Doring Ltd				DATE COMPLETED	
DEPTH 50		ELEVATION OF		ESTIMATED SURVEYED CASING DIAM. LENGTH	
METHOD OF CONSTRUCTION		CASING DIAM.		LENGTH	
SCREEN LOCATION		SCREEN		SIZE LENGTH TYPE	
SANITARY SEAL YES NO		SCREEN		SIZE LENGTH TYPE	
PERFORATED CASING		LENGTH		PERFORATIONS FROM TO	
GRAVEL PACK		LENGTH		DIAM. SIZE GRAVEL, ETC.	
DISTANCE TO WATER		ESTIMATED WATER LEVEL		FROM MEASURED ELEVATION ARTESIAN PRESSURE	
DATE OF WATER LEVEL MEASUREMENT		WATER USE		Domestic	
CHEMISTRY				PRODUCTION TEST SUMMARY	
TEST BY				DATE	
TOTAL DISSOLVED SOLIDS mg/l				TEMPERATURE °C	
CONDUCTANCE umhos/cm AT 25°C				TOTAL IRON (Fe) mg/l	
TOTAL ALKALINITY (CaCO3) mg/l				PHEN. ALKALINITY (CaCO3) mg/l	
COLOUR				ODOUR	
ANIONS mg/l epm				CATIONS mg/l epm	
CARBONATE (CO3)				CALCIUM (Ca)	
BICARBONATE (HCO3)				MAGNESIUM (Mg)	
SULPHATE (SO4)				SODIUM (Na)	
CHLORIDE (Cl)				POTASSIUM (K)	
NO2 + NO3 (NITROGEN)				IRON (DISSOLVED)	
TKN (NITROGEN)					
PHOSPHORUS (P)					
TKN = TOTAL KJELDAHL NITROGEN				CHEMISTRY SITE NO.	
NO2 = NITRITE NO3 = NITRATE					
CHEMISTRY FIELD TESTS				LITHOLOGY	
TEST BY				DATE	
EQUIPMENT USED					
CONTENTS OF FOLDER					
DRILL LOG				PUMP TEST DATA	
SIEVE ANALYSIS				CHEMICAL ANALYSIS	
				GEOPHYSICAL LOGS	
				REPORT	
OTHER					
SOURCES OF INFORMATION					

[illegible]

SOUTH

CARD BY _____ DATE _____
ADDITIONAL DATA ADDED BY _____



Aquifer Description (Mapping Report - 2012):

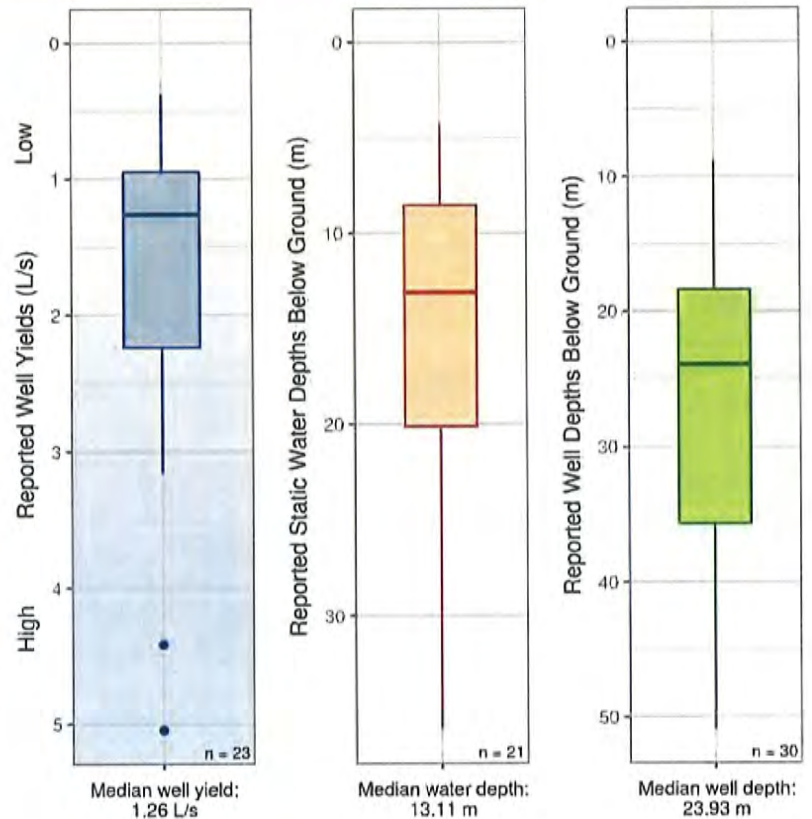
Unconfined glacio-fluvial outwash or ice contact sand and gravel aquifers generally formed near or at the end of the last period of glaciation (sub-type = 4a).

Aquifer Details

Region	Kootenay
Water District	Nelson
Aquifer Area	1.6 km ²
No. Wells Correlated	30
Vulnerability to Contamination	Moderate
Productivity	Moderate
Aquifer Classification	IIB
Hydraulic Conductivity *	Unknown
Transmissivity *	Unknown
Storativity *	Unknown
No. Water Licences Issued to Wells	Unknown
Observation Wells (Active, Inactive)	None

* min - max

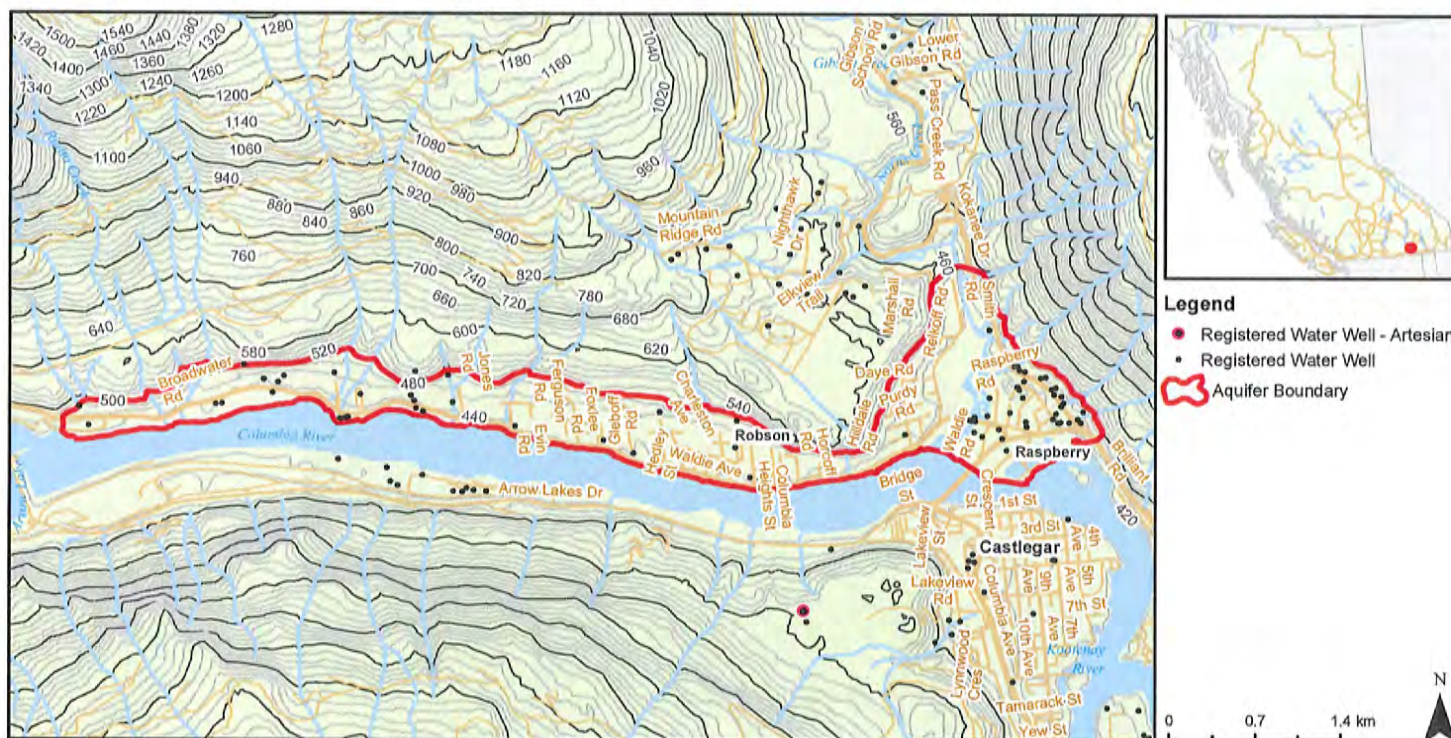
For Hydraulic Connection see [guidance document](#)



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Detailed methods for all figures are described in the companion document ([Aquifer Factsheet - Companion Document.pdf](#)).

Factsheet generated: 2022-07-27. Aquifers online: <https://apps.nrs.gov.bc.ca/gwells/aquifers>.



Aquifer Description (Mapping Report - 2012):

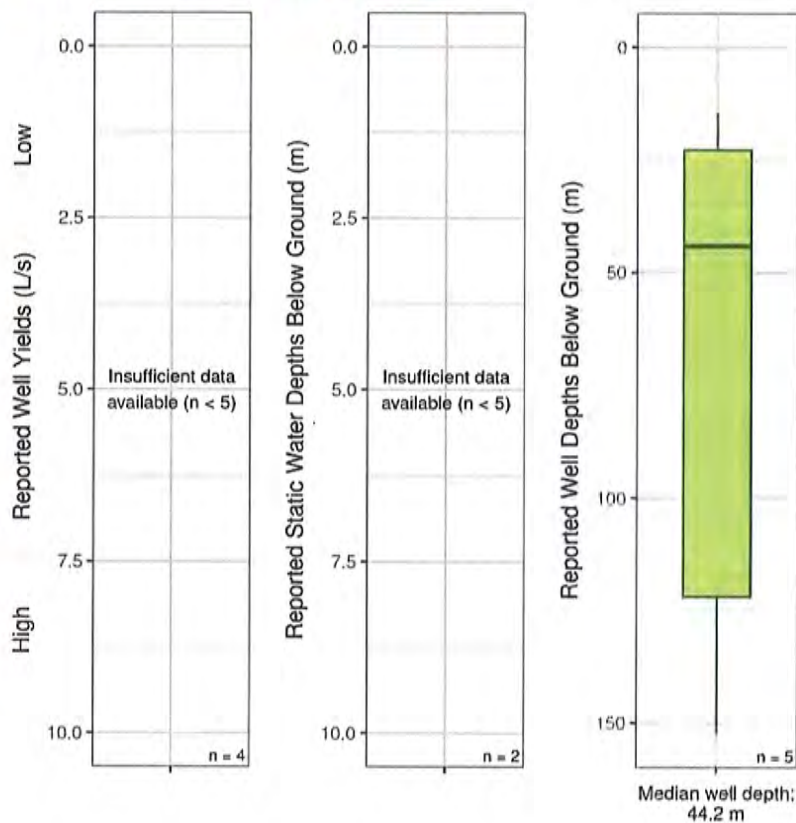
Fractured crystalline (igneous intrusive or meta-morphic, meta-sedimentary, meta-volcanic, volcanic) rock aquifer (subtype = 6b).

Aquifer Details

Region	Kootenay
Water District	Nelson
Aquifer Area	4.5 km ²
No. Wells Correlated	5
Vulnerability to Contamination	Moderate
Productivity	Moderate
Aquifer Classification	IIIB
Hydraulic Conductivity *	Unknown
Transmissivity *	Unknown
Storativity *	Unknown
No. Water Licences Issued to Wells	Unknown
Observation Wells (Active, Inactive)	None

* min - max

For Hydraulic Connection see [guidance document](#)



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