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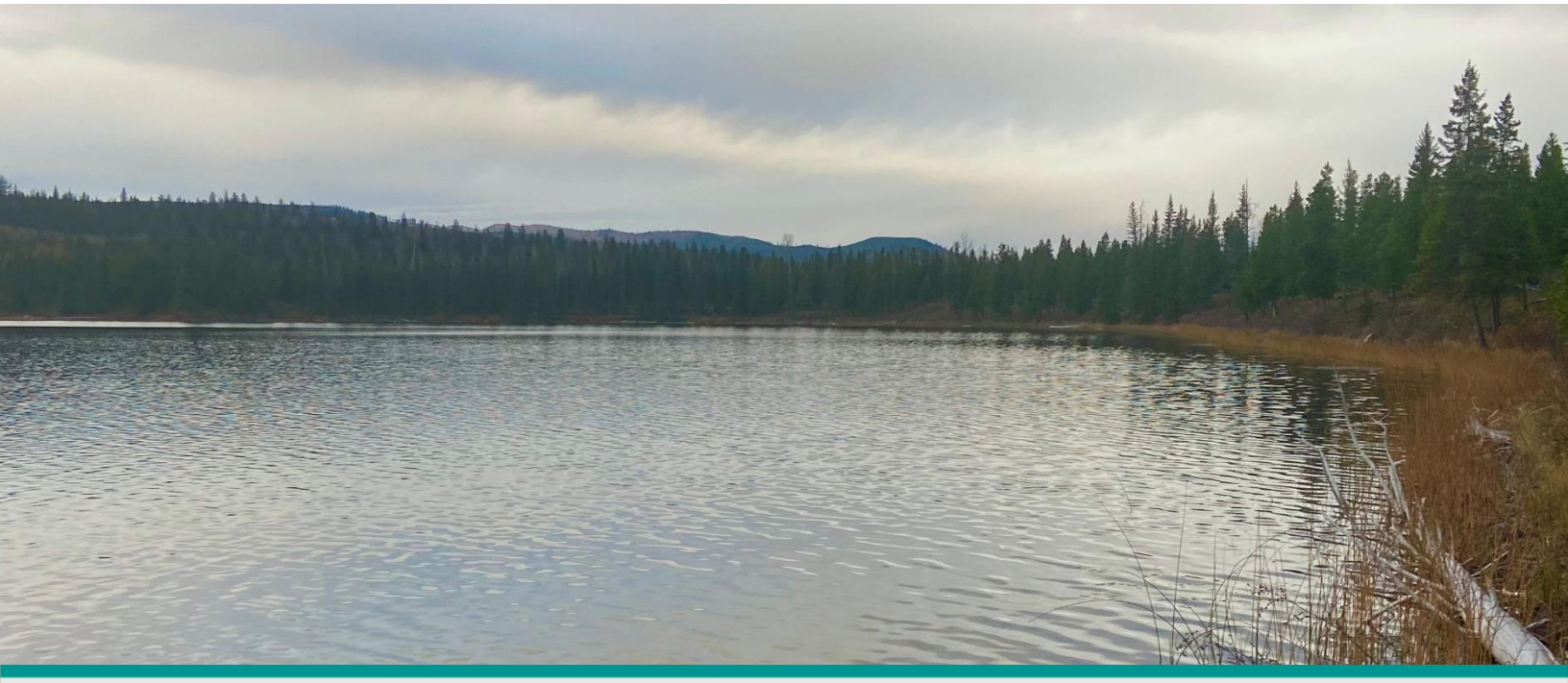

Bouchie Lake Community Wastewater Feasibility Study

September 22, 2025 | Rev. 0

Submitted to: Cariboo Regional District
Prepared by McElhanney

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Our file: 2341-21917-00

Your Challenge.
Our Passion.

Our File: 2341-21917-00

September 22, 2025

Cariboo Regional District
Suite D, 180 Third Avenue North
Williams Lake, BC, Canada V2G 2A4

Attention: Larry Loveng

Bouchie Lake Community Wastewater Feasibility Study

McElhanney Ltd. (McElhanney) is pleased to submit the feasibility study for the wastewater system for the community of Bouchie Lake. The community is located approximately 10 kilometers west of Quesnel, BC, and has roughly 500 residents with around 80 waterfront properties.

The lake has a long history of annual algae blooms, which pose health, safety, and environmental concerns for human and animal populations of the lake. Over the past 30 years, the community has been searching for ways to improve the water quality of the lake.

This study investigates the feasibility of installing a new wastewater system in the community. It compares three (3) different lagoon locations, as well as various piping layouts for each. Our recommended option based on this study is Option #1 – Phase 2, with the new lagoon located at 2231 Bartkow Rd, Quesnel. This option provides servicing to all the waterfront properties, as well as the properties adjacent to them.

McElhanney appreciates the opportunity to work with the Cariboo Reginal District to investigate the wastewater systems through this feasibility study. The undersigned would be pleased to address any questions or concerns you may have.

Sincerely,
McElhanney Ltd.

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1. Introduction

1.1. FEASIBILITY STUDY PURPOSE

The Cariboo Regional District (the “Region”) is investigating options to manage the water quality in Bouchie Lake. The lake has a long history of seasonal algae blooms, which pose health, safety, and environmental concerns for all populations of the lake.

Bouchie Lake is located approximately 10 kilometers northwest of Quesnel, BC, and the community has roughly 500 residents. *Figure 1*, below, shows the lake’s location relative to Quesnel.

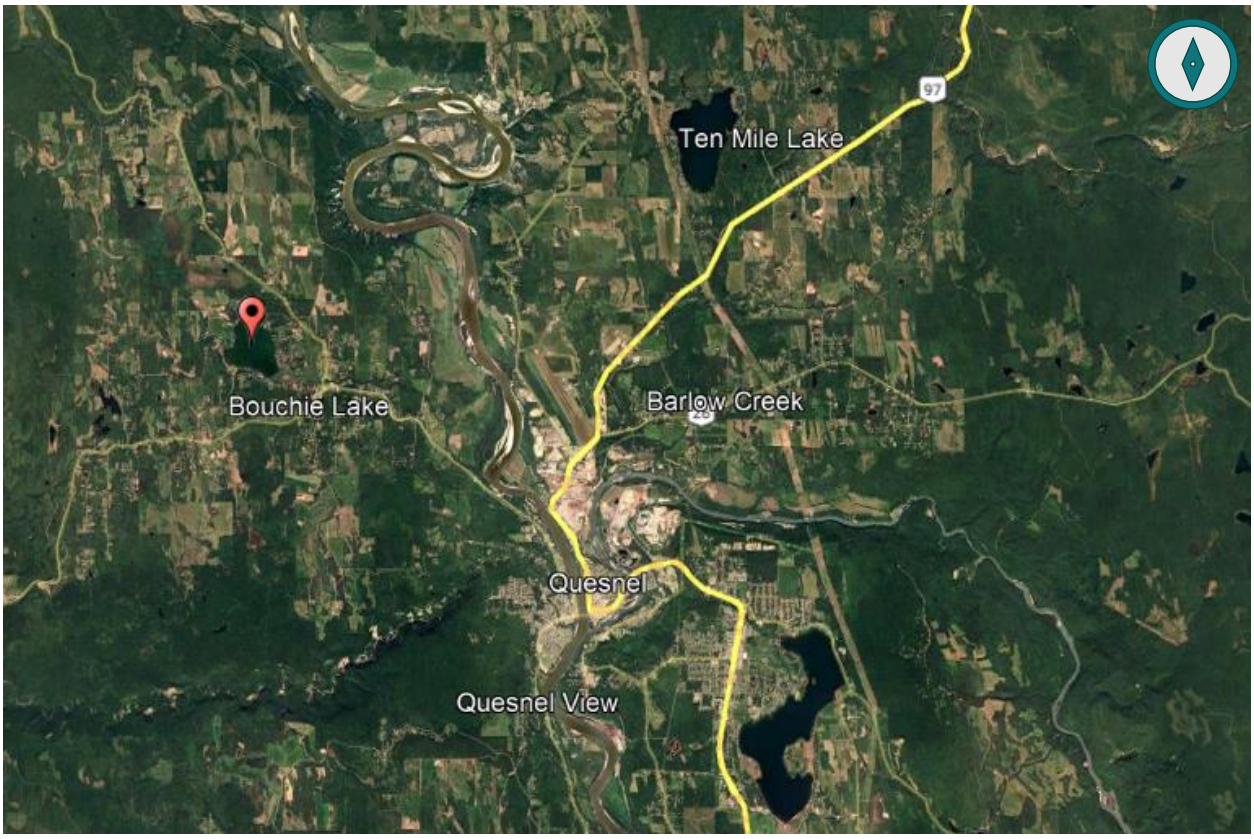

Figure 1: Location of Bouchie Lake (shown with red marker) (Google Earth Pro, 2025)

The purpose of this study is to investigate the feasibility of installing a wastewater system in the community, from both a physical and economical standpoint. The proposed solutions will consider a sustainable design that serves the highest number of parcels with the least amount of infrastructure.

The findings of this study will be shared with the Region and the Bouchie Lake community members to provide a comprehensive basis for evaluating the feasibility of proposed wastewater solutions and guiding infrastructure investment decisions.

1.2. PROJECT JUSTIFICATION

1.2.1. Long Term Community Needs

The Bouchie Lake Stewardship Committee (BLSC) has been working for over 30 years to try to improve Bouchie Lake. Over the years, there have been major fish-kills in the lake due to algal blooms and lake turn-over resulting in oxygen depletion. The BLSC and residents of Bouchie Lake are motivated to find a solution to this ongoing problem (BLSC, 2009).

The BLSC developed a watershed management plan in 2009 in collaboration with the Baker Creek Enhancement Society (BCES) and the BC Ministry of Environment (MOE). The plan summarizes key concerns from the community, which includes the need to improve the water quality and the lake. The plan addressed the following needs:

- Continued testing on water quality of the lake, inputs, and output,
- Improvement/elimination of algae and cyanobacterial blooms,
- Improvement to shoreline erosion, and
- Reduction of Phosphorus (P) loading.

1.2.2. Historical Water Quality

Bouchie Lake has a long history of poor water quality according to multiple studies over the last 25 years. In 2000, the Ministry of the Environment, Lands and Parks published a report that analysed the water quality of over 25 lakes in the Cariboo Region. Bouchie Lake was found to have the second highest Total Phosphorus (TP) concentration levels compared to the other 13 lakes that were sampled at overturn in 1998 (O'Keeffe, Zirnhelt, & Savage, 2000). The report also notes that an algal bloom was present during the summer of 1999.

An analysis was completed in 2002 by J.S. Hart and Associates to examine the phosphorus sources in the Bouchie-Milburn watershed. Annual phosphorus input to Bouchie Lake from the watershed is broken down in *Table 1*.

Table 1: Annual phosphorus input to Bouchie Lake from the watershed

Phosphorus source	Amount (kg)	% of total
Agriculture land (including hobby farms)	190.2	42.2
Lakeshore sewage disposal systems	70.0	15.5
Livestock wintering areas	60.2	13.4
Crown land (excluding lakes and ponds)	37.6	8.3
Lakeshore residential land	36.0	8.0
Rural residential land	28.2	6.3
Atmospheric contributions to lakes and ponds	28.2	6.3
Total	**450.3**	**100.0**

1.2.3. Adverse Effects to Community and Wildlife

From a study performed in Ontario beginning in 1968, Dr. John Reubec Vallentyne and his team were able to conclude that phosphorus was the largest contributing factor that led to algal blooms, as blue-green algae did not grow in lakes without phosphorus. (Clean Lakes Alliance, 2025)

Cyanobacteria (also known as blue-green algae) are naturally occurring microscopic bacteria that are common to freshwater ecosystems across BC and North America. In most circumstances, cyanobacteria cause no apparent harm in waterbodies, but when conditions favour their growth (e.g., warmer water temperatures, high nutrient concentrations, stable conditions), they can multiply very quickly and create a bloom.

Cyanobacteria blooms are of particular concern as there are several species capable of producing toxins that can be harmful to humans, domestic animals, and livestock. They can produce potent liver toxins, neurotoxins, as well as skin irritants (Ministry of Environment, 2022).

2. Existing Conditions

2.1.1. Existing Wastewater Treatment

Currently, there is no dedicated wastewater treatment system in the community. Each property is responsible for their own sewer system, and there is little in terms of maintenance and repair standards, aside from general enforcement by Public Health Officers of maintenance requirements under the provincial Sewerage System Regulation. As mentioned above, the study completed in 2002 by J.S. Hart and Associates confirmed that the largest sources of nutrient loading come from agricultural uses of lands in the watershed, and sewage disposal systems for lakeshore properties that are in various stages of repair.

2.1.2. Watershed

Bouchie Lake is a part of the Bouchie-Milburn Watershed, as shown in *Figure 2*. The watershed encompasses the west side of Milburn Mountain, Mit Lake, Milburn Lake, Bouchie Lake, and the associated creeks (BLSC, 2009).

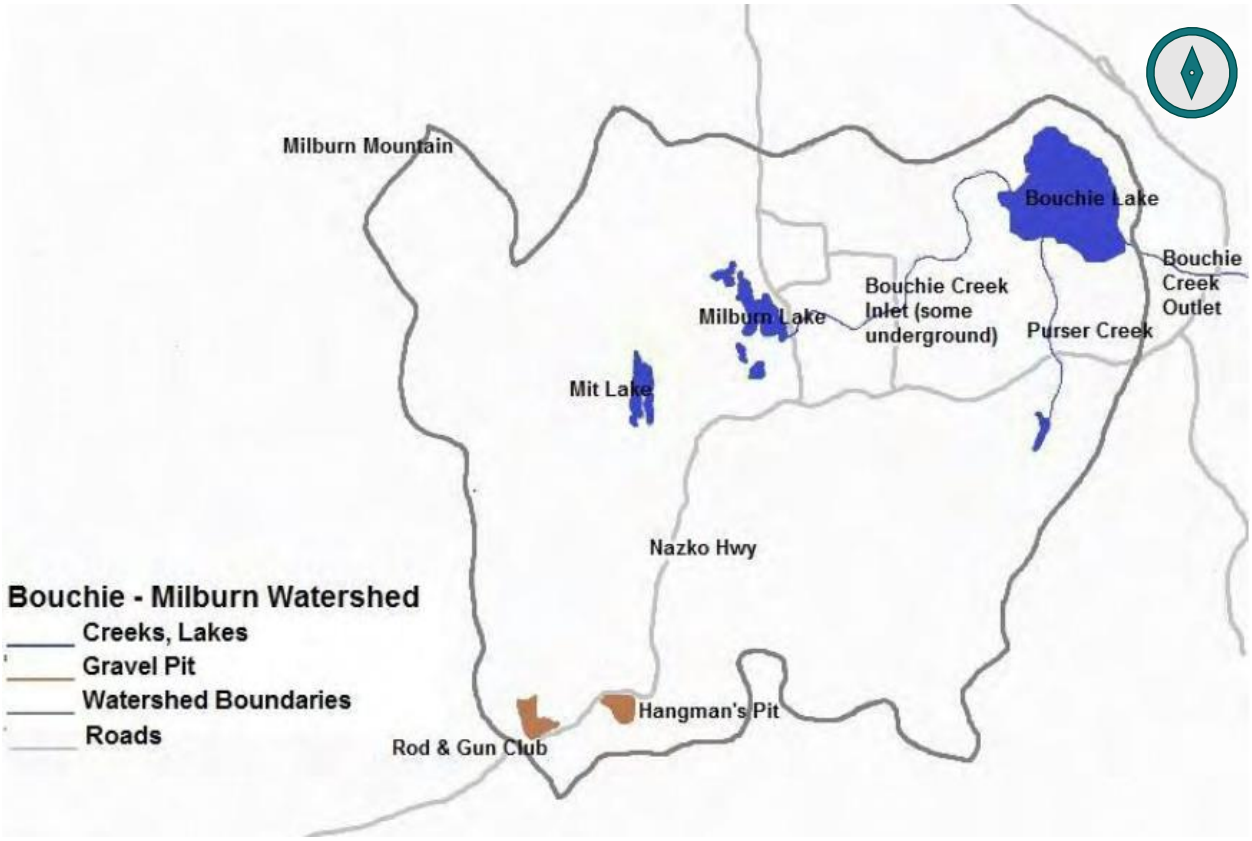

Figure 2: Bouchie-Milburn Watershed (BLSC, 2009)

2.1.3. Proposed Service Areas

The waterfront and adjacent parcels are the target area for the new wastewater system. In April 2024, the map in *Figure 3* was presented to the community as the proposed service area.

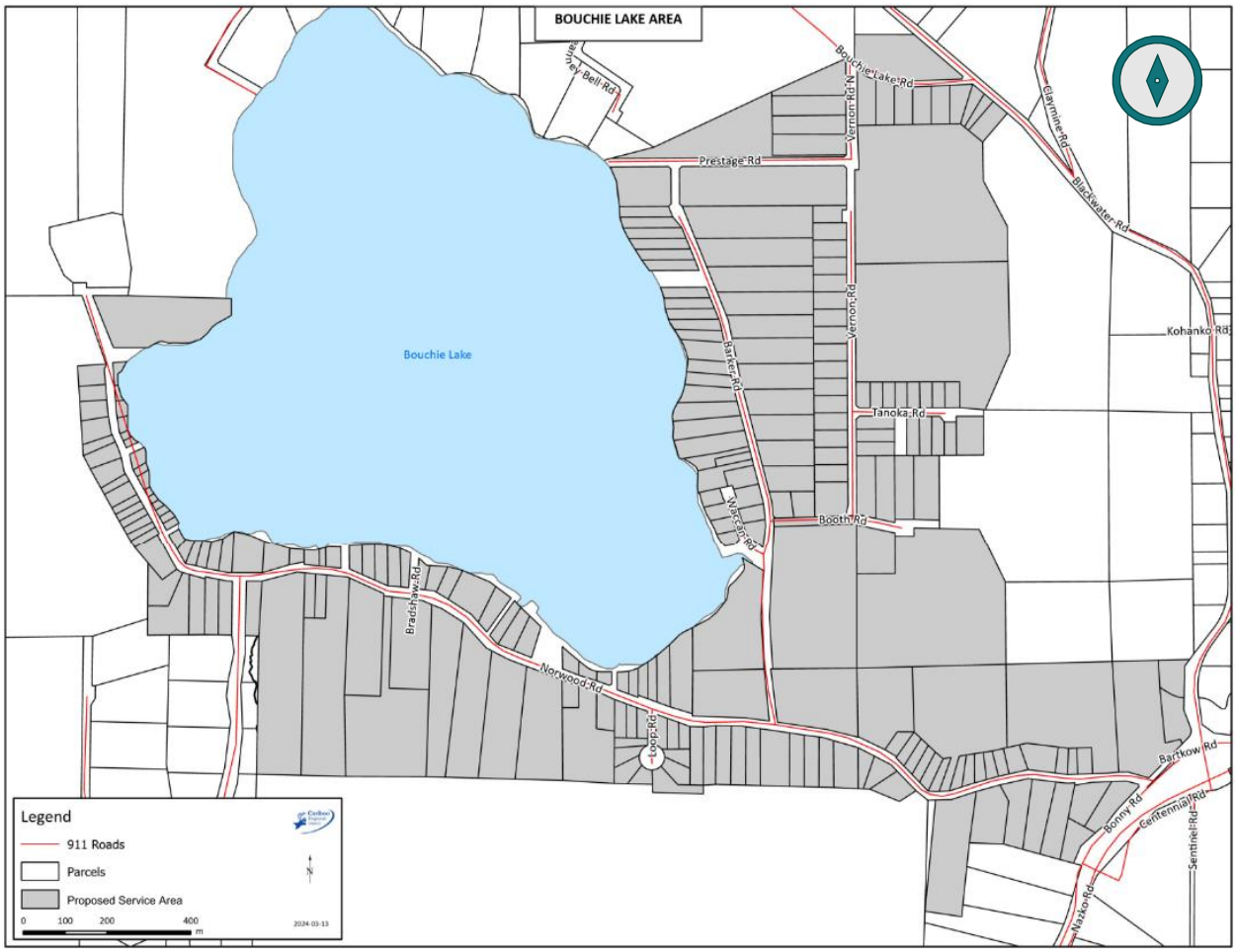

Figure 3: Proposed service area for new wastewater system

When determining the final service area for the new wastewater system, three (3) options, or "phases" are presented in this study. For each lagoon location option, phases have been determined as follows:

- Phase 1: Waterfront parcels only along Norwood Road and Barker Road.
- Phase 2: Parcels adjacent to Phase 1's main sewer piping.
- Phase 3: Remaining parcels in the community.

2.1.4. Geotechnical Hazard Zones

A search through the Region's Geotechnical Hazard Map indicated that the west bank of the lake is classified as a Steep Slope, as shown in *Figure 4*. It is recommended that additional geotechnical assessments are conducted in this area to ensure that a new wastewater system will not have a detrimental impact on the slope stability (AMEC Earth & Environmental, 2009).

Figure 4: Geotechnical Hazard Zone on west bank of Bouchie Lake (Cariboo Regional District, 2025)

2.1.5. Soil Conditions

General soil conditions in the area have been reviewed based on the British Columbia Soil Information Finder Tool. There are two soils polygons in the study area. The first polygon shown in *Figure 5* features very poor drainage within peat materials in 70% of the area. The remaining areas within this polygon are poorly drained silt loams.

A second, larger soils area polygon is shown in *Figure 6*. The second polygon features 60% silt clay loam which is moderately drained, 25% silty clay which is imperfectly drained, and 15% silt loam which is poorly drained. The distribution of these three soil characteristics is unknown within the area. A general comment is provided that “water is removed from the soil somewhat slowly in relation to supply due to low perviousness, shallow water table, lack of gradient, or some combination of these” (Government of BC, 2025).

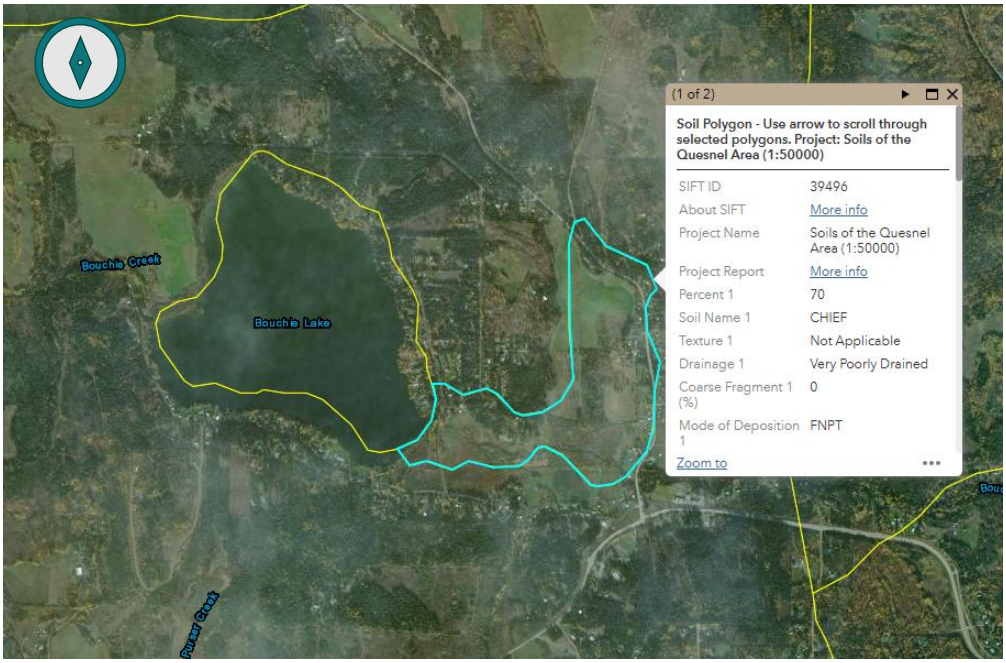

Figure 5: Soils Polygon at Bouchie Creek Outlet (Government of BC, 2025)

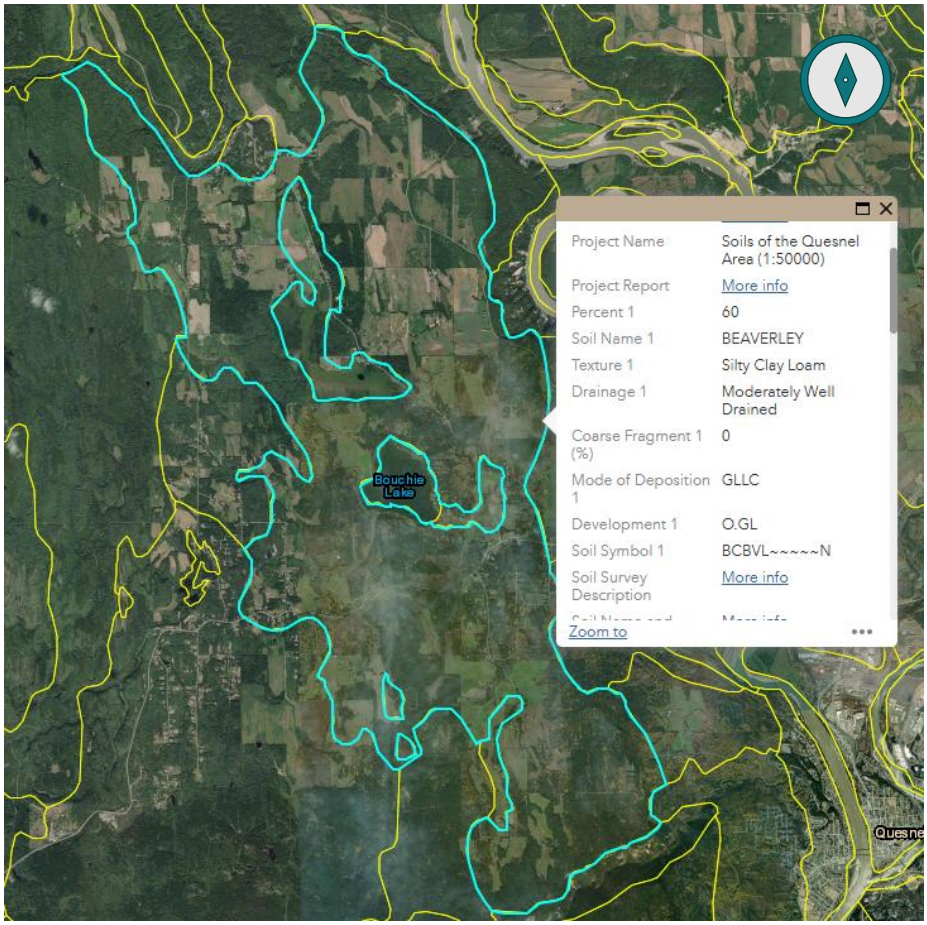

Figure 6: Soils Polygon Surrounding Bouchie Lake and Area (Government of BC, 2025)

2.2. APPLICABLE DESIGN STANDARDS

The design of a new wastewater system must follow requirements under the following resources:

- National Building Code
- Provincial Environmental Management Act
- Provincial Municipal Wastewater Regulation (applicable to any discharge over 22.7 m^3/d)
- Provincial Sewerage System Regulation administered by the Ministry of Health (applicable to discharges under 22.7 m^3/d)
- Federal Wastewater Systems Effluent Regulations (typically applies to discharges over 100 m^3/d)
- Federal Strategy for the Management of Municipal Wastewater Effluent
- MMCD Design Guidelines, 2022, Master Municipal Construction Documents Association
- City of Quesnel, Development Servicing Bylaw No, 1916 of 2022
- Quesnel Fringe Area – Official Community Plan

2.3. DESIGN VALUES

As there are no specific design guidelines for the Bouchie Lake community, several sources have been compared to determine a realistic daily domestic design flow. *Table 2* summarizes the various sources evaluated for each design value, as well as the selected values for this study.

Table 2: Design Value Selection

Design Value Source	Design Value	Notes
Design Population		
CoPG Design Guidelines	150 people per hectare	Assuming medium density residential
Sewerage System Standard Practice Manual	3.75 people per 3-bedroom residence	Assuming each parcel has a 3-bedroom residence
Quesnel Fringe Area – OCP	2.3 people per household	Based on 2016 Census
Selected Design Population	**3 people per household**	Accounts for population growth from Quesnel Fringe Area OCP
Average Daily Wastewater Flow (ADWF)		
CoPG Design Guidelines	380 L/cap/day	
City of Quesnel Design Guidelines	350 L/cap/day	
MMCD		
Sewerage System Standard Practice Manual – Table II-8	1,300 L/res/day	Assuming each parcel has a 3-bedroom residence
Sewerage System Standard Practice Manual – Table II-9	350 L/cap/day	Assuming each parcel has a 3-bedroom residence
Selected ADWF	**350 L/cap/day**	Considered conservative for this community
Peak Hour Factor		
CoPG Design Guidelines	$1 + \frac{14}{4 \times \sqrt{P/1000}}$	
City of Quesnel Design Guidelines		
MMCD		
Sewerage System Standard Practice Manual	4	
Selected Peaking Factor	**4**	Considered acceptable for rural applications

3. Options Analysis

3.1. DECISION CRITERIA

The decision criteria as determined through discussions with the Region is as follows:

- The wastewater system should be as efficient as possible, in terms of servicing the highest number of parcels with the least amount of infrastructure.
- The wastewater system should prioritize the protection of Bouchie Lake.
- The cost per parcel serviced and the overall capital costs are important factors in the decision to proceed with the new system.
- Lengthy regulatory processes should be where possible.

Table 3 below shows the weighting of each criteria to be used in determining the selected design.

Table 3: Weighted decision criteria

Decision Criteria	Weighting
System Efficiency (Parcels/Infrastructure)	30%
Protection of Bouchie Lake (Land/Infrastructure)	25%
Cost per Parcel	10%
Total Cost	20%
Regulatory Processes	15%
Total	**100%**

3.2. LAGOON LOCATION OPTIONS

The Region has proposed three (3) potential lots for the new lagoon, as shown in *Figure 7* with additional details in *Table 4*. Full Property Reviews are included in *Appendix B*. Note that at this preliminary phase, no discussions have occurred with landowners, and it is assumed that the selected location could be acquired in the future.

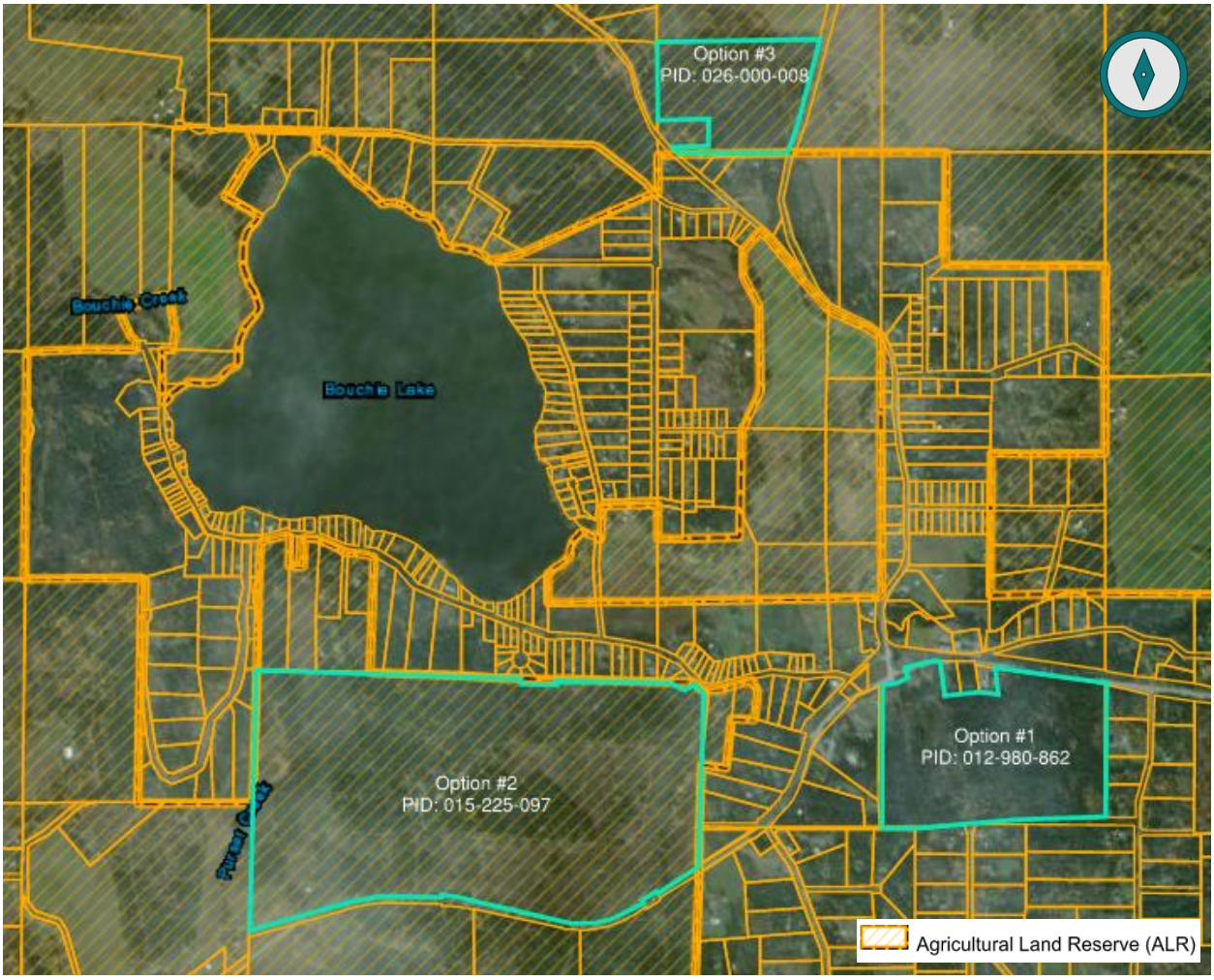

Figure 7: Potential parcels for new lagoon

Table 4: Parcel Information

	Option #1	Option #2	Option #3
PID	012-980-862	015-225-097	026-000-008
Street Address	2231 Bartkow Rd	2580 Nazko Rd	N/A
Zoning	Rural 3 (RR 3) Country Residential Single Family Residential (Unserviced) Special Infill Parcel	Resource /Agricultural (RA 1) Residential 2 (R 2) Agricultural and Resource	Resource / Agricultural (R/A) Parks/Recreation/Open Space
Applicable Bylaws	3504 – Quesnel Fringe Area Zoning Bylaw, 1999 5419 – Bouchie-Milburn Neighbourhood Plan	3504 – Quesnel Fringe Area Zoning Bylaw, 1999 5419 – Bouchie-Milburn Neighbourhood Plan	3505 – North Cariboo Area Rural Land Use Bylaw, 1999 5419 – Bouchie-Milburn Neighbourhood Plan
Actual Land Use	Code 061 – 2 Acres or More (Vacant)	Code 060 – 2 Acres or More (Single Family Dwelling, Duplex)	Code 061 – 2 Acres or More (Vacant)
Owner	Private		Cariboo Regional District
Approximate elevation	703 m	721 m	718 m
Constructability	General grading appears favourable for gravity pipe to pump station on Blackwood Rd, however the eastern portion of Norwood Rd may require deep piping. Force main from pump station to lagoon.	General grading appears favourable for gravity pipe to pump station on Norwood Rd. Force main from pump station to lagoon.	Gravity pipe along Norwood Rd to pump station at Norwood Rd & Baker Rd. intersection. Force main for all piping north of pump station to the lagoon.
Additional Considerations		Located within the Agricultural Land Reserve	Located within the Agricultural Land Reserve

3.3. SERVICE AREA OPTIONS

3.3.1. Phase 1: Waterfront Only

This phase focuses on the properties that are directly adjacent to the waterfront, as those parcels are considered to have the largest impact on the quality of Bouchie Lake. Ensuring that the wastewater from their private systems is no longer making its way into the lake will result in an overall reduction of phosphorus in the lake.

3.3.2. Phase 2: Properties Adjacent to Phase 1 Piping

This phase does not require any additional sewer main from Phase 1, as it connects the adjacent, non-waterfront properties to the sewer main. Additional service connections and a potentially larger diameter for the sewer main line are the only difference from Phase 1.

3.3.3. Phase 3: Remaining Parcels in the Community

The phase includes additional sewer main to collect the wastewater from all the parcels presented in *Figure 3.* While including these parcels requires more infrastructure work, it provides the highest level of protection of the lake by ensuring that there is no wastewater travelling into the water.

3.4. EVALUATION OF LAGOON OPTIONS AND PHASES

Sketches of the phases for each lagoon location option are included in *Appendix C*. The following tables summarize the number of parcels that are serviced with each option's phase, as well as their total land areas and required sewer main length. Based on this, the Average Daily Wastewater Flows (ADWF), maximum Daily Wastewater Flows (Max. DWF), and lagoon volumes and footprints have been determined. The max. DWF is double the ADWF and is used to size the lagoons. The lagoons are sized to retain 365 days of maximum daily flows.

Table 5: Evaluation of Option #1 Phases

Parameter	Unit	Phase 1	Phase 2	Phase 3
Parcels in Phase		83	90	51
Total parcels serviced		83	173	224
Approx. Land Area	ha	40	147	201
Total length of sewer main	km	4.83	4.83	6.52
Design Population	cap	249	519	672
ADWF	m^3/day	87.2	181.7	235.2
Max. DWF	m^3/day	174.3	363.3	470.4
Required Lagoon Volume	m^3	63,620	132,605	171,696
Lagoon Footprint Dimensions	L x W	256 m x 134 m	358 m x 185 m	402 m x 207 m
Lagoon Footprint Area	ha	3.45	6.64	8.35

Table 6: Evaluation of Option #2 Phases

Parameter	Unit	Phase 1	Phase 2	Phase 3
Parcels in Phase		83	70	71
Total parcels serviced		83	153	224
Approx. Land Area	ha	40	122	201
Total length of sewer main	km	4.01	4.01	6.22
Design Population	cap	249	459	672
ADWF	m^3/day	87.2	160.7	235.2
Max. DWF	m^3/day	174.3	321.3	470.4
Required Lagoon Volume	m^3	63,620	117,275	171,696
Lagoon Footprint Dimensions	L x W	256 m x 134 m	338 m x 175 m	402 m x 207 m
Lagoon Footprint Area	ha	3.45	5.94	8.35

Table 7: Evaluation of Option #3 Phases

Parameter	Unit	Phase 1	Phase 2	Phase 3
Parcels in Phase		83	106	35
Total parcels serviced		83	189	224
Approx. Land Area	ha	40	169	201
Total length of sewer main	km	5.62	5.62	6.54
Design Population	cap	249	567	672
ADWF	m^3/day	87.2	198.5	235.2
Max. DWF	m^3/day	174.3	396.9	470.4
Required Lagoon Volume	m^3	63,620	144,869	171,696
Lagoon Footprint Dimensions	L x W	256 m x 134 m	372 m x 192 m	402 m x 207 m
Lagoon Footprint Area	ha	3.45	7.16	8.35

3.5. CAPITAL COST ESTIMATES

Class D cost estimates have been prepared for each lagoon location option and their corresponding phases. A detailed breakdown is included in *Appendix D*, and summarized in *Table 8* below.

Table 8: Summary of Class D estimates

	Option 1			Option 2			Option 3		
	Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3
1.0 General	$180,000	$180,000	$180,000	$180,000	$180,000	$180,000	$180,000	$180,000	$180,000
2.0 Site Prep	$1,935,500	$3,979,125	$5,127,400	$1,935,500	$3,525,875	$5,127,400	$1,935,500	$4,337,725	$5,127,400
3.0 Sanitary	$3,373,000	$4,858,000	$6,354,000	$3,109,000	$4,264,000	$6,285,500	$3,397,500	$5,146,500	$6,077,500
Subtotal	$5,488,500	$9,017,130	$11,661,400	$5,224,500	$7,969,880	$11,592,900	$5,513,000	$9,664,230	$11,384,900
Contingency	$2,744,000	$4,509,000	$5,831,000	$2,612,000	$3,985,000	$5,796,000	$2,757,000	$4,832,000	$5,692,000
Total	**$8,232,500**	**$13,526,130**	**$17,492,400**	**$7,836,500**	**$11,954,880**	**$17,388,900**	**$8,270,000**	**$14,496,230**	**$17,076,900**
Cost/Parcel	**$99,190**	**$78,190**	**$78,090**	**$94,420**	**$78,140**	**$77,630**	**$99,640**	**$76,700**	**$76,240**

3.6. EVALUATION MATRIX

The tables below show the ranking of each option and their phases. The scores were determined by comparing each phase's parameter against the best score for all options. For example, the system efficiency for *Option 1 – Phase 1* is compared to the most efficient system from all the options' phases. This allows objective scoring and comparisons to determine the best lagoon location and piping layout.

Table 9: Evaluation Matrix of Option #1

Parameter	Weighting	Phase 1	Phase 2	Phase 3
System Efficiency	30%	4.5	9.4	9.0
Lake Protection	25%	3.7	9.3	9.8
Cost per Parcel	10%	7.7	9.8	9.8
Total Cost	20%	9.5	5.8	4.5
Regulatory Processes	15%	9.0	9.0	9.0
Total Score	**100%**	**6.30**	**8.63**	**8.37**

Table 10: Evaluation Matrix of Option #2

Parameter	Weighting	Phase 1	Phase 2	Phase 3
System Efficiency	30%	5.4	10.0	9.4
Lake Protection	25%	4.0	9.0	10.0
Cost per Parcel	10%	8.1	9.8	9.8
Total Cost	20%	10.0	6.6	4.5
Regulatory Processes	15%	7.0	7.0	7.0
Total Score	**100%**	**6.47**	**8.58**	**8.26**

Table 11: Evaluation Matrix of Option #3

Parameter	Weighting	Phase 1	Phase 2	Phase 3
System Efficiency	30%	3.9	8.8	9.0
Lake Protection	25%	3.5	9.6	9.8
Cost per Parcel	10%	7.7	9.9	10.0
Total Cost	20%	9.5	5.4	4.6
Regulatory Processes	15%	7.0	7.0	7.0
Total Score	**100%**	**5.75**	**8.16**	**8.10**

3.7. OPTION SELECTION

Based on the evaluations presented above, the highest-ranking layout is Option #1 – Phase 2. A preliminary conceptual site plan is included in *Appendix E*. While this option does not service the entire community, it maximizes the efficiency of the system along with the protection of the lake.

4. Operation and Maintenance

This section describes the general operation and maintenance requirements of the system, regardless of which option is selected during detailed design.

4.1. LAGOON SYSTEM

Daily/Weekly Tasks:

- Inspect lagoon cells for sludge beaching, foam, odors, and vegetation overgrowth (e.g., duckweed, willows, and cattails).
- Monitor influent and effluent flows, ensuring meters are functional and readings are within expected ranges.
- Check freeboard and berm integrity for erosion or animal damage.

Monthly/Annual Tasks:

- Sludge depth monitoring: Keep sludge below 30% of lagoon depth to maintain treatment efficiency.
- Calibrate equipment: pH probes, DO meters, etc.
- Nutrient and pH monitoring: Watch for ammonia, nitrate/nitrite, phosphorus, and pH < 6.5, which can affect treatment and cause odors.
- Complete annual discharge procedure: Includes cell isolation, cell holding, and water sampling.
- Submit Discharge Monitoring Reports (DMRs): Required monthly or quarterly depending on permit terms.

Other:

- Send annual reminders to community members with tips to maintain their private systems.

4.2. LIFT STATION

Routine Maintenance:

- Pump & Motor Care: Lubricate, check for wear, overheating and vibration.
- Wet Well Cleaning: Remove grease, grit, and debris to prevent clogs and odors.
- Valve & Float Switch Checks: Ensure proper operation and exercise valves annually.
- Draw Down Tests: Check pump’s operation efficiency.
- Ventilation & Odor Control: Maintain airflow systems and monitor for persistent smells.
- Corrosion Prevention: Apply protective coatings and inspect for rust or wear.
- Electrical systems: Ensure control panels, alarms, and backup power are functional.
- Maintenance Management: Regularly review and update the Maintenance Management Plan.

Emergency Preparedness:

- Keep spill kits and flotation devices accessible.
- Maintain a logbook with operational actions, weather conditions, and staff on duty.
- Develop and regularly update an Emergency Response Plan.

4.3. COST ESTIMATE

Table 12, below, provides an estimate of the costs associated with operating and maintaining a lagoon and list station system over a 20-year lifespan.

Table 12: Operations and Maintenance Cost Estimate

	Times per year	Times per 20-year lifespan	Quantity	Unit	Unit Cost	Annual Cost	Cost over 20 years
Routine Maintenance							
Lagoon inspection and maintenance	52	1040	4	hours	$90	$18,720	$374,400
Lift Station inspection and maintenance	24	480	2	hours	$90	$4,320	$86,400
Maintain lagoon vegetation (summer months)	6	120	2	hours	$75	$900	$18,000
Sludge depth monitoring	1	20	1	ea	$5,000	$5,000	$100,000
Water sample testing	6	120	1	ea	$300	$1,800	$36,000
Filter replacements	6	120	1	ea	$300	$1,800	$36,000
Electrical costs	365	7300	24	kW-hr	$0.13	$1,139	$22,776
Replacement Costs							
Pump		2	1	ea	$15,000	$15,000	$30,000
Monitoring Equipment		5.00	1	ea	$2,000	$2,000	$10,000
Sub-Totals						$50,679	$713,576
Contingency (20%)						$10,136	$142,715
Totals						**$60,815**	**$856,291**

5. Additional Investigations

If the community decides to proceed with the new wastewater system, further investigations are required to complete the design. These investigations include:

- Geotechnical investigations
- Survey
- Environmental assessments

Additionally, effluent discharge from the lagoon must be determined in the detailed design phase. There are several possible options for effluent discharge, including:

- Discharge to ground → requires confirmation of an area with suitable permeable soil, as determined by a Hydrogeological Assessment and an Environmental Impact Study.
- Discharge to water → typically requires a minimum dilution ration of 40:1 in a receiving stream or river and is subject to an Environmental Impact Study.
- Reclaimed water for beneficial use, e.g. spray irrigation of woodlands for fire suppression → not accepted as a stand-alone solution under current regulations, therefore requires a backup discharge such as to ground or to a water body.
- Zero-discharge lagoon → this is allowable in household scale systems under the Sewerage System Regulation in regions of BC with appropriate moisture deficits; however, considerable study would be required to support a community scale system with this approach and the outcome is uncertain.

Additional background studies and investigations are required before a means for discharge is finalized.

6. Closing

Based on the findings of this feasibility study, we have determined that a new wastewater system for the Bouchie Lake community is feasible and would improve the water quality of the lake. Option #1 – Phase 2 is deemed to be the best option for the community, with the new lagoon located at 2231 Bartkow Rd, Quesnel. This option provides servicing to all the waterfront properties, as well as the properties adjacent to them with an approximate cost of $13.5 million.

Should the community decide not to proceed with this lagoon system, McElhanney recommends that at a minimum, the properties within the community should upgrade their current systems and ensure they are well maintained.

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APPENDIX A

Statement of Limitations

Statement of Limitations

Use of this Report. This report was prepared by McElhanney Ltd. ("**McElhanney**") for the particular site, design objective, development and purpose (the "**Project**") described in this report and for the exclusive use of the client identified in this report (the "**Client**"). The data, interpretations and recommendations pertain to the Project and are not applicable to any other project or site location and this report may not be reproduced, used or relied upon, in whole or in part, by a party other than the Client, without the prior written consent of McElhanney. The Client may provide copies of this report to its affiliates, contractors, subcontractors and regulatory authorities for use in relation to and in connection with the Project provided that any reliance, unauthorized use, and/or decisions made based on the information contained within this report are at the sole risk of such parties. McElhanney will not be responsible for the use of this report on projects other than the Project, where this report or the contents hereof have been modified without McElhanney's consent, to the extent that the content is in the nature of an opinion, and if the report is preliminary or draft. This is a technical report and is not a legal representation or interpretation of laws, rules, regulations, or policies of governmental agencies.

Standard of Care and Disclaimer of Warranties. This report was prepared with the degree of care, skill, and diligence as would reasonably be expected from a qualified member of the same profession, providing a similar report for similar projects, and under similar circumstances, and in accordance with generally accepted engineering and scientific judgments, principles and practices. McElhanney expressly disclaims any and all warranties in connection with this report.

Information from Client and Third Parties. McElhanney has relied in good faith on information provided by the Client and third parties noted in this report and has assumed such information to be accurate, complete, reliable, non-fringing, and fit for the intended purpose without independent verification. McElhanney accepts no responsibility for any deficiency, misstatements or inaccuracy contained in this report as a result of omissions or errors in information provided by third parties or for omissions, misstatements or fraudulent acts of persons interviewed.

Effect of Changes. All evaluations and conclusions stated in this report are based on facts, observations, site-specific details, legislation and regulations as they existed at the time of the report preparation. Some conditions are subject to change over time and the Client recognizes that the passage of time, natural occurrences, and direct or indirect human intervention at or near the site may substantially alter such evaluations and conclusions. Construction activities can significantly alter soil, rock and other geologic conditions on the site. McElhanney should be requested to re-evaluate the conclusions of this report and to provide amendments as required prior to any reliance upon the information presented herein upon any of the following events: a) any changes (or possible changes) as to the site, purpose, or development plans upon which this report was based, b) any changes to applicable laws subsequent to the issuance of the report, c) new information is discovered in the future during site excavations, construction, building demolition or other activities, or d) additional subsurface assessments or testing conducted by others.

Independent Judgments. McElhanney will not be responsible for the independent conclusions, interpretations, interpolations and/or decisions of the Client, or others, who may come into possession of

this report, or any part thereof. This restriction of liability includes decisions made to purchase, finance or sell land or with respect to public offerings for the sale of securities.

Construction Cost Estimates. This construction cost estimate has been prepared using the design and technical information currently available, and without the benefit of Survey, Geotechnical, or Environmental information. Furthermore, McElhanney cannot predict the competitive environment, weather or other unforeseen conditions that will prevail at the time that contractors will prepare their bids. The cost estimate is therefore subject to factors over which McElhanney has no control, and McElhanney does not guarantee or warranty the accuracy of such estimate.

APPENDIX B

Property Reviews

OPTION #1

Property Review

Folio Number: 728-05191.000

Property Details

Folio Number: 728-05191.000
Status: Active
Freeform Legal Description: DISTRICT LOT 4499, CARIBOO LAND DISTRICT, EXCEPT PLAN B3590, & EXP PL B5141, B5555, B6142, 6092, 6407, 7788, 7789 & 32698 & EXCEPTING THEREHOUT ANY PORTION OF THE SRW OF THE DOMINON TELEGRAPHE LINE HAVEIN G A WIDTH OF 100 FT WHICH MAY LIE WITHIN THE BOUNDARIES OF SAID DL

Property Details

PID: 012-980-862

Addresses

Street #	Pre-Direction	Street Name	Direction	Unit #	Status
2231		BARTKOW RD			Active

Zone (Rural 3 (RR 3))

Zone Type: Rural 3 (RR 3)
Status: Active
Bylaw: 3504 - Quesnel Fringe Area Zoning Bylaw, 1999
Appendix:
108 Land Use Contract:

Zone (Country Residential)

Zone Type: Country Residential
Status: Active
Bylaw: 5419 - Bouchie-Milburn Neighbourhood Plan
Appendix:
108 Land Use Contract:

Zone (Single Family Residential (Unserviced))

Zone Type: Single Family Residential (Unserviced)
Status: Active
Bylaw: 5419 - Bouchie-Milburn Neighbourhood Plan
Appendix:
108 Land Use Contract:

Zone (Special Infill Parcel)

Zone Type: Special Infill Parcel
Status: Active
Bylaw: 5419 - Bouchie-Milburn Neighbourhood Plan
Appendix:
108 Land Use Contract:

Assessment Details

Assessment:

Code	Property Class	Type	Exempt Value	Gross Value
01	Residential	Land	$0.00	$202,000.00

Taxable	Exempt	Net
$202,000.00	$0.00	$202,000.00

Tax Codes:

Property Code	Property Description	Exempt Code	Exempt Description
01	Residential	00	All Fully Taxable Land, Structures, Etc.

Actual Use:

Code	Description	Electoral Area
061	2 Acres Or More (Vacant)	

Powered by CityView

OPTION #2

Property Review

Folio Number: 728-04925.000

Property Details

Folio Number: 728-04925.000
Status: Active
Freeform Legal Description: DISTRICT LOT 3363, CARIBOO LAND DISTRICT, EXCEPT PLAN EPP4300, & EXC PL EPP29207 & EPP75287

Property Details

PID: 015-225-097

Addresses

Street #	Pre-Direction	Street Name	Direction	Unit #	Status
2580		NAZKO RD			Active

Zone (Resource /Agricultural (RA 1))

Zone Type: Resource /Agricultural (RA 1)
Status: Active
Bylaw: 3504 - Quesnel Fringe Area Zoning Bylaw, 1999
Appendix:
108 Land Use Contract:

Zone (Residential 2 (R 2))

Zone Type: Residential 2 (R 2)
Status: Active
Bylaw: 3504 - Quesnel Fringe Area Zoning Bylaw, 1999
Appendix:
108 Land Use Contract:

Zone (Agricultural and Resource)

Zone Type: Agricultural and Resource
Status: Active
Bylaw: 5419 - Bouchie-Milburn Neighbourhood Plan
Appendix:
108 Land Use Contract:

Assessment Details

Assessment:

Code	Property Class	Type	Exempt Value	Gross Value
01	Residential	Land	$254,000.00	$508,000.00
01	Residential	Buildings	$0.00	$974,000.00

Taxable	Exempt	Net
$1,482,000.00	$254,000.00	$1,228,000.00

Tax Codes:

Property Code	Property Description	Exempt Code	Exempt Description
01	Residential	00	All Fully Taxable Land, Structures, Etc.
01	Residential	13	Land In The Agricultural Land Reserve

Actual Use:

Code	Description	Electoral Area
060	2 Acres Or More (Single Family Dwelling, Duplex)	

Powered by CityView

OPTION #3

Property Review

Folio Number: 728-06306.200

Property Details

Folio Number: 728-06306.200
Status: Active
Freeform Legal Description: BLOCK E, DISTRICT LOT 8639, CARIBOO LAND DISTRICT

Property Details

PID: 026-000-008

Addresses

There is no visible address information.

Zone (Resource / Agricultural (R/A))

Zone Type: Resource / Agricultural (R/A)
Status: Active
Bylaw: 3505 - North Cariboo Area Rural Land Use Bylaw, 1999
Appendix:
108 Land Use Contract:

Zone (Parks/Recreation/Open Space)

Zone Type: Parks/Recreation/Open Space
Status: Active
Bylaw: 5419 - Bouchie-Milburn Neighbourhood Plan
Appendix:
108 Land Use Contract:

Assessment Details

Assessment:

Code	Property Class	Type	Exempt Value	Gross Value
01	Residential	Land	$158,000.00	$158,000.00

Taxable	Exempt	Net
$158,000.00	$158,000.00	$0.00

Tax Codes:

Property Code	Property Description	Exempt Code	Exempt Description
01	Residential	73	Regional District Property

Actual Use:

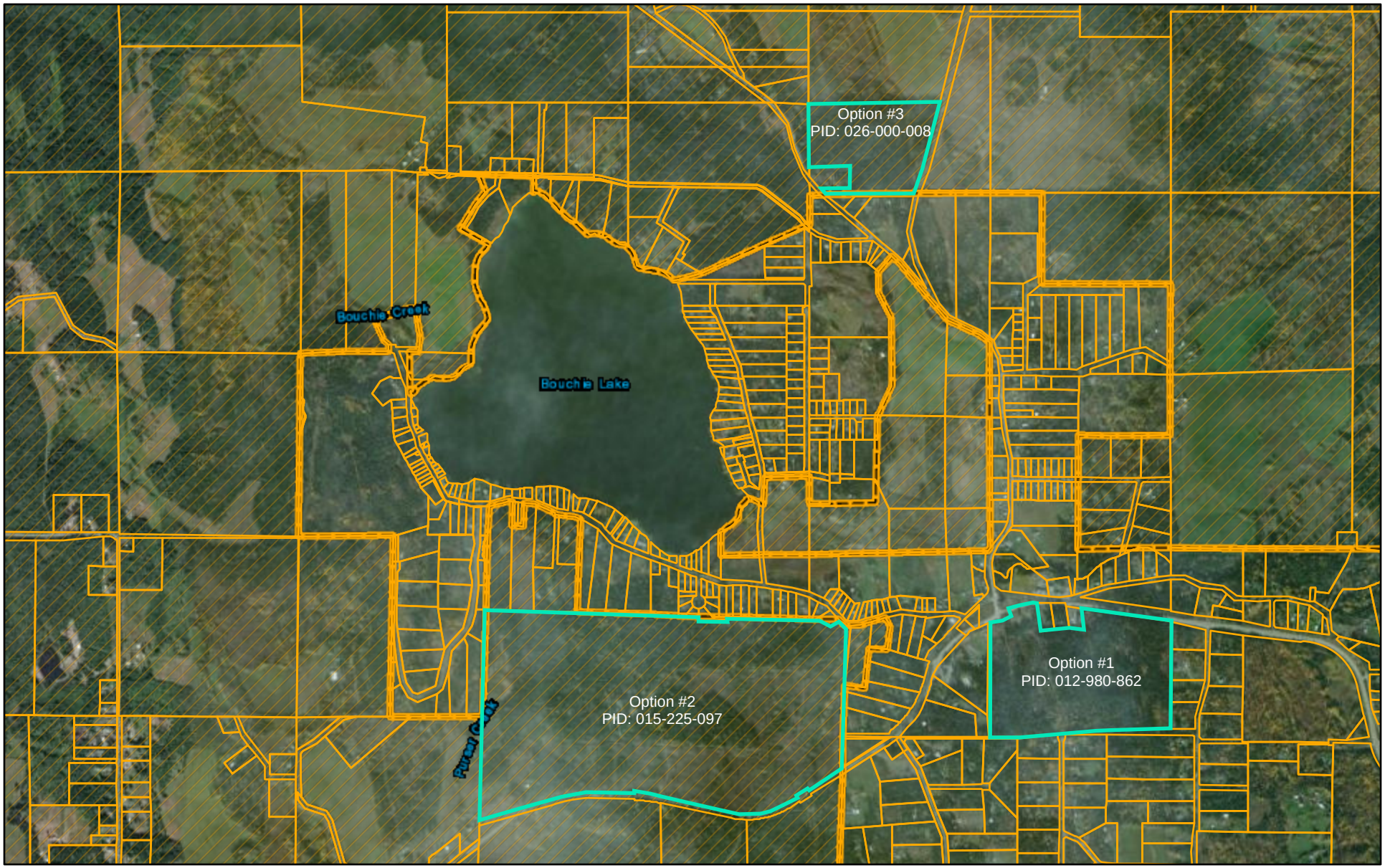
Code	Description	Electoral Area
061	2 Acres Or More (Vacant)	

Powered by CityView

APPENDIX C

Sketches of Lagoon Options and Phases

Cariboo Regional District



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Agricultural Land Reserve (ALR)

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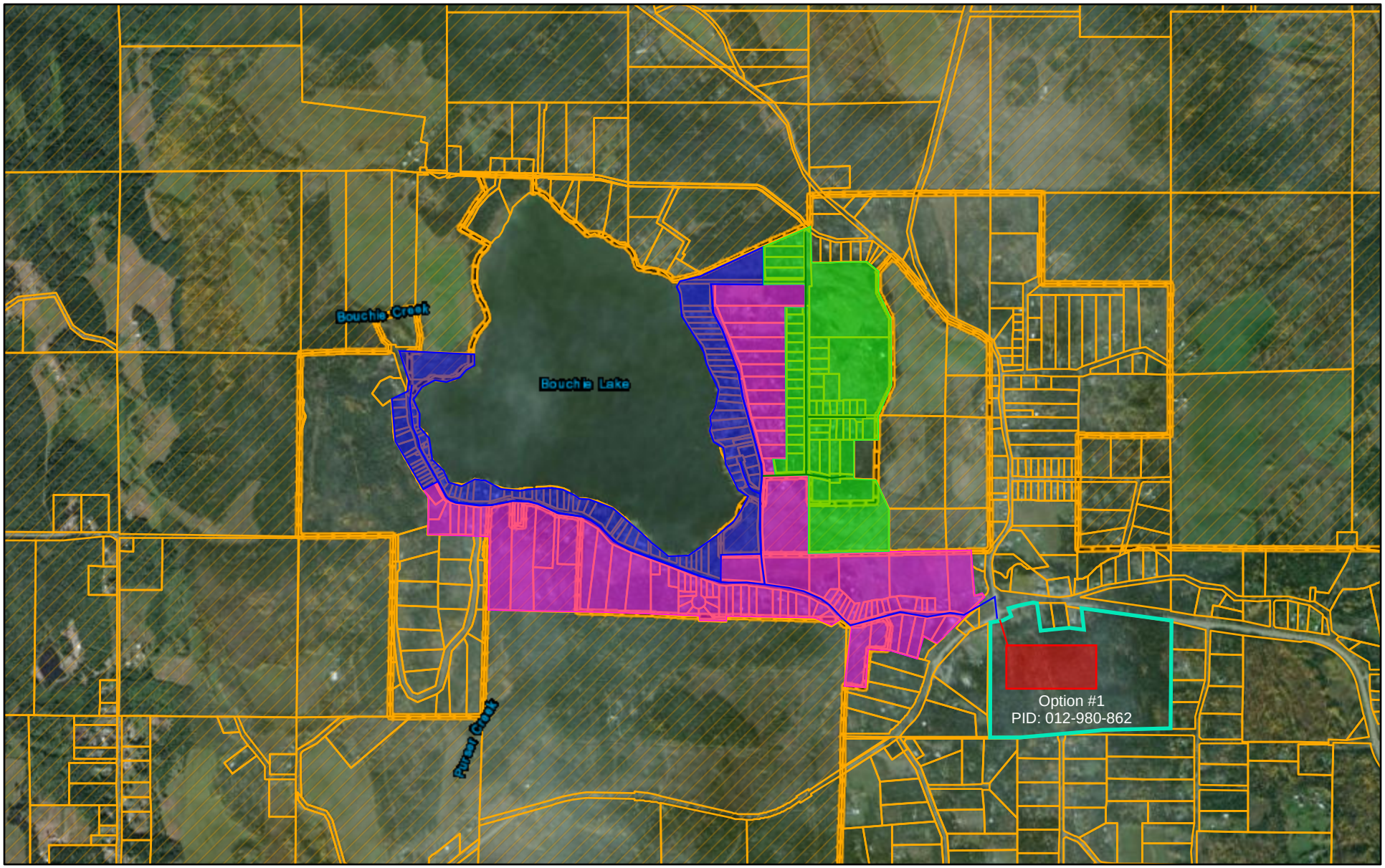
0 0.2 0.4 0.8 mi

0 0.33 0.65 1.3 km

Esri, HERE, Garmin, NRCan, Maxar

Cariboo Regional District



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Esri, HERE, Garmin, NRCan, Maxar

Agricultural Land Reserve (ALR)

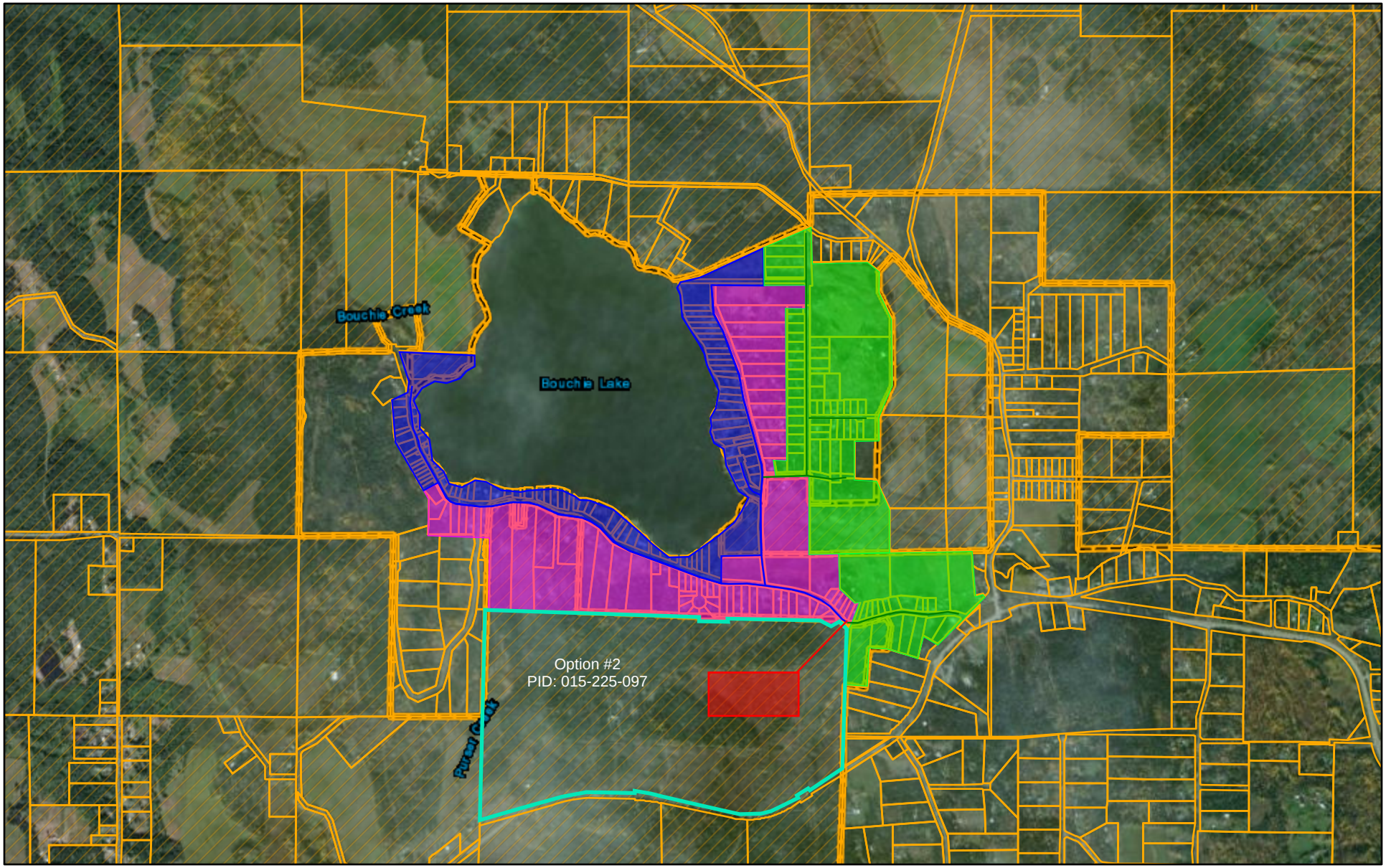
Phase 1

Phase 2

Phase 3

Cariboo Regional District

Cariboo Regional District



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0 0.2 0.4 0.8 mi

0 0.33 0.65 1.3 km

Esri, HERE, Garmin, NRCan, Maxar

Agricultural Land Reserve (ALR)

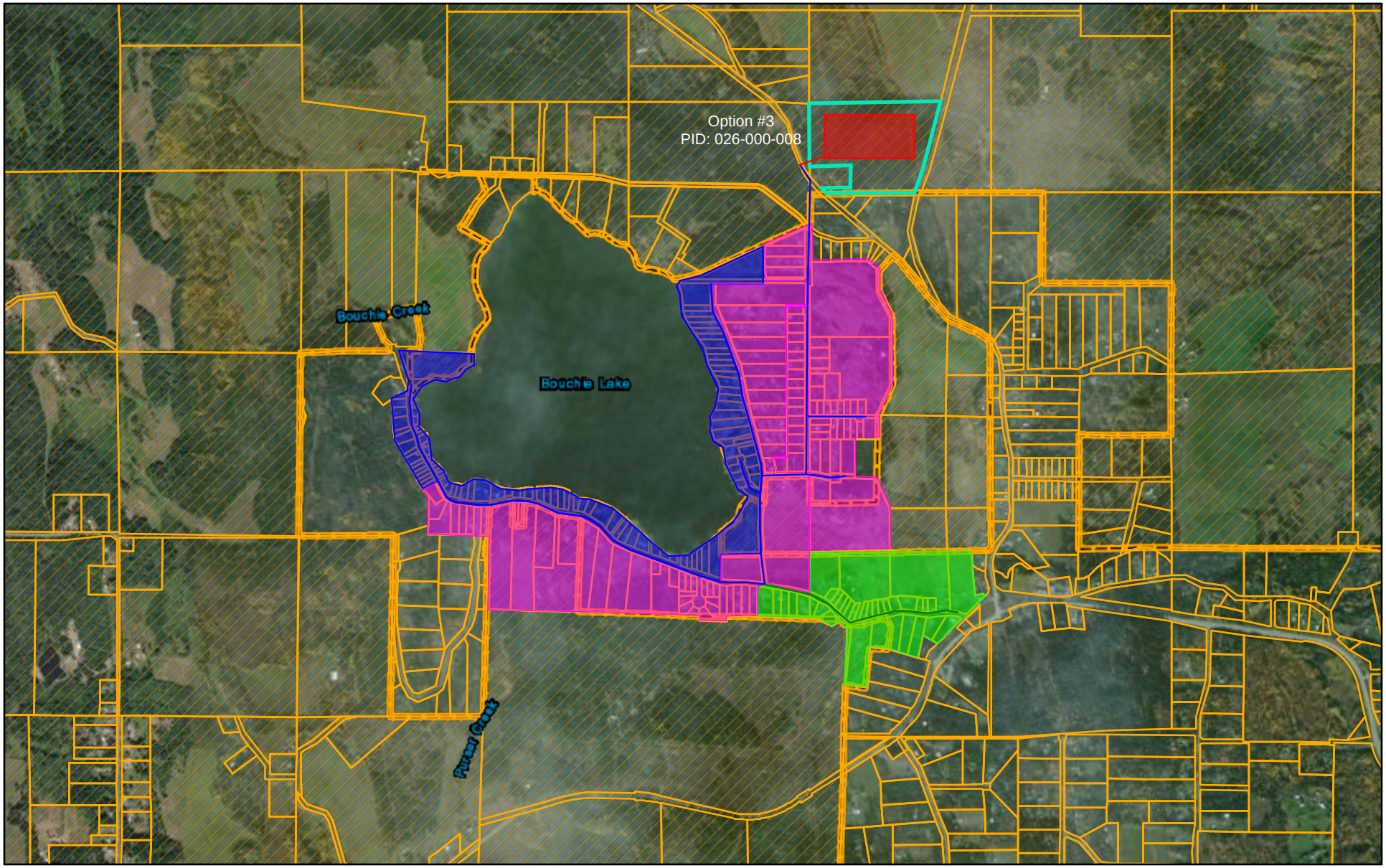
Phase 1

Phase 2

Phase 3

Cariboo Regional District

Cariboo Regional District



6/19/2025, 3:42:09 PM

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0 0.2 0.4 0.8 mi

0 0.33 0.65 1.3 km

Esri, HERE, Garmin, NRCan, Maxar

Agricultural Land Reserve (ALR)

Phase 1

Phase 2

Phase 3

Cariboo Regional District

APPENDIX D

Capital Cost Estimates

McElhanney

Cariboo Regional District
Bouchie Lake Community Wastewater Feasibility Study
Class D Cost Estimate

				Option #1					
				Phase 1		Phase 2		Phase 3	
			Number of Parcels	83		173		224	
			Length of Sewer Main (KM)	4.83		4.83		6.52	
			Lagoon Volume (CM)	63,620		132,605		171,696	
			Lagoon Footprint (HA)	3.45		6.64		8.35	
Item	Description	Unit	Rate	Quantity	Cost	Quantity	Cost	Quantity	Cost
1.0 General									
1.1	Detailed Engineering Design	LS	$20,000	1	$20,000	1	$20,000	1	$20,000
1.2	Traffic Management and Detours	LS	$15,000	1	$15,000	1	$15,000	1	$15,000
1.3	Utility Locates	LS	$10,000	1	$10,000	1	$10,000	1	$10,000
1.4	Geotechnical Assessment & Monitoring	LS	$50,000	1	$50,000	1	$50,000	1	$50,000
1.5	Site Survey	LS	$35,000	1	$35,000	1	$35,000	1	$35,000
1.6	Environmental Site Assessment & Monitoring	LS	$50,000	1	$50,000	1	$50,000	1	$50,000
			1.0 Subtotal		**$180,000**		**$180,000**		**$180,000**
2.0 Site Preparation									
2.1	Site Preparation (Clearing, Grubbing, Grading, Tree Removal)	SM	$10	34,500	$345,000	66,400	$664,000	83,500	$835,000
2.2	Lagoon excavation and earthworks	CM	$25	63,620	$1,590,500	132,605	$3,315,125	171,696	$4,292,400
			2.0 Subtotal		**$1,935,500**		**$3,979,125**		**$5,127,400**
3.0 Sanitary Main and Servicing									
3.1	200 mm Dia. PVC SDR35 Sanitary Main	LM	$350	4,830	$1,690,500	4,830	$1,690,500	6,520	$2,282,000
3.2	100 mm Dia. PVC DR11 Sanitary Force Main	LM	$250	150	$37,500	150	$37,500	150	$37,500
3.3	1050 mm Dia Manhole (base, lid, slab, cover and frame)	EA	$4,500	39	$175,500	39	$175,500	53	$238,500
3.4	Lift Station c/w Chamber, Concrete Base and accessories	LS	$100,000	1	$100,000	1	$100,000	1	$100,000
3.5	100 mm Dia. PVC SDR35 Sanitary Service	LM	$250	498	$124,500	1,038	$259,500	1,344	$336,000
3.6	On-site septic tanks with pumps	EA	$15,000	83	$1,245,000	173	$2,595,000	224	$3,360,000
			3.0 Subtotal		**$3,373,000**		**$4,858,000**		**$6,354,000**
			Subtotal Cost	**$5,488,500**		**$9,017,130**		**$11,661,400**	
		Contingency	**50%**	**$2,744,000**		**$4,509,000**		**$5,831,000**	
			Total Estimated Cost	**$8,232,500**		**$13,526,130**		**$17,492,400**	
			Cost per Parcel	**$99,190**		**$78,190**		**$78,090**	

Assumptions:
1. Pricing based on similar tenders.
2. Land acquisition costs are not included.

Prepared by: D. Mielke
Reviewed by: C. Hutchinson
Date: 2025-09-18

McElhanney

Cariboo Regional District
Bouchie Lake Community Wastewater Feasibility Study
Class D Cost Estimate

				Option #2					
				Phase 1		Phase 2		Phase 3	
			Number of Parcels	83		153		224	
			Length of Sewer Main (KM)	4.01		4.01		6.22	
			Lagoon Volume (CM)	63,620		117,275		171,696	
			Lagoon Footprint (HA)	3.45		5.94		8.35	
Item	Description	Unit	Rate	Quantity	Cost	Quantity	Cost	Quantity	Cost
1.0 General									
1.1	Detailed Engineering Design	LS	$20,000	1	$20,000	1	$20,000	1	$20,000
1.2	Traffic Management and Detours	LS	$15,000	1	$15,000	1	$15,000	1	$15,000
1.3	Utility Locates	LS	$10,000	1	$10,000	1	$10,000	1	$10,000
1.4	Geotechnical Assessment & Monitoring	LS	$50,000	1	$50,000	1	$50,000	1	$50,000
1.5	Site Survey	LS	$35,000	1	$35,000	1	$35,000	1	$35,000
1.6	Environmental Site Assessment & Monitoring	LS	$50,000	1	$50,000	1	$50,000	1	$50,000
			1.0 Subtotal		**$180,000**		**$180,000**		**$180,000**
2.0 Site Preparation									
2.1	Site Preparation (Clearing, Grubbing, Grading, Tree Removal)	SM	$10	34,500	$345,000	59,400	$594,000	83,500	$835,000
2.2	Lagoon excavation and earthworks	CM	$25	63,620	$1,590,500	117,275	$2,931,875	171,696	$4,292,400
			2.0 Subtotal		**$1,935,500**		**$3,525,875**		**$5,127,400**
3.0 Sanitary Main and Servicing									
3.1	200 mm Dia. PVC SDR35 Sanitary Main	LM	$350	4,010	$1,403,500	4,010	$1,403,500	6,220	$2,177,000
3.2	100 mm Dia. PVC DR11 Sanitary Force Main	LM	$250	350	$87,500	350	$87,500	350	$87,500
3.3	1050 mm Dia Manhole (base, lid, slab, cover and frame)	EA	$4,500	33	$148,500	33	$148,500	50	$225,000
3.4	Lift Station c/w Chamber, Concrete Base and accessories	LS	$100,000	1	$100,000	1	$100,000	1	$100,000
3.5	100 mm Dia. PVC SDR35 Sanitary Service	LM	$250	498	$124,500	918	$229,500	1,344	$336,000
3.6	On-site septic tanks with pumps	EA	$15,000	83	$1,245,000	153	$2,295,000	224	$3,360,000
			3.0 Subtotal		**$3,109,000**		**$4,264,000**		**$6,285,500**
			Subtotal Cost	**$5,224,500**		**$7,969,880**		**$11,592,900**	
			Contingency	**50%**	**$2,612,000**		**$3,985,000**		**$5,796,000**
			Total Estimated Cost	**$7,836,500**		**$11,954,880**		**$17,388,900**	
			Cost per Parcel	**$94,420**		**$78,140**		**$77,630**	

Assumptions:
1. Pricing based on similar tenders.
2. Land acquisition costs are not included.

Prepared by: D. Mielke
Reviewed by: C. Hutchinson
Date: 2025-09-18

McElhanney

Cariboo Regional District
Bouchie Lake Community Wastewater Feasibility Study
Class D Cost Estimate

				Option #3					
				Phase 1		Phase 2		Phase 3	
		Number of Parcels		83		189		224	
		Length of Sewer Main (KM)		5.62		5.62		6.54	
		Lagoon Volume (CM)		63,620		144,869		171,696	
		Lagoon Footprint (HA)		3.45		7.16		8.35	
Item	Description	Unit	Rate	Quantity	Cost	Quantity	Cost	Quantity	Cost
1.0 General									
1.1	Detailed Engineering Design	LS	$20,000	1	$20,000	1	$20,000	1	$20,000
1.2	Traffic Management and Detours	LS	$15,000	1	$15,000	1	$15,000	1	$15,000
1.3	Utility Locates	LS	$10,000	1	$10,000	1	$10,000	1	$10,000
1.4	Geotechnical Assessment & Monitoring	LS	$50,000	1	$50,000	1	$50,000	1	$50,000
1.5	Site Survey	LS	$35,000	1	$35,000	1	$35,000	1	$35,000
1.6	Environmental Site Assessment & Monitoring	LS	$50,000	1	$50,000	1	$50,000	1	$50,000
			1.0 Subtotal		**$180,000**		**$180,000**		**$180,000**
2.0 Site Preparation									
2.1	Site Preparation (Clearing, Grubbing, Grading, Tree Removal)	SM	$10	34,500	$345,000	71,600	$716,000	83,500	$835,000
2.2	Lagoon excavation and earthworks	CM	$25	63,620	$1,590,500	144,869	$3,621,725	171,696	$4,292,400
			2.0 Subtotal		**$1,935,500**		**$4,337,725**		**$5,127,400**
3.0 Sanitary Main and Servicing									
3.1	200 mm Dia. PVC SDR35 Sanitary Main	LM	$350	3,550	$1,242,500	3,550	$1,242,500	4,470	$1,564,500
3.2	100 mm Dia. PVC DR11 Sanitary Force Main	LM	$250	2,220	$555,000	2,220	$555,000	2,220	$555,000
3.3	1050 mm Dia Manhole (base, lid, slab, cover and frame)	EA	$4,500	29	$130,500	29	$130,500	36	$162,000
3.4	Lift Station c/w Chamber, Concrete Base and accessories	LS	$100,000	1	$100,000	1	$100,000	1	$100,000
3.5	100 mm Dia. PVC SDR35 Sanitary Service	LM	$250	498	$124,500	1,134	$283,500	1,344	$336,000
3.6	On-site septic tanks with pumps	EA	$15,000	83	$1,245,000	189	$2,835,000	224	$3,360,000
			3.0 Subtotal		**$3,397,500**		**$5,146,500**		**$6,077,500**
			Subtotal Cost	**$5,513,000**		**$9,664,230**		**$11,384,900**	
		Contingency	**50%**	**$2,757,000**		**$4,832,000**		**$5,692,000**	
			Total Estimated Cost	**$8,270,000**		**$14,496,230**		**$17,076,900**	
			Cost per Parcel	**$99,640**		**$76,700**		**$76,240**	

Assumptions:
1. Pricing based on similar tenders.
2. Land acquisition costs are not included.

Prepared by: D. Mielke
Reviewed by: C. Hutchinson
Date: 2025-09-18

APPENDIX E

Conceptual Site Plan

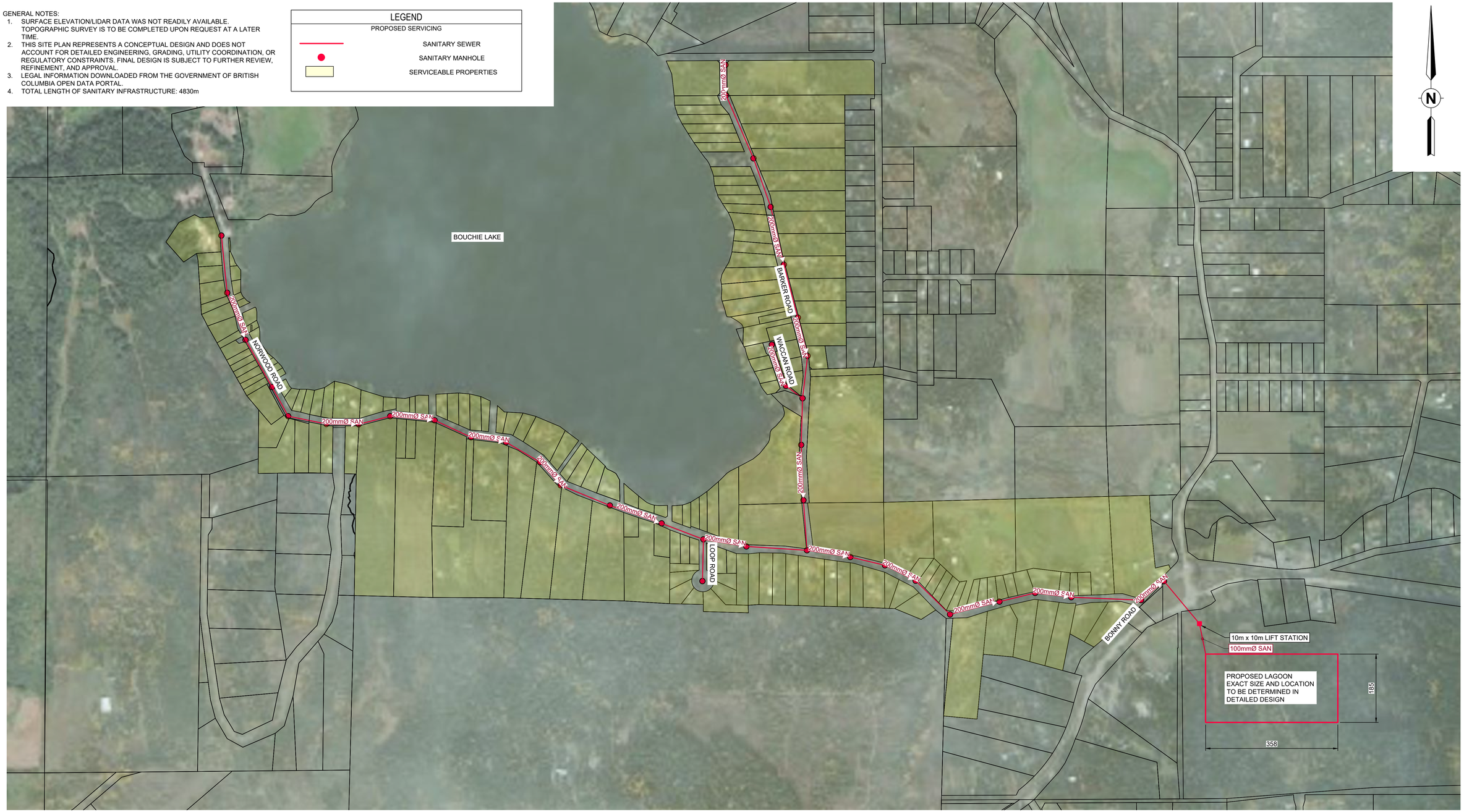
GENERAL NOTES:

1. SURFACE ELEVATION/LIDAR DATA WAS NOT READILY AVAILABLE. TOPOGRAPHIC SURVEY IS TO BE COMPLETED UPON REQUEST AT A LATER TIME.
2. THIS SITE PLAN REPRESENTS A CONCEPTUAL DESIGN AND DOES NOT ACCOUNT FOR DETAILED ENGINEERING, GRADING, UTILITY COORDINATION, OR REGULATORY CONSTRAINTS. FINAL DESIGN IS SUBJECT TO FURTHER REVIEW, REFINEMENT, AND APPROVAL.
3. LEGAL INFORMATION DOWNLOADED FROM THE GOVERNMENT OF BRITISH COLUMBIA OPEN DATA PORTAL.
4. TOTAL LENGTH OF SANITARY INFRASTRUCTURE: 4830m

LEGEND

PROPOSED SERVICING

- SANITARY SEWER
- SANITARY MANHOLE
- SERVICEABLE PROPERTIES



Rev	Date	Description	Drawn	Design	App'd
0	2025-09-18	ISSUED FOR CONCEPTUAL DESIGN	AA	DM	DM

BENCHMARK
ALL ELEVATION REFER TO CONTROL MONUMENT: -
LOCATED AT: -
ELEVATION: -

0 1:5,000 250

ORIGINAL DWG SIZE: ANSI D (22" x 34")

McElhanney

12 - 556 North Nechako Road,
Prince George BC V2K 1A1
Tel. 250 561 2229

Cariboo Regional District

PRELIMINARY
NOT FOR CONSTRUCTION

THIS DRAWING HAS NOT BEEN APPROVED AND MAY CONTAIN ERRORS AND OMISSIONS

CARIBOO REGIONAL DISTRICT
SUITE D, 180 THIRD AVENUE NORTH, WILLIAMS LAKE, BC

BOUCHIE LAKE COMMUNITY WASTEWATER CONCEPTUAL SANITARY OPTION #1 - PHASE 2 SITE PLAN

Drawing No. C01

Project Number 2341-21917-00

Rev. 0

DESTROY ALL PRINTS BEARING PREVIOUS REVISION

DATE: 2025-09-19, 14:02 FILE: X:\2341\Projects\2341219\700 CRD-Feasibility Study for Bouchie Lake Sewer System\07_DRAWINGS\04_Models\21917-00 Base.dwg

McElhanney ANSI D - 2025-01-10

Contact
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778-693-2211
dmielke@mcelhanney.com

McElhanney

CANADA BEST MANAGED COMPANIES
Platinum member