

Mill Lake Process Water Treatment Plant

Effluent Quality Criteria (EQC) Amendment for Total Suspended Solids (TSS)

Water Licence W2020L8-0003

AECOM, CIRNAC and PSPC

Presentation Overview – Previous engagements

- TSS EQC Amendment
 - Proposed Amendment
 - Background on EQC development
 - Why is an Amendment Needed?
 - Timeline
 - TSS in other Water Licences
 - Comparison of 15 vs 25 mg/L
 - Potential Impacts from Increased TSS
 - Questions

Proposed Water Licence Amendment (W2020L8-0003)

- **Part E: Waste and Water Management**
 - Condition 17. Effluent Quality Criteria – Mill Lake Water Treatment Facility
- **Total Suspended Solids (TSS)**
 - Current – Maximum Grab Concentration (MGC) of 15 mg/L
 - Amendment request – MGC of 25 mg/L

Parameter	EQC
	Maximum Grab Concentration
Ammonia (total)	499 µg/L
Fluoride	120 µg/L
Nitrate	13,000 µg/L
Nitrite (as NO ₂)	197 µg/L
Copper (total)	2.8 µg/L
Iron (total)	300 µg/L
Nickel (total)	25 µg/L
Uranium (total)	15 µg/L
Zinc (total)	23 µg/L
Total Suspended Solids	15 mg/L
Total Petroleum Hydrocarbons	5 mg/L

Background - Evolution of TSS EQC



April 8, 2021

GNWT Intervention

- GNWT recommends a maximum average concentration (MAC) of 15 mg/L and maximum grab concentration (MGC) of 25 mg/L for TSS

April 19, 2021

CIRNAC Response to GNWT Intervention

- CIRNAC agrees it can apply the suggested EQC for TSS

April 30, 2021

GNWT Presentation

- Addition of EQC for TSS and TPH
- GNWT supported the list of parameters to have EQC for discharge to Sherman Lake

June 10, 2021

GNWT Review of Draft Water Licence

- GNWT indicated that following discussion at the public hearing on the preferred use of one value as MGC, their recommendations were resolved.
- GNWT recommended MGC of 15 mg/L for TSS

June 17, 2021

CIRNAC Response to Draft Water Licence Review Comments

- CIRNAC agreed to the recommended EQC for TSS

July 2, 2021

GNWT Closing Arguments

- GNWT recommends a MAC of 15 mg/L and a MGC of 25 mg/L for TSS

September 30, 2021

WLWB Recommendation for Approval and Reasons for Decision

- EQC for MGC of 15 mg/L for TSS

November 18, 2021

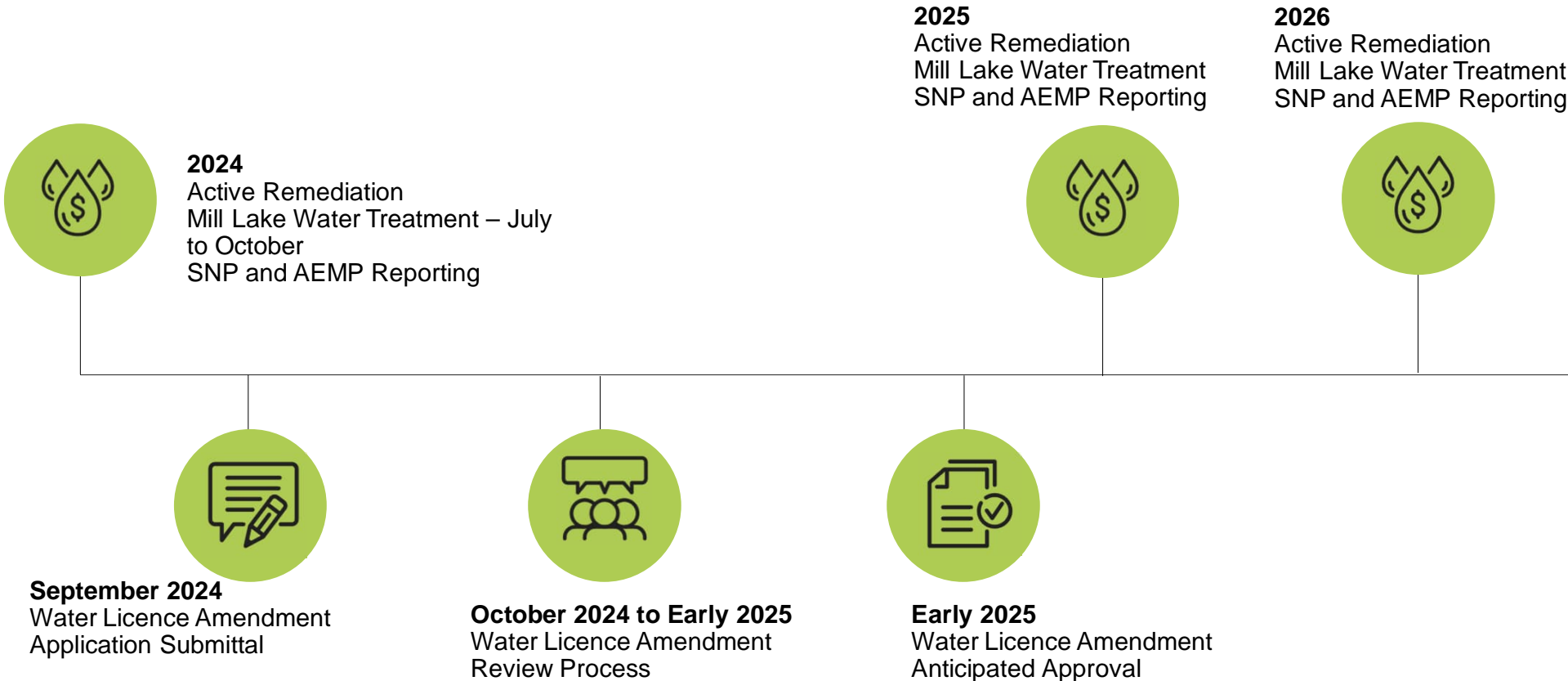
WLWB Issuance of Water Licence W2020L8-0003

- EQC for MGC of 15 mg/L for TSS

Why is an amendment to the EQC for TSS needed?

- **During Water Licence review process:**
 - Misunderstanding on use of Maximum Average Concentration (MAC) as the Maximum Grab Concentration (MGC) based on commitments to Tlicho Elders
 - Lack of clarity in submissions on derivation of MGC of 15 mg/L for TSS
 - MGC of 15 mg/L for TSS not explicitly discussed or agreed upon
 - Contract specifications developed based on MGC of 25 mg/L for TSS (prior to Water Licence issue)
- **After Water Licence issued:**
 - Discrepancy identified between TSS criteria in Contract (25 mg/L) and Water Licence (15 mg/L)
 - Contractor water treatment performance for metals established with MGC of 25 mg/L of TSS
 - Committed to treating water to as low as practically achievable
 - Estimate to add treatment capability to meet MGC of 15 mg/L in the millions of dollars
- **Water Treatment Plant performance criteria for end-of-pipe discharge**
 - What is achievable
 - Allowing room for compliance

Estimated Timeline



What TSS criteria are in other Water Licences?

Water Licence	Type	Company	Activity	Discharge Volume (m ³)	TSS EQC	
					Maximum Average Concentration (mg/L)	Maximum Grab Concentration (mg/L)
W2015L2-0001	A	Diavik	Diamond Mining and Milling	14,000,000 (year round)	15	25
W2022L2-0001	A	Ekati	Diamond Mining and Milling		15	25
			Construction related to runoff management		50	100
MV2005L2-0015	A	Gahcho Kué	Diamond Mining and Milling		15	25
W2008L2-0004	A	NICO - Fortune Minerals	Mining and Milling		15	25
W2021L2-0004	A	Nighthawk Gold	Mining and Milling		15	30
MV2007L8-0031	A	CIRNAC - Giant Mine	Miscellaneous - Remediation (Giant)	1,200,000 (currently summer only)	15	30
W2021L8-0003	B	CIRNAC -CARD	Miscellaneous - Remediation (Colomac)		15	30
S17L8-002	B	CIRNAC -CARD	Miscellaneous - Remediation (GBL Sites)		N/A	30
MV2016L8-0003	A	CIRNAC -CARD	Miscellaneous - Remediation (Tundra)		15	30

TSS - 15 mg/L vs 25 mg/L

Total Effluent Volume		134,265 m³
	2025	68,940 m ³
	2026	65,325 m ³

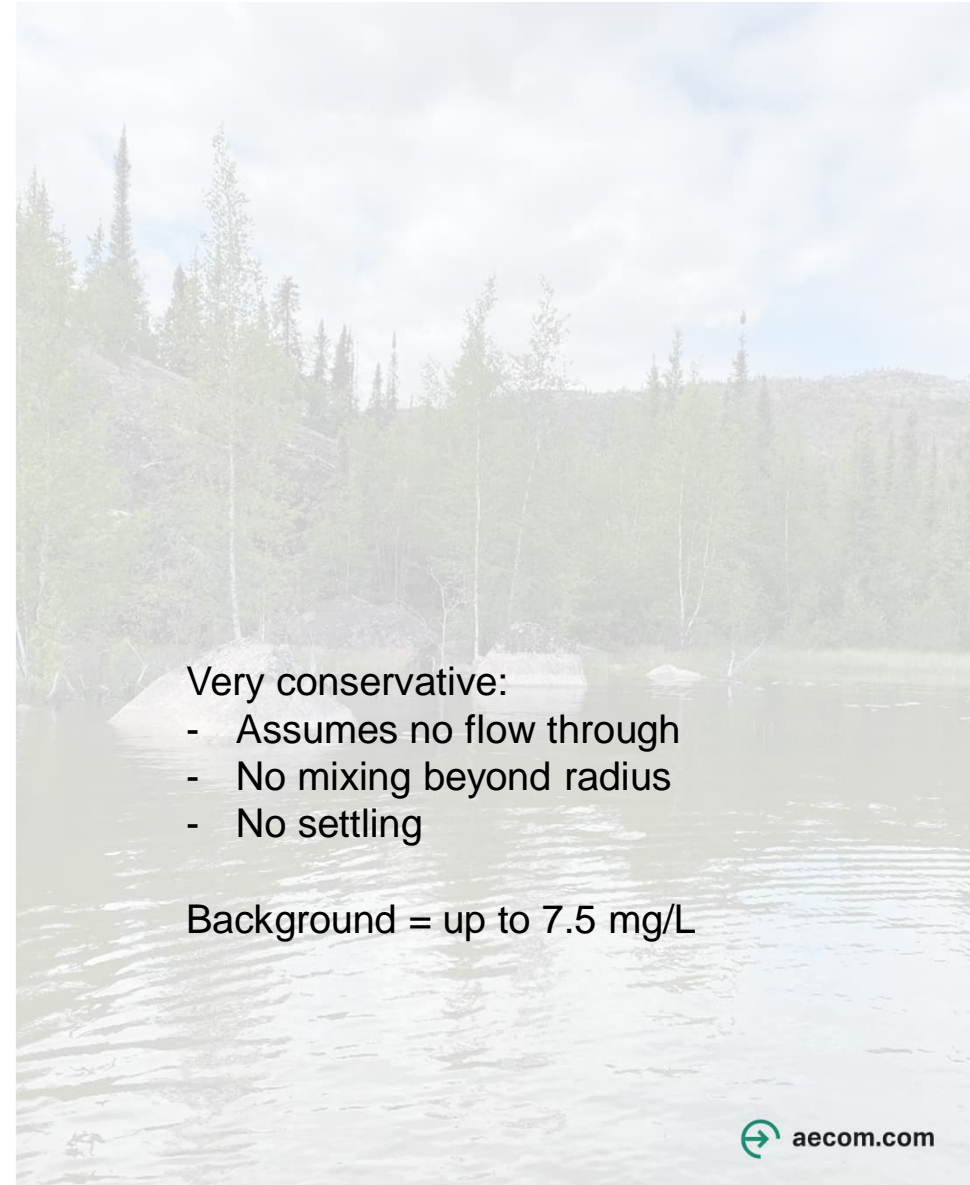
Sherman Lake Volume		5,355,000 m ³
Bay Volume		46,500 m ³
100 m from Diffuser		67,485 m ³
250 m from Diffuser		245,271 m ³

TSS concentrations (15 mg/L discharge)

Bay	21-22 mg/L
100 m from Diffuser	15 mg/L
250 m from Diffuser	4 mg/L

TSS concentrations (25 mg/L discharge)

Bay	35-37 mg/L
100 m from Diffuser	24-26 mg/L
250 m from Diffuser	7 mg/L



Very conservative:

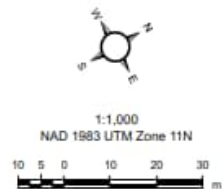
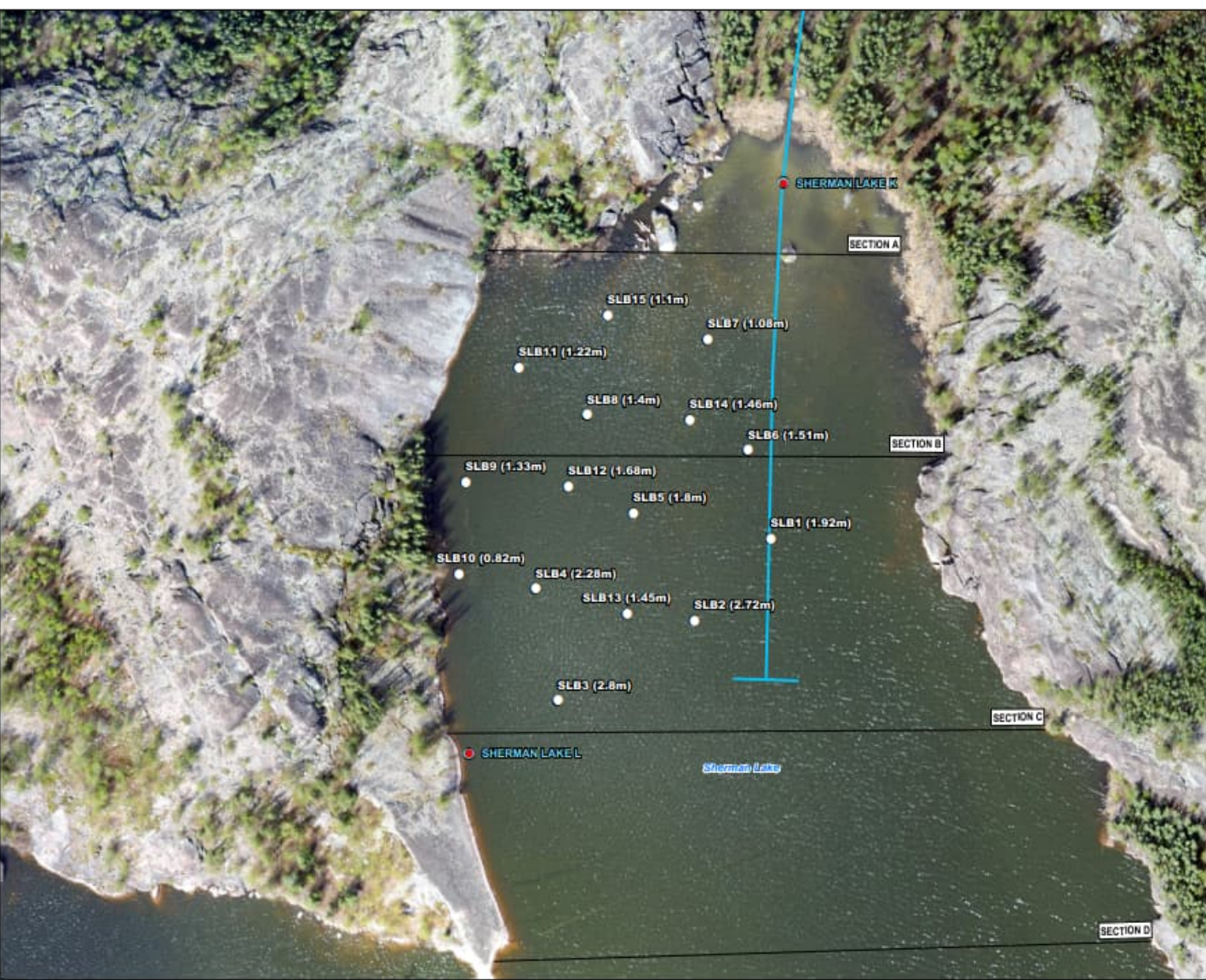
- Assumes no flow through
- No mixing beyond radius
- No settling

Background = up to 7.5 mg/L

- Legend**
- SNP Sampling Location
 - AEMP Sampling Location - Water, Sediment, and Benthic
 - 2021 Water Depth Measurement Location
 - Approximate Diffuser Location

Section A - 50 m W x 30 m L x 1.0 m D = 1,500 m³
 Section B - 100 m W x 50 m L x 1.5 m D = 7,500 m³
 Section C - 125 m W x 60 m L x 2.0 m D = 15,000 m³
 Section D - 150 m W x 50 m L x 3.0 m D = 22,500 m³

Estimated volume of discharge bay in Sherman Lake
 Total = 46,500 m³



Ortho-imagery: Arcadis Canada Inc. (Photo Date: May 26, 2017)
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AECOM
Figure: 2

SHERMAN LAKE EFFLUENT DISCHARGE
 - LAKE VOLUME ESTIMATE
 TSS ENVIRONMENTAL RISK EVALUATION

RAYROCK REMEDIATION PROJECT
 PUBLIC SERVICES AND PROCUREMENT CANADA
 Project No.: 60693488 Date: 2024-03-27



Sherman Lake – Discharge Line and Diffuser



Discharge line to Sherman Lake from shore, August 16, 2024



Effluent discharge line to Sherman Lake on water, August 16, 2024



Diffuser operating at end of effluent discharge line to Sherman Lake, August 16, 2024

Aquatic Risk from TSS Exposure Scenarios

- Within hypothetical “closed” exposure areas
- Exposure temporary and gradual
 - Short-term discharge period - 4 months/year over remaining 2 years
 - Exposure to maximum calculated TSS concentration would occur at the end of seasonal discharge period
- Fish avoidance expected in immediate diffuser turbulent area during discharge
- Potential for localised mortality or reduced abundance for aquatic invertebrates and plants/algae (near the diffuser) – SEV Approach (CCME and BC MOE)
- Increase in effluent TSS is not expect to create a potential for significant or long-term risks to develop in the receiving aquatic environment
- 25 mg/L still considered to be protective of sensitive aquatic communities

Severity-of-ill-effects (SEV) Approach (from Newcombe and Jensen 1996)

		Duration of exposure to SS (loge hours)												
		0	1	2	3	4	5	6	7	8	9	10		
Concentration (mg SS/L)		Average severity-of-ill-effect scores (calculated)												
		162,755	59,874	22,026	8,103	2,981	1,097	403	148	55	20	7	3	1
		12	12	13	13	13	14	14	14	14	14	14	12	
		11	12	12	13	13	13	13	14	14	14	14	11	
		10	11	11	12	12	13	13	13	13	14	14	10	
		9	10	10	11	11	12	12	13	13	13	13	9	
		8	9	9	10	10	11	11	12	12	13	13	8	
		7	8	8	9	9	10	10	11	11	12	12	7	
		6	7	7	8	8	9	9	10	10	11	12	6	
		5	6	6	7	7	8	8	9	9	10	11	5	
		4	5	5	6	6	7	7	8	8	9	10	4	
		4	4	4	5	5	6	6	7	7	8	9	3	
		3	3	4	4	4	5	5	6	6	7	7	2	
		3	3	3	4	4	4	5	5	6	6	7	1	
		2	2	3	3	3	4	4	4	5	5	6	0	
		1	3	7	1	2	6	2	7	4	11	30		
		Hours			Days			Weeks			Months			

Figure 3. Average severity-of-ill-effects (SEV) scores matrix. Group 2, adult salmonids. N = 63.

Severity-of-ill-effects (SEV) Approach (from Newcombe and Jensen 1996)

		Duration of exposure to SS (loge hours)											
		0	1	2	3	4	5	6	7	8	9	10	
		Average severity-of-ill-effect scores (calculated)											
Concentration (mg SS/L)	162,755	7	8	9	10	11	12	12	13	13	14	14	12
	59,874	7	8	9	10	10	11	12	13	13	13	14	11
	22,026	7	8	8	9	10	11	12	12	13	13	14	10
	8,103	6	7	8	9	10	11	11	12	13	13	13	9
	2,981	6	7	8	9	9	10	11	12	12	13	13	8
	1,097	6	6	7	8	9	10	11	12	12	13	13	7
	403	5	6	7	8	8	9	10	11	12	12	13	6
	148	5	6	6	7	8	9	10	11	12	12	13	5
	55	5	5	6	7	8	9	9	11	11	12	13	4
	20	4	5	6	7	7	8	9	10	11	12	12	3
	7	4	5	5	6	7	8	9	10	10	11	12	2
	3	4	5	5	6	7	8	8	9	10	11	12	1
	1	4	4	5	6	6	7	8	9	10	11	11	0
		1	3	7	1	2	6	2	7	4	11	30	
		Hours			Days			Weeks		Months			

Figure 4. Average severity-of-ill-effects (SEV) scores matrix. Group 6, adult freshwater non-salmonids. N = 22.

Severity-of-ill-effects (SEV) Approach (from Newcombe and Jensen 1996)

		Duration of exposure to SS (loge hours)												
		0	1	2	3	4	5	6	7	8	9	10		
		Average severity-of-ill-effect scores (calculated)												
Concentration (mg SS/L)	162,755	11	12	13	13	13	14	14	14	14	14	14	12	LOGe (mg SS/L)
	59,874	11	11	12	13	13	14	14	14	14	14	14	11	
	22,026	10	11	12	12	13	13	14	14	14	14	14	10	
	8,103	9	10	11	12	12	13	13	14	14	14	14	9	
	2,981	8	10	10	11	12	13	13	14	14	14	14	8	
	1,097	8	9	10	11	11	12	13	13	14	14	14	7	
	403	7	8	9	10	11	12	12	13	13	14	14	6	
	148	6	7	8	9	10	11	12	13	13	13	14	5	
	55	6	7	8	9	9	10	11	12	13	13	13	4	
	20	5	6	7	8	9	10	10	11	12	13	13	3	
	7	5	5	6	7	8	9	10	11	11	12	13	2	
	3	4	5	6	7	7	8	9	10	11	12	12	1	
	1	4	4	5	6	7	8	8	9	10	11	12	0	
		1	3	7	1	2	6	2	7	4	11	30		
		Hours			Days			Weeks		Months				

Figure 5. Average severity-of-ill-effects (SEV) scores matrix. Group 8, aquatic invertebrates and flora. N = 61.

Severity-of-ill-effects (SEV) score - description of effects

SEV	Fish	Invertebrates	Flora
0	No behavioral effects	No harmful effects	No harmful effects
1	Alarm reaction	No data. Intermediate value	No data. Intermediate value
2	Abandonment of cover	No data. Intermediate value	No data. Intermediate value
3	Avoidance response	Increased drift	No data. Intermediate value
4	Short-term reduction in feeding rates or feeding success	Short-term (<1 h) reduction in feeding rates, (~10%) including ingestion and incorporation	No data. Intermediate value
5	Minor physiological stress; increase in rate of coughing; increased respiration rate	Short-term (<1 h) reduction in feeding rates, (~90%) including ingestion and incorporation	No data. Intermediate value
6	Moderate physiological stress	No data. Intermediate value	No data. Intermediate value
7	Moderate habitat degradation; impaired homing	No data. Intermediate value	No data. Intermediate value
8	Indications of major physiological stress; long-term reduction in feeding rate or success; poor condition	Silt intolerant species less abundant; long-term (>24 h) reduction in feeding rate or success; temporary changes in community structure; potential starvation of invertebrates	No data. Intermediate value
9	Reduced growth rate; delayed hatching; reduced fish density	No data. Intermediate value	No data. Intermediate value
10	0-20% mortality; increased predation; moderate to severe habitat degradation	Number of taxa reduced; standing crop reduced by 0-20%; survival and fecundity reduced; species diversity reduced; taxonomic diversity reduced; gills or gut, or both, clogged with particles; 0-20% mortality; increased predation	Number of taxa reduced; standing crop reduced by 0-20%; survival or fecundity reduced; species diversity reduced; taxonomic diversity reduced; 0-20% mortality;

11	>20-40% mortality	>20-40% mortality; abundance of invertebrates reduced by similar percentage (>20-40%)	>20-40% mortality; abundance or distribution reduced by similar percentage (>20-40%)
12	>40-60% mortality	>40-60% mortality, or reduced abundance	>40-60% mortality, or reduced abundance or reduced distribution (>40-60%)
13	>60-80% mortality	>60-80% mortality, or reduced abundance	>60-80% mortality, or reduced abundance or reduced distribution (>60-80%) leaves severely damaged by abrasion
14	>80-100% mortality	>80-100% mortality, or reduced abundance	>80-100% mortality, or reduced abundance or reduced distribution (>80-100%)

0 = nil effect

1-3 = behavioural effects

4-8 = sublethal effects

9-14 = lethal and para-lethal effects

(Newcombe and Jensen 1996)

SEV Score for Discharge Scenarios

TSS concentrations (25 mg/L discharge)

Bay 35-37 mg/L
100 m from Diffuser 24-26 mg/L
250 m from Diffuser 7 mg/L

Table 4b. SEV Score Description of Effects for 20 mg/L to 54 mg/L TSS over a 4-month Period for Aquatic Receptors in Groups 2, 6, and 8 (Appendix B)

Group	SEV Score	Description of Effects
2 – adult salmonids	7	Moderate habitat degradation; impaired homing
6 – adult freshwater non-salmonids	11	>20-40% mortality
8 – aquatic invertebrates and flora	12	>40-60% mortality, or reduced abundance

Aquatic Risk from TSS Exposure Scenarios

- Within hypothetical “closed” exposure areas
- Exposure temporary and gradual
 - Short-term discharge period - 4 months/year over remaining 2 years
 - Exposure to maximum calculated TSS concentration would occur at the end of seasonal discharge period
- Fish avoidance expected in immediate diffuser turbulent area during discharge
- Potential for localised mortality or reduced abundance for aquatic invertebrates and plants/algae (near the diffuser) – SEV Approach (CCME and BC MOE)
- Increase in effluent TSS is not expect to create a potential for significant or long-term risks to develop in the receiving aquatic environment
- 25 mg/L still considered to be protective of sensitive aquatic communities

Questions

Sherman Lake Shoreline Survey Location SLAS-02, June 26, 2024