Village of Lions Bay

SOURCE WATER PROTECTION PLAN

2025.4 Edition

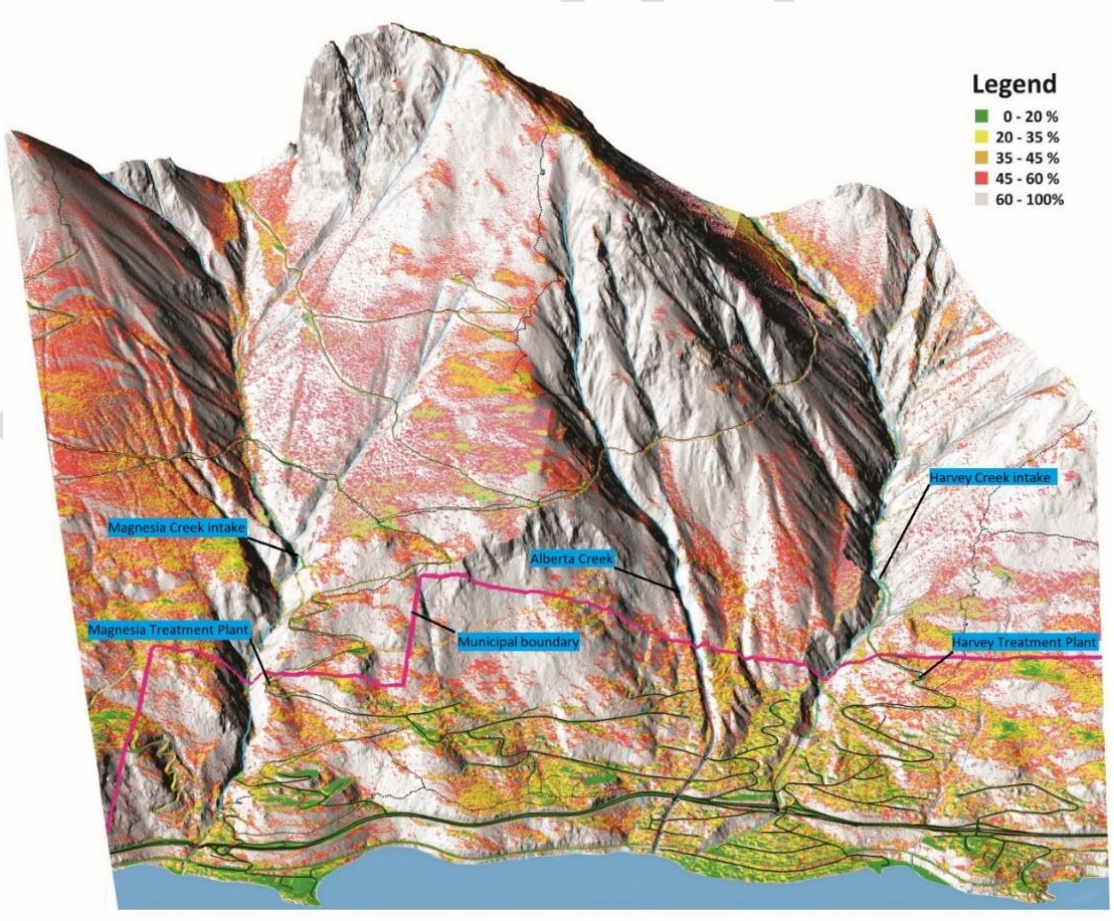
INTRODUCTION

The Village of Lions Bay is a British Columbia municipality of 1368 census residents, located on Highway 99, midway between Vancouver and Squamish on the steep eastern slopes of Howe Sound. Unlike most members of the Metro Vancouver Regional District, which receive drinking water wholly or partly from the Greater Vancouver Water District, Lions Bay produces all of its drinking water, operating as a Municipal Water Utility under the *Local Government Act,* the *Drinking Water Protection Act* and the *Drinking Water Protection Regulation*.

The foundation of producing safe drinking water is establishing barriers to hazards during collection, treatment and distribution. Source water protection is a first barrier, and this document identifies source water hazards and outlines the measures in place to mitigate them. Further barriers to hazards during treatment and distribution are discussed in the annual water quality reports available at https://www.lionsbay.ca/government/reports-documents-library/annual-drinking-water-quality-reports.

WATER CATCHMENTS

Lions Bay's raw water supply originates from rainfall, snowmelt and groundwater flows in Magnesia, Alberta and Harvey creeks:



With raw water reservoirs not feasible in the steep and permeable terrain, supply must be drawn on demand from the creeks, under provincial water licenses:

STREAM	WATER LICENSE	LICENSED QUANTITY (m^3/YEAR)	*2024 DRAW (m^3)[1]*
Harvey Creek	C119916	41,483 (9,125,000 iG)	*398,664 (137% of license)*
	C119917	248,898 (54,750,000 iG)	
Magnesia Creek	C059405	45,461 (10,000,000 iG)	*81,005 (82% of license)*
	C065267	19,912 (4,380,000 iG)	
	C065316	33,186 (7,300,000 iG)	
Alberta Creek	C042330	82,966 (8,250,000 iG)	*10 (testing only)[2]*

For security reasons this public document does not provide explicit geographic locations, photos or maps, but in general, weirs on the three creeks capture and screen raw water for rocks and vegetation before piping it by gravity and a pump station to the Magnesia and Harvey Treatment Plants for disinfection using ultraviolet and chlorine:

CATCHMENT, CREEK WEIR AND INTAKE PARAMETERS	HARVEY CREEK	MAGNESIA CREEK	ALBERTA CREEK
Jurisdiction of watershed land feeding into intake	Ministry of Forests, Land and Natural Resource Operations (FLNRO) with "Community Watershed" designation, which provides some protection under the Forest and Range Practices Act although recreational access, mining, forestry and energy development uses are not excluded. Licenses of Occupation for municipal intake works, delivery pipeline and access roads		Municipal and FLNRO. Intake works, delivery pipeline and access roads on municipal lands.
Catchment area above intake	635 ha.	421 ha.	51 ha.
Vegetation	Redcedar, Douglas-fir, hemlock, alder, big-leaf maple. Hemlock needles tend to clog screens, and alder and maple leaves tend to build up on intake grates.		
Weir elevation	317 m	444 m	273 m
Access control	Two locked gates on intake access road	Locked gate on intake access road	Locked gates on trail crossing creek at intake (while in operation)
Climate: precipitation, snowpack, freshet	The combined watershed experiences a maritime climate with a moderate temperature regime and a pronounced precipitation peak October through January. Approximately 2000 mm a year of precipitation occurs as rain and snow at sea-level, increasing to 4000 mm at the ridge crest (air masses condense out water due to thermodynamic cooling from pressure drop when driven upslope by onshore winds). Rain, snow melt and groundwater exfiltration drive creek flows. Water invariably flows year round at the temperatures currently experienced at the intakes. But when snowpack is gone, our supply tracking shows that groundwater-only flows entering the creek channels would		

[1] With an estimated 50 percent leakage in the distribution network (as of November 2024) and with consumer use unknown, the municipality recognises that Lions Bay's water demand is excessive. Demand is addressed by leak detection and public awareness campaigns. A successful 2025 proposal to the Provincial Water Metering Pilot Program will install $3.94 mil. worth of universal premise metering, watermain zone metering and automated pressure turndown capability by early 2027 to further control demand.

[2] Operational since 15 Aug. 2024, the Alberta Supply-Augmentation Project (ASAP) can supply up to 273 m^3/day (72,000 GPD) to the Harvey Treatment Plant.

CATCHMENT, CREEK WEIR AND INTAKE PARAMETERS	HARVEY CREEK	MAGNESIA CREEK	ALBERTA CREEK
	have reached zero in several cases in the recent years, were it not for propitious occasional rain.		
Uphill geology and geomorphology	Geomorphology in the area is a product of post-glacial erosion. Once the ice that filled what is now Howe Sound had fully retreated by about 10,600 years BP, water erosion and mass wasting (debris slides and flows, rockfall, avalanches) rapidly reworked glacial sediments, declining over time such that by no later than 7,500 years ago the landscape was similar to today. Steep rockfall aprons developed on mid to lower slopes of the Coast Mountain, and Magnesia, Alberta and Harvey Creeks re-incised their debris cones. Local geology comprises lower-Cretaceous Gambier Group marine sedimentary and volcanic bedrock. Upslope, the channels of Magnesia, Alberta and Harvey Creeks are underlain by mid-Cretaceous era Coast Plutonic Complex rock, which has intruded into the older Gambier Group rocks. Outcrops primarily consist of greenish volcanic rock that is highly fractured (10 cm spacings) with red oxidation on exposed surfaces. Prominent northwest-trending faults and jointing create structural instability. The Magnesia catchment is anecdotally believed to be more friable than Harvey's, judging by the nature of the material trapped in the weir and screens.		
Supply, anecdotal (salt-dilution rating curves are being produced to be able to measure and model creek flow year-round)	Up to 95 lps (1500 GPM) usable, the max. capacity of the Harvey Plant's 4-inch inlet valve (a 6-inch valve opens if the treated water storage tank reaches Low-Low setpoint, usually due to sharp draws for firefighting purposes).	Up to 63 lps (1000 GPM) usable, the max. capacity of the Mag Plant's 2-inch inlet valve (a 4-inch valve opens if the treated water storage tank reaches Low-Low setpoint, usually due to sharp draws for firefighting purposes).	Up to 3.1 lps (50 GPM), the capacity of the ASAP pump system. The V-notch weir at the intake indicates flows ranging from 4.4 lps (70 GPM) in late summer (believed to be spring fed), to over 60 lps (1000 GPM) after heavy rain, with rapid decline due to the small catchment.

RAW WATER INTAKES

PARAMETER	HARVEY CREEK	MAGNESIA CREEK	ALBERTA CREEK
Supply metering	Solar power cellular-connected pressure transducer in whole-flow pool above weir. Real-time data delivery operational late-2025.	Mains powered Wi-Fi connected pressure transducer in whole-flow pool above weir, operational mid-2025.	V-notch manual-read metering weir as of 2024 (rating curve in development, real-time data delivery operational late-2025)
Weir width, height	5 X 3 m	4 X 2 m	0.7 X 0.4 m
Pool depth	0.9 m at grate	1.5 m when not filled with rocks	0.2 m at bottom of V-notch metering weir
Grate	Horizontal 3” steel beams (to handle impact from rocks up to 0.5 m), with 3” gaps		1” parallel to flow, plus one above downstream catch basin
Screen	¼” in screening building		¼” in catch basin
Strainers	1/8” basket strainer midway along supply line. Basket filter at treatment plant PRV fill station.	None	1/8” Y-strainer in supply line. Basket filter at Oceanview buffer tank fill station
Delivery to treatment plant	Underground 700 m 8” DI pipe	Underground 600 m 6” DI pipe	Overland 900 m 3” HDPE pipe to Oceanview buffer tank and pumpstation, 160 m to plant
Other appurtenances	-	A newer intermediate PRV in the supply line drops pressure to reduce load on the station above the plant’s fillstation.	Excess flow shutoff valve to prevent runaway flow in event of break in surface supply line. Vacuum breaker at high point.
Servicing	Open weir sluicegate to flush rocks, scour grate, flush settling building screens, clean mid-line and fill station basket strainers	Open weir sluicegate to flush rocks, scour grate, flush settling building screens, clean fill station basket strainers	Remove metering weir drain plugs, scour two catch basin grates, open lower catch basin flush valve, flush downstream Y-strainer, open mid-pipeline flush valve, clean tank fill station basket strainer, flush settlement in Oceanview tank, clean pump strainers

HAZARDS & RISKS

Specific raw water issues include organic matter colouring water and reducing UV transmissivity, erosion and slumping in the creeks causing turbidity spikes, and animal and human fecal contamination, managed as follows.

Likelihood (probability a hazard will occur)		
Descriptor	***Description***	***Probability of event in next 10 years***
Almost certain	*Is expected to occur in most circumstances*	*>90%*
Likely	*Will probably occur in most circumstances*	*71-90%*
Possible	*Will probably occur at some time*	*31-70%*
Unlikely	*Could occur at some time*	*10-30%*
Rare	*May only occur in exceptional circumstances*	*<10%*

Consequence (impact of a hazard occurring)	
Descriptor	***Description***
Insignificant	*Insignificant impact, no illness, little disruption to normal operation, little or no increase in normal operating costs*
Minor	*Minor impact for small population, mild illness moderately likely, some manageable operation disruption, small increase in operating costs for a matter of weeks*
Moderate	*Minor impact for large population, mild to moderate illness probable, significant modification to normal operation but manageable, operating costs increase, increased monitoring, for weeks to months*
Major	*Major impact for small population, severe illness likely, systems significantly compromised and abnormal operation (if operating at all), high level of monitoring required, for months*
Catastrophic	*Major impact for the entire population, for months to years*

HAZARD	RISK	EXISTING PREVENTATIVE MEASURES AND MITIGATION	FURTHER PREVENTATIVE MEASURES
Landslide, mudslide, avalanche: supply interruption	Likelihood: Possible Threat: Major	Three intakes are maintained	Increase capacity of Alberta's delivery to allow it to take over from any one of the other two intakes
Landslide, mudslide, avalanche: high turbidity	Likelihood: Likely Threat: Moderate	Treatment/disinfection I.e. - chlorination, UV, filtering,. Settling tank for Alberta	Remote NTU monitoring at Harvey and Mag intakes
Dissolved organics reducing UVT	Likelihood: Almost certain Threat: Minor	UVT instrumentation at Magnesia Intake, allowing flow to be throttled or bypassed when out of specification	Same for Harvey Intake when funding allows. Additionally, bypass flow through the intake screen will be diverted using a powered valve, to

HAZARD	RISK	EXISTING PREVENTATIVE MEASURES AND MITIGATION	FURTHER PREVENTATIVE MEASURES
			reduce blockages
Wildfire	Likelihood: Possible Threat: Catastrophic	Signage	IR camera(s) trained on hillsides. Advocacy for the Province to purchase skid-mounted floc package plants to deliver to affected communities Increase capacity of Alberta supply line to allow it to take over from any one of the other two intakes
Drought	Likelihood: Possible (long range local climate projections call for warmer winters and more intense rain events). Threat: Catastrophic (lack of drinking water is the least risk: more serious is lack of water for toilet flushing and food preparation making homes uninhabitable, and fire hydrants running dry due to constant leakage, and a health hazard when the mains are eventually refilled).	Supply augmentation, demand management (leak detection, conservation levels)	Demand management (universal metering, nighttime pressure turndown, commencing Sep. 2025). Trucked-in drinking water once leakage is under control (otherwise couldn't keep up)
E. coli production from humans and animals (not preventable due to watersheds being recreation areas)	Likelihood: Almost certain Threat: Moderate	Locked gates in fencing around intakes Explanatory/interpretive public signage: drinking water source, community watershed, see below.	
Contamination by onsite wastewater (septic) fields	N/A: significantly above highest septic system plume in catchment	-	-
Deliberate poisoning of the water supply	Likelihood: Unlikely Threat: Moderate	Prevention and mitigation measures are not publicly discussed, but poisoning of constantly flowing creeks, above the intakes, would need to be undiscovered for a long time to affect the large volume for stored treated water	
Trace metals continuously entering the water supply through	Likelihood: Unlikely Threat: Major	Twice-annual testing for a wide range of substances is performed on all three creeks. In general, **samples are within the limits for**	In the event of sustained changes, additional treatment would be required.

HAZARD	RISK	EXISTING PREVENTATIVE MEASURES AND MITIGATION	FURTHER PREVENTATIVE MEASURES
natural means.		**all metals and other substances set in Guidelines for Canadian Drinking Water Quality.**	
Stagnation	Likelihood: Rare Threat: Moderate	N/A for Harvey and Magnesia: steep mountain streams and no raw water storage. Alberta utilizes the 100,000 iG "Oceanview" tank to buffer raw water: fill cycle runs from full to halfway, turning over 50% of the vessel each time	-
Organic loading	Likelihood: Almost Certain Threat: Moderate	Chlorine injection at the treatment plants up to 3 mg/ℓ allows residuals between 0.6 and 1.2 mg/ℓ exiting the treatment water storage tanks, and never less than 0.2 mg/ℓ anywhere in the distribution network	Realtime chlorine residual measurement at endpoints
Leakage in mains: even at high inside pressure the velocity at the surface of a pipe break is zero, and contaminants can enter the mains	Likelihood: Unlikely Threat: Moderate	Maintenance of chlorine residual	

A NOTE ON TURBIDITY IN SOURCE WATER (SEE TOO ANNUAL DRINKING WATER QUALITY REPORTS)

Lions Bay's raw water arises in steep, forested catchments, and is particularly subject to turbidity from organic and mineral particulates entering the creeks during rain events. Turbidity is measured in Nephelometric Turbidity Units (NTU), a measure of the concentration of suspended particles in a sample of water determined using a light-scattering method. Both UV and chlorine treatment are affected by turbidity:

- For UV treatment, particulates shadow, absorb and scatter UV light
- For chlorine treatment, microorganisms sheltered in particulate crevices may avoid direct contact with chlorine. Further, organic compounds in the turbidity load react with and deplete chlorine, somewhat mitigated by chlorine residual levels being raised whenever turbidity rises above 1 NTU, and even when heavy rain is only expected.

Creek channels above the intakes are occasionally inspected by drone, but the reality is catchments are always under threat of major turbidity events every time it rains:

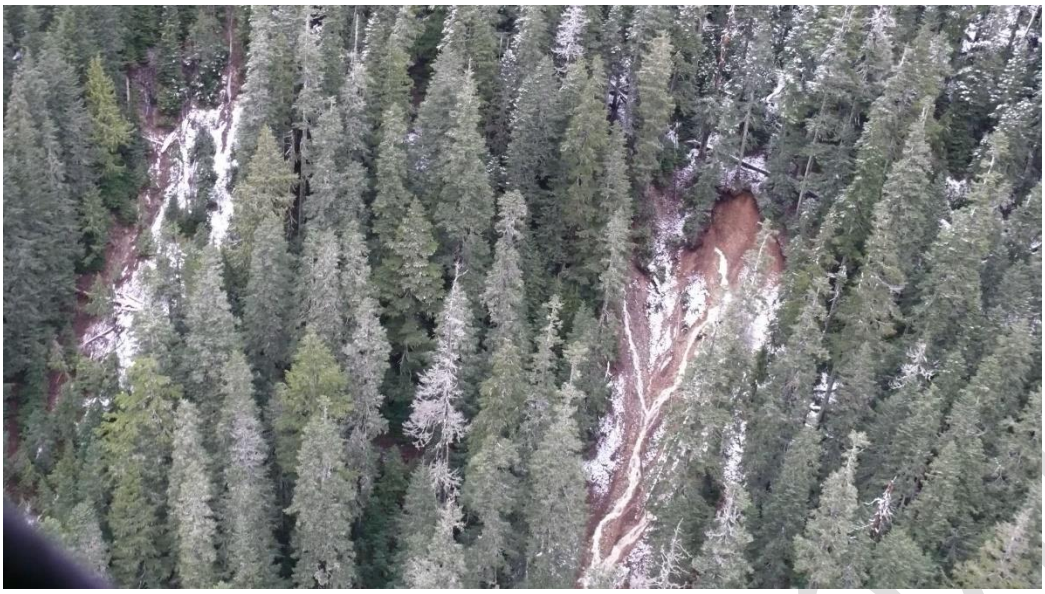


Figure 1: Helicopter inspection after Dec. 2014 major rainfall event showed scouring, landslides and streams piping from the ground

Condition 3 of 4 of Lions Bay's source water filtration exemption also requires that *"average daily turbidity levels measured at equal intervals (at least every four hours) at the treatment plant immediately before the disinfectant is applied is…around 1 NTU, but…not exceed[ing] 5 NTU for more than two days in a 12-month period."* Except during excessive events turbidity typically does not exceed 3 NTU in either Harvey or Magnesia Creek, with Alberta Creek still be quantified.

The proviso is that the NTU meters' current upper cutoff is 10 NTU, so assessment might be correct, or it might be entirely spurious, because readings of 10 exactly have been seen. The municipality is thus proceeding with plans to implement process ENSuRe (Excessive Ntu ShUtdown RoutinE), discussed in detail in the Water Quality Report.

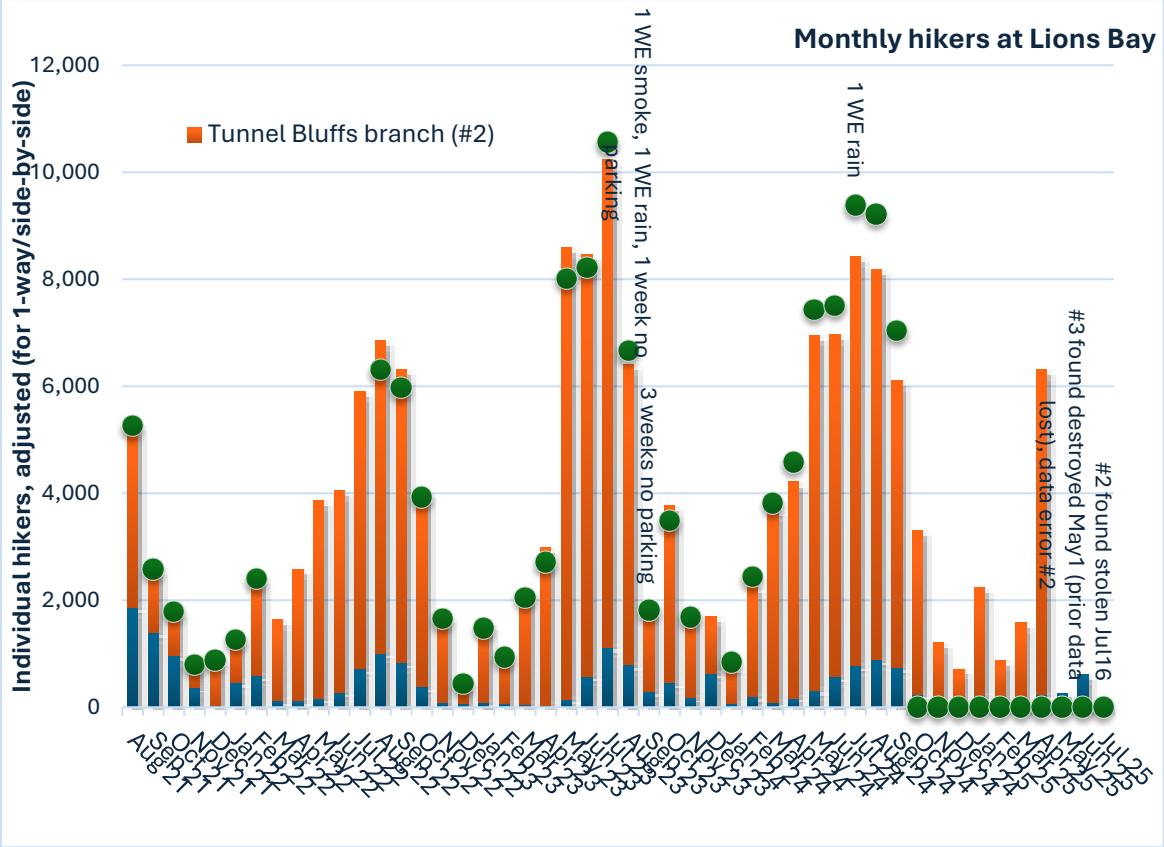
A NOTE ON FECAL CONTAMINATION IN SOURCE WATER

Condition 2 of 4 of Lions Bay's source water filtration exemption requires *E. coli in raw water not to exceed 20 colony-forming units per 100 ml…in at least 90% of weekly samples from the previous six months.*

In all years tested, this **condition has been met.**

Condition 4 of 4 requires *a watershed control program…that minimizes the potential for fecal contamination in the source water*.

Fecal coliform is present in the digestive tracts of warm-blooded animals, that is mammals and birds, only. Its presence indicates recent fecal contamination by animals that may carry far more serious pathogens, including cholera, polio, typhoid, hepatitis and enteric. Animal mammals including dogs, bear, cougar, lynx, deer, squirrels and mice, and dozens of bird species, are abundant in the watersheds. Human presence above the community raw water intakes is quantified by hiking trail counter data, reaching over 8,000 individuals a month in summer:



Consideration of DNA testing to quantify species contamination was dropped when it became clear that the test would only confirm various species present, not their relative contributions. Testing for caffeine would similarly only confirm what is already known: there are people in the watershed, and for the purposes of this Condition it is assumed that contamination will arise from human and dog presence in the watersheds.

Alternative elimination facilities

The majority of the users of the trails in Lions Bay's watersheds are regional visitors--locals on daily walks typically use routes below the intakes. Although on Crown land, trails in the watershed are not regionally or provincially

recognized or maintained. The municipality maintains public toilet facilities throughout the community. In March 2025 the Sunset trailhead was furnished with seven portable toilets of 32 gal. capacity each. Signage at 2 km, 1 km and 400 m on the return journey seems to encourage people to wait: the units are overfull on any Wednesday pumpout when the weather on preceding weekend was fine.

Funding is to be sought at Mayoral level to build an even more user friendly permanent pumped cesspit toilet facility with higher capacity before Summer 2026.

Signage

Hiker advisory signage has been placed on trail access to the Tunnel Bluff and Mt. Harvey trails, even though Provincial ministries object when discovering signage in Crown lands. Dog is intentional:

Feedback has been received people may validly understand “Drinking Water Catchment Area” to mean one CAN drink the water in the catchment, so this text will be changed to “Raw Water Catchment Area” when time and budget allow.

In Spring 2024 a water fountain was installed as an active billboard that drinking water comes from where hikers are headed:

Trail access at the Alberta Intake is controlled: