Aquifer and Wellhead Protection Plan

Village of Haines Junction - Community Wells: Well No.3 and Well No.5.

Our Water Supply…

…Comes From Groundwater…

Our groundwater is recharged from rainfall and snowmelt in the surrounding mountains and from there flows in deep groundwater systems towards our community water wells.

…Up Through Wells…

Our community water system draws water from both Well No.3 and Well No.5. Well No.3 targets a thin sand and gravel aquifer approximately 80 m below ground while Well No.5 targets a sand and gravel aquifer approximately 365 m bg. Both wells are overlain and protected by thick sequences of silt and clay and target artesian aquifers, with natural water elevations that rise above ground level.

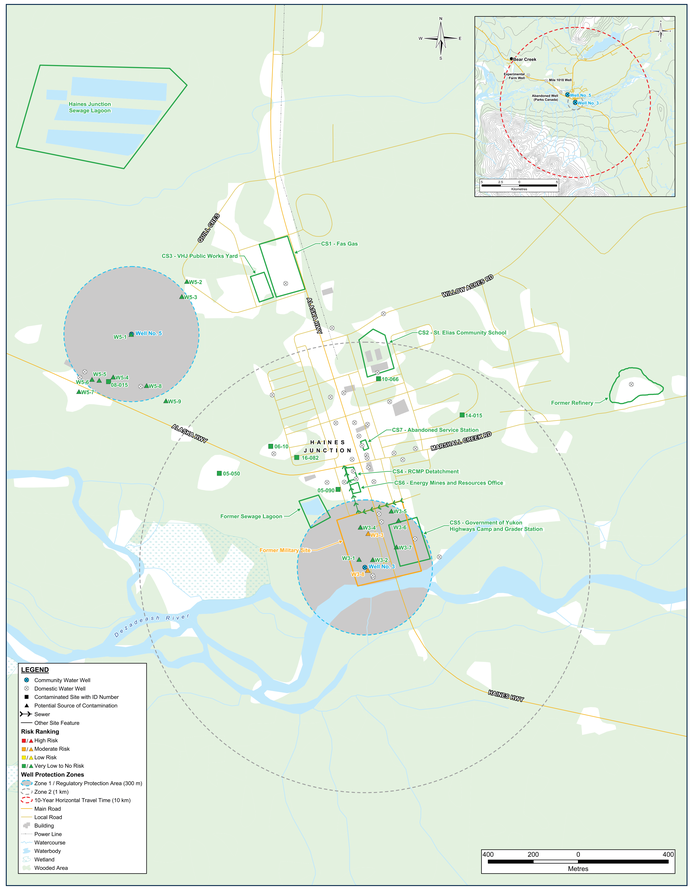
…Is Treated…

Well water is pumped from the wells to pumphouses where it is treated by chlorine injection and pH adjustment via CO2 injection. Concentrations of naturally occurring arsenic are lowered to below drinking water guidelines using oxide arsenic filtration.

…And Delivered to Our Homes. …

Treated, safe drinking water is then delivered from the water treatment plant to our homes and community buildings via our piped water distribution system.

Community Well Protection Zones and Risk Map

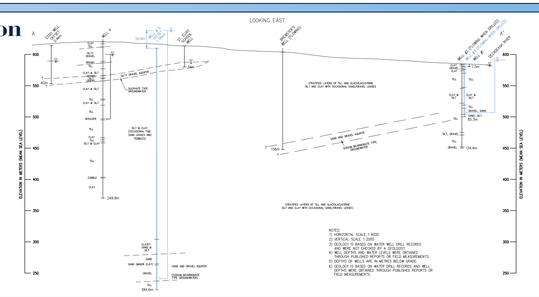


...Aquifer Protection...

The aquifers targeted by Well No.3 and Well No.5 are naturally protected from contamination in several ways:

- The aquifers are recharged many kilometers away in the surrounding mountains where there are few, if any potential contamination sources.
- Both aquifers are overlain by thick silt and clay intervals which, due to their low permeability, protect the aquifers from surface based sources of groundwater contamination.
- Natural artesian conditions in the subsurface in the Haines Junction region means that groundwater is moving in an upwards direction in the subsurface, also helping to protect the drinking water aquifer.

Cross Section



...Risks to Our Groundwater Are...

There are minimal risks to groundwater thanks to the natural protection offered by the silt and clay and artesian pressures. The greatest risk is considered to be from potential migration of contaminants to the Well No.3 aquifer via abandoned and unused wells in the Village area.

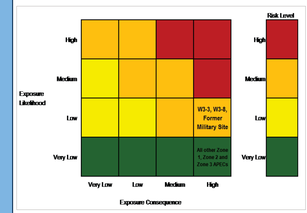
While there are considered to be other potential routes for contamination to get into the water supply; either directly into the well through broken/corroded casing or to migrate to depth along the annulus between the well casing and soils, the actual risk from these routes is considered to be very low.

Summary of Identified Areas of Concern

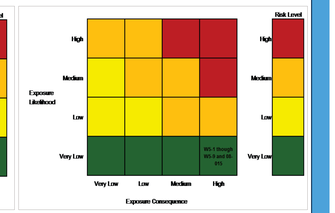
Map ID	Hazard Description	Hazard Risk Factors: Exposure Likelihood	Hazard Risk Factors: Exposure Consequence	Risk Rank
W3-3	Former waste oil dump since the 1940's. Migration of hydrocarbons from this site could potentially introduce hydrocarbons to the Well No.3 source aquifer. This APEC has been defined a higher risk category due to the unconfirmed type of waste deposited and the long period since deposition may have occurred (60+ years). While the horizontal travel time to Well No.3 in the shallow sand and gravel aquifer inferred to exist close to the river may be less than 90 days, the actual potential for contaminants to impact the well is considered low as the only mechanism for impact is through migration along the borehole annulus to depth considered unlikely due to the thick clay and silt sequence which would likely have formed a seal in the months after drilling) or through corroded/broken well casing (considered unlikely given the well is still within its estimated life expectancy).	Low	High	Medium
W3-8	Ground squirrels living under cement slab at Well No.3 have the potential to introduce fecal matter into the well infrastructure should corrosion of casing or breakage of welds occur. This APEC has been defined a higher risk category due to the vicinity of the contamination source to the well. While the horizontal travel time to Well No.3 in the shallow sand and gravel aquifer inferred to exist close to the river may be less than 90 days, the actual potential for contaminants to impact the well is considered low as the only mechanism for impact is through migration along the borehole annulus to depth considered unlikely due to the thick clay and silt sequence which would likely have formed a seal in the months after drilling) or through corroded/broken well casing (considered unlikely given the well is still within its estimated life expectancy).	Low	High	Medium
Former Military Site	Former military site from the 1940's to the 1970's. Potential for migration of chemicals from this site to impact the Well No.3 source aquifer. This APEC has been defined a higher risk category due to the potential deposition/disposal of unknown wastes and the long period since deposition may have occurred (60+ years). While the horizontal travel time to Well No.3 in the shallow sand and gravel aquifer inferred to exist close to the river may be less than 90 days, the actual potential for contaminants to impact the well is considered low as the only mechanism for impact is through migration along the borehole annulus to depth considered unlikely due to the thick clay and silt sequence which would likely have formed a very tight seal in the months after drilling) or through corroded/broken well casing (considered unlikely given the well is still within its estimated life expectancy).	Low	High	Medium

Risk Ranking Matrix

Risk rankings for each hazard identified in the VHJ are shown in the risk matrix corresponding to the community well that could potentially be impacted and are colour coded to represent the estimated level of risk the hazard presents to the community water users.



Risk Ranking for Potential Contaminant Sources identified in the vicinity of Well No.3



Risk Ranking for Potential Contaminant Sources identified in the vicinity of Well No.5

...We Can Reduce Risk By....

While there is considered to be little risk to Well No.3 or Well No.5 from surface sources of contamination, due to uncertainties in the subsurface we cannot fully discount all risk of impacting the aquifers. Therefore, the following strategies should be implemented to both further reduce risk while also protecting the environment:

- Proper disposal of hazardous wastes
- Definition of Wellhead Protection Areas to manage the risk around the most vulnerable areas
- Identify and assess all wells in the Haines Junction area that have the possibility of providing a pathway for contamination to rapidly reach water supply aquifers.
- Comprehensive emergency response planning to reduce the likelihood of exposure
- Regular tracking and monitoring of the identified risks
- Increase community awareness through education and signage
- Review and update AWPP regularly to ensure awareness of risks is up to date

Strategies for reducing/eliminating specific risks identified in this study are summarized below.

Risk Reduction/Elimination Strategies to Consider

Map ID	Hazard Description	Current Risk Level	Risk Reduction Options to Consider	Risk Elimination Options to Consider
W3-3	Potential migration of contaminants from former waste oil dump.	Medium	Include monitoring for hydrocarbons in the annual water quality monitoring at Well No.3	Determine the existence, extent and amount of contamination by conducting a test pitting and drilling program. Remediate the site by removing contaminant sources and/or removing/remediating contaminated soils onsite.
W3-8	Ground squirrels living under cement slab at Well No.3 have the potential to introduce fecal matter into the well infrastructure should corrosion of casing or breakage of welds occur.	Medium	-	Repair cement slab under the wellhouse to prevent ground squirrels from burrowing under the building. Install insulated cutoff-wall around slab perimeter to deter burrowing rodents.
Former Military Site	Former military site from the 1940's to the 1970's. Migration of hydrocarbons from this site could potentially introduce hydrocarbons to the Well No.3 source aquifer. This APEC has been defined a higher risk category due to the unconfirmed type of waste deposited and the long period since deposition may have occurred (60+ years).	Medium	Include monitoring for hydrocarbons in the annual water quality monitoring at Well No.3	Determine the existence, extent and amount of contamination by conducting a geophysics, test pitting and drilling program. Remediate the site by removing contaminant sources and/or removing/remediating contaminated soils onsite.

Our Groundwater Could Become Contaminated By...

Solid Waste Disposal - Dump sites with mixed materials can be a source of toxic metals, chemicals and other inorganic contaminants.

Fuel Spills and Leaks - Fuel spills/leaks from vehicles, above-ground storage tanks (ASTs) and underground storage tanks (USTs) are common sources of hydrocarbon contamination.

Uncontrolled Dumping - Improper waste disposal such as dumping cars, household garbage, animal carcasses or other garbage can cause various contamination including hydrocarbon, chemical and biological contamination.

Septic Systems - Septic tanks or leach pits are potential sources of biological, organic and inorganic contamination. Improperly constructed or failing septic systems can potentially contaminate groundwater with bacteria, viruses, nitrates, phosphorous, hazardous cleaning materials and other household chemicals.

Fuel Stations - Fuel stations are common sources of hydrocarbon contamination.

Cemeteries - Decomposing corpses potentially release a variety of pathogenic organisms. As well, arsenic was used as an historical embalming chemical until around 1910.

Livestock - Fecal matter from animals are sources of bacteria, viruses and protozoa.

Sewage Lagoon - Improperly located sewage lagoons or dumping of septic materials in the well capture zone areas can result in biological and chemical contamination of the groundwater.

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