5.50 Watson Lake Area - 2/2.4/2.5 Mile Liard First Nation Water Supply System

The 2/2.4/2.5 Mile Community (2 Mile Community) is located on the Alaska Highway just north of Watson Lake and is home to residents of the Liard First Nation (LFN). The community is home to about 397 people (Neegan Burnside, 2010). Residents in the LFN communities of Upper Liard, 2 Mile Village, and Albert Creek as well as other locations are supplied with domestic water by a trucked water distribution from the LFN bulk water delivery system. The system consists of two groundwater wells (TW05-02 and TW05-03), a treatment plant, a piped distribution system and a trucked distribution system. Both the water supply system and water treatment plant are owned and operated by LFN. The LFN bulk water delivery system is classified as a Large Public Drinking Water Supply System under the Yukon Drinking Water Regulations – Guidelines for Part I – Large Public Drinking Water Systems (YG 2007).

5.50.1 Data Compilation Methodology

Tetra Tech approached stakeholders including water system operators and owners to let them know the project was in progress and to request their assistance in compiling the most complete data set possible. Through the process of compiling the data, Tetra Tech has had communication with the following proponents regarding the Liard First Nation 2 Mile Community water supply system:

- Liard First Nation – Confirmed in 2016 that Tetra Tech had the most up to date well data, gave information for water delivery and water connections to new subdivision and gave approval for use of Tetra Tech data for the project.
- YG Environmental Health – YG EHS was contacted and project review comments and data for systems where the information available was not complete.

Tetra Tech was not able to contact LFN water system operators or public works managers to obtain review comments for this 2017 system summary.

5.50.2 Hydrogeology

The LFN 2 Mile Community is located on undulating moraine and colluvium deposits overlying bedrock. Surficial geology mapping indicates a continuous zone of similar overburden sediments extending throughout and in between the Town of Watson Lake community wells and the 2 Mile Community on the west side of the Robert Campbell Highway. These sediments are described as gravel, sand and silt, outwash plain deposits with occurrences of silty till sediments, typically less than 30 m in thickness (Tetra Tech 2006).

Available lithological information recorded in well logs confirm the above surficial geology interpretations. The majority of existing wells in the area have been completed a depths less than 30 m, and have generally indicated a large degree of heterogeneity with respect to the grain size distribution and permeability of the sediments encountered. Continuous zones of sediments with similar grain size distributions are not likely to extend for large distances vertically or horizontally; therefore, the groundwater potential at specific locations is difficult to predict. Nonetheless, the potential for development of a groundwater supply to meet the water demand of small communities, is typically quite high for these types of deposits (Tetra Tech 2006).

Groundwater flow directions in the 2 Mile Community area are interpreted to be south to southwesterly in the immediate vicinity of Small Lake. A groundwater flow divide is inferred along the topographic high between Tu Cho Drive and Eskeyeh Tene Drive. The groundwater flow direction to the north of this divide is interpreted to range from west to north, generally towards Watson Lake (Tetra Tech 2006).

The two wells serving the LFN public water supply system, TW05-02 and TW05-03, are both completed within a semi-confined to unconfined sand and gravel aquifer overlain by varying degrees of silt, sand and till (Tetra Tech 2008).

As part of aquifer and wellhead protection planning, Tetra Tech completed an analysis of the vulnerability of the aquifer in 2008 based on the semi-quantitative ISI (Ontario Ministry of Environment, 2001). The ISI values for the aquifer were found to be 34 and 26 at TW05-02 and TW05-03 respectively. The ISI method defines aquifers that score between 30 and 80 as having moderate susceptibility to surface source of contamination and those scoring less than 30 as having high susceptibility to surface source of contamination. The score of 26-34 suggests that the aquifer here has medium to high vulnerability to surface sources of contamination.

5.50.3 Summary of Wells

Logs for the two public wells serving the LFN public water supply system are included as attachments in the map and database portion of this project. The following tables summarize the completion characteristics of the LFN wells.

Table 5-128: Liard First Nation Public Water Supply, Well TW05-02 Summary

Well Construction Parameters	Details	Source
Date of construction	Well was completed by Double D Drilling Ltd. in November 2005	Tetra Tech 2006
Total well depth	37.5 m bgs	
Casing	8" (203 mm) ID Steel Well Casing	
Casing depth	35.7 m bgs	
Well screen	1.8 m 60 slot (1.52 mm) stainless steel well screen from 35.7 m bgs to 37.5 m bgs	
Static water level	13.3 m bgs (January 10, 2006)	
Sanitary seal	Bentonite surface seal to 5.8 m bgs	
Wellhead completion	Pitless unit	Tetra Tech 2012 site visit
Wellhead stickup	1.0 m	
Well rated capacity	10.8 L/s (142 IGPM)	Tetra Tech 2006
Well GUDI status	Not assessed	
Well Construction Comments:	Well was constructed to meet Canadian Groundwater Association Well Construction Guidelines.	

Table 5-129: Liard First Nation Public Water Supply, Well TW05-03 Summary

Well Construction Parameters	Details	Source
Date of construction	Well was completed by Double D Drilling Ltd. in November 2005	Tetra Tech 2006
Total well depth	43.4 m bgs	
Casing	8" (203 mm) ID Steel Well Casing	
Casing depth	41.9 m bgs	
Well screen	1.5 m 60 slot (1.52 mm) stainless steel well screen from 41.9 m bgs to 43.4 m bgs	
Static water level	12.9m bgs (January 12, 2006)	
Sanitary seal	Bentonite surface seal to 6.1 m bgs	
Wellhead completion	Pitless unit	Tetra Tech 2012 site visit
Wellhead stickup	1.0 m	
Well rated capacity	10.8 L/s (142 IGPM)	Tetra Tech 2006
Well GUDI status	Not assessed	
Well Construction Comments:	Well was constructed to meet Canadian Groundwater Association Well Construction Guidelines.	

5.50.4 Source Water Quality

Water supplied from wells TW05-02 and TW05-03 at the 2 Mile Community system is sourced from the same aquifer based on well completion depth, hydraulic testing results and water chemistry results. In 2012, Tetra Tech conducted a review of groundwater chemistry results for this site as part of the LPDWSA. At the time of the 2012 LPDWSA, only three water samples were available for review. The following observations are from the 2012 review:

- The water from the aquifer can be classified as calcium-bicarbonate type;
- The source water was hard to very hard ranging from 167 mg/L to 214 mg/L (as CaCO3) on the dates sampled;
- Iron has been found in all samples collected from both wells to be in exceedance of GCDWQ AO of 0.3 mg/L. The iron concentration was found to increase in well TW05-02 and reached a maximum concentration of 2 mg/L on January 12, 2006; the measured iron concentration was approximately 6.7 times the GCDWQ AO value;
- Manganese has consistently been found to have a concentration of approximately 0.1 mg/L in all the samples taken, which were above the GCDWQ AO of 0.05 mg/L; and
- Turbidity was found to be high in all samples taken, ranging from 13.1 NTU to 26.2 NTU. Health Canada recommends that groundwater sources provide water with turbidity less than 1.0 NTU and that water from GUDI sources have appropriate filtration and disinfection. Filtration is expected to achieve a turbidity level of 1.0 NTU for slow sand or diatomaceous earth filtration, 0.3 NTU for conventional direct filtration and 0.1 NTU for membrane filtration in 95% of samples between filter changes or per month with no measurements exceeding 3.0 NTU.

5.50.5 Water Treatment and Distribution

Table 5-130: Liard First Nation Public Water Supply, Water Treatment and Distribution Details

Item	Details	Source
Owner/Operator	Liard First Nation	Tetra Tech 2006
Water source	Groundwater	
Wells serving the system	TW05-02 and TW05-03	
Treatment type	Pre-chlorination, greensand filtration, chlorine disinfection	Annual inspection report 2016/2017
Number of connections	10 piped and approximately 90 truck delivery locations	p.c. Robert Greenway, March 2016
Delivery method	Trucked/Piped	
Age of system/last known update	The water treatment system was constructed in 2010	

5.50.6 Source Water Protection Planning

Source Water Protection Planning in the form of an AWPP for the LFN public water supply wells was completed in 2008 by Tetra Tech. The AWPP can be found as an attachment to the GIS map and database.

Tetra Tech developed the AWPP for these wells based on the Risk Based Approach. Capture zones for the wells were developed using numerical modelling based on the Visual MODFLOW modelling code (Version 4.1.0.145) developed by Waterloo Hydrogeological Inc., and based on the USGS MODFLOW code for simulating groundwater flow. To account for uncertainty in the model, Tetra Tech added a 20 m buffer zone to the outside of the modelled capture zones.

The key recommendations and conclusions from the AWPP included:

- The vulnerability of the semi-confined aquifer in which the LFN Community Wells are completed is rated as medium to high;
- Most existing risks were medium including septic systems, heating oil tanks, and livestock corrals, however the existence of the former oil pipeline represented a high risk if historical spills had occurred;
- The proposed (at the time, now built) development on residential lots could present risk to the aquifer;
- Any release of contaminants within the identified capture zones would represent a potential risk to the aquifer and water quality for the community wells;
- Risk management/mitigation and monitoring strategies including contingency planning, regular annual tracking, septic system monitoring, increased well security and hazardous waste minimization and collection programs should be used to reduce the existing risks and the likelihood of potential risk scenarios;
- Potential contaminants of concern in the vicinity of the public supply wells are related to residential use including heating fuel supply, septic systems and livestock corals. Additional potential contamination sources include possible spills on the Robert Campbell Highway and a former pipeline right of way; and

- The LFN water supply system is supported by two wells serving as the primary and backup supply wells to create redundancy and prevent loss of water supply should one well fail or be temporarily shut off for maintenance or repair.

5.50.7 Water Supply Information Data Gaps

Tetra Tech conducted reviews of available data, and after communication with YG CS, INAC and the water system operator, we are not aware of any other upgrades to the system. Tetra Tech was not able to contact the LSCFN water system operator to obtain review comments for this 2017 system summary. For the purposes of this study, Tetra Tech has identified the following data gaps:

- The AWPP was last updated in 2008, and Tetra Tech recommends updating the AWPP on a 5-year basis to capture any changes in the well capture zones. Potential risks posed from the new residential area that has been developed in the vicinity of TW05-02 and TW05-03 should be assessed and incorporated in the AWPP.