NEEGAN BURNSIDE

National Assessment of First Nations Water and Wastewater Systems

Yukon Regional Roll-Up Report
FINAL

Department of Indian Affairs and Northern Development

January 2011

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Department of Indian and Northern Affairs Canada

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Prepared for:

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Statement of Qualifications and Limitations for Regional Roll-Up Reports

This regional roll-up report has been prepared by Neegan Burnside Ltd. and a team of sub-consultants (Consultant) for the benefit of Indian and Northern Affairs Canada (Client). Regional summary reports have been prepared for the 8 regions, to facilitate planning and budgeting on both a regional and national level to address water and wastewater system deficiencies and needs.

The material contained in this Regional Roll-Up report is:

- preliminary in nature, to allow for high level budgetary and risk planning to be completed by the Client on a national level.
- based on a compilation of the data and findings from the individual community reports prepared and issued for a specific region.
- not proposing to identify the preferred solution to address deficiencies for each community. Rather this report will identify possible solution(s) and probable preliminary costs associated with solution(s) presented in greater detail in the community reports. Community specific studies including more detailed evaluation will be required to identify both preferred solutions and final costs.
- based on existing conditions observed by, or reported to the Consultant. This assessment does not wholly eliminate uncertainty regarding the potential for costs, hazards or losses in connection with a facility. Conditions existing but not recorded were not apparent given the level of study undertaken.
- to be read in the context of its entirety.
- not to be used for any purpose other than that agreed to with the Client. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Any other user specifically denies any right to claims against the Consultant, Sub-Consultants, their Officers, Agents and Employees.

Risk as it pertains to health and safety issues and building code compliance is based upon hazards readily identifiable during a simple walk through of the water and wastewater facilities, and does not constitute a comprehensive assessment with regard to health and safety regulations and or building code regulations.

The Consultant accepts no responsibility for any decisions made or actions taken as a result of this report.

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1.0 Introduction

The Government of Canada is committed to providing safe, clean drinking water in all First Nations communities, and to ensuring that wastewater services in all First Nations communities meet acceptable effluent quality standards. As part of this commitment, the Government announced the First Nations Water and Wastewater Action Plan (FNWWAP). The plan funds the construction and renovation of water and wastewater facilities, operator training, and public health activities related to water and wastewater on reserves. It also provided for a national, independent assessment – *The National Assessment of First Nations Water and Wastewater Systems* – which will inform the Government's future, long-term investment strategy. This assessment was also recommended by the Senate Standing Committee on Aboriginal Peoples.

The purpose of the *National Assessment* is to define the current deficiencies and the operational needs of water and wastewater systems, identify the long-term water and wastewater needs of each community and recommend sustainable, long-term infrastructure development strategies.

The objectives of the *National Assessment* are to:

- Identify which upgrades will be required for existing public systems to meet INAC's *Level of Service Standards*; INAC's *Protocol for Safe Drinking Water in First Nations Communities*; INAC's *Protocol for Wastewater Treatment and Disposal in First Nations Communities*; and applicable provincial regulations, codes, and standards

- Complete the Annual Inspection, Risk Assessment and Asset Condition Reporting Systems (ACRS) assessment for water and wastewater assets

- Conduct an overall community serviceability assessment of private, on-site communal and/or central systems

- Prepare Class "D" cost estimates for each of the communities visited. Class "D" estimates are preliminary, and are based on available site information. They indicate the approximate magnitude of the cost of the recommended actions, and they may be used to develop long-term capital plans. In addition, these estimates may be used in preliminary discussions of proposed capital projects.

This assessment involved collecting background data and information about each community, undertaking a site visit, and preparing individual community reports for each participating First Nation. Neegan Burnside Ltd. and its sub-consultants conducted an assessment for each of the eight regions. This report summarizes the findings for the Yukon region.

1.1 Site Visits

Site visits in the Yukon Region were undertaken by personnel from Neegan Burnside Ltd. and sub-consultants, R.J. Burnside & Associates Limited. These site visits were undertaken during September of 2009 and during June and July of 2010. Each visit included at least two team members. In addition to the consultant staff, additional participants including the Circuit Rider Trainer (CRT), an INAC Representative, an Environmental Health Officer (EHO) from Health Canada, and a Tribal Council Representative were invited to attend the site visits. The additional participants that were able to attend are identified in each community report.

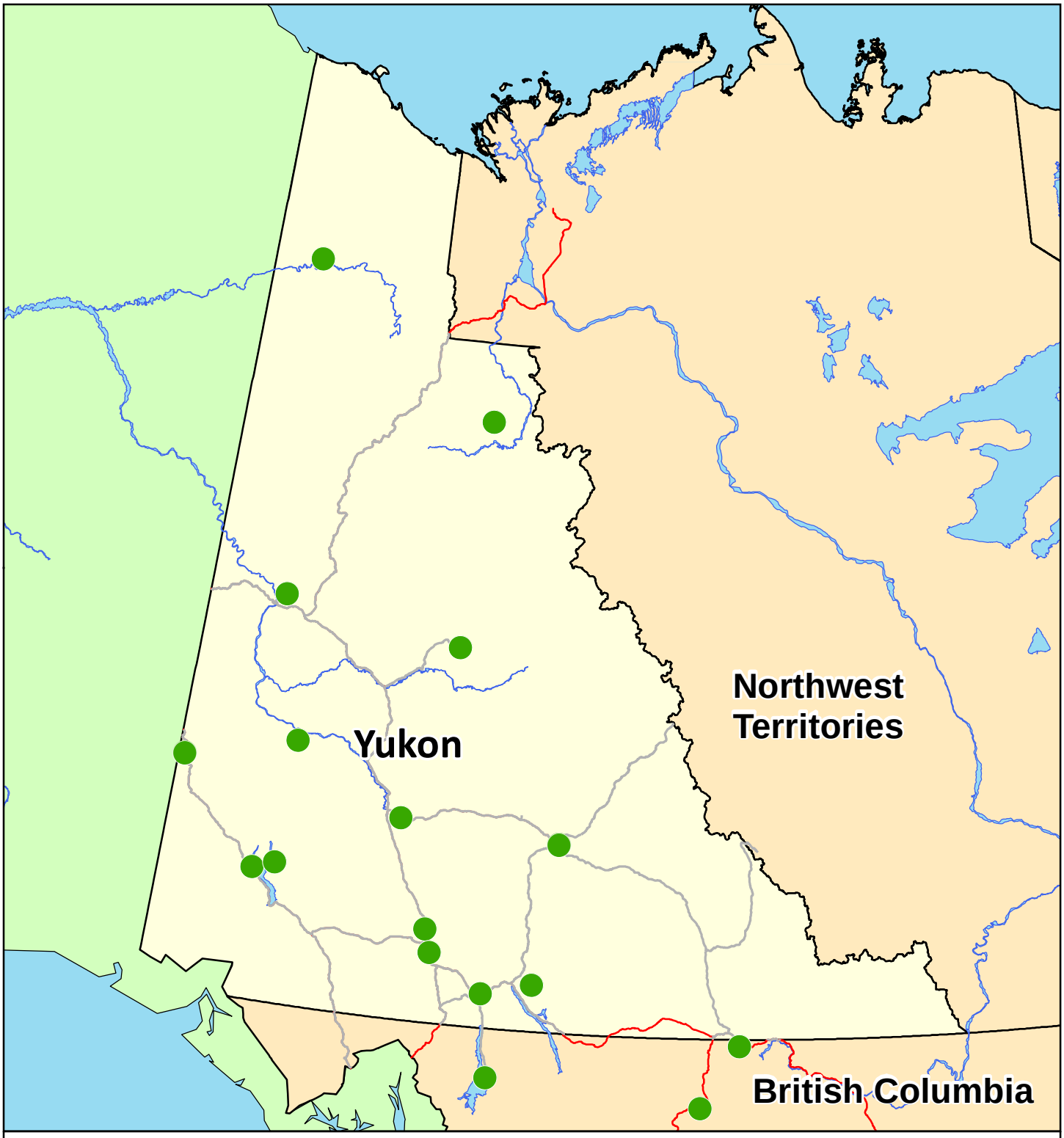
After confirming the various components that the First Nation uses to provide water and wastewater services to the community (i.e. number and types of systems, piping, individual systems, etc.) along with population and future servicing needs (planned development and population growth), an assessment was carried out of the water and wastewater systems, as well as 5% of the individual systems.

1.2 Reporting

Individual Community Reports have been prepared for each First Nation. In cases where the First Nation consisted of more than one community located in geographically distinct areas, a separate report was prepared for each community. In the Yukon region, there was 100% participation from the 17 First Nations, which resulted in the preparation of 18 individual community reports. Figure 1.1 indicates the location of each First Nation visited as a part of this study.

The reports include an assessment of existing communal systems and existing individual systems, identification of needs to meet departmental, federal and provincial protocols and guidelines, and an assessment of existing servicing of the community along with projections of population and flows for future servicing for the 10 year period. Costing for the recommendations to meet departmental protocol, federal and provincial guidelines, and an evaluation of servicing alternatives along with life cycle costing for each feasible alternative are also included in each report.

An annual water inspection, risk evaluation and ACRS inspection was completed for each system and are included in the Appendices of each report.



NATIONAL ASSESSMENT OF FIRST NATION WATER AND WASTEWATER SYSTEMS

Figure 1.1 - Yukon First Nations Visited

- Yukon First Nations (Visited)
- Yukon Roads
- Major National Roads
- Major Lakes

N

0 50 100 150 200 250

Kilometers

Indian and Northern Affairs Canada / Affaires indiennes et du Nord Canada

NOTES

This map has been compiled with data of varying scale and accuracy.This is not a plan of survey.

SOURCES

Geobase® Aboriginal Lands (First Nations) - Accessed from http://geobase.ca.

DISCLAIMER

Neegan Burnside Ltd. and the above mentioned sources and agencies are not responsible for the accuracy of the spatial, temporal, or other aspects of the data represented on this map. It is recommended that users confirm the accuracy of the information represented.

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Projection: Geographic, Canada LCC

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2.0 Regional Overview

The Yukon region includes 17 First Nations. There are 24 water systems (14 First Nation systems and 10 Municipal Type Agreements) and 11 wastewater systems (2 First Nation systems and 9 Municipal Type Agreements).

A water or wastewater system considered a First Nation system, consists of INAC-funded assets, and serves five or more residences or public facilities. A Municipal Type Agreement (MTA), on the other hand, is when First Nations are supplied with treated water from or send their wastewater to a nearby municipality or neighbouring First Nation or corporate entity as outlined in a formal agreement between the two parties.

The First Nation communities' populations range from 44 to 892 people, and household sizes range from 1.7 to 4.3 people per unit (ppu). The total number of homes is 1,697, and the average household size in the Yukon region is 3.1 ppu.

2.1 Water Servicing

There are a total of 24 water systems serving 17 First Nations. The 24 water systems include:

- 10 systems that receive their water supply through a Municipal Type Agreement (MTA)
- 11 groundwater systems
- 1 groundwater under direct influence (GUDI) of surface water system
- 2 surface water systems.

For water distribution, the 24 systems include:

- 10 distribution systems that are maintained through a Municipal Type Agreement (MTA)
- 13 distribution systems that are maintained by the First Nation
- 1 system that does not have a distribution system (First Nation members obtain water directly from the pumphouse in buckets).

The following is a summary of the level of service being provided to the homes within the Yukon region:

- 31% of the homes (521) are piped
- 51% of the homes (871) are on truck delivery
- 18% of the homes (305) are on private wells.

The following table provides an overview of the water systems by system classification, source type, treatment type and storage type. In general, the treatment system classification reflects the complexity of the treatment. Treatment systems labeled as "Small System" and "Level I" are groundwater systems, and systems labeled "Level II" are surface water systems. The distribution classification reflects the size of the community being serviced. The classifications follow the regulations for the Yukon.

Table 2.1 - Water Overview

System Classification	No.	% of Total
Small System	5	21%
Level I	7	29%
Level II	2	8%
MTA	10	42%

Source Type	No.	% of Total
Groundwater	11	46%
Surface Water	2	8%
Groundwater GUDI	1	4%
MTA	10	42%

Storage	No.	% of Total
None	14	58%
Elevated	1	4%
Grade level	5	21%
Underground	4	17%

Treatment Type	No.	% of Total
None - Direct Use	2	8%
Disinfection Only	2	8%
Conventional	3	13%
Membrane Filtration	7	29%
MTA	10	42%

2.2 Wastewater Servicing

There are a total of 11 wastewater systems serving 10 First Nations. The remaining seven First Nations are serviced solely by individual septic systems.

For wastewater treatment, the 11 systems include:

- 9 wastewater systems are provided treatment through a Municipal Type Agreement (MTA)
- 2 First Nation wastewater treatment systems consisting of lagoons.

For wastewater collection, the 11 systems include:

- 8 wastewater collection systems that are maintained through a Municipal Type Agreement (MTA)
- 3 wastewater collection systems that are maintained by the First Nation.

The following is a summary of the level of service being provided to the homes within the Yukon Region:

- 28% of the homes (478) are piped
- 23% of the homes (382) are on truck haul
- 49% of the homes (837) are serviced by individual septic systems and shoot-outs.

The following table provides an overview of the wastewater systems by system classification and treatment type:

Table 2.2 - Wastewater Overview

System Classification	No.	% of Total
Small System	1	9%
Level I	1	9%
MTA	9	82%

Treatment Type	No.	% of Total
Facultative Lagoon	2	18%
MTA	9	82%

3.0 Preliminary Results and Trends

3.1 Per Capita Consumption and Plant Capacity

Historical flow records were available for approximately 15% of the First Nation communal water systems, including two Municipal Type Agreements. The average per capita demand for systems with trucked delivery is 114 L/c/d, and the average for systems with piped delivery is 300 L/c/d.[1]

For systems with no available flow data, an average per capita demand of 325 L/c/d was used for piped water and 90 L/c/d for trucked water to evaluate the systems.

Out of the 24 water systems, 5 have piped service only, 13 have trucked service only, and the remaining 6 have a combination of trucked and piped service. The range of per capita flow is outlined in Table 3.1.

Table 3.1 - Range of Per Capita Water Usage Rates

	No. of systems 2009
Less than 250 L/c/d	15
250 L/c/d to 375 L/c/d	7
Greater than 375 L/c/d	2

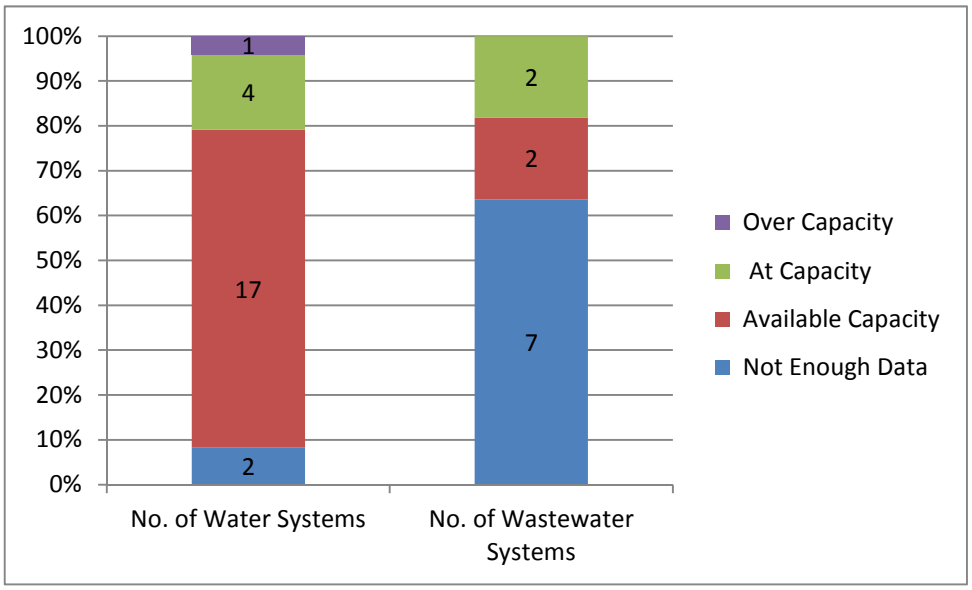
Historical flow data for wastewater was not available. Therefore, to evaluate the ability of the existing infrastructure to meet the current and projected needs, an average daily flow was calculated based on the actual or assumed per capita water consumption, plus an infiltration allowance of 90 L/c/d for piped flow only.

The following figure provides a summary of the water and wastewater treatment capacities for the 17 First Nations:

- over capacity: the existing system is unable to meet the current needs
- at capacity: the existing system is able to meet the current needs
- available capacity: the existing system has sufficient capacity to meet more than the current needs
- not enough data: insufficient data to determine the actual system capacity.

[1] By comparison, according to Environment Canada (2004), the average per capita consumption across Canada is 329 L/c/d.

Figure 3.1 - Water and Wastewater Treatment Capacities



The data collected shows that five water systems and two wastewater systems are operating at or beyond their estimated capacities. For plants identified as over capacity, the per capita demand is within typical values for the region, according to available records.

3.2 Distribution and Collection

The household size for the 17 First Nations ranges from 1.7 to 4.3 people per unit (ppu), with an average size of 3.1 ppu[2]. The total number of piped connections in the region is 521 for water and 478 for wastewater. The average length per connection of watermain is 47 m. The average length per connection of sanitary main is 35 m.

As shown in the table and figures below, there is no real correlation between the size of the community and the length of pipe per connection. However, in some cases the data provided for watermains includes dedicated transmission main lengths with no service connections and non-distribution mains (i.e. intake pipes, raw water pipes). As a result, the average length per connection is inflated, particularly for smaller communities where the additional pipe length is spread over a smaller number of connections.

The table below indicates the number of water and wastewater systems that have pipe lengths above and below 30 m/connection. It should be noted that this information was not available for all of the systems.

[2] By comparison, according to Statistics Canada (2009), the average household size in Canada is 2.5 ppu.

Table 3.2 - Average Water Distribution and Wastewater Collection Pipe Lengths

	Watermain	Sewer
Average m/connection	47	35
No. of systems with pipe lengths above 30 m/connection	5	1
No. of systems with pipe lengths below 30 m/connection	2	1

Figure 3.2 - Water Distribution: Average Pipe Length per Connection

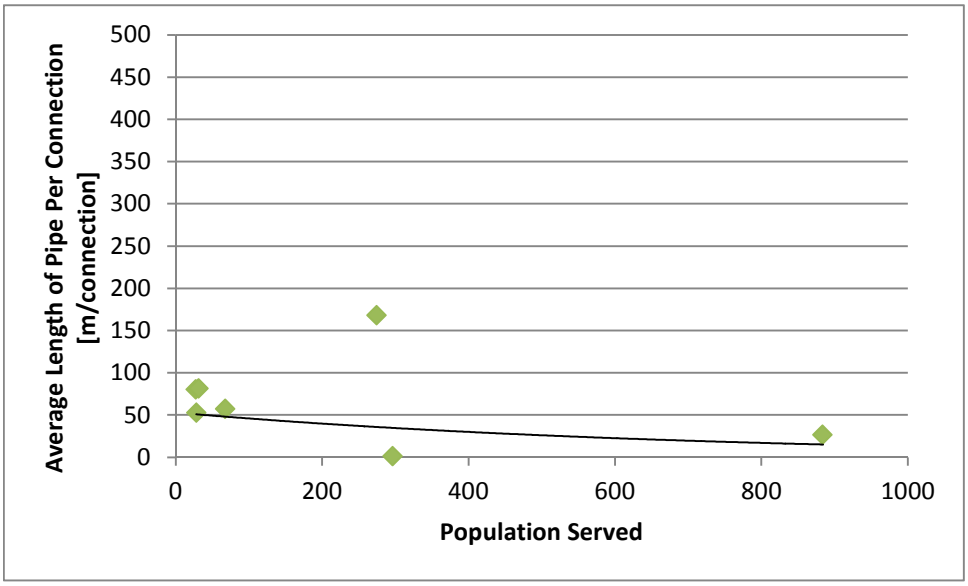
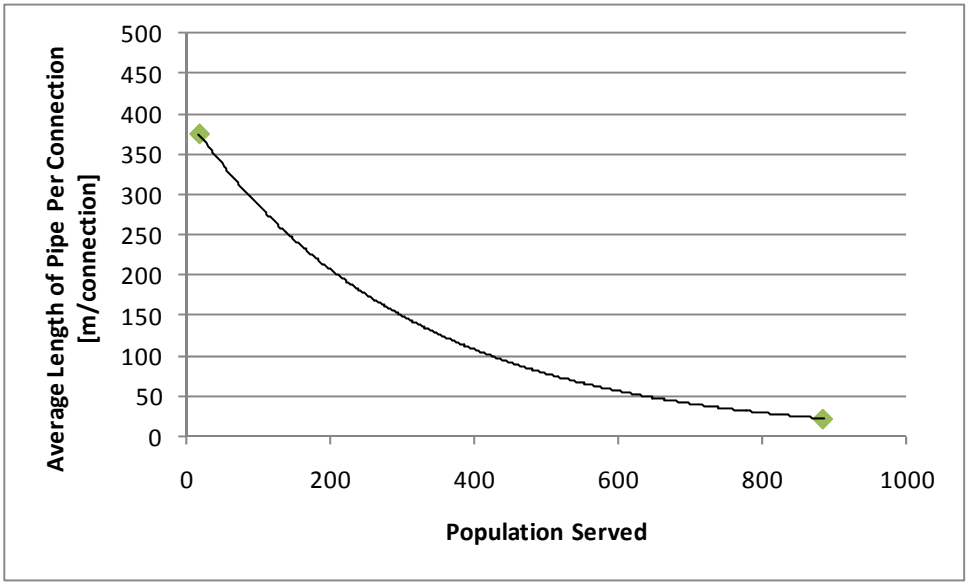


Figure 3.3 - Wastewater Collection: Average Pipe Length per Connection



3.3 Water Risk Evaluation

A risk assessment has been completed for each water system according to INAC's *Risk Level Evaluation Guidelines.* Each facility is ranked in risk according to the following categories: Water Source, Design, Operation (and Maintenance), Reporting and Operators. The overall risk score is a weighted average of the component risk scores.

Each of the five risk categories, as well as the overall risk level of the entire system is ranked numerically from 1 to 10. Low, medium and high risks are defined as follows:

- **Low Risk (1.0 to 4.0):** These are systems that operate with minor deficiencies. Low-risk systems usually meet the water quality parameters that are specified by the appropriate Canadian Guidelines for drinking water (in particular, the *Guidelines for Canadian Drinking Water Quality* (GCDWQ)).
- **Medium Risk (4.1 to 7.0):** These are systems with deficiencies, which— individually or combined— pose a medium risk to the quality of water and to human health. These systems do not generally require immediate action, but the deficiencies should be corrected to avoid future problems.
- **High Risk (7.1 to 10.0):** These are systems with major deficiencies, which— individually or combined— pose a high risk to the quality of water. These deficiencies may lead to potential health and safety or environmental concerns. They could also result in water quality advisories against drinking the water (such as, but not limited to, boil water advisories), repetitive non-compliance with guidelines, and inadequate water supplies. Once systems are classified under this category, regions and First Nations must take immediate corrective action to minimize or eliminate deficiencies.

Regional Risk Summary:

Of the 24 water systems inspected:

- 6 are categorized as high overall risk
- 5 are categorized as medium overall risk
- 13 are categorized as low overall risk.

The 13 low-risk systems include 8 Municipal Type Agreement systems, 3 groundwater systems and 2 surface water systems.

Neighbouring municipalities operate and maintain all ten of the Municipal Type Agreement systems.

The table in Appendix E.1 summarizes the correlation between component risk and overall risk. In general, Municipal Type Agreement systems have the lowest risk, followed by systems with a surface water source, a groundwater source and, finally, the system with a groundwater under the direct influence of surface water (GUDI) source source.

Figure 3.4 provides a geographical representation of the final risk for the water systems that were inspected.

3.3.1 Overall System Risk by Source

The following table summarizes the overall system risk by water source. It is assumed that Municipal Type Agreement systems typically have low-risk water supplies because they operate in accordance with territorial legislation. Groundwater systems also tend to be low-risk systems. More complicated surface water systems, on the other hand, typically have higher-risk water supplies. However, in the Yukon, both surface water systems are low risk, whereas 5 of 11 groundwater systems are high risk.

Table 3.3 - Summary of Overall Risk Levels by Water Source

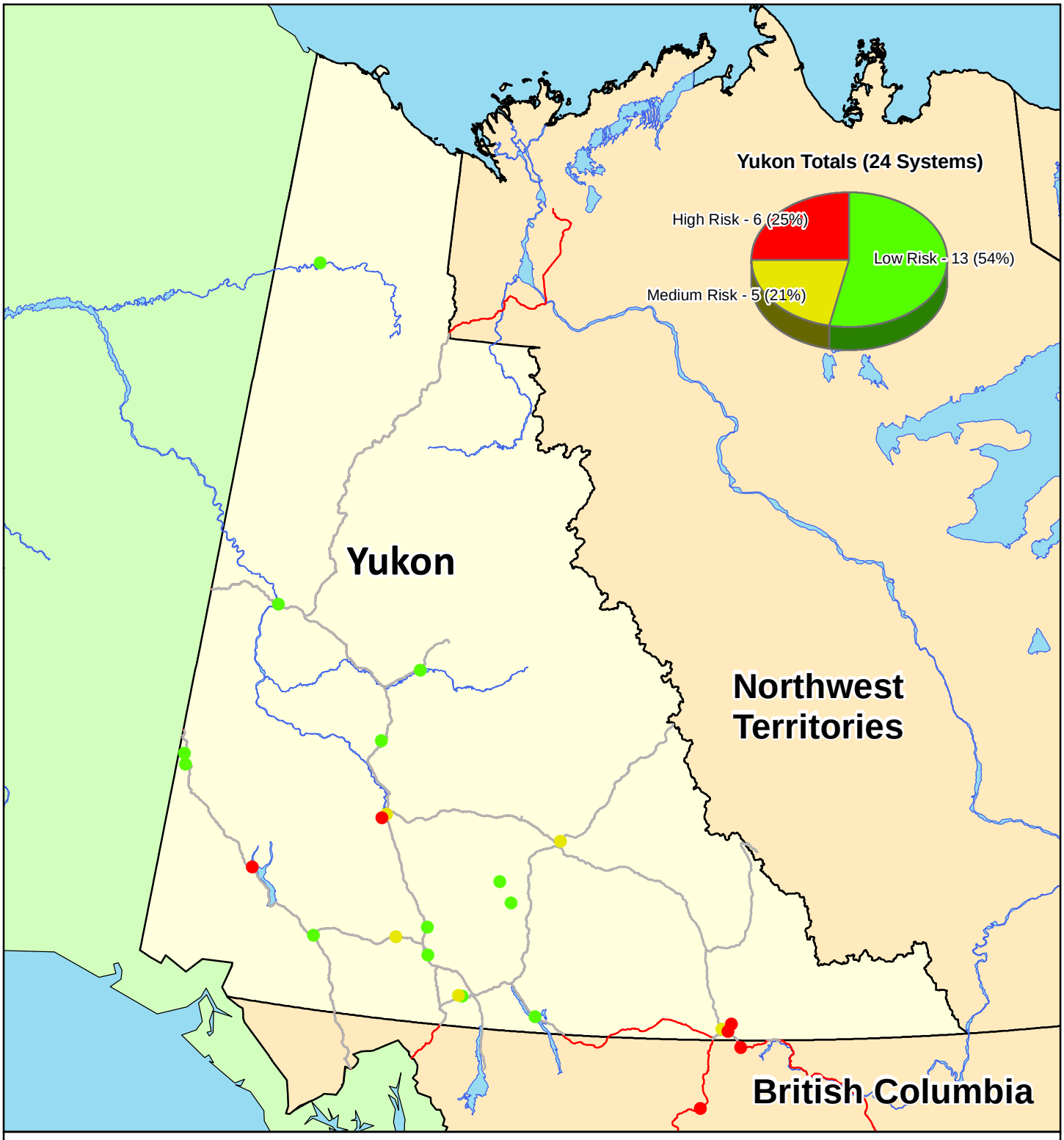
Final Risk Level	Groundwater	GUDI	Surface Water	MTA	TOTAL
High	5	1	0	0	**6**
Medium	3	0	0	2	**5**
Low	3	0	2	8	**13**
Total	**11**	**1**	**2**	**10**	**24**

3.3.2 Overall System Risk by Treatment Classification

There is no clear pattern between the “System Classification Level” and the “Overall System Risk.”

Table 3.4 - Summary of Final Risk Levels by Treatment System Classification

Final Risk Level	Small System	Level I	Level II	MTA	Total
High	2	4	0	0	**6**
Medium	2	1	0	2	**5**
Low	1	2	2	8	**13**
Total	**5**	**7**	**2**	**10**	**24**



NATIONAL ASSESSMENT OF FIRST NATION WATER AND WASTEWATER SYSTEMS

Water System Risk Level

- High
- Medium
- Low
- Yukon Roads
- Major National Roads
- Major Lakes

Figure 3.4 - Yukon Water System Risk

0 50 100 150 200 250

Kilometers

NOTES

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SOURCES

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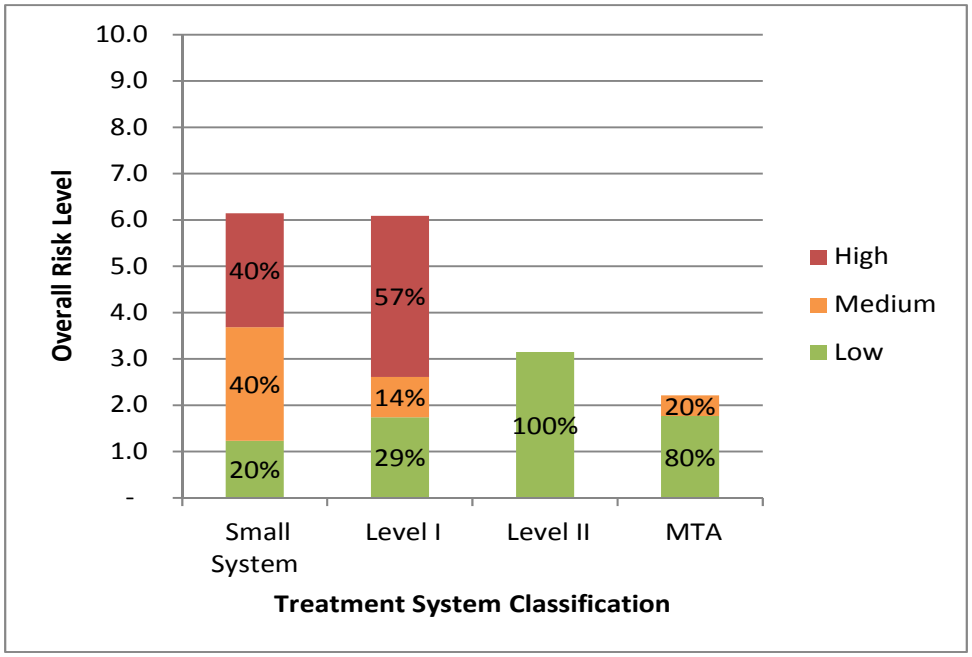
Figure 3.5 - Risk Profile Based on Water Treatment System Classification



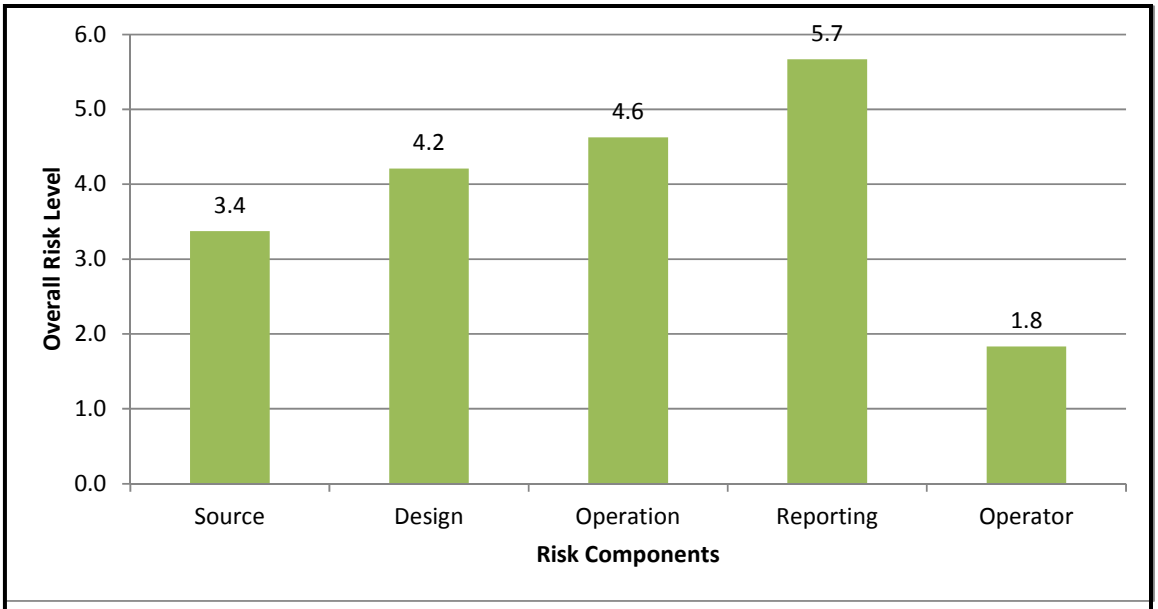
3.3.3 Overall Risk by Number of Connections

In the Yukon region, there is no apparent correlation between the number of connections and the overall risk.

3.3.4 Component Risks: Water

The overall risk is comprised of five component risks: water source, design, operation, reporting and operator. Each of these component risk factors is discussed below.

Figure 3.6 - Water: Risk Profile Based on Risk Components



	Source	Design	Operation	Reporting	Operator
Risk	3.4	4.2	4.6	5.7	1.8
Minimum	1.0	1.0	1.0	1.0	1.0
Maximum	9.0	8.0	8.0	10.0	7.0
Std. Dev.	2.7	3.2	2.6	4.2	1.9

3.3.5 Component Risk - Water: Source

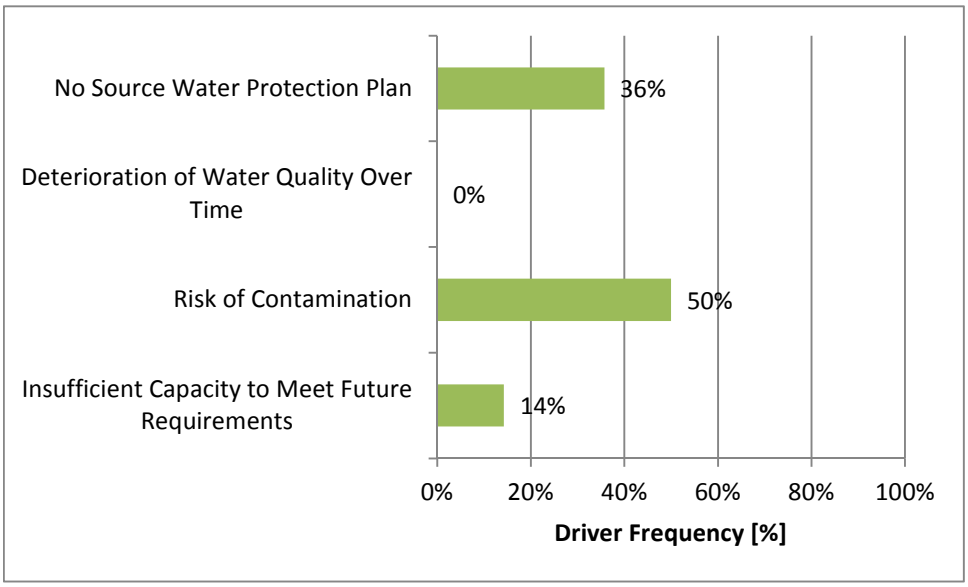
The risk associated with the source has a mean score of 3.4. The mean source risk score by type of source is:

- groundwater at 3.9
- groundwater under the direct influence of surface water (GUDI) at 9.0
- surface water at 8.0
- Municipal Type Agreement (MTA) at1.3.

The data indicates that systems that rely on surface water or GUDI generally have a higher component risk score than systems that rely on groundwater. As a result, the risk formula automatically assigns a higher base risk to these types of systems.

The following figure identifies drivers that contribute to source risk scores.

Figure 3.7 - Source Risk Drivers



3.3.6 Component Risk - Water: Design

The risk associated with the design has a mean score of 4.2. The mean design risk score by type of source is:

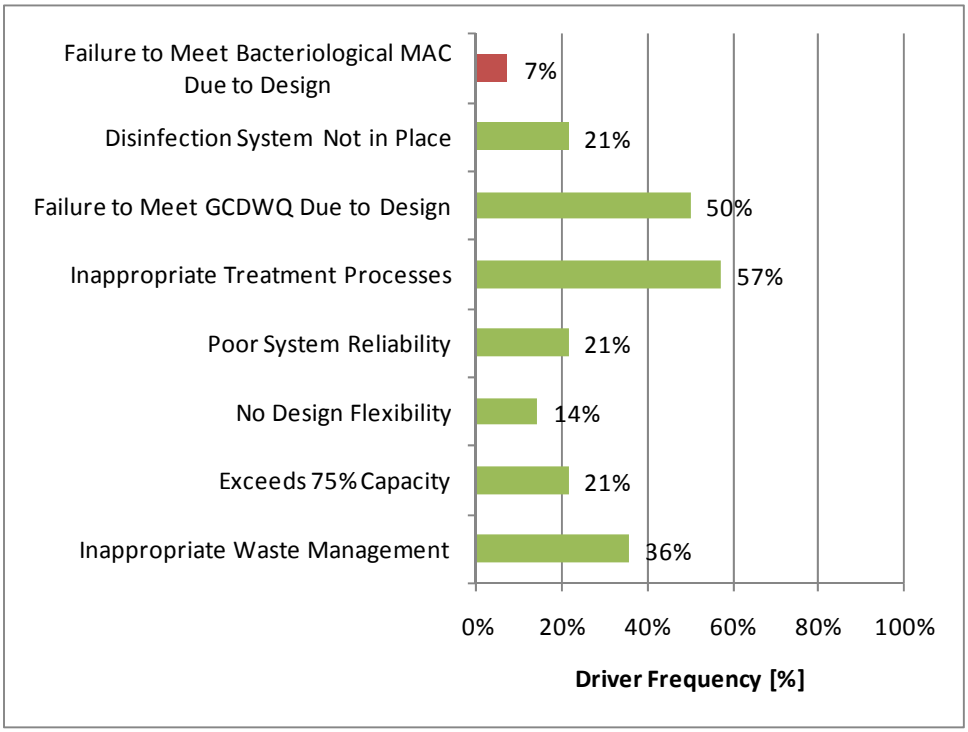
- groundwater at 5.9
- groundwater under the direct influence of surface water (GUDI) at 8.0
- surface water at 3.0
- Municipal Type Agreement (MTA) at 2.2.

There is a higher design risk associated with groundwater and GUDI systems because these systems do not have sufficient treatment to ensure that they meet bacteriological, aesthetic and operational guidelines. As part of the multi-barrier approach to water treatment, chlorination is now required for all water systems. Typically, a groundwater system has an increased design risk if it does not have disinfection systems in place, or if there is insufficient contact time to ensure that the chlorination process is adequate.

There are several key drivers of the region's design risk scores, including:

- failure to meet the *Guidelines for Canadian Drinking Water Quality* (GCDWQ)
- exceeding the GCDWQ Maximum Acceptable Concentration (MAC) for bacteria
- no disinfection system in place or a disinfection system that is not being used
- no appropriate treatment in place to meet INAC's Protocol requirements
- systems approaching or exceeding design capacity
- systems not having appropriate waste management.

Figure 3.8 - Design Risk Drivers



It should be noted that the design risk drivers in red result in the entire water system being given a high risk score, regardless of all of the other component risk scores.

3.3.7 Component Risk - Water: Operation

The risk associated with operation has a mean score of 4.6. The mean operation risk score by type of source is:

- groundwater at 6.0
- groundwater under the direct influence of surface water (GUDI) at 8.0
- surface water at 3.0
- Municipal Type Agreement (MTA) at 3.1.

Areas that increase risk include operators not maintaining records, operators not having or using approved Operation & Maintenance manuals, and operators not scheduling and performing maintenance activities. Increased effort focused on these areas would result in lowering both the operation risk component and the overall risk scores.

There are several key drivers of the region's operation risk scores, including:

- failure to meet the *Guidelines for Canadian Drinking Water Quality* (GCDWQ)
- exceeding the GCDWQ Maximum Acceptable Concentration (MAC) for bacteria
- maintenance logs being inadequately maintained
- lack of general system maintenance

- Emergency Response Plan not in place
- Operations & Maintenance manual not available or not in use.

Figure 3.9 - Operation Risk Drivers

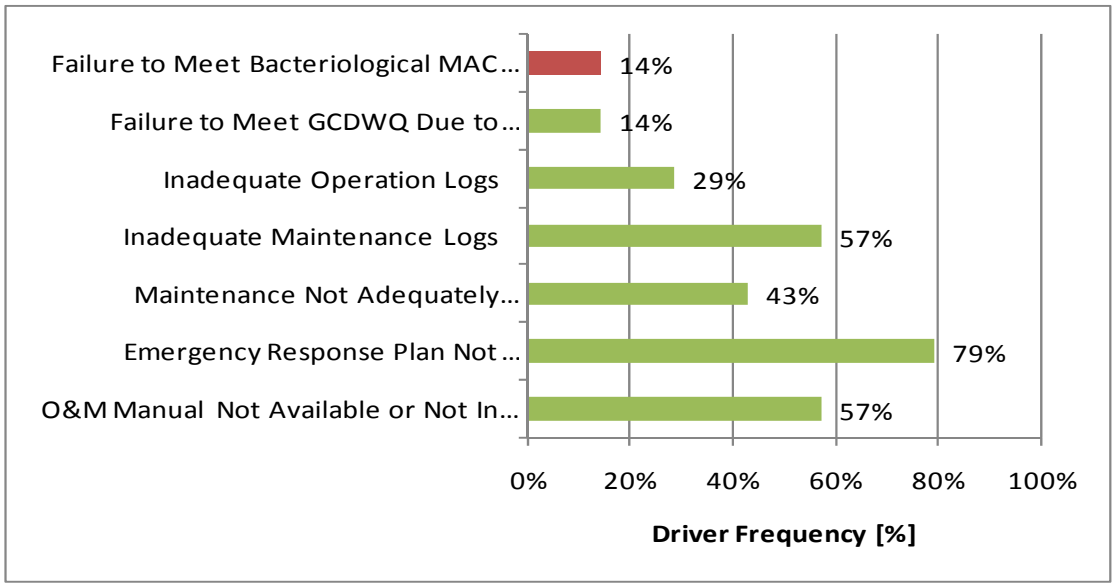
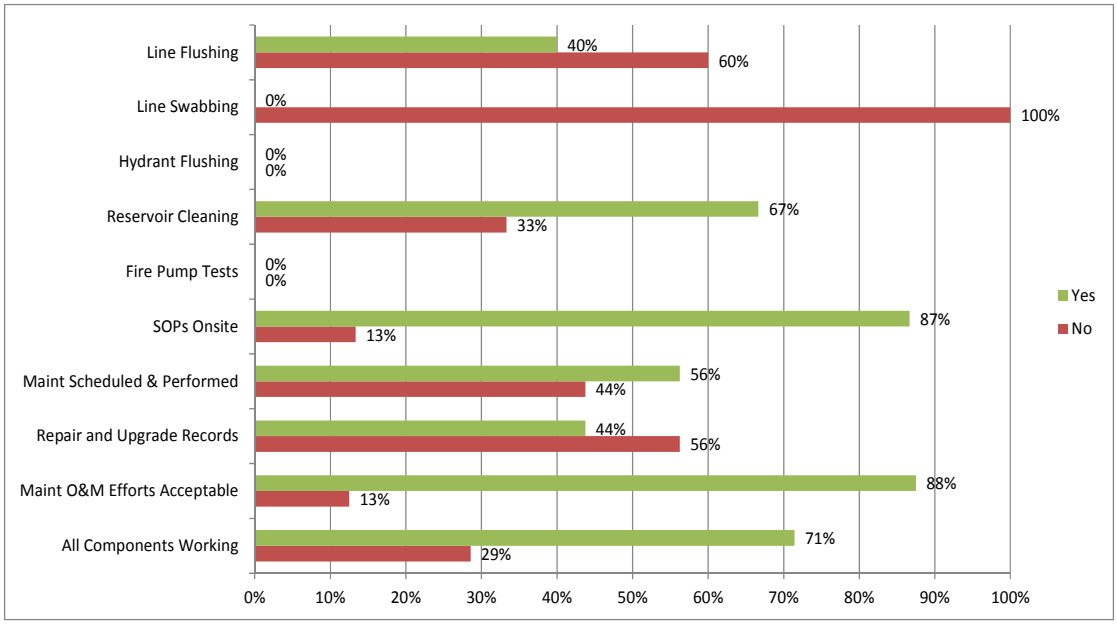


Figure 3.10 - Summary of Findings: Water Systems Operational Practices



3.3.8 Component Risk - Water: Reporting

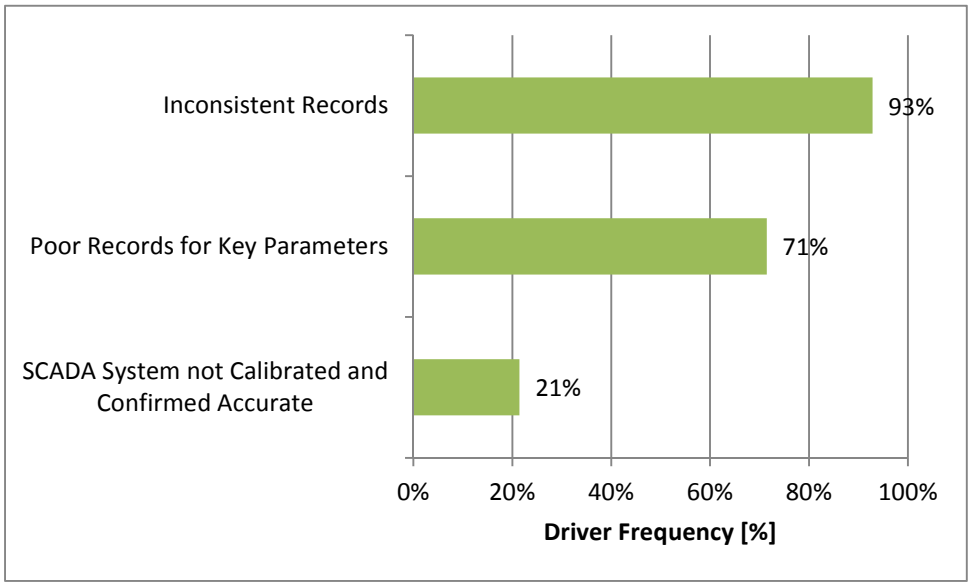
The risk associated with reporting has a mean score of 5.7. The minimal reporting required of systems serviced by Municipal Type Agreements is reflected in the mean risk score of 1.9. The mean reporting risk score by type of source is:

- groundwater at 9.3
- groundwater under the direct influence of surface water (GUDI) at 8.0
- surface water at 3.5
- Municipal Type Agreements (MTA) at 1.9.

Poor record keeping and inconsistent records are the main risk drivers for all systems (71% and 93%). For systems with a Supervisory Control and Data Acquisition (SCADA) system in place, an additional driver is that the instruments are not being calibrated to ensure that the information being recorded is accurate (21%).

An important consideration is that the systems were evaluated based on the requirements for monitoring and reporting as set out in INAC's Protocol. Typically, the operators' monitoring and reporting do not meet these requirements. Operator awareness and training could have a significant impact on these risk scores.

Figure 3.11 - Reporting Risk Drivers



3.3.9 Component Risk - Water: Operator

The risk associated with the operator has a mean score of 1.8. Operator Risk has the lowest overall component risk score for all types of systems. The mean operator risk score by type of source is:

- groundwater at 2.4
- groundwater under the direct influence of surface water (GUDI) at 1.0
- surface water at 1.0
- Municipal Type Agreement (MTA) at 1.5.

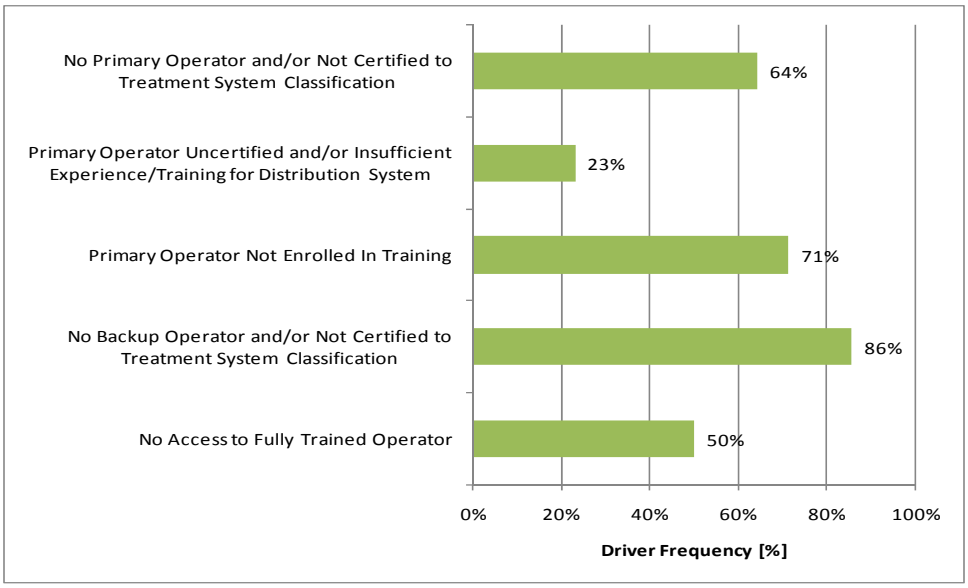
The extent to which existing systems have fully certified primary and backup operators is presented in Table 3.5. Of the 14 systems that require a certified operator for the water treatment system, 64% did not have a fully certified primary operator and 86% did not have a fully certified backup operator. Of the 13 systems that require a certified operator for the distribution system, 23% did not have a fully certified primary operator and 69% did not have a fully certified backup operator.

Table 3.5 - Water: Operator Status for Yukon Region

	Primary Operator		Backup Operator	
	Treatment	**Distribution**	**Treatment**	**Distribution**
No. of Systems Currently Without an Operator	0	0	3	2
No. of Systems with Operator with No Certification	2	0	9	7
No. of Systems with Operator Certified but not to the Required Level of the System	7	3	0	0
No. of Systems with Operator with Adequate Certification	5	10	2	4
No. of Systems Not Requiring Operators with Certification	10	11	10	11
Total No. of Systems	**24**	**24**	**24**	**24**

Those factors which frequently contribute to increased operator risk are identified in Figure 3.12. A lack of certification, lack of training and the lack of primary or backup operator are common drivers that increase operator risk.

Figure 3.12 - Operator Risk Drivers



3.4 Wastewater Risk Evaluation

A risk assessment was completed for each wastewater system according to INAC's *Risk Level Evaluation Guidelines*. The risk of each wastewater facility is ranked according to the following categories: effluent receiver, design, operation and maintenance, reporting, and operators. The overall risk score is a weighted average of the component risk scores.

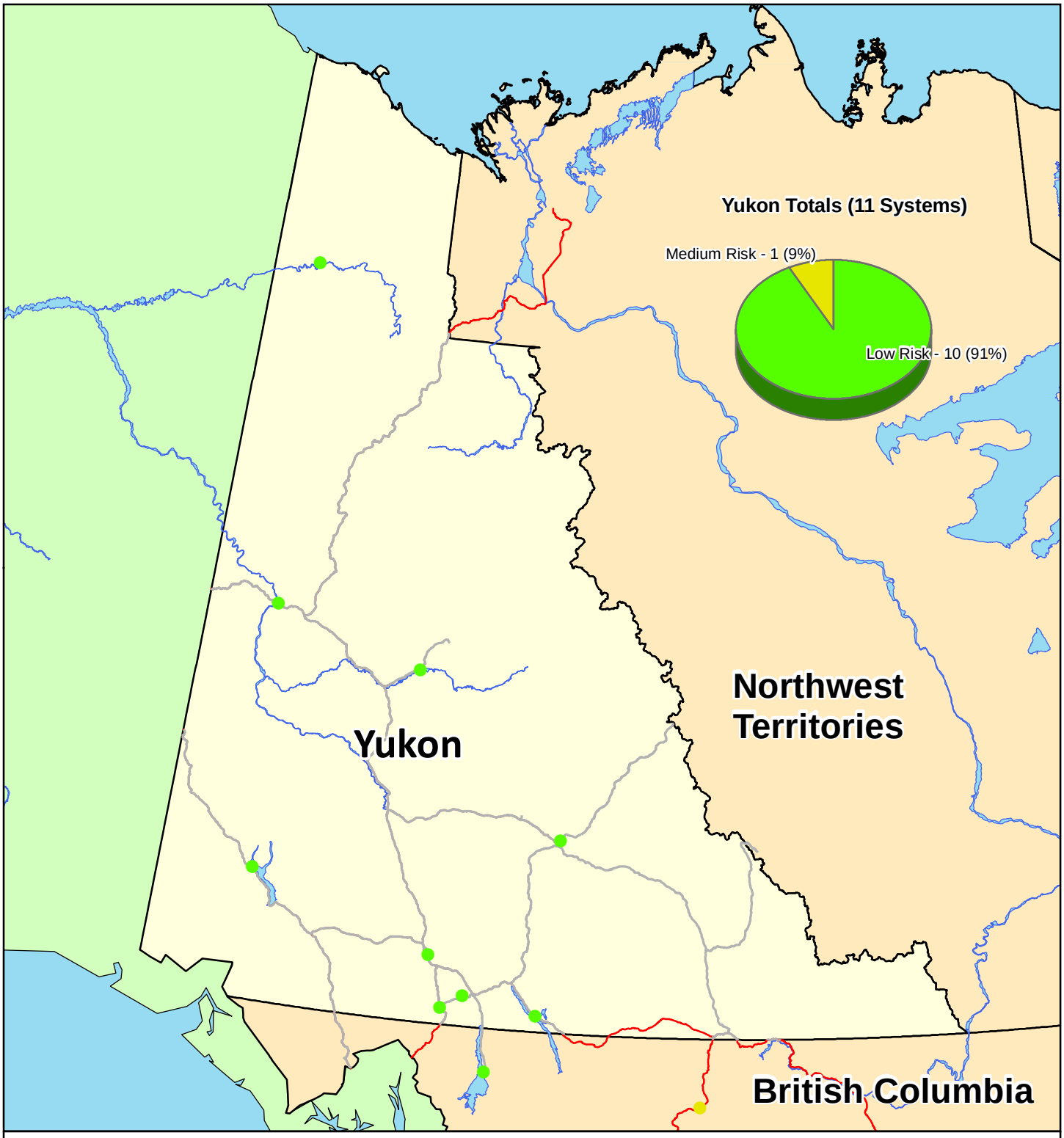
Each of the five risk categories, as well as the overall risk level of the entire system, is ranked numerically from 1 to 10. A risk ranking of 1.0 to 4.0 represents a low risk, a risk ranking of 4.1 to 7.0 represents a medium risk, and a risk ranking of 7.1 to 10.0 represents a high risk.

Of the 11 wastewater systems inspected:

- 1 is categorized as medium overall risk
- 10 are categorized as low risk.

Appendix E.2 provides a table that summarizes the correlation between the component risk and the overall risk.

Figure 3.13 provides a geographical representation of the final risk for the wastewater systems that were inspected.



NATIONAL ASSESSMENT OF FIRST NATION WATER AND WASTEWATER SYSTEMS

Wastewater System Risk Level

- High
- Medium
- Low
- Yukon Roads
- Major National Roads
- Major Lakes

Figure 3.13 - Yukon Wastewater System Risk

N

0 50 100 150 200 250

Kilometers

NOTES

This map has been compiled with data of varying scale and accuracy.This is not a plan of survey.

SOURCES

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United States Boundaries © ESRI

Geobase® Aboriginal Lands (First Nations) - Accessed from http://geobase.ca.

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Project: FGY16308
Drawn By: B. Goll

Projection: Geographic, Canada LCC

Indian and Northern Affairs Canada | Affaires indiennes et du Nord Canada

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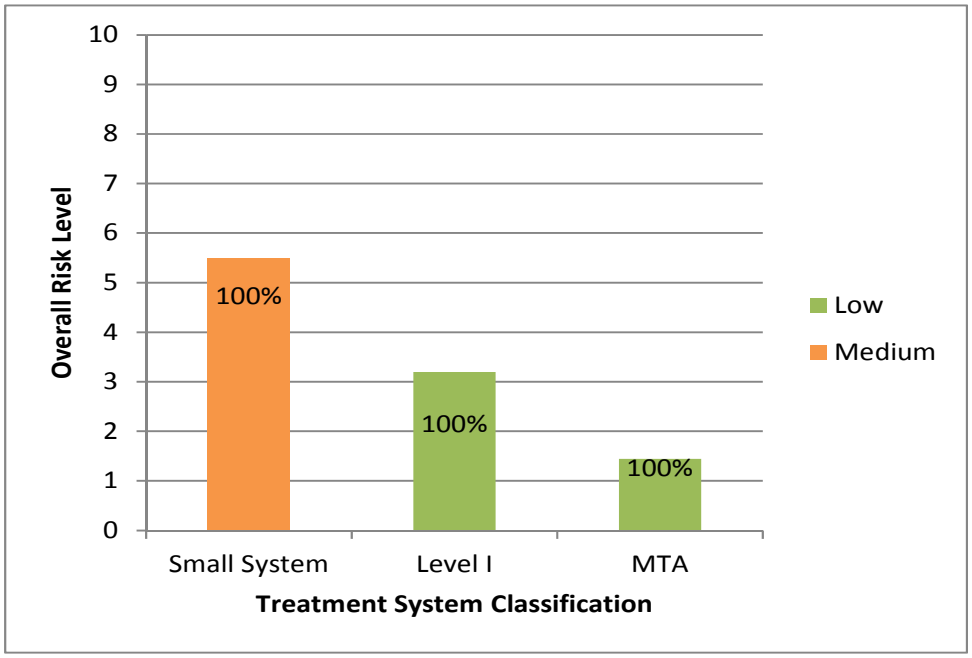
P:_FGY16308\Maps\Yukon\YU_WW_System_Risk.mxd

3.4.1 Overall System Risk by Treatment Classification

In the Yukon region there is one Small System, one Level I system, and nine Municipal Type Agreements (MTAs). It was assumed that municipalities operate their systems in accordance with territorial legislation, which results in low-risk scores for MTAs. All of the MTAs are low risk. One of the two First Nation communal wastewater systems is medium risk.

The following figure demonstrates the correlation between the mean overall system risk and the classification level of the treatment system.

Figure 3.14 - Risk Profile Based on Wastewater Treatment System Classification



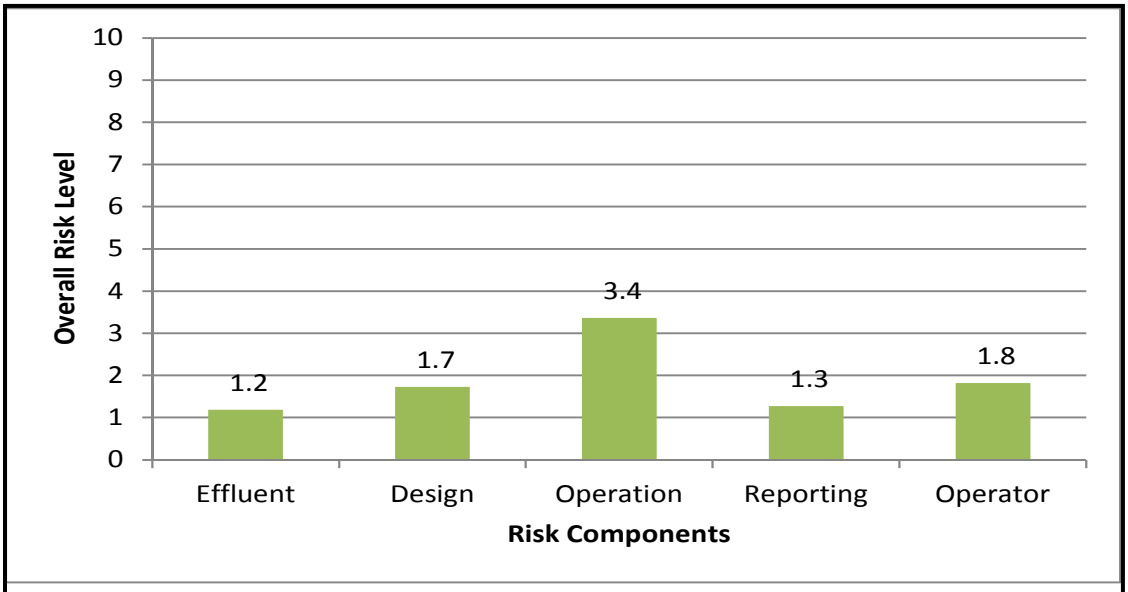
3.4.2 Overall System Risk by Number of Connections

In the Yukon region, there is no clear pattern between the overall system risk and the number of connections.

3.4.3 Component Risks: Wastewater

The overall risk is comprised of five component risks: effluent receiver, design, operation, reporting and operators. Each of these component risk factors is discussed below.

Figure 3.15 - Wastewater: Risk Profile Based on Risk Components

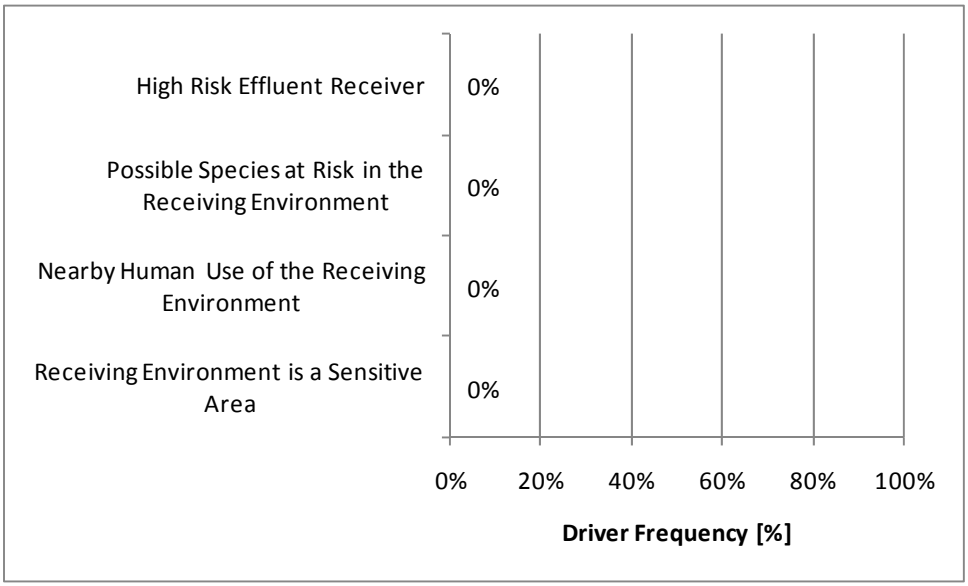


	Effluent	Design	Operation	Reporting	Operator
Risk	1.2	1.7	3.4	1.3	1.8
Minimum	1.0	1.0	1.0	1.0	1.0
Maximum	2.0	5.0	7.0	4.0	10.0
Std. Dev.	0.4	1.2	2.1	0.9	2.7

3.4.4 Component Risk - Wastewater: Effluent Receiver

The risk associated with the effluent receiver has a mean score of 1.2. As the figure below illustrates, there are no concerns regarding effluent receivers in the region.

Figure 3.16 - Effluent Risk Drivers



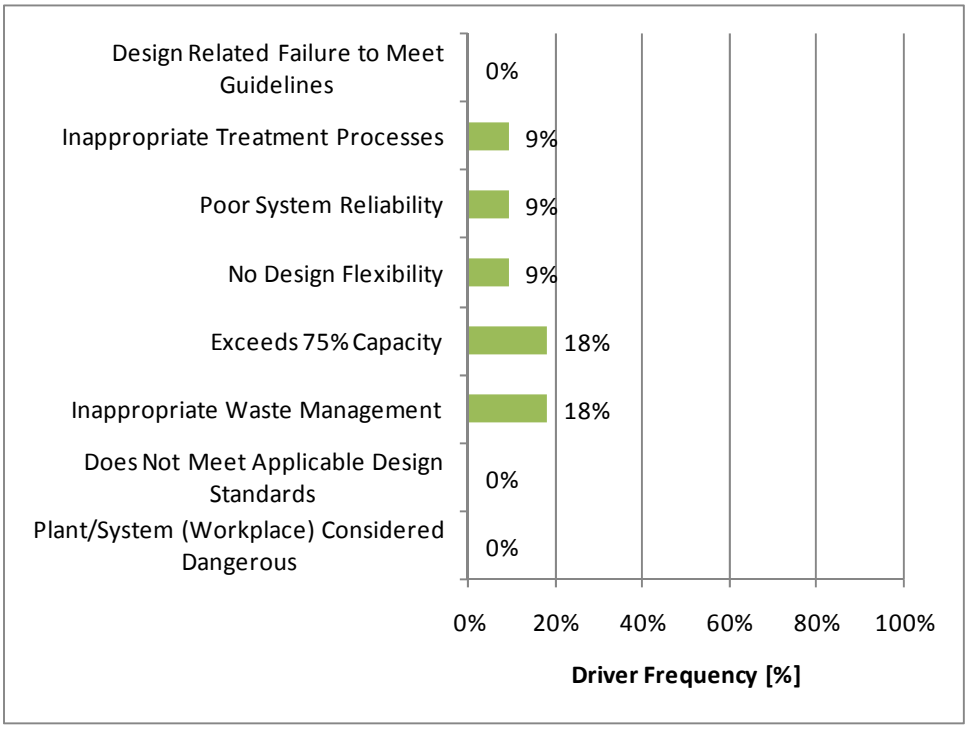
3.4.5 Component Risk - Wastewater: Design

The risk associated with the design has a mean score of 1.7. One of the 11 systems has a medium risk.

There are several key drivers of the design component risk scores in the region, including:

- inappropriate treatment processes
- problems with system reliability
- system lacks the flexibility to meet future growth
- system has exceeded the design capacity
- inappropriate waste management.

Figure 3.17 - Design Risk Drivers



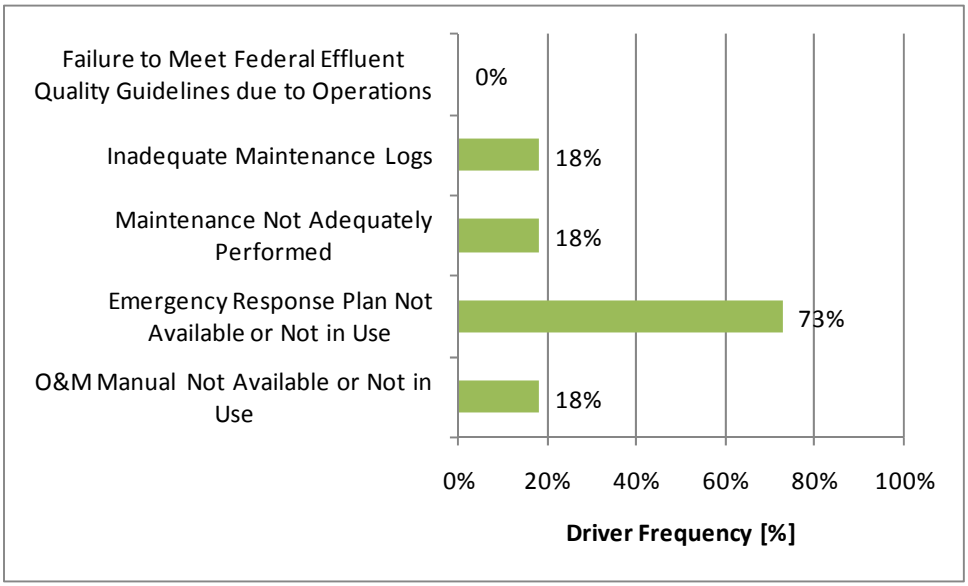
3.4.6 Component Risk - Wastewater: Operation

The risk associated with the operation has a mean risk score of 3.4. All wastewater systems have a low risk score with the exception of one of the First Nation operated systems which has a high risk score of 10.

There are several key drivers of the operation risk in the region, including:

- inadequate maintenance logs
- general maintenance not being adequately performed
- Emergency Response Plans not in place or not being used
- Operation & Maintenance manuals not available or not being used.

Figure 3.18 - Operation Risk Drivers



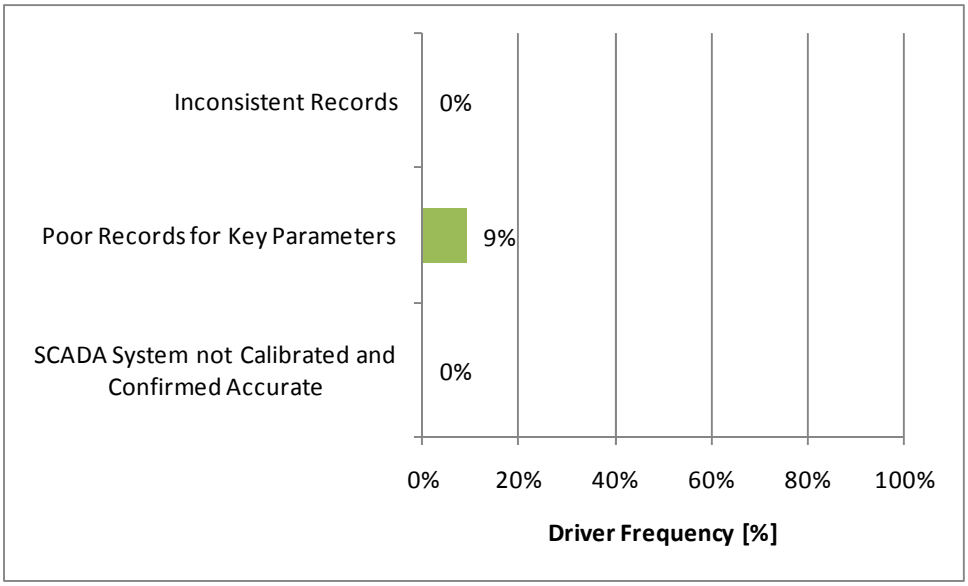
3.4.7 Component Risk - Wastewater: Reporting

The risk associated with reporting has a mean score of 1.3. All wastewater systems have a low risk score for reporting.

There key drivers of the reporting risk in the region are:

- inconsistent record keeping
- inconsistent records for key parameters.

Figure 3.19 - Reporting Risk Drivers



3.4.8 Component Risk - Wastewater: Operator

The risk associated with the operator has a mean score of 1.8. All wastewater systems have a low risk score with the exception of one of the First Nation operated wastewater systems which has a high risk score of 10.

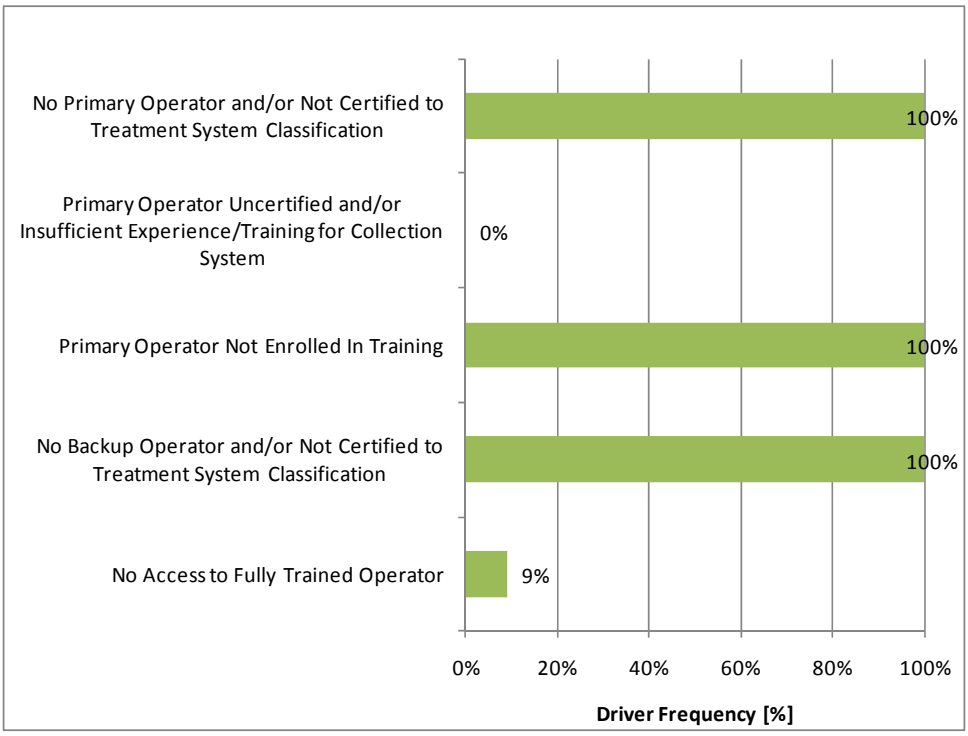
The extent to which existing wastewater systems have fully certified primary and backup operators is presented in Table 3.6. Of the two systems which require a certified operator for the wastewater treatment system, both systems did not have a fully certified primary operator or a fully certified backup operator. Of the 2 systems which require a certified operator for the collection system, both systems did not have a fully certified primary operator or a fully certified backup operator.

Table 3.6 - Wastewater: Operator Status for Yukon Region

	Primary Operator		Backup Operator	
	Treatment	**Collection**	**Treatment**	**Collection**
No. of Systems Currently Without an Operator	2	2	2	2
No. of Systems with Operator with No Certification	0	0	0	0
No. of Systems with Operator Certified but not to the Required Level of the System	0	0	0	0
No. of Systems with Operator with Adequate Certification	0	0	0	0
No. of Systems Not Requiring Operators with Certification	9	9	9	9
Total No. of Systems	**11**	**11**	**11**	**11**

Those factors which frequently contribute to increased wastewater operator risk are identified in Figure 3.20. A lack of certification, lack of training and the lack of primary or backup operator are common drivers that increase operator risk.

Figure 3.20 - Operators Risk Drivers



3.5 Plans

Information was collected regarding the availability of various documents, including Source Water Protection Plans (SWPP), Maintenance Management Plans (MMP), and Emergency Response Plans (ERP). The following tables provide a summary of the percentages of First Nations that have plans in place:

Table 3.7 - Plans Summary: Water

Source	*Percentage of Water Systems that have a (an)...*		
	Source Water Protection Plan	**Maintenance Management Plan**	**Emergency Response Plan**
Groundwater	82%	45%	36%
Groundwater GUDI	0%	0%	0%
MTA	N/A	0%	10%
Surface Water	0%	100%	0%
Overall	**64%**	**29%**	**21%**

Table 3.8 - Plans Summary: Wastewater

Percentage of Wastewater Systems that have a (an)…	
Maintenance Management Plan	**Emergency Response Plan**
0%	18%

3.5.1 Source Water Protection Plan (SWPP)

Source water protection planning is one component of a multi-barrier approach to providing safe drinking water. Source Water Protection Plans seek to identify threats to the water source. They also establish policies and practices to prevent contamination of the water source and to ensure that the water service provider is equipped to take corrective action in the event of water contamination. Source water protection is appropriate for groundwater and surface water sources.

For the Yukon region, 64% of the systems have a Source Water Protection Plan in place.

3.5.2 Maintenance Management Plans (MMP)

Maintenance Management Plans are intended to improve the effectiveness of maintenance activities. MMP's focus on planning, scheduling and documenting preventative maintenance activities and identify unscheduled maintenance efforts to be documented by the operator. The plans represent a change from reactive to proactive thinking, and—when executed properly—help the operator optimize maintenance spending, minimize service disruption, and extend asset life.

For the Yukon region, 29% of the First Nation water systems have a Maintenance Management Plan in place.

3.5.3 Emergency Response Plans (ERP)

Emergency Response Plans (ERPs) are intended to be a quick reference to assist operators and other stakeholders in managing and responding to emergency situations. Emergency Response Plans should be in place for both water and wastewater systems. They include key contact information for those who should be notified and who may be of assistance in case of emergency (agencies, contractors, suppliers, etc.), and they provide standard communication and response protocols. Emergency Response Plans recommend corrective actions for "foreseeable" emergencies, and they establish methodologies for addressing unforeseen situations. They are essentially the last potential "barrier" in a multi-barrier approach to protecting the drinking water supply and the natural environment, and they provide the last opportunity to mitigate damages.

21% of the water systems and 18% of the wastewater systems have an Emergency Response Plan in place.

4.0 Cost Analysis

4.1 Upgrade to Meet Protocol: Water

In 2006, INAC began to develop a series of Protocol documents for centralised and decentralised water and wastewater systems in First Nations communities. The Protocols contain standards for the design, construction, operation, maintenance, and monitoring of these systems.

One of the objectives of this study was to review the existing water and wastewater infrastructure and to identify the potential upgrade costs to meet INAC's Protocols, and federal and provincial guidelines, standards and regulations. The total estimated construction cost for water system upgrades to meet the INAC Protocol is $9.3M.

Table 4.1 provides a breakdown of the estimated total capital costs. A separate line item is included for engineering and contigency. Figure 4.1 provides a comparison graph of each of the categories.

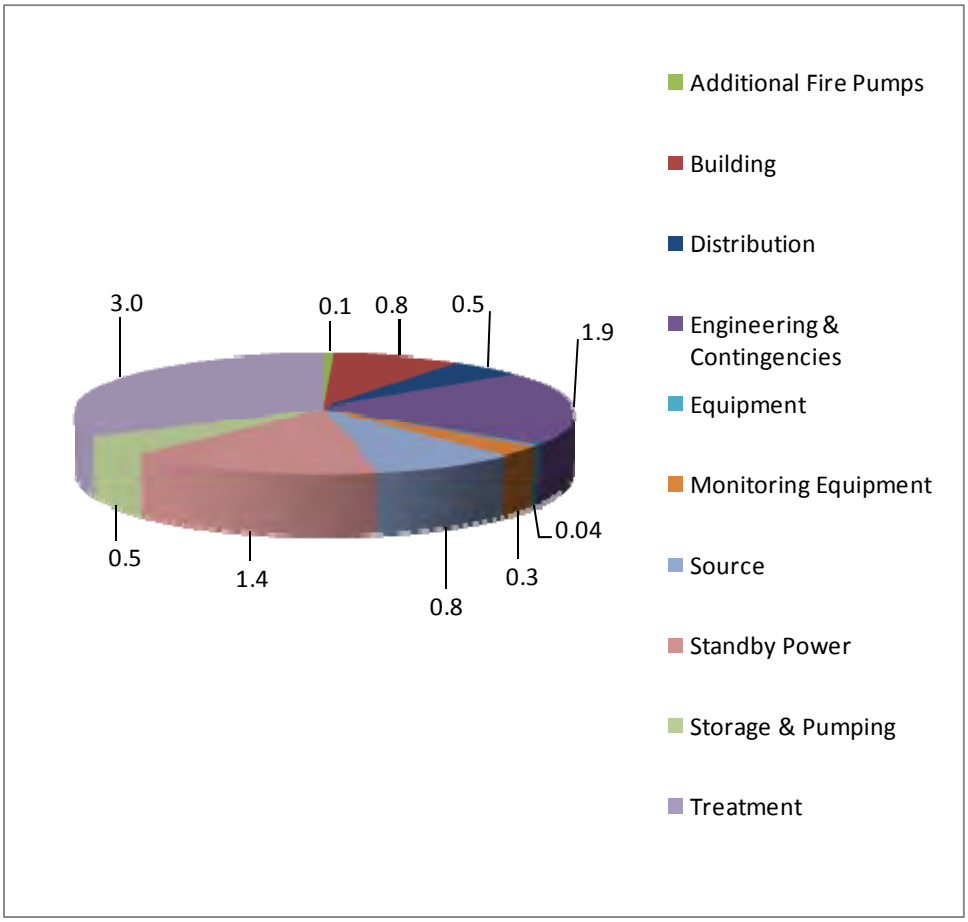
Table 4.1 - Estimated Total Construction Costs: Water

Description	Protocol - Estimated Cost	Federal - Estimated Cost	Provincial - Estimated Cost
Building	$836,000	$35,000	$116,000
Distribution	$485,000	$85,000	$85,000
Equipment	$42,000	$42,000	$0
Additional Fire Pumps	$70,000	$0	$70,000
Monitoring Equipment	$272,500	$183,500	$61,500
Source	$797,500	$2,500	$2,500
Storage & Pumping	$502,000	$390,000	$65,000
Treatment	$3,041,000	$2,384,000	$1,699,000
Standby Power	$1,420,000	$0	$0
Engineering & Contingencies	$1,872,000	$783,500	$529,000
Construction Total Estimate	**$9,338,000**	**$3,905,500**	**$2,628,000**

There are five water systems that may potentially have groundwater under the direct influence (GUDI) of surface water supplies. The upgrade costs for these systems have been estimated under the assumption that they will prove to be secure groundwater supplies, but further studies are recommended to confirm this assumption.

If the GUDI studies indicate that these supplies should be considered to be surface water *rather than* groundwater, then additional upgrade requirements will be necessary for these systems to meet INAC's Protocol. It is estimated that, depending on system capacity and site indices, an additional $1.0 to $2.5 million will be required for each system that requires upgrading to surface water treatment.

Figure 4.1 - Breakdown of the Estimated Construction Costs to Meet Protocol: Water ($ - M)



The following lists provide a summary of the Protocol items for the three categories with the highest cumulative Protocol costs Treatment, Building, and Standby Power.

Treatment costs include:

- Providing spare chemical feed equipment.
- Providing spare disinfection equipment.
- Providing additional filter trains.
- Providing secondary containment for treatment chemicals.
- Providing specific treatment equipment (i.e. arsenic, manganese, etc.).
- Providing contact piping.
- Providing surge suppression/uninterruptible power supplies for critical electronic equipment.
- Upgrading the capacity of existing water treatment plant(s).

Building costs include:

- Installing blow offs on dead ends.
- Installing isolation valves.
- Looping distribution systems.
- Installing additional fire hydrants.
- Providing additional water trucks.
- Replacing cisterns.
- Replacing pipeline.

Standby Power costs include:

- Providing standby power.

Table 4.2 - Estimated Total Non- Construction Costs: Water

Description	Protocol - Estimated Cost	Federal - Estimated Cost	Provincial - Estimated Cost
Training	$110,000	$110,000	$110,000
GUDI Studies	$325,000	$0	$0
Plans/Documentation	$767,500	$522,500	$80,000
Studies	$20,000	$0	$0
Non-Construction Total Estimate	**$1,222,500**	**$632,500**	**$190,000**

Additional annual operations and maintenance costs, shown in Table 4.3, include costs that occur annually for items that are not currently being completed to meet protocols, such as calibrating monitoring equipment, additional sampling, cleaning the reservoir, and backup operator's salary.

Table 4.3 - Estimated Additional Annual Operation & Maintenance Costs: Water

Description	Estimated Cost
Sampling	$504,100
Operations	$71,000
Operator	$90,000
Water O&M Total Estimated Cost	**$665,100**

The total estimated cost, including construction and non-construction costs, for water system upgrades to meet the INAC Protocol is $10.6M. This excludes costs associated with potentially GUDI systems, which prove to be GUDI systems as discussed previously.

4.2 Upgrade to Meet Protocol: Wastewater

The total construction cost estimate for the two wastewater systems for upgrades to meet INAC's Protocol is $0.6 M. Below is a list of the specific needs of the systems, the number of systems impacted by the upgrades, and the total cost for each need.

Table 4.4 - Estimated Total Construction and Related Costs: Wastewater

Description	Protocol - Estimated Cost	Federal - Estimated Cost	Provincial - Estimated Cost
Collection System	$400,000	$400,000	$400,000
Monitoring Equipment	$18,000	$0	$0
Treatment	$75,000	$75,000	$75,000
Engineering & Contingencies	$123,000	$119,000	$119,000
Construction Total Estimate	**$616,000**	**$594,000**	**$594,000**

Figure 4.2 - Breakdown of the Estimated Construction Costs to Meet Protocol: Wastewater ($ - M)

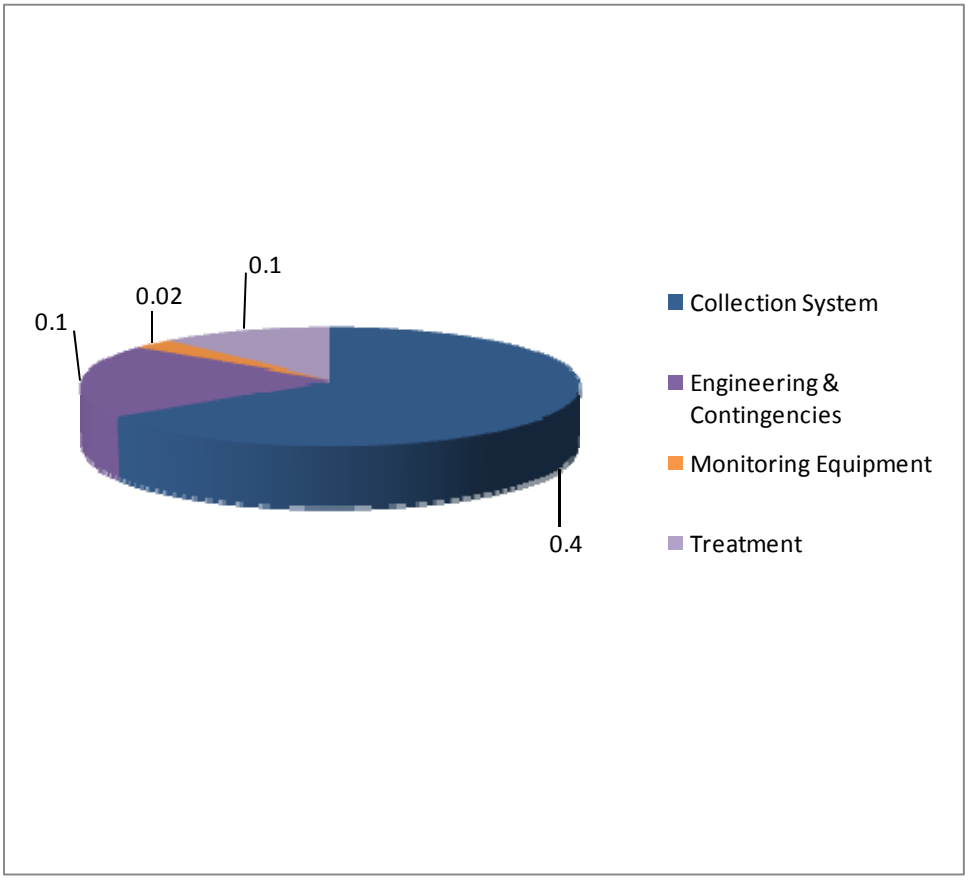


Table 4.5 - Estimated Total Non-Construction and Related Costs: Wastewater

Description	Protocol - Estimated Cost	Federal - Estimated Cost	Provincial - Estimated Cost
Plans/Documentation	$30,000	$10,000	$0
Studies	$20,000	$0	$0
Non-Construction Total Estimate	**$50,000**	**$10,000**	**$0**

Additional annual operations and maintenance costs, as shown in Table 4.6, include costs that occur annually, for items that are not currently being completed to meet protocols, such as calibrating monitoring equipment, additional sampling, and backup operator's salary.

Table 4.6 - Estimated Additional Annual Operation & Maintenance Costs: Wastewater

Description	Estimated Cost
Operator	$110,000
Wastewater O&M Total Estimated Cost	**$110,000**

4.3 Upgrade Cost Summary

Table 4.7 provides a summary of the upgrade costs for systems to meet INAC's Protocol, and federal and territorial guidelines and regulations.

Table 4.7 - Summary and Comparison of Upgrade Costs

	Total Estimated Cost	
	Water	Wastewater
Upgrade to meet Protocol	$10,560,500	$666,000
Upgrade to meet Federal Guidelines	$4,538,000	$604,000
Upgrade to meet Provincial Guidelines	$2,818,000	$594,000

The following tables present a breakdown of the estimated upgrade costs to meet INAC's Protocols, broken down by overall risk level.

Table 4.8 - Breakdown of Protocol Estimated Costs by Risk Level: Water

Risk Level	Short Term	Long Term	Total
High	$5,577,733	$0	**$5,577,733**
Medium	$2,950,522	$0	**$2,950,522**
Low	$2,032,244	$0	**$2,032,244**
Total	**$10,560,500**	**$0**	**$10,560,500**

Table 4.9 - Breakdown of Protocol Estimated Costs by Risk Level: Wastewater

Risk Level	Short Term	Long Term	Total
High	$0	$0	**$0**
Medium	$73,591	$0	**$73,591**
Low	$592,409	$0	**$592,409**
Total	**$666,000**	**$0**	**$666,000**

4.4 Asset Condition and Reporting System Needs

ACRS (Asset Condition and Reporting System) inspections were completed for all water and wastewater related assets. In order to avoid duplicating the “Upgrade to Protocol” needs identified previously, ACRS needs were limited to required repairs of existing facilities, and any upgrade costs were not included.

The following two tables (Tables 4.10 and 4.11) provide a summary of the required repairs, broken down by asset for both water and wastewater:

Table 4.10 - Asset Condition and Reporting System Identified Operation & Maintenance Costs: Water

Asset Code	Description	Estimated Cost
A5A	Buildings	$44,900
B1B	Watermains	$30,000
B1C/B1D	Treatment	$51,700
B1E	Reservoirs	$500
B1F	Community Wells	$170,900
	Water ACRS Total Estimated Cost	**$298,000**

Table 4.11 - Asset Condition and Reporting System Identified Needs: Wastewater

Asset Code	Description	Estimated Cost
B2A	Sewers	$25,000
B2E/B2I	Lagoons	$36,000
B2F	Septic Systems	$50,200
	Wastewater ACRS Total Estimated Cost	**$111,200**

4.5 Community Servicing

An analysis was completed to evaluate future servicing alternatives for a 10-year design period. The analysis considers a variety of alternatives, including expanding existing systems, developing new systems, establishing local Municipal Type Agreements (if applicable), and using individual systems.

A theoretical operation and maintenance cost was developed for each alternative, along with a 30-year life-cycle cost. The cost of the upgrades that are necessary for systems to meet INAC Protocol is included in the new servicing cost, if appropriate (i.e. for new servicing alternatives that include continued use of the existing system).

The following table summarizes the capital cost and the total estimated operation & maintenance cost for the recommended servicing alternatives:

Table 4.12 - Future Servicing Costs

	Total Estimated Cost		Cost Per Connection	
	Water	Wastewater	Water	Wastewater
Future Servicing Cost	$30,000,000	$20,000,000	$14,300	$8,500
Annual O&M to service future growth	$6,700,000	$3,900,000	$3,200	$1,900

The evaluation of future servicing included continuing to service the existing population with the same level of service that was currently in place and evaluating the options for providing service to the future 10 year growth for the community. Existing servicing includes piped, trucked and individual servicing.

It was found that, for the most part, extending piped water and wastewater servicing for the future growth is the most cost-effective solution. This solution assumes that future homes will be constructed in a more compact subdivision setting adjacent to the existing serviced area. If some residents choose to build homes in outlying areas, individual servicing or truck haul may be more appropriate. Initial information provided by First Nations suggests that their preferred servicing strategy is development in the core.

5.0 Regional Summary

All 17 First Nations in the Yukon Region were visited during the completion of this project. The 24 water systems include 12 groundwater systems, 2 surface water systems and 10 Municipal Type Agreements. The 11 wastewater systems include 2 lagoons and 9 Municipal Type Agreements.

The majority of the First Nations are self-governing. These communities receive support services from the Yukon Territorial Government, and their water and wastewater systems appear to be well maintained. Many of the communities are located adjacent to a non-First Nation community, which leads to the development of shared servicing.

For water systems, operator risk is the lowest of the component risks. However, it is important to provide ongoing training for operators to ensure that all systems are operated and maintained by trained/certified operators and to ensure that operators are monitoring and record keeping in accordance with INAC's Protocol.

The design, operation, and reporting risk components are medium or high for 50% of the water systems. Addressing the concerns associated with these components would have the greatest impact on reducing the overall risk.

For wastewater systems, the operation, the reporting and the operator risk components are high for both systems. Providing operators for these two systems would reduce the overall risk.

NEEGAN BURNSIDE

Appendix A
Glossary

Appendix A: Glossary of Terms and Acronyms

Aeration (see also lagoon): The process of bringing air into contact with a liquid (typically water), usually by bubbling air through the liquid, spraying the liquid into the air, allowing the liquid to cascade down a waterfall, or by mechanical agitation. Aeration serves to (1) strip dissolved gases from solution, and/or (2) oxygenate the liquid. (Gowen Environmental)

Aesthetic Objective (AO): Aesthetic objectives are set for drinking water quality parameters such as colour or odour, where exceeding the objective may make the water less pleasant, but not unsafe. (INAC *Protocol for Decentralised Water and Wastewater*)

Ammonia (See also: Potable water; Effluent quality requirements): A pungent colorless gaseous alkaline compound of nitrogen and hydrogen (NH_3) that is very soluble in water and can easily be condensed to a liquid by cold and pressure (*Merriam-Webster*). Ammonia is used in several areas of water and wastewater treatment, such as pH control. It is also used in conjunction with chlorine to produce potable water. The existence of ammonia in wastewater is common in industrial sectors as a by-product of cleaning agents. This chemical impacts both human and environmental conditions. Treatment of ammonia can be completed in lagoon systems and mechanical plants.
(R.M. Technologies)

Arsenic: A metallic element that forms a number of compounds. It is found in nature at low levels, mostly in compounds with oxygen, chlorine, and sulphur; these are called inorganic arsenic compounds. Organic arsenic in plants and animals combines with carbon and hydrogen. Inorganic arsenic is a human poison. Organic arsenic is less harmful. High levels of inorganic arsenic in food or water can be fatal.
(Medicinenet.com)

Aquifer (confined): A layer of soil or rock below the land surface that is saturated with water. There are layers of impermeable material both above and below it, and it is under pressure so that when the aquifer is penetrated by a well, the water will rise above the top of the aquifer. (INAC *Protocol for Decentralised Water and Wastewater Systems*)

Aquifer (unconfined): An unconfined aquifer is one whose upper water surface (water table) is at atmospheric pressure, and thus is able to rise and fall. (INAC *Protocol for Decentralised Water and Wastewater Systems*)

As-built/record drawings: Revised set of drawing submitted by a contractor upon completion of a project or a particular job. They reflect all changes made in the specifications and working drawings during the construction process, and show the exact dimensions, geometry, and location of all elements of the work completed under the contract. Also called as-built drawings or just as-builts.

ACRS Inspection (Asset Condition Reporting System Inspection): For centralised water and wastewater systems, an ACRS (asset condition reporting system) inspection of the system is to be performed once every three (3) years by a qualified person (consulting engineer, Tribal Council engineer), who is not from the First Nation involved, to assess the condition of the asset, adequacy of maintenance efforts, and need for additional maintenance work. The ACRS inspection report will be discussed with, and submitted to, the First Nation council and the INAC regional office. Inspections will be conducted in accordance with the ACRS Manual, a copy of which can be obtained from the INAC regional office.

Bacteria (plural) bacterium (singular): Microscopic living organisms usually consisting of a single cell. Bacteria can aid in pollution control by consuming or breaking down organic matter in sewage and/or other water pollutants. Some bacteria may also cause human, animal, and plant health problems. Bacteria are predominantly found in the intestines and feces of humans and animals. The presence of *coliform* bacteria in water indicates the contamination of water by raw or partially treated sewage. (INAC *Protocol for Decentralised Water and Wastewater Systems*)

Baffle (concrete and/or curtain): Vertical/horizontal impermeable barriers in a pond or reservoir. Baffles direct the flow of water into the longest possible path through the reservoir in order to eliminate short-circuiting in the water treatment system. In potable water treatment, short-circuiting can reduce the effectiveness of disinfectants. In effluent treatment, short-circuiting may result in an increase of pollutants at the outlet. Short-circuiting occurs when water flows directly from the inlet to the outlet across a pond or reservoir. (Layfield)

BOD_5 (Biochemical Oxygen Demand): The most widely used parameter of organic pollution applied to both wastewater and surface water is the 5-day BOD (BOD_5). This determination involves the measurement of the dissolved oxygen used by microorganisms in the biochemical oxidation of organic matter. BOD test results are used to: determine the approximate quantity of oxygen that will be required to biologically stabilize the organic matter present; to determine the size of waste treatment facilities; to measure the efficiency of some treatment processes; and to determine compliance with wastewater discharge permits. (Metcalf & Eddy)

Capacity (actual vs. design): Refers to the capacity of the treatment system, with the "design capacity" being the flow rate proposed by the designer or manufacturer. If the system is not operating to design levels, the "actual capacity" could be limited by failing pumps, clogged filters or not meeting the Protocol (i.e. Protocol requires two filter trains such that one could operate while another is being cleaned/repaired and this was previously not explicitly required; therefore, the actual capacity is half of the design capacity).

Chemical feed equipment: All equipment associated with introducing chemicals to the raw water as part of the treatment process including coagulants, coagulant aids, disinfectants, etc.

Chlorine: A disinfectant used in either gas or liquid from gas that is added to water to protect the consumer from bacteria and other micro-organisms. It is widely used because it is inexpensive and easily injected into water. Because of its concentration, a gallon can treat a large amount of water. However, chlorine use does have drawbacks: when chlorine is used as a disinfectant it combines with naturally occurring decaying organic matter to form Trihalomethanes (THMs). (Vital Life Systems)

Chlorination: The application of chlorine to water, sewage or industrial wastes for disinfection (reduction of pathogens) or to oxidize undesirable compounds. (City of Toronto)

Chlorine Residual: The chlorine level in potable water immediately after it has been treated. (Ontario Ministry of the Environment)

Circuit Rider (see also Circuit Rider Training Program): Under the department's Circuit Rider Trainer Program (CRTP) INAC provides funds to engage circuit riders (third party water and wastewater system experts who provide water and wastewater system operators with on-site, mentoring, training, and emergency assistance). The third-party service providers that provide circuit rider services also provide operators with a 24/7 emergency hotline. (INAC *Protocol for Centralised Wastewater Systems in First Nations Communities*)

Circuit Rider Training Program: The main vehicle by which most First Nations operators receive the required training to operate their systems. This program provides qualified experts who rotate through a circuit of communities, providing hands-on training for the operators on their own system. Circuit rider trainers also help the First Nations with minor troubles and issues of operation and maintenance of their systems. (INAC *Plan of Action*)

Cistern: A tank for storing potable water or other liquids, usually placed above the ground. (Bow River Basin Council, cited in Alberta Environment *Glossary*)

Class "D" Cost Estimates: A preliminary estimate, for each community visited, based on available site information, which indicates the approximate magnitude (+/- 40%) of the cost of the actions recommended in the report, and which may be used in developing long-term capital plans and for a preliminary discussion of proposed capital projects.

Collection piping: Sanitary sewer collecting wastewater from individual buildings and homes, for treatment and disposal at a public facility.

Component risk / component risk factors: The overall risk is determined by five component risks: water source/effluent, design, operation, reporting, and operator.

Community Health Representatives (CHRs): Health Canada's local health representatives. They undertake bacteriological and chlorine residual sampling of distributed water within most First Nation communities.

Contact piping: Dedicated watermain to provide chlorine contact time before potable water is distributed to the first user.

Containment liners (for on-site fuel storage): A form of secondary containment used for diesel driven generators or fire pumps.

Continuous discharge to a receiving body: The release of treated wastewater effluent to a lake, river, stream, etc. where the rate of release is continuous (i.e. not batch discharge).

Conventional Wastewater Treatment: Consists of preliminary processes, primary settling to remove heavy solids and floatable materials, secondary biological aeration to metabolize and flocculate colloidal and dissolved organics, and secondary settling to remove additional solids. Tertiary treatment such as disinfection or filtration to further treat the wastewater depending on the level of treatment required for discharge. Waste sludge drawn from these operations is thickened and processed for ultimate disposal, usually either land application or landfilling. Preliminary treatment processes include coarse screening, medium screening, shredding of solids, flow measuring, pumping, grit removal, and pre-aeration. Chlorination of raw wastewater sometimes is used for odor control and to improve settling characteristics of the solids.

Conventional Water Treatment: Consists of a combination of coagulation (adding chemicals called coagulants), flocculation (particles binding together with coagulants) and sedimentation (settling of particles) to remove a large amount of organic compounds and suspended particles, filtration (water passing through porous media) to remove bacteria protozoa and viruses (slow sand filtration) or suspended particles (rapid sand filtration), and disinfection to ensure all the bacteria protozoa and viruses are removed, and provide safe drinking water.

Cross connections: A cross connection is a link between a possible source of pollution and a potable water supply. A pollutant may enter the potable water system when a) the pressure of the pollution source exceeds the pressure of the potable water source or b) when a sudden loss of pressure occurs in the water system and "backflow" occurs. The flow through a water treatment plant should have no instances of treated water coming into contact with raw or wastewater. Backflow preventers should be tested regularly and any actual physical links should be removed.

Decentralized System: A group or groups of communal (as opposed to private) on-site water or wastewater systems. (INAC *Protocol for Decentralised Water and Wastewater Systems*)

Dedicated transmission main: A length of watermain which has no service connections or hydrants; can refer to the length of raw watermain from a raw water source to the water treatment plant or in the distribution system where there are larger distances between homes.

Discharge Frequency: The frequency in which treated wastewater is discharged; could be continuous, seasonal, annual, etc.

Discharge quality data: Data acquired through the completion of a laboratory analysis of treated wastewater effluent prior to obtaining permission to discharge. Relevant parameters for testing include: 5 day Biochemical Oxygen Demand, Suspended Solids, Fecal Coliforms, pH, Phenols, Oils & Greases, Phosphorus and Temperature.

Disinfectant: A disinfectant is a chemical (commonly chlorine, chloramines, or ozone) or physical process (e.g., ultraviolet light) that inactivates or kills microorganisms such as bacteria, viruses, and protozoa. (INAC *Protocol for Decentralised Water and Wastewater Systems*)

Disinfection: A process that has as its objective destroying or inactivating pathogenic micro-organisms in water. (Government of Alberta, *Environmental Protection and Enhancement Act*, cited in Alberta Environment *Glossary*)

Disinfection By-products: Disinfection by-products are chemical, organic and inorganic substances that can form during a reaction of a disinfectant with naturally present organic or anthropogenic matter in the water. (Lenntech)

Distribution Classification > piped / trucked: Refers to the classification of the delivery of potable water leaving the water treatment plant. This can be either piped (via watermain) or trucked (via truck delivery to individual homes/cisterns). The level of classification involves the number of house connections (population served).

Domestic flows: All demands in the water system excluding fire flows.

Drinking Water: Water of sufficiently high quality that can be consumed or used without risk of immediate or long term harm.

Drinking Water Advisory (DWA): Drinking Water Advisories (DWAs) are preventive measures that are regularly issued in municipalities and communities across Canada; they protect public health from waterborne contaminants that can be present in drinking water. A DWA can be issued in any community and may include *boil water advisories, do not consume advisories* and *do not use advisories.* (INAC "Fact Sheet")

Effluent: 1. The liquid waste of municipalities/communities, industries, or agricultural operations. Usually the term refers to a treated liquid released from a wastewater treatment process. (Bow River) 2. The discharge from any *on-site sewage* treatment component. (Alberta Municipal Affairs; cited in Alberta Environment *Glossary*)

Effluent quality data: Any test results or monitoring data that describes the condition of treated wastewater effluent.

Effluent Quality Requirements: All effluents from wastewater systems in Canada must comply with all applicable federal legislation including the *Canadian Environmental Protection Act, 1999* and the *Fisheries Act,* as well as any other applicable legislation, including provincial, depending on the geographical location of the system.
In addition, all discharges from First Nations wastewater systems shall meet the quality requirements found in the *Guidelines for Effluent Quality and Wastewater Treatment at Federal Establishments* - EPS 1-EC-76-1 (1976 Guidelines).

For the purposes of determining effluent quality related to ammonia and chlorine, the *Notice Requiring the Preparation and Implementation of Pollution Prevention Plans for Inorganic Chloramines and Chlorinated Wastewater Effluents* and the *Guideline for the Release of Ammonia Dissolved in Water Found in Wastewater Effluents* contain additional and/or updated information to the requirements provided in the 1976 Guidelines.

A copy of the *Guideline for the Release of Ammonia Dissolved in Water Found in Wastewater Effluents* can be found at Environment Canada's website. (INAC *Protocol for Centralised Wastewater Systems in First Nations Communities*)

Effluent Receiver (also referred to as the receiving body; the receiving environment; the receiver) (see also Effluent and Component risks): The environment that receives treated wastewater, including lakes, rivers, wetlands, sub-surfaces, title fields, open marines, and enclosed bays. It may also refer to a community's method for dealing with wastewater (e.g. Municipal Type Agreements or evaporation).

Elevated Storage: A water tower, which is a reservoir or storage tank mounted on a tower-like structure at the summit of an area of high ground in a place where the water pressure would otherwise be inadequate for distribution at a uniform pressure. (Collins)

Emergency Response Plan (ERP): Emergency response plans for water and wastewater systems are intended to be a quick reference to assist operators and other stakeholders in managing and responding to emergency situations. They include key contact information for persons to be notified and for persons who may be of assistance (e.g. agencies, contractors, suppliers, etc.), as well as standard communication and response protocols. Emergency response plans identify recommended action for "foreseeable" emergencies, and provide methodologies for unforeseen situations.

Facultative Lagoon: The most common type of wastewater treatment lagoon used by small communities and individual households. Facultative lagoons rely on both aerobic and anaerobic decomposition of waste, can be adapted for use in most climates and require no machinery to treat wastewater.

Filter: A device used to remove solids from a mixture or to separate materials. Materials are frequently separated from water using filters. (Edwards Aquifier)

Filter train equipment: Includes all components that form part of the water filtration process from where the raw water enters the filter process to where the filtered water leaves the treatment unit. This does not refer to the disinfection equipment.

Filtration: The mechanical process which removes particulate matter by separating water from solid material, usually by passing it through sand. (Edwards Aquifier)

Fire pump tests: A monthly test for the basic operation and functionality of the fire pump.

Grade Level Storage: A treated water storage reservoir that is constructed at grade, typically with earth mounded on top to provide some frost protection.

GPS: Global Positioning System (GPS) - A navigational system involving satellites and computers that can determine the latitude and longitude of a receiver on Earth by computing the time difference for signals from different satellites to reach the receiver.

Groundwater: Groundwater is any water that is obtained from a subsurface water-bearing soil unit (called an aquifer). 1) Water that flows or seeps downward and saturates soil or rock, supplying springs and wells. The upper surface of the saturate zone is called the water table. 2) Water stored underground in rock crevices and in the pores of geologic materials that make up the Earth's crust. (INAC, *Protocol for Decentralised Water and Wastewater Systems*)

Groundwater, confined: Groundwater that is under pressure significantly greater than atmospheric, with its upper limit the bottom of a bed with hydraulic conductivity distinctly lower than that of the material in which the confined water occurs. (INAC, *Protocol for Decentralised Water and Wastewater Systems*)

Groundwater, unconfined: Water in an aquifer that has a water table that is exposed to the atmosphere. (INAC *Protocol for Decentralised Water and Wastewater Systems*)

Groundwater under the direct influence of surface water (GUDI): This term refers to groundwater sources (e.g., wells, springs, infiltration galleries, etc.) where microbial pathogens are able to travel from nearby surface water to the groundwater source. (Government of Nova Scotia)

Guidelines: Guidelines as referred to in this Assessment include all federal and provincial water and wastewater guidelines for domestic potable water and household sanitary waste. These guidelines include the "Guidelines for Canadian Drinking Water Quality" and all its recommended health and aesthetic guidelines for water quality.

Guidelines for Canadian Drinking Water Quality (GCDWQ): Water quality guidelines developed by the Federal-Provincial-Territorial Committee on Drinking Water and have been published by Health Canada since 1968.

Canadian drinking water supplies are generally of excellent quality. However, water in nature is never "pure." It picks up traces of everything it comes into contact with, including minerals, silt, vegetation, fertilizers, and agricultural run-off. While most of these substances are harmless, some may pose a health risk. To address this risk, Health Canada works with the provincial and territorial governments to develop guidelines that set out the maximum acceptable concentrations of these substances in drinking water. These drinking water guidelines are designed to protect the health of the most vulnerable members of society, such as children and the elderly. The guidelines set out the basic parameters that every water system should strive to achieve in order to provide the cleanest, safest and most reliable drinking water possible.

The Guidelines for Canadian Drinking Water Quality deal with microbiological, chemical and radiological contaminants. They also address concerns with physical and aesthetic characteristics of water, such as taste and odour. (Health Canada)

Guidelines for Effluent Quality and Wastewater Treatment at Federal Establishments, April 1976: The purpose of these guidelines is to indicate the degree of treatment and effluent quality that will be applicable to all wastewater discharged from existing and proposed Federal installations. Use of these guidelines is intended to promote a consistent wastewater approach towards the cleanup and prevention of water pollution and ensure that the best practicable control technologies used. (Government of Canada)

Highlift Pumping: Refers to pumps installed that provide treated water into the water distribution system at pressure; either directly or via water tower.

Hydrant Flushing (see line flushing and swabbing)

Influent: Water, wastewater, or other liquid flowing into a reservoir, basin or treatment plant. (Gowen)

Lagoon: A shallow pond where sunlight, bacterial action, and oxygen work to purify wastewater. Lagoons are typically used for the storage of wastewaters, sludges, liquid wastes, or spent nuclear fuel. (Edwards Aquifier)

Lagoon, aerated: See Aeration

Lagoon, facultative: See Facultative Lagoon.

L/c/d: Measurement of daily water usage as Litres per capita, per day.

Level of Service Standards (INAC): The Level of Service Standards (LOSS), determined on a national basis, are the levels of service that the Department of Indian Affairs and Northern Development (DIAND) is prepared to financially support to assist First Nations in providing community services comparable to the levels of service that would generally be available in non-native communities of similar size and circumstances.

The Level of Service Standards provide a description of criteria which will be used to establish the level of funding for safe, cost-effective, domestic water supply and wastewater disposal systems for on-reserve housing units and administrative, operative, institutional and recreational buildings. (INAC "Water and Sewage Systems")

Lift Station (also Pumping Station): A point in the sewer system where the wastewater needs to be pumped (lifted) to a higher elevation so that gravity can be used to bring the wastewater to the treatment plant. (Hailey City Hall Public Works)

Line flushing and swabbing (also referred to as watermain swabbing and flushing): Watermain swabbing entails inserting a soft material shaped like a bullet into the watermain through a fire hydrant. The diameter is slightly larger than the watermain and the bullet (swab) is pushed along the watermain by water pressure. As it passes through the watermain, the swab executes a scouring action on the sediment inside the watermain.

During watermain flushing, high velocity water flowing from hydrants is used to remove loose sediment from watermains. (City of Guelph)

L/p/d: Measurement of daily water usage as Litres per person, per day.

MAC (Maximum acceptable concentration): In the Guidelines for Canadian Drinking Water Quality (GCDWQ), Maximum Acceptable Concentrations (MACs) have been established for certain physical, chemical, radiological and microbiological parameters or substances that are known or suspected to cause adverse effects on health. For some parameters, Interim Maximum Acceptable Concentrations (IMACs) are also recommended in the guidelines.

Drinking water that continually has a substance at a greater concentration than the specified MACs will contribute significantly to consumer exposure to the substance and may, in some instances, produce harmful health effects. However, the short-term presence of substances above the MAC levels does not necessarily mean the water constitutes a risk to health. (INAC, *National Assessment Summary Report*)

Maintenance Management Plan (MMP): Maintenance management plans apply to both water and wastewater systems. They are intended to improve the effectiveness of maintenance activities and are focused on planning, scheduling, and documenting preventative maintenance activities and on documenting unscheduled maintenance.

Manganese: Manganese is a mineral that naturally occurs in rocks and soil and is a normal constituent of the human diet. In some places, it exists in well water as a naturally occurring groundwater mineral, but may also be present due to underground pollution sources. Manganese may become noticeable in tap water at concentrations greater than 0.05 milligrams per liter (mg/L) of water by imparting a colour, odour, or taste to the water. However, health effects from manganese are not a concern until concentrations are approximately 10 times higher. (Conneticut Dept. of Health)

Mechanical Plant/ Mechanical Treatment: Refers to any type of wastewater treatment plant including treatments systems consisting of rotating biological contactors (RBC), sequencing batch reactors (SBR), extended aeration (EA), etc. It does not include natural forms of wastewater treatment like lagoons or septic systems.

Metals Scan (Full): A full metal scan refers to what laboratories call Inductively Coupled Plasma Mass Spectrometry (ICP-MS) analysis for the evaluation of trace metals in water samples. This test covers a complete scan of over 20 trace metals in a single analysis.

Municipal Type Agreement (MTA): The situation where First Nations are supplied with treated water from or send their wastewater to a nearby municipality, as outlined in a formal agreement between the two parties. The term is also used in this report to describe a system where the First Nation is supplied with treated water or wastewater treatment services by another First Nation or other independent body such as a corporate entity such as a Casino etc.

Multi-Barrier Approach: Approach used to ensure that drinking water is safe. In the past, the term „multi-barrier' referred only to the barriers involved in the actual treatment of raw water to provide quality drinking water. This approach has now been expanded to include a number of key elements that are an integral part of a drinking water program to ensure delivery of safe, secure supplies of drinking water. Barriers may be physical (eg: filter) or administrative (eg: planning) in nature. (Alberta Environment, *Glossary & Alberta's Drinking Water Program*)

None: Indicates that the treatment and/or distribution/collection system has not been classified.

O & M: Operation and Maintenance.

Operational Plan (OP): An Operational Plan is the primary instrument for communicating the Community's quality management system (QMS) from the public works departments (water and wastewater) to Chief and Council, and from Council to INAC, Health Canada and the community members.

Phosphorus: A non-metallic element of the nitrogen family that occurs widely especially as phosphates (*Merriam-Webster*). Phosphorus occurs naturally in rocks, soil, animal waste, plant material, and even the atmosphere. In addition to these natural sources, phosphorus comes from human activities such as agriculture, discharge of industrial and municipal waste, and surface water runoff from residential and urban areas. Nutrients held in soil can be dissolved in water and carried off by leaching, tile drainage or surface runoff.

Phosphorus does not pose a direct threat to human health; it is an essential component of all cells and is present in bones and teeth. It does, however, pose an indirect threat to both aesthetics and to human health by affecting source waters used for drinking and recreation. For example, excessive nutrients can promote the growth of algal blooms, which can contribute to a wide range of water quality problems by affecting the potability, taste, odour, and colour of the water. (Canadian Council of Ministers of the Environment)

Piped Distribution System: A water distribution system which relies on pipes to convey water through pumping or elevated storage to the end user. Different from trucked distribution in that a trucked distribution system delivers water to end users in batch quantities to individual holding tanks (cisterns).

Potable water: Potable water is water that is destined for human consumption.
For the purposes of the *Protocol for Centralised Drinking Water Systems in First Nations Communities*, water destined for human consumption is water that is consumed directly as drinking water, water that is used in cooking, water that is used to wash food, and water that is used for bathing infants (individuals under 1 year in age). (INAC, *Protocol for Centralised Drinking Water Systems in First Nations Communities*)

PPU: People per unit. Measurement to describe housing density.

Primary Operator: The main operator of a water or wastewater system. The primary operator must be certified to the level of the treatment and distribution/collection system.

Primary Wastewater Treatment: Removal of particulate materials from domestic wastewater, usually done by allowing the solid materials to settle as a result of gravity. Typically, the first major stage of treatment encountered by domestic wastewater as it enters a treatment facility. Primary treatment plants generally remove 25 to 35 percent of the *Biological Oxygen Demand (BOD)* and 45 to 65 percent of the total suspended matter. Also, any process used for the decomposition, stabilization, or disposal of sludges produced by settling. (North American Lake Management Society; cited in Alberta Environment *Glossary*)

Protocol for Safe Drinking Water in First Nations Communities: Standards for design, construction, operation, maintenance, and monitoring of drinking water systems and is intended for use by First Nations staff responsible for water systems. It is also intended for use by Indian and Northern Affairs Canada (INAC) staff, Public Works and Government Services Canada (PWGSC) for INAC staff, and all others involved in providing advice or assistance to First Nations in the design, construction, operation, maintenance, and monitoring of their drinking water systems in their communities, in accordance with established federal or provincial standards, whichever are the most stringent.

Any water system that produces drinking water destined for human consumption, that is funded in whole or in part by INAC, and that serves five or more households or a public facility, must comply with the requirements of this protocol. (INAC *Protocol*)

Quality Assurance/Quality Control (QA/QC): A quality management system that focuses on fulfilling quality requirements and providing confidence that quality requirements will be fulfilled.

Reporting Risk: The Reporting risk level is the risk inherent with the operational method of recording data and providing the required reports. This would include both manual and automatic methods of record keeping. The reporting risk ranking is based on the adequacy of the operational records and the number of reports submitted during the year compared to the total number of records and reports required according to the appropriate legislation, standards, and operation procedures of the system in question.

Reservoir: A man-made lake that collects and stores water for future use. During periods of low river flow, reservoirs can release additional flow if water is available. (Government of Alberta, *Water for Life*, cited in Alberta *Glossary*)

Reservoir Cleaning: This involves the pump-down, clean-out, removal of settled material, disinfection and refill of a water storage reservoir. This activity requires confined space entry equipment and training.

Retrofit: 1. To furnish with new or modified parts or equipment not available or considered necessary at the time of manufacture; 2. To install (new or modified parts or equipment) in something previously manufactured or constructed; 3**.** To adapt to a new purpose or need**:** modify. (*Merriam-Webster*)

Rotating Biological Contactor (RBC): A technology used to treat wastewater classified as mechanical treatment.

Risk (Management Risk Level/Management Risk Score): Risk is defined in INAC's *Management Risk Level Evaluation Guidelines for Water and Wastewater Systems in First Nations Communities* (Revised 2010). These guidelines follow the Multi-Barrier Approach for water management. This approach, developed by the Federal-Provincial-Territorial Committee on Drinking Water and the Canadian Council of Ministers of the Environment (CCME) Water Quality Task Group, is intended to prevent the presence of water-borne contaminants in drinking water by ensuring effective safeguards are in place at each stage of a drinking water system.

Following that approach, INAC assesses five main components of a system to determine an overall system management risk score:
-Source Water (drinking water systems) or Effluent Receiver (wastewater systems)
-System Design
-Operation and Maintenance
-Records and Reporting
-Operator Training and Experience

Each of these components is assigned a risk score, which are then weighed to determine the overall management risk score of a system. The resulting score will then result in the management of the system as being classified as either high risk, medium risk, or low risk.

-High Risk: Major deficiencies in most of the components. Should a problem arise, the system and management as a whole is unlikely to be able to compensate, thus there is a high probability that any problem could result in unsafe water. Issues should be addressed as soon as possible.

-Medium Risk: Minor deficiencies in several components, or major deficiencies in one or two components. Should a problem arise, the system and management can probably compensate for the problem, but the noted deficiencies makes this uncertain, thus there is a medium probability that any problem could result in unsafe water. Issues need to be addressed.

-Low Risk: Minor or no deficiencies with the system or management. Should a problem occur, it is likely that the system and management as a whole will be able to compensate and continue to provide safe water while the issue is being resolved.

It is important to distinguish between INAC's system management risk level and drinking water quality. The actual quality of the water produced by a system is but one part of determining the overall system management risk level.

Unsafe drinking water is noted through the implementation of Drinking Water Advisories (DWA), not by the management risk level of the system. DWA come in multiple forms, the most common being the boil water advisory.

A system with a high-risk ranking under INAC's management evaluation is, because of its multiple deficiencies, likely to be unable to cope with problems that may occur in the system that result in a DWA. This means that DWA are likely to occur more frequently and to have a longer-term duration on a high-risk system. On the other hand, while problems can and do occur in low-risk systems, because of better overall risk management, these systems are more likely to address the problem in the short term, resulting in the rapid removal of problems and DWA.

This means that a high-risk drinking system can still produce perfectly safe and potable water. Deficiencies should be addressed as quickly as possible, however, before any issues arise with the water quality. (INAC, *Management Risk Level Evaluation Guidelines*)

SCADA (Supervisory Control and Data Acquisition) system: Refers to a control and/or computer system that can monitor, record and control infrastructure, or facility-based processes.

Screened reservoir vents: Reservoir vents should be screened to allow air movement and to prevent vermin from entering.

Seasonal discharge: Discharge of wastewater at times of maximum or substantial stream flow. This may vary from location to location.

Secondary containment for treatment chemicals: Secondary containment is required for the storage of all regulated hazardous materials. Secondary containment must be constructed using materials capable of containing a spill or leak for at least as long as the period between monitoring inspections. A means of providing overfill protection for any primary container may be required. This may be an overfill prevention device and/or an attention getting high level alarm. Materials that in combination may cause a fire or explosion, the production of a flammable, toxic, poisonous gas, or the deterioration of a primary or secondary container will be separated in both the primary and secondary treatment containment so as to avoid intermixing.

Secondary Treatment: involving the biological process of reducing suspended, colloidal, and dissolved organic/inorganic matter in effluent from primary treatment systems and which generally removes 80 to 95 percent of the *Biochemical Oxygen Demand (BOD)* and suspended matter. Secondary wastewater treatment may be accomplished by biological or chemical-physical methods. Activated sludge and trickling filters are two of the most common means of secondary treatment. (North American Lake Management Society, cited in Alberta *Glossary*)

Septic tank: A tank used to detain domestic wastes to allow the settling of solids prior to distribution to a leach field for soil absorption. Septic tanks are used when a piped wastewater collection system is not available to carry them to a treatment plant. A settling tank in which settled sludge is in immediate contact with sewage flowing through the tank, and wherein solids are decomposed by anaerobic bacterial action. (INAC *Protocol for Centralised Wastewater*)

Septic system: A combination of underground pipe(s) and holding tank(s) which are used to hold, decompose, and clean wastewater for subsurface disposal. (Bow River, cited in Alberta *Glossary*)

Sequencing Batch Reactor (SBR): A treatment technology used to treat wastewater classified as mechanical treatment.

Sewage treatment plant (STP) (also known as Wastewater Treatment Plant (WWTP) or Water Pollution Control Plant (WPCP)): Facility designed to treat wastewater (sewage) by removing materials that may damage water quality and threaten public health. (Ontario Ministry of Environment)

Sewage treatment systems: Facility or system designed to treat wastewater (sewage) by removing materials that may damage water quality and threaten public health. (Ontario Ministry of Environment)

Shoot-out: A septic system consisting of a septic tank with untreated wastewater effluent being discharged to the surface; this poses a health risk.

Sludge: The accumulated wet or dry solids that are separated from wastewater during treatment. This includes precipitates resulting from the chemical or biological treatment of wastewater. (Government of Alberta, *Activities*, cited in Alberta *Glossary*)

Source Classification: The determination of the water source classification in this assessment includes the options of: surface water, groundwater, GUDI or MTA. Surface water includes water from lakes or rivers; groundwater includes any well water that is not influenced by surface water infiltration; GUDI is any groundwater source under the direct influence of surface water; MTA as a source refers to the community acquiring the treated water from a municipality.

Source risk: The risk inherent in the quality and quantity of the raw source water prior to treatment.

Source Water Protection: 1. The prevention of pollution of the lakes, reservoirs, rivers, streams, and groundwater that serve as sources of drinking water. Wellhead protection would be an example of a source water protection approach that protects groundwater sources, whereas management of land around a lake or reservoir used for drinking water would be an example for surface water supplies. Source water protection programs typically include: delineating source water protection areas; identifying sources of

contamination; implementing measures to manage these changes; and planning for the future. (North American Lake Management Society, cited in Alberta *Glossary*)

2. Action taken to control or minimize the potential for introduction of chemicals or contaminants in source waters, including water used as a source of drinking water (Alberta Environment, *Standards and Guidelines*, cited in Alberta *Glossary*).

SPS: An abbreviation of the term sewage pumping station.

Standard Operating Procedures (SOPs): An SOP is a written document or instruction detailing all steps and activities of a process or procedure. This would include all procedures used in water/wastewater treatment processes that could affect the quality.

Standpipe Storage: An above-grade storage facility where the storage volume is contained within the entirety of the structure. This type of storage is most feasible for use where there is sufficient change in the topography to allow for maximum usable volume in the standpipe.

Storage Type: Refers to whether the community water storage is via grade-level, below-grade or elevated storage (including standpipes and towers). In some cases there is no storage thus the storage type would be considered "direct pump."

Surface water: Surface water is any water that is obtained from sources, such as lakes, rivers, and reservoirs that are open to the atmosphere. (INAC, *Protocol for Centralised Drinking Water*)

System Designer: A system designer is a person, such as a professional engineer, who is qualified to design a water or wastewater systems. (INAC, *Protocol for Centralised Drinking Water*)

System Operator: A system operator is a First Nation employee or third party under contract to a First Nation who is tasked with managing a water or wastewater system. (INAC, *Protocol for Centralised Drinking Water*)

System Manager: A system manager is a First Nation employee or third party under contract to a First Nation who is tasked with managing a water or wastewater system. (INAC, *Protocol for Centralised Drinking Water*)

Tertiary Treatment: Selected biological, physical, and chemical separation processes to remove organic and inorganic substances that resist conventional treatment practices. *Tertiary Treatment* processes may consist of flocculation basins, clarifiers, filters, and chlorine basins or ozone or ultraviolet radiation processes. Tertiary techniques may also involve the application of wastewater to land to allow the growth of plants to remove plant nutrients. Can include advanced nutrient removal processes. (North American Lake Management Society, cited in Alberta *Glossary*)

Trihalomethanes (THMs): Chemical compounds that can be formed when water is disinfected using chlorine or bromine as the chemical disinfection agent. These chemical compounds are formed when organic material present in the raw source water reacts with chlorine or bromine. Therefore, THMs are classified as disinfection by-products (DBPs). The primary source of organic material comes from decaying vegetation found in lakes, rivers and streams and for this reason, THMs are more commonly observed in water systems that use a surface water source. The four chemical compounds that are measured and used to calculate total THMs are: chloroform, bromoform, bromodichloromethane (BDCM) and chlorodibromomethane (CDBM). THMs are a concern in potable water because there is scientific evidence that they may pose a risk in the development of cancer.

Treatment Certification: The treatment level to which an operator is certified for water treatment and distribution and wastewater treatment and collection systems (see Treatment Classification).

Treatment Classification: The size (flow) and complexity of a water or wastewater system is used to determine the Class of a system using a point template. The knowledge and experience it takes to operate a system is closely related to its classification and is reflected in the level of certification of the operator. Systems that are small and relatively simple, are classified as Small Water or Wastewater Systems. Larger or more complex systems are ranked as Class I, II, III, and IV with the highest being Class IV. Systems should be operated under the supervision of an operator certified to at least the same level of the facility.

TSS (Total Suspended Solids): Measure of the amount of non-dissolved solid material present in water or wastewater. Total suspended solids (TSS) can cause: a) interference with light penetration (in UV applications), b) build-up of sediment and c) can carry nutrients and other toxic pollutants that cause algal blooms and potential reduction in aquatic habitat (wastewater).

Underground Storage: A water storage facility (reservoir/clearwell) which is located 100% below-grade. Often located below the water treatment plant.

Waste: Any solid or liquid material, product, or combination of them that is intended to be treated or disposed of or that is intended to be stored and then treated or disposed. This does not include recyclables. (Government of Alberta, Activities Designation Regulation, cited in Alberta *Glossary*)

Waste management plan: A Waste Management Plan identifies and describes types of waste generated during operations and how they are managed and disposed of.

Wastewater (*Industrial Wastewater, Domestic Wastewater)*: A combination of liquid and water-carried pollutants from homes, businesses, industries, or farms; a mixture of water and dissolved or suspended solids. (North American Lake Management Society, cited in Alberta *Glossary*)

Wastewater System: an organized process and associated structures for collecting, treating, and disposing of wastewater. For the purposes of this report, it is a system serving five or more houses. It includes any or all of the following:
1. Sewers and pumping stations that make up a wastewater collection system.
2. Sewers and pumping stations that transport untreated wastewater from a wastewater collection system to a wastewater treatment plant.
3. Wastewater treatment plants.
4. Facilities that provide storage for treated wastewater.
5. Wastewater sludge treatment and disposal facilities.
6. Sewers that transport treated wastewater from a wastewater treatment plant to the place where it is disposed of.
7. Treated wastewater outfall facilities, including the outfall structures to a watercourse or any structures for disposal of treated wastewater to land or to wetlands. (Government of Alberta, *Environmental Protection and Enhancement Act*, cited in Alberta *Glossary*)

Wastewater Treatment: Any of the mechanical, chemical or biological processes used to modify the quality of wastewater (sewage) in order to make it more compatible or acceptable to man and his/her environment. (North American Lake Management System, cited in Alberta *Glossary*)

Wastewater Treatment Plant: Any structure, thing, or process used for the physical, chemical, biological, or radiological treatment of wastewater before it is returned to the environment. The term also includes any structure, thing, or process used for wastewater storage or disposal, or sludge treatment, storage, or disposal. (Government of Alberta, *Activities*, cited in Alberta *Glossary*)

Watermain: A principal pipe in a system of pipes for conveying water, especially one installed underground. (*American Heritage Dictionary*)

Water quality: The term used to describe the chemical, physical, and biological characteristics of water, usually with respect to its suitability for a particular purpose. (INAC, *Protocol for Centralised Drinking Water*)

Water use: The term water use refers to water that is used for a specific purpose, such as for domestic use, irrigation, or industrial processing. Water use pertains to human interaction with and influence on the hydrolic cycle, and includes elements, such as water withdrawal from surface- and ground-water sources, water delivery to homes and businesses, consumptive use of water, water released from wastewater-treatment plans, water returned to the environment, and in-stream uses, such as using water to produce hydroelectric power. (INAC, *Protocol for Centralised Drinking Water*)

Water Well: An opening in the ground, whether drilled or altered from its natural state, that is used for the production of groundwater, obtaining data on groundwater, or recharging an underground formation from which groundwater can be recovered. By definition in the provincial Water Act, a water well also includes any related equipment, buildings, and structures. (Government of Alberta, *Water for Life*, cited in Alberta, *Glossary*)

Wellhead Protection Area: A protected surface and subsurface zone surrounding a well or well field supplying a public water system to keep contaminants from reaching the well water. (Edwards Aquifier)

Wellhead Protection Plan: A wellhead protection plan defines the wellhead protection area, identifies potential sources of contamination, manages the potential contaminant sources including properly decommissioning abandoned wells, identifies emergency and contingency plans (i.e. what to do if the well becomes contaminated or requires additional capacity) and provides overall public awareness.

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Appendix B

Water System Summary

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Appendix B.1
Water System Summary

Regional Roll-Up Summary

Region: YUKON
Total No. of First Nations: 17
Participating No. of First Nations: 17
Participation Level: 100%
No. of Community Reports Issued: 18

Water

		Groundwater	GUDI	Surface	MTA	Totals
Total No. of Systems		**11**	**1**	**2**	**10**	**24**
System Age						
	0-5 years (2006 - 2010)	3	0	1	0	**4**
	6-10 years (2001 - 2005)	3	0	0	0	**3**
	10-15 years (1996 - 2000)	2	1	0	0	**3**
	15 -20 years (1991 - 1995)	1	0	1	0	**2**
	> 20 years (≤ 1990)	2	0	0	10	**12**
Treatment						
	None - Direct Use	2	0	0	0	**2**
	Disinfection only	1	1	0	0	**2**
	Conventional Filtration	8	0	2	0	**10**
	MTA	0	0	0	10	**10**
Classification - Treatment						
	Small system	5	0	0	0	**5**
	Level I	6	1	0	0	**7**
	Level II	0	0	2	0	**2**
	MTA	0	0	0	10	**10**
Classification - Distribution						
	Small system	7	1	0	0	**8**
	Level I	3	0	2	0	**5**
	MTA	0	0	0	8	**8**
	None	1	0	0	2	**3**

				Groundwater	GUDI	Surface	MTA	Totals
Total No. of Systems				**11**	**1**	**2**	**10**	**24**
Distribution								
	Piped			4	0	1	0	**5**
	Trucked			5	0	1	7	**13**
	Self Haul			1	0	0	0	**1**
	Combined			1	1	0	3	**5**
Water Quality								
	Fails Health							
		Yes, fails health due to:		3	1	0	1	**5**
			Design	2	0	0	0	**2**
			Combination	1	1	0	0	**2**
			Unknown	0	0	0	1	**1**
	Fails Aesthetic							
		Yes, fails aesthetic due to:		4	0	0	1	**5**
			Design	2	0	0	0	**2**
			Operation	0	0	0	0	**0**
			Combination	1	0	0	0	**1**
			Unknown	1	0	0	1	**2**
Primary Operator - Treatment								
	Not certified			2	0	0	0	**2**
	No operator			0	0	0	0	**0**
	Not required			0	0	0	10	**10**
	Certified to Level			5	0	0	0	**5**
	Certified			4	1	2	0	**7**
Back-up Operator - Treatment								
	Not certified			6	1	2	0	**9**
	No operator			3	0	0	0	**3**
	Not required			0	0	0	10	**10**
	Certified to Level			2	0	0	0	**2**
	Certified			0	0	0	0	**0**

		Groundwater	GUDI	Surface	MTA	Totals	
Total No. of Systems		**11**	**1**	**2**	**10**	**24**	
Primary Operator - Distribution							
	Not certified	0	0	0	0	**0**	
	No operator	0	0	0	0	**0**	
	Not required	1	0	0	10	**11**	
	Certified to Level	7	1	2	0	**10**	
	Certified	3	0	0	0	**3**	
Back-up Operator - Distribution							
	Not certified	4	1	2	0	**7**	
	No operator	2	0	0	0	**2**	
	Not required	1	0	0	10	**11**	
	Certified to Level	4	0	0	0	**4**	
	Certified	0	0	0	0	**0**	
Risk (mean)						**Mean**	**Mean excluding MTA**
	Final	5.9	8.0	3.1	2.2	**4.2**	**5.7**
	Source	3.9	9.0	8.0	1.3	**3.4**	**4.9**
	Design	5.9	8.0	3.0	2.2	**4.2**	**5.6**
	Operations	6.0	8.0	3.0	3.1	**4.6**	**5.7**
	Reporting	9.3	8.0	3.5	1.9	**5.7**	**8.4**
	Operator	2.4	1.0	1.0	1.5	**1.8**	**2.1**

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Appendix B.2

Wastewater System Summary

Regional Roll-Up Summary

Region: YUKON
Total No. of First Nations: 17
Participating No. of First Nations: 17
Participation Level: 100%
No. of Community Reports Issued: 18

Wastewater

	Septic	Aerated Lagoon	Facultative Lagoon	Mechanical	Other	MTA	Totals
Total No. of Systems	**0**	**0**	**2**	**0**	**0**	**9**	**11**
System Age							
0-5 years (2006 - 2010)	0	0	0	0	0	0	**0**
6-10 years (2001 - 2005)	0	0	0	0	0	0	**0**
10-15 years (1996 - 2000)	0	0	0	0	0	0	**0**
15 -20 years (1991 - 1995)	0	0	0	0	0	1	**1**
> 20 years (≤ 1990)	0	0	2	0	0	8	**10**
Classification - Treatment							
Small System	0	0	1	0	0	0	**1**
MTA	0	0	0	0	0	9	**9**
Level I	0	0	1	0	0	0	**1**
Classification - Collection							
Small System	0	0	1	0	0	0	**1**
Level I	0	0	1	0	0	0	**1**
MTA	0	0	0	0	0	8	**8**
None	0	0	0	0	0	1	**1**
Collection							
Piped	0	0	0	0	0	4	**4**
Trucked	0	0	1	0	0	5	**6**
Combined	0	0	1	0	0	0	**1**
Effluent Quality							
Meets	0	0	2	0	0	3	**5**
No Data	0	0	0	0	0	6	**6**

		Septic	Aerated Lagoon	Facultative Lagoon	Mechanical	Other	MTA	Totals	
Total No. of Systems		**0**	**0**	**2**	**0**	**0**	**9**	**11**	
Primary Operator - Treatment									
	Not certified	0	0	0	0	0	0	**0**	
	No operator	0	0	2	0	0	0	**2**	
	Not required	0	0	0	0	0	9	**9**	
	Certified to Level	0	0	0	0	0	0	**0**	
	Certified	0	0	0	0	0	0	**0**	
Back-Up Operator - Treatment									
	Not certified	0	0	0	0	0	0	**0**	
	No operator	0	0	2	0	0	0	**2**	
	Not required	0	0	0	0	0	9	**9**	
	Certified to Level	0	0	0	0	0	0	**0**	
	Certified	0	0	0	0	0	0	**0**	
Primary Operator - Collection									
	Not certified	0	0	0	0	0	0	**0**	
	No operator	0	0	2	0	0	0	**2**	
	Not required	0	0	0	0	0	9	**9**	
	Certified to Level	0	0	0	0	0	0	**0**	
	Certified	0	0	0	0	0	0	**0**	
Back-Up Operator - Collection									
	Not certified	0	0	0	0	0	0	**0**	
	No operator	0	0	2	0	0	0	**2**	
	Not required	0	0	0	0	0	9	**9**	
	Certified to Level	0	0	0	0	0	0	**0**	
	Certified	0	0	0	0	0	0	**0**	
Receiver									
	Evaporation	0	0	2	0	0	0	**2**	
	MTA	0	0	0	0	0	9	**9**	
Risk (mean)								**Mean**	**Mean excluding MTA**
	Final	0.0	0.0	4.3	0.0	0.0	1.4	**2.0**	**4.3**
	Effluent Receiver	0.0	0.0	2.0	0.0	0.0	1.0	**1.2**	**2.0**
	Design	0.0	0.0	3.5	0.0	0.0	1.3	**1.7**	**3.5**
	Operations	0.0	0.0	7.0	0.0	0.0	2.6	**3.4**	**7.0**
	Reporting	0.0	0.0	2.5	0.0	0.0	1.0	**1.3**	**2.5**
	Operator	0.0	0.0	5.5	0.0	0.0	1.0	**1.8**	**5.5**

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Appendix C
Site Visit Methodology

Site Visits

Typical Day

Arrive in Community – Lead/Senior Inspector & Technical Support

- Meet with Circuit Rider and/or DIAND representative and First Nation/Tribal Council Representatives to undergo introductions and provide a brief synopsis of the activities to be undertaken for the day. This is based on the assumption that the First Nation has been fully briefed by DIAND on the purpose, process and benefits for the First Nation to cooperate and collaborate with the project.
- Confirm the various components that the First Nation uses to provide water to the entire community (i.e. number and types of distribution systems, source types, private wells, etc.) to help build assessment form for the community.
- Pre-select areas to undertake private system evaluations on community map.
- Confirm any missing background data that may be available allowing the First Nation time during the day to have Public Works Director/Supervisor/Secretary/etc to locate such materials.

Lead/Senior – Inspector

- Meet with Chief/Housing Manager/Band Manager/Finance Manager, to identify:
    - future servicing needs (planned development and population growth)
    - servicing constraints (source availability, soils, groundwater, bedrock, topography, etc.)
    - identify the extent to which non structural solutions or optimization strategies (water conservation, leak reduction, etc) have been previously investigated or implemented
    - confirm current population and housing numbers
    - obtain financial information not previously provided
    - note community concerns related to future servicing.
- Complete a walk through of the water plant from source to storage.
- Prepare a flow schematic (internal use).
- Complete the assessment questionnaire on treatment/storage/operations/operator(s) etc. with Operator/Circuit Rider.
- Take photographs.
- Travel to main sewage pumping station and wastewater treatment facility.
- Complete a walk through of the plant from influent to effluent.
- Prepare a flow schematic (internal use).
- Complete assessment questionnaire.
- Take photographs.
- Complete ACRS update.
- Repeat for additional water or wastewater facilities.
- Review information collected by Technical Support
- Gather all background/operational data gathered by First Nation.
- Complete overall notes.

Technical Support

- Gather any relevant operational data (water and wastewater), if not already provided and arrange with the First Nation to have copied/scanned that day.
- Obtain GPS coordinates of source(s) and treatment.
- Complete the source questions on the assessment questionnaire.
- Undertake sampling of the raw and/or treated water, if necessary.
- Take photographs.
- Complete ACRS update.
- Travel around community with First Nation representative and undertake private system assessments for water and/or septic including GPS coordinates, photographs, assessment forms and sampling.
- Meet back with Lead/Senior Inspector at wastewater location and assist with sampling, if required.

Sampling Requirements

Water Sampling

The terms of reference state, *"The sampling program for public water systems should reflect the requirements of the most stringent regulations applicable in the Province in which the community is located. However, should an adequate sampling program already be in place, then existing data may be used. Bidders should assume sampling and testing will be required for 5% of total wells, septics, and cisterns identified in SW5. Septics and cisterns only require a visual inspection. All bidders are required to carry a $500,000 allowance for this purpose. Any variances should be identified in the Inception Report."*

Health Canada data is anticipated to be available for the majority of the water systems. Where data is not available, sampling will be conducted as part of the inspection.

Minimum existing data required will include:

Community systems
- bacteriological – monthly available for previous year
- general chemistry – annually (treated)
- full Volatile Organic Compound analysis – within 5 years

Private wells
- bacteriological – one sample within past year
- basic chemistry – one sample within past year

For public systems where data is not available, treated water samples will be obtained and submitted to a laboratory for testing that would include; Basic Chemistry, Full Metals Scan, Bacteria and Volatile Organic Compounds.

For public systems that include a piped distribution system and where distributed water quality data is not available, a sample will be taken from the most remote point in the distribution system and sampled for Disinfection By-Products.

For individual wells, samples will be obtained from a representative number of wells (5% of total wells) in the community. The testing will include; Basic Chemistry, Full Metals Scan and Bacteria.

Wastewater Sampling

For systems lacking existing discharge quality data, and that will be discharging at the time of the site visit, representative samples will be obtained and submitted to a laboratory for testing. This would include seasonal discharges at the time of the site visit and from plants with continuous discharge to a receiving body. Sewage treatment systems providing an equivalent to secondary treatment (lagoons, and mechanical facilities) for which effluent quality data does not include the parameters of BOD_5, TSS, and E.Coli, will be sampled in the field, if they are in fact discharging at the time of site visit. Similarly, sewage treatment systems providing an equivalent to tertiary treatment for which effluent quality data does not include BOD_5, TSS, Ammonia, Total Phosphorous and E.Coli, will be sampled in the field, if they are in fact discharging at the time of the site visit.

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Appendix D

First Nation Water Summaries

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Appendix D.1

Individual First Nation Water Summary

Table D.1 - 1: Water System Regional Summary of Water Treatment, Storage and Distribution Systems

First Nation Information		Water System Information			Water System Design Information						Storage Information		Distribution System Information						
Band #	Band Name	System #	System Name	Water Source	Treatment Class	Const Year	Design Capacity [m3/d]	Actual Capacity [m3/d]	Max Daily Volume [m3/d]	Disinfection	Storage Type	Storage Capacity	Distribution Class	Population Served	Homes Piped	Homes Trucked	Number of Trucks in Service	Pipe Length	Pipe Length / Connection
491	Carcross/Tagish First Nations No. 140	7078	Carcross/Tagish Well and WTP	MTA	MTA	0				MTA		MTA	MTA	182	0	79	0		
491	Carcross/Tagish First Nations No. 140		TAGISH TRUCK FILL STATION	Groundwater	Small System	1999	95.0	95.0	22.1	Yes	Grade level	20.46	Small System	175	0	66	1		
507	Champagne and Aishihik First Nations	7110	9999- Champagne Aishihik WTP Takhini	Groundwater	Level I	1995	108.84	108.84	12.1	Yes	Grade level	54	Level I	96	0	30	1		
507	Champagne and Aishihik First Nations	NEW001	MTA	MTA	MTA	0		28.3	28.3	MTA	None	MTA	NA	224	0	70	1		
504	Dease River	7093	Dease River WTP	Groundwater GUDI	Level I	1999		190	51.8	Yes	None		Small System	68	30	10	1	1712	57
495	First Nation of Nacho Nyak Dun	7112	9999- Nacho Nyak Dun - Water Delivery	MTA	MTA	0				MTA		MTA	MTA	297	75	24	1	100	1
503	Kluane First Nation	7088	08435- Kluane WTP	Groundwater	Small System	2000	99	99	9	Yes	Grade level	9500	Small System	104	0	50	1		
500	Kwanlin Dun First Nation	7096	08454-Kwanlin Dun First Nation	MTA	MTA	1990				MTA		MTA	MTA	884	200	7	1	5313	26
502	Liard First Nation	7081	08412- Liard River - Water truck	MTA	MTA	1950	23.8	23.8	23.8	MTA	None	MTA	NA	189	0	70	1		
502	Liard First Nation		EAST CLUSTER WELL	Groundwater	Level I	2003	13.6	13.6	13.6	No	None		Small System	14	5	0	0		
502	Liard First Nation		WEST CLUSTER WELL	Groundwater	Level I	2002	13.6	13.6	13.6	No	None		Small System	14	5	0	0		
492	Little Salmon/Carmacks First Nation	NEW001	PTARMIGAN SELF HAUL	Groundwater	Small System	2005	11.2	11.2	0.5	No	None		NA	48	0	0	0		
492	Little Salmon/Carmacks First Nation		WATER TREATMENT SYSTEM	Groundwater	Small System	1983	43.6	43.6	9	Yes	Elevated	2	Small System	71	0	24	1		
424	Lower Post First Nation	7085	Lower Post, BC Water Delivery - Daylu Dene FN	Groundwater	Level I	1950	518.4	345.6	17	Yes	Underground	42	Small System	135	0	44	1		
497	Ross River	9867	Ross River Dena Council Water Treatment System	MTA	MTA	0				MTA	None	MTA	MTA	411	0	115	0		
498	Selkirk First Nation	7082	SELKIRK NO. 7 Willow Creek Community Well (Trucked Water)	Groundwater	Small System	2009	168	168	186	Yes	Underground	60	Small System	275	55	30	1	9230	167
508	Ta'an Kwach'an	NEW001	MTA	MTA	MTA	1980				MTA	None	MTA	MTA	44	0	11	0		
501	Taku River Tlingit	7091	08445- Taku 5 mile	Surface Water	Level II	1992	432	432	36	Yes	Underground	22	Level I	120	0	39	1		
501	Taku River Tlingit	7092	08445- Taku Village WTP	Surface Water	Level II	2008	432	432	27	Yes	Underground	14	Level I	28	14	0	0	1125	80
499	Teslin Tlingit Council	9861	Teslin Tlingit Council Water Treatment System	MTA	MTA	1988				MTA	None	MTA	MTA	244	0	75	1		
494	Tr'ondëk Hwëch'in	9863	Tr'on dek Hwech'in Water Treatment System - MTA	MTA	MTA	1950				MTA	None	MTA	MTA	319	120	12	0		
496	Vuntut Gwitchin		VUNTUT GWITCHIN WATER TREATMENT SYSTEM (MTA)	MTA	MTA	0				MTA	None	MTA	MTA	359	0	115	1		
506	White River First Nation	NEW001	SYSTEM NO. 1	Groundwater	Level I	2008	138	138	31	Yes	Grade level	18	Level I	32	9	0	0	731	81
506	White River First Nation	NEW002	SYSTEM NO. 2	Groundwater	Level I	2008	138	138	28	Yes	Grade level	18	Level I	29	8	0	0	420	52

Table D.1 - 2: Regional Summary of Water Quality Information

First Nation Information		Water System Information			Water Quality Information							
Band #	Band Name	System #	System Name	Water Source	Meets Guidelines	Quality - Cause of Failure	Quality - Fails Health Guidelines	Quality - Fails Aesthetic Guidelines	Quality - Fails MAC by Design	Quality - Fails MAC by Operation	DWA In Effect	DWA Count
491	Carcross/Tagish First Nations No. 140	7078	Carcross/Tagish Well and WTP	MTA	Meets Requirements	N/A	N/A	N/A	No	No	No	0
491	Carcross/Tagish First Nations No. 140		TAGISH TRUCK FILL STATION	Groundwater	High Freq AND High Mag	Design	Yes	No	No	No	No	0
507	Champagne and Aishihik First Nations	7110	9999- Champagne Aishihik WTP Takhini	Groundwater	High Freq AND High Mag	Design	Yes	No	No	No	No	0
507	Champagne and Aishihik First Nations	NEW001	MTA	MTA	Meets Requirements	N/A	N/A	N/A	No	No	No	0
504	Dease River	7093	Dease River WTP	Groundwater GUDI	Low Freq, Low Mag	Both	Yes	No	Yes	Yes	Yes	1
495	First Nation of Nacho Nyak Dun	7112	9999- Nacho Nyak Dun - Water Delivery	MTA	Meets Requirements	N/A	N/A	N/A	No	No	No	0
503	Kluane First Nation	7088	08435- Kluane WTP	Groundwater	Low Freq, Low Mag	Both	Yes	Yes	No	Yes	No	0
500	Kwanlin Dun First Nation	7096	08454-Kwanlin Dun First Nation	MTA	Meets Requirements	N/A	N/A	N/A	No	No	No	0
502	Liard First Nation	7081	08412- Liard River - Water truck	MTA	Meets Requirements	N/A	N/A	N/A	No	No	No	0
502	Liard First Nation		EAST CLUSTER WELL	Groundwater	High Freq OR High Mag	Design	No	Yes	No	No	No	0
502	Liard First Nation		WEST CLUSTER WELL	Groundwater	High Freq OR High Mag	Design	No	No	No	No	No	0
492	Little Salmon/Carmacks First Nation	NEW001	PTARMIGAN SELF HAUL	Groundwater	Meets Requirements	N/A	N/A	N/A	No	No	No	0
492	Little Salmon/Carmacks First Nation		WATER TREATMENT SYSTEM	Groundwater	High Freq, Low Mag	Design	No	Yes	No	No	No	0
424	Lower Post First Nation	7085	Lower Post, BC Water Delivery - Daylu Dene FN	Groundwater	Meets Requirements	N/A	No	Yes	No	No	No	0
497	Ross River	9867	Ross River Dena Council Water Treatment System	MTA	High Freq AND High Mag	Unknown	Yes	Yes	No	No	No	0
498	Selkirk First Nation	7082	SELKIRK NO. 7 Willow Creek Community Well (Trucked Water)	Groundwater	Meets Requirements	N/A	N/A	N/A	No	No	No	0
508	Ta'an Kwach'an	NEW001	MTA	MTA	Meets Requirements	N/A	N/A	N/A	No	No	No	0
501	Taku River Tlingit	7091	08445- Taku 5 mile	Surface Water	Meets Requirements	N/A	N/A	N/A	No	No	No	0
501	Taku River Tlingit	7092	08445- Taku Village WTP	Surface Water	Meets Requirements	N/A	N/A	N/A	No	No	No	0
499	Teslin Tlingit Council	9861	Teslin Tlingit Council Water Treatment System	MTA	Meets Requirements	N/A	N/A	N/A	No	No	No	0
494	Tr'ondëk Hwëch'in	9863	Tr'on dek Hwech'in Water Treatment System - MTA	MTA	Meets Requirements	N/A	N/A	N/A	N/A	No	No	0
496	Vuntut Gwitchin		VUNTUT GWITCHIN WATER TREATMENT SYSTEM (MTA)	MTA	Meets Requirements	N/A	N/A	N/A	No	No	No	0
506	White River First Nation	NEW001	SYSTEM NO. 1	Groundwater	Meets Requirements	N/A	N/A	N/A	No	No	No	0
506	White River First Nation	NEW002	SYSTEM NO. 2	Groundwater	Meets Requirements	N/A	N/A	N/A	No	No	No	0

Table D.1 - 3: Regional Summary of Water Operator Information

First Nation Information		Water System Information			Operator Information					
Band #	Band Name	System #	System Name	Water Source	Primary Operator Exists	Primary Operator Treatment Class	Primary Operator Distribution Class	Secondary Operator Exists	Secondary Operator Treatment Class	Secondary Operator Distribution Class
491	Carcross/Tagish First Nations No. 140	7078	Carcross/Tagish Well and WTP	MTA	NR	Not Required	Not Required	No	Not Required	Not Required
491	Carcross/Tagish First Nations No. 140		TAGISH TRUCK FILL STATION	Groundwater	Yes	Not Required	No Operator	Yes	Not Required	No Operator
507	Champagne and Aishihik First Nations	7110	9999- Champagne Aishihik WTP Takhini	Groundwater	Yes	Not Required	No Operator	No	Not Required	No Operator
507	Champagne and Aishihik First Nations	NEW001	MTA	MTA	Yes	Not Required	No Certification	No	Not Required	Not Required
504	Dease River	7093	Dease River WTP	Groundwater GUDI	Yes	Not Required	No Operator	Yes	No Certification	No Certification
495	First Nation of Nacho Nyak Dun	7112	9999- Nacho Nyak Dun - Water Delivery	MTA	NR	Not Required	Not Required	No	Not Required	Not Required
503	Kluane First Nation	7088	08435- Kluane WTP	Groundwater	Yes	Not Required	No Operator	Yes	Not Required	No Operator
500	Kwanlin Dun First Nation	7096	08454-Kwanlin Dun First Nation	MTA	NR	Not Required	Not Required	No	Not Required	Not Required
502	Liard First Nation	7081	08412- Liard River - Water truck	MTA	Yes	No Certification	Level II	Yes	No Certification	
502	Liard First Nation		EAST CLUSTER WELL	Groundwater	Yes	No Certification	Level II	Yes	No Certification	No Operator
502	Liard First Nation		WEST CLUSTER WELL	Groundwater	Yes	No Certification	Level II	Yes	No Certification	No Operator
492	Little Salmon/Carmacks First Nation	NEW001	PTARMIGAN SELF HAUL	Groundwater	Yes	Not Required	No Operator	No	Not Required	No Operator
492	Little Salmon/Carmacks First Nation		WATER TREATMENT SYSTEM	Groundwater	Yes	Not Required	No Operator	Yes	No Certification	No Certification
424	Lower Post First Nation	7085	Lower Post, BC Water Delivery - Daylu Dene FN	Groundwater	Yes	Not Required	No Operator	No	Not Required	No Operator
497	Ross River	9867	Ross River Dena Council Water Treatment System	MTA	NR	Not Required	Not Required	No	Not Required	Not Required
498	Selkirk First Nation	7082	SELKIRK NO. 7 Willow Creek Community Well (Trucked Water)	Groundwater	Yes	Not Required	No Operator	Yes	No Certification	No Certification
508	Ta'an Kwach'an	NEW001	MTA	MTA	NR	Not Required	Not Required	No	Not Required	Not Required
501	Taku River Tlingit	7091	08445- Taku 5 mile	Surface Water	Yes	Level I	Level I	Yes	No Certification	No Certification
501	Taku River Tlingit	7092	08445- Taku Village WTP	Surface Water	Yes	Level I	Level I	Yes	No Certification	No Certification
499	Teslin Tlingit Council	9861	Teslin Tlingit Council Water Treatment System	MTA	NR	Not Required	Not Required	No	Not Required	Not Required
494	Tr'ondëk Hwëch'in	9863	Tr'on dek Hwech'in Water Treatment System - MTA	MTA	NR	Not Required	Not Required	No	Not Required	Not Required
496	Vuntut Gwitchin		VUNTUT GWITCHIN WATER TREATMENT SYSTEM (MTA)	MTA	NR	Not Required	Not Required	No	Not Required	Not Required
506	White River First Nation	NEW001	SYSTEM NO. 1	Groundwater	Yes	Not Required	No Operator	Yes	No Certification	No Certification
506	White River First Nation	NEW002	SYSTEM NO. 2	Groundwater	Yes	Not Required	No Operator	Yes	No Certification	No Certification

NEEGAN BURNSIDE

Appendix D.2

Individual First Nation Wastewater Summary

Table D.2 - 1: Regional Summary of Wastewater Treatment

First Nation Information				Wastewater System Design Information										
Band #	Band Name	System #	System Name	Const Year	Receiver Name	Treatment Class	Design Capacity [m3/d]	Max Daily Volume [m3/d]	Wastewater System Type	Wastewater Treatment Level	Wastewater Disinfection Chlorine	Wastewater Disinfection UV	Discharge Frequency	Wastewater Sludge Treatment
491	Carcross/Tagish First Nations No. 140		CARCROSS SEWAGE TREATMENT (MTA)	0	MTA	MTA			MTA	MTA	MTA	MTA	MTA	MTA
491	Carcross/Tagish First Nations No. 140		TAGISH WASTEWATER MTA	0	MTA	MTA			MTA	MTA	MTA	MTA	MTA	MTA
504	Dease River	7635	08448- Dease River Lagoon	1976	Evapouration	Small System	17	6.1	Faculative lagoon	Secondary	No	No	Other	No
495	First Nation of Nacho Nyak Dun	NEW001	NACHO NYAK DUN - WASTEWATER MTA	0	MTA	MTA	93	93	MTA	MTA	MTA	MTA	MTA	MTA
503	Kluane First Nation		KLUANE WASTEWATER MTA	0	MTA	MTA	9	9	MTA	MTA	MTA	MTA	MTA	MTA
500	Kwanlin Dun First Nation		KWANLIN DUN WASTEWATER MTA	1990	MTA	MTA			MTA	MTA	MTA	MTA	MTA	MTA
497	Ross River	9866	Ross River Dena Council Wastewater Treatment System - MTA	0	MTA	MTA			MTA	MTA	MTA	MTA	MTA	MTA
501	Taku River Tlingit	9859	Atlin- Taku River Tlingit Wastewater Treatment System	1981	Evapouration	Level I	Unknown	24	Faculative lagoon	Secondary	No	No	Other	No
499	Teslin Tlingit Council	9860	Teslin Tlingit Council Wastewater Treatment System	1991	MTA	MTA			MTA	MTA	MTA	MTA	MTA	MTA
494	Tr'ondëk Hwëch'in	9862	Tr'on dek Hwech'in Wastewater Treatment System	1950	MTA	MTA			MTA	MTA	MTA	MTA	MTA	MTA
496	Vuntut Gwitchin		VUNTUT GWITCHIN WASTEWATER SYSTEM (MTA)	0	MTA	MTA			MTA	MTA	MTA	MTA	MTA	MTA

Table D.2 - 2: Regional Summary of Wastewater Collection Systems, Effluent Quality and Operators

First Nation Information				Collection System Information										Effluent Quality		Operator Information					
Band #	Band Name	System #	System Name	Collection Type	Collection Class	Pop. Served	Homes Piped	Homes Trucked	No. of Trucks in Service	Pipe Length	Pipe Length / Connection	Low Pressure Sewer	No. of Pumping Stations	Meets Guidelines	Quality - Cause of Failure	Primary Operator Exists	Primary Operator Treatment Class	Primary Operator Collection Class	Secondary Operator Exists	Secondary Operator Treatment Class	Secondary Operator Collection Class
491	Carcross/Tagish First Nations No. 140		CARCROSS SEWAGE TREATMENT (MTA)	Trucked	MTA	198	0	86	1			No		MTA	MTA	NR	Not Required	Not Required	No	Not Required	Not Required
491	Carcross/Tagish First Nations No. 140		TAGISH WASTEWATER MTA	Trucked	MTA	175	0	66	1			No		MTA	MTA	NR	Not Required	Not Required	No	Not Required	Not Required
504	Dease River	7635	08448- Dease River Lagoon	Piped, Trucked	Small System	17	8	2	1	3000	375	No	0	Meets Requirements	Unknown	No	No Certification	No Certification	No	No Operator	No Operator
495	First Nation of Nacho Nyak Dun	NEW001	NACHO NYAK DUN - WASTEWATER MTA	Piped	MTA	297	75	0	1			No	0	MTA	MTA	NR	Not Required	Not Required	No	Not Required	Not Required
503	Kluane First Nation		KLUANE WASTEWATER MTA	Trucked	MTA	104	0	50	1			No		MTA	MTA	NR	Not Required	Not Required	No	Not Required	Not Required
500	Kwanlin Dun First Nation		KWANLIN DUN WASTEWATER MTA	Piped	MTA	884	200	0	1	4430	22	No	1	MTA	MTA	NR	Not Required	Not Required	No	Not Required	Not Required
497	Ross River	9866	Ross River Dena Council Wastewater Treatment System - MTA	Trucked	NA	36	0	10	1			No		MTA	MTA	NR	Not Required	Not Required	No	Not Required	Not Required
501	Taku River Tlingit	9859	Atlin- Taku River Tlingit Wastewater Treatment System	Trucked	Level I	130	0	53	1			No		Meets Requirements	Unknown	No	No Operator	No Operator	No	No Operator	No Operator
499	Teslin Tlingit Council	9860	Teslin Tlingit Council Wastewater Treatment System	Piped	MTA	244	75	0	0			No	4	MTA	MTA	NR	Not Required	Not Required	No	Not Required	Not Required
494	Tr'ondëk Hwëch'in	9862	Tr'on dek Hwech'in Wastewater Treatment System	Piped	MTA	290	120	0	0			No	0	MTA	MTA	NR	Not Required	Not Required	No	Not Required	Not Required
496	Vuntut Gwitchin		VUNTUT GWITCHIN WASTEWATER SYSTEM (MTA)	Trucked	MTA	359	0	115	1			No		MTA	MTA	NR	Not Required	Not Required	No	Not Required	Not Required

NEEGAN BURNSIDE

Appendix E
Risk Summary

NEEGAN BURNSIDE

Appendix E.1

Individual First Nation Water Risk Summary

Table E.1: Individual First Nation Water Risk Summary

Legend: High Risk | Medium Risk | Low Risk

Band #	Band Name	System #	System Name	Water Source	Treatment Class	Source Risk	Design Risk	Operations Risk	Report Risk	Operator Risk	Final Risk Score
491	Carcross/Tagish First Nations No. 140		TAGISH TRUCK FILL STATION	Groundwater	Small System	6.0	8.0	5.0	5.0	1.0	5.2
507	Champagne and Aishihik First Nations	7110	9999- Champagne Aishihik WTP Takhini	Groundwater	Level I	9.0	8.0	5.0	8.0	2.0	6.0
503	Kluane First Nation	7088	08435- Kluane WTP	Groundwater	Small System	6.0	8.0	8.0	9.0	1.0	8.0
502	Liard First Nation		EAST CLUSTER WELL	Groundwater	Level I	3.0	8.0	8.0	10.0	7.0	8.0
502	Liard First Nation		WEST CLUSTER WELL	Groundwater	Level I	4.0	8.0	8.0	10.0	7.0	8.0
492	Little Salmon/Carmacks First Nation	NEW001	PTARMIGAN SELF HAUL	Groundwater	Small System	3.0	8.0	8.0	10.0	2.0	8.0
492	Little Salmon/Carmacks First Nation		WATER TREATMENT SYSTEM	Groundwater	Small System	3.0	8.0	7.0	10.0	1.0	6.0
424	Lower Post First Nation	7085	Lower Post, BC Water Delivery - Daylu Dene FN	Groundwater	Level I	3.0	5.0	8.0	10.0	2.0	8.0
498	Selkirk First Nation	7082	SELKIRK NO. 7 Willow Creek Community Well (Trucked Water)	Groundwater	Small System	2.0	2.0	5.0	10.0	1.0	3.5
506	White River First Nation	NEW001	SYSTEM NO. 1	Groundwater	Level I	2.0	1.0	2.0	10.0	1.0	2.3
506	White River First Nation	NEW002	SYSTEM NO. 2	Groundwater	Level I	2.0	1.0	2.0	10.0	1.0	2.3
504	Dease River	7093	Dease River WTP	Groundwater GUDI	Level I	9.0	8.0	8.0	8.0	1.0	8.0
491	Carcross/Tagish First Nations No. 140	7078	Carcross/Tagish Well and WTP	MTA	MTA	2.0	1.0	1.0	1.0	1.0	1.1
507	Champagne and Aishihik First Nations	NEW001	MTA	MTA	MTA	1.0	1.0	2.0	1.0	1.0	1.3
495	First Nation of Nacho Nyak Dun	7112	9999- Nacho Nyak Dun - Water Delivery	MTA	MTA	2.0	1.0	3.0	1.0	1.0	1.7
500	Kwanlin Dun First Nation	7096	08454-Kwanlin Dun First Nation	MTA	MTA	2.0	1.0	3.0	1.0	1.0	1.7
502	Liard First Nation	7081	08412- Liard River - Water truck	MTA	MTA	1.0	5.0	5.0	10.0	6.0	5.3
497	Ross River	9867	Ross River Dena Council Water Treatment System	MTA	MTA	1.0	8.0	8.0	1.0	1.0	5.2
508	Ta'an Kwach'an	NEW001	MTA	MTA	MTA	1.0	1.0	3.0	1.0	1.0	1.6
499	Teslin Tlingit Council	9861	Teslin Tlingit Council Water Treatment System	MTA	MTA	1.0	2.0	3.0	1.0	1.0	1.9
494	Tr'ondëk Hwëch'in	9863	Tr'on dek Hwech'in Water Treatment System - MTA	MTA	MTA	1.0	1.0	1.0	1.0	1.0	1.0
496	Vuntut Gwitchin		VUNTUT GWITCHIN WATER TREATMENT SYSTEM (MTA)	MTA	MTA	1.0	1.0	2.0	1.0	1.0	1.3
501	Taku River Tlingit	7091	08445- Taku 5 mile	Surface Water	Level II	8.0	3.0	3.0	1.0	1.0	2.9
501	Taku River Tlingit	7092	08445- Taku Village WTP	Surface Water	Level II	8.0	3.0	3.0	6.0	1.0	3.4

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Appendix E.2

Individual First Nation Wastewater Risk Summary

Table E.2: Individual First Nation Wastewater Risk Summary

						Legend:	High Risk		Medium Risk		Low Risk	
Band #	**Band Name**	**System #**	**System Name**	**Receiver Type**	**Treatment Class**	**Effluent Risk**	**Design Risk**	**Operations Risk**	**Report Risk**	**Operator Risk**	**Final Risk Score**
504	Dease River	7635	08448- Dease River Lagoon	Evapouration	Small System	2.0	5.0	7.0	1.0	10.0	5.5
501	Taku River Tlingit	9859	Atlin- Taku River Tlingit Wastewater Treatment System	Evapouration	Level I	2.0	2.0	7.0	4.0	1.0	3.2
491	Carcross/Tagish First Nations No. 140	0	CARCROSS SEWAGE TREATMENT (MTA)	MTA	MTA	1.0	2.0	3.0	1.0	1.0	1.7
491	Carcross/Tagish First Nations No. 140	0	TAGISH WASTEWATER MTA	MTA	MTA	1.0	2.0	3.0	1.0	1.0	1.7
495	First Nation of Nacho Nyak Dun	NEW001	NACHO NYAK DUN - WASTEWATER MTA	MTA	MTA	1.0	1.0	3.0	1.0	1.0	1.5
503	Kluane First Nation	0	KLUANE WASTEWATER MTA	MTA	MTA	1.0	2.0	5.0	1.0	1.0	2.2
500	Kwanlin Dun First Nation	0	KWANLIN DUN WASTEWATER MTA	MTA	MTA	1.0	1.0	3.0	1.0	1.0	1.5
497	Ross River	9866	Ross River Dena Council Wastewater Treatment System - MTA	MTA	MTA	1.0	1.0	1.0	1.0	1.0	1.0
499	Teslin Tlingit Council	9860	Teslin Tlingit Council Wastewater Treatment System	MTA	MTA	1.0	1.0	2.0	1.0	1.0	1.2
494	Tr'ondëk Hwëch'in	9862	Tr'on dek Hwech'in Wastewater Treatment System	MTA	MTA	1.0	1.0	1.0	1.0	1.0	1.0
496	Vuntut Gwitchin	0	VUNTUT GWITCHIN WASTEWATER SYSTEM (MTA)	MTA	MTA	1.0	1.0	2.0	1.0	1.0	1.2

NEEGAN BURNSIDE

Appendix F

Protocol and servicing Costs

REGION: YUKON
January 2011

Table F: Protocol and Servicing Costs *(Water & Wastewater Combined)*

Band #	Band Name	Community Name	Population	Current Homes	Forecast Population	Forecast Homes	Zone Markup	Upgrade To Protocol	Per Lot Upgrades to Protocol (Current Homes)	Recommended Servicing	Per Lot Reccomended Servicing (Forecast Homes)	Recommended O&M	Per Lot O&M (Forecast Homes)
491	Carcross/Tagish First Nations No. 140	Carcross	198	86	373	173	1.769	$ 250,000	$ 2,900	$ 4,980,000	$ 28,800	$ 950,000	$ 5,500
491	Carcross/Tagish First Nations No. 140	Tagish	175	66	213	85	1.769	$ 1,101,000	$ 16,700	$ 2,220,000	$ 26,100	$ 770,000	$ 9,100
507	Champagne and Aishihik First Nations	Champagne and Aishihik First Nations	330	103	353	110	1.769	$ 2,220,500	$ 21,600	$ 2,390,000	$ 21,700	$ 900,000	$ 8,200
504	Dease River	Dease River	68	40	101	73	2.096	$ 1,829,000	$ 45,700	$ 2,760,000	$ 37,800	$ 470,000	$ 6,400
495	First Nation of Nacho Nyak Dun	Mayo	297	99	329	109	2.175	$ 15,000	$ 200	$ 730,000	$ 6,700	$ 440,000	$ 4,000
503	Kluane First Nation	Burwash Landing	104	50	117	56	1.769	$ 1,039,500	$ 20,800	$ 1,140,000	$ 20,400	$ 550,000	$ 9,800
500	Kwanlin Dun First Nation	Kwanlin Dun First Nation	892	209	974	229	1.638	$ 15,000	$ 100	$ 2,980,000	$ 13,000	$ 740,000	$ 3,200
502	Liard First Nation	Liard	397	147	447	172	2.175	$ 1,895,500	$ 12,900	$ 900,000	$ 5,200	$ 820,000	$ 4,800
492	Little Salmon/Carmacks First Nation	Carmacks Landing	444	150	530	193	1.769	$ 145,500	$ 1,000	$ 1,750,000	$ 9,100	$ 750,000	$ 3,900
424	Lower Post First Nation	Liard River No. 3	194	63	259	84	2.175	$ 841,500	$ 13,400	$ 5,550,000	$ 66,100	$ 320,000	$ 3,800
497	Ross River	Ross River	411	115	460	131	2.175	$ 30,000	$ 300	$ 980,000	$ 7,500	$ 600,000	$ 4,600
498	Selkirk First Nation	Selkirk First Nation	388	120	437	136	1.769	$ 590,000	$ 4,900	$ 2,840,000	$ 20,900	$ 690,000	$ 5,100
508	Ta'an Kwach'an	Lake Laberge No. 1	44	11	144	36	1.638	$ 15,000	$ 1,400	$ 1,390,000	$ 38,600	$ 130,000	$ 3,600
501	Taku River Tlingit	Taku Village & Five Mile Point	148	56	158	61	1.769	$ 266,000	$ 4,800	$ 1,060,000	$ 17,400	$ 760,000	$ 12,500
499	Teslin Tlingit Council	Teslin Post No. 13	364	112	409	127	1.769	$ 20,000	$ 200	$ 810,000	$ 6,400	$ 540,000	$ 4,300
494	Tr'ondëk Hwëch'in	Moosehide Creek	319	132	378	161	2.175	$ -	$ -	$ 4,770,000	$ 29,600	$ 390,000	$ 2,400
496	Vuntut Gwitchin	Vuntut Gwitchin	359	115	411	132	3.011	$ 20,000	$ 200	$ 7,190,000	$ 54,500	$ 360,000	$ 2,700
506	White River First Nation	Beaver Creek	83	23	99	28	2.175	$ 933,000	$ 40,600	$ 1,220,000	$ 43,600	$ 380,000	$ 13,600