Fletcher Creek Improvement District

Preliminary System Design Brief

April,

2019

Client:

Fletcher Creek Improvement District

Version:

1.0

Suite 304-625 Front Street

Nelson, BC | V1L 4B6

www.9doteng.com

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Part I OVERVIEW

1.0 General Information

9dot Engineering Inc. has been contracted by the Fletcher Creek Improvement District (FCID) to provide engineering, design, and consulting services for the design of an Interior Health Authority (IHA) approved water treatment system that meets the 4-3-2-1-0 guidelines. This system design brief summarizes this project's design parameters as part of the Construction Permit Application to (IHA) for the new proposed equipment and works. Additional information is included detailing upgrades to existing storage and distribution infrastructure to meet the BC Design Guidelines for Rural Residential Community Water Systems (Design Guidelines).

The area of the FCID is located approximately 10km south of Kaslo, BC, on BC Highway 31. The FCID has 42 active users year round plus an additional 5 users with inactive curbstops. The intake for the water system supplying the building is located approximately 700m up the mountain west of the highway.

There is currently no treatment of the source water prior to it entering the distribution system.

The new water treatment plant (WTP) would be supplied by the same surface source, Fletcher Creek and would utilize the same intake and distribution infrastructure. Consumption data that has been collected and analyzed demonstrates the estimated peak flow of treated water to meet current domestic demands of the FCID is 70 US gallons/minute.

This design brief outlines two options for the FCID and is intended to provide budgetary projections for consideration of the FCID before going through the involved IHA construction permit application process. The first option includes recommended infrastructure upgrades to meet IHA's 4-3-2-1-0 guidelines and to provide additional reservoir storage to meet the Design Guideline's recommendations for domestic and irrigation usage. The second option includes the items in option one, but also lists the requirements to provide fire flow capability to the FCID in the case of a structure fire. Providing fire flow would significantly reduce the insurance rates of the FCID's users.

1.1 Company Profile

9dot Engineering Inc. (9dot) offers innovative solutions in civil and structural engineering by delivering sustainable, practical, and economical solutions. 9dot specializes in providing engineering and construction services to small and medium sized rural communities, priding themselves in project designs that meet the needs of the clients. 9dot understands that a common sense, innovative approach is essential to keeping design and implementation simple thereby reducing overall costs.

9dot is currently registered with NAPEG, APEGA and PEO, and is in good standing with WorkSafe BC. 9dot carries insurance for errors and omissions as well as general liability.

9dot can work with its sister company AquaDiversities Inc. (Aqua) to supply WTP equipment or other OEM equipment manufactures.

Aqua specializes in the construction and operation of both water and wastewater systems with an office in Nelson, BC. Aqua carries insurance for errors and omissions as well as general liability and is

in good standing with WorkSafe BC. In addition to designing and constructing numerous provincially and federally approved water treatment systems around BC and Alberta with subsequent operations and maintenance contracts, Aqua is also a competitive supplier and distributor for the majority of industry standard water and wastewater treatment equipment.

1.2 Project Parameters

Below is a table outlining the project parameters and site information.

Table 1 - Site Information and Project Parameters

	Information	Source
Property Information at Intake	Lot 484, Plan 9819 B, Kootenay District	Conditional Water License No. 57357
Number of Service Connections	Active: 42 Residential. Inactive: 5 Residential	FCID
Recorded Flow August – September 2018	70 USGPM(instantaneous peak flow) 45,844 USGPD (max. day) 19,728 USGPD (average day)	9dot
Water Licence Volume Fletcher Creek	99,559.371 m^3/year = 72,064.8 USGPD	Conditional Water Licence No. CO 57357
Existing Storage (Tanks)	2 stainless steel tanks 4,514 USG total (Pre-Treatment)	9dot
System Pressure	At existing reservoir: 0 psi (atmosphere) Distribution System: ~100 psi	9dot
Turbidity UVT	0.21 NTU 94.1% @254nm	CARO, August 2018, July 2012
Water Quality Chemistry Concerns (MAC or AO)	None	CARO, August 2018
Water Quality Microbiological Concerns	Total coliforms and E.Coli present	CARO, August 2018, November 2018

1.3 Site Information

1.3.1 Water Quality Report

Testing data provided by the FCID and 9dot and the chemical analysis of the ground source (Fletcher Creek) were reviewed and analyzed.

The unacceptable test results to present include:

Table 2 – Summary of Unacceptable Test Results

Date of Sample	Testing Parameter Exceeded	Test Result
Aug 8, 2018	Total Coliforms E.Coli	>= 33 CFU/100 mL >1 CFU/100 mL
Nov 5, 2018	Total Coliforms E.Coli	= 120 CFU/100 mL >1 CFU/100 mL

Results from the August 2018 Water Quality and Chemical Analysis performed by CARO on Fletcher Creek show total coliforms and E. Coli present above the Maximum Allowable Concentration (MAC) of none detected. There are no chemical or recoverable metal levels indicated on the report that exceed either MAC or Aesthetic Objectives (AO) as defined by the Guidelines for Canadian Drinking Water Quality (Feb. 2017).

1.3.2 Water Licences

The FCID currently has one water license (CO 57357) for local water works totalling 99,559.371 cubic metres per year, which equates to an average of 72,064.8 USG (272,765.3L) per day inclusive of domestic and irrigation consumption.

1.3.3 Existing Source Description

Water flows from Fletcher Creek into a perforated manhole barrel in the creek into the existing reservoir building. The intake is located approximately 700m off of the highway up a gravel road and is on private property. The owner of the property is not a member of the FCID and has granted an easement to the FCID for access to the intake in exchange for being provided water.

The surrounding area is steep and rugged mountain terrain. Another intake upstream of the FCID utilizes the same creek to run a micro-hydro turbine, which returns its water to Fletcher Creek downstream of the FCID intake.

Figure 1 – Creek Intake

Figure 2 – Existing Reservoir Tank (1 of 2)

1.3.4 Existing Storage and Flow Control

Two existing open to atmosphere reservoirs provide a total of 4,514 USG (2,257 USG each) of untreated water storage. Flow through the distribution system is on demand from the reservoirs. The reservoir tanks are 8' diameter stainless steel lined culverts placed on end with a concrete bottom.

Any pressure-treated wood used for the reservoir covers should be replaced with non-pressure-treated wood. Pressure-treated wood is not considered safe for use where it may come into contact with drinking water. The culvert material between the intake manhole barrel and reservoirs is unconfirmed, but should be lined or replaced with NSF approved material if it is still galvanized steel.

The FCID has reported water shortages during the summer months when water demands are high and the creek level is low. Currently the reservoirs are not sized to meet the Design Guidelines requirements for balancing and emergency storage. Increasing the total reservoir storage volume should be a high priority of the FCID to reduce water shortages.

1.3.5 Existing Collection and Distribution System

A steel culvert from the intake manhole feeds the reservoir building where a half-culvert shown below allows flow into the reservoir tanks. The half culvert is at the same elevation as the top of the reservoir tanks and excess flow continues down the culvert and back to Fletcher Creek when the reservoirs are full.

The existing distribution system is a mix of 6", 4", and 2" buried pipe and is shown on the site plan attached to this design brief. 9dot installed a portable bolt-on ultrasonic flow meter on the outside of the 6" SCH.40 PVC that was exposed by the FCID, of which the exterior was in acceptable condition. Although SCH.40 PVC is certified for potable water use, buried water main should be C900 PVC or HDPE. Any capital replacement planning done by the FCID should consider this including the separate associated IHA construction permit application, which would be required but is not included in the budgetary scope of this report.

The distribution currently has six standpipes used for flushing of the distribution system. There are no fire hydrants currently installed and the FCID does not provide fire flow to its users.

The FCID have noted their concerns of leakage in the distribution system during conversations with 9dot. Data from the ultrasonic flow meter showed zero-flow on numerous occasions. Although this does not guarantee that leakage is not occurring in the system, it does indicate that it is not a major concern.

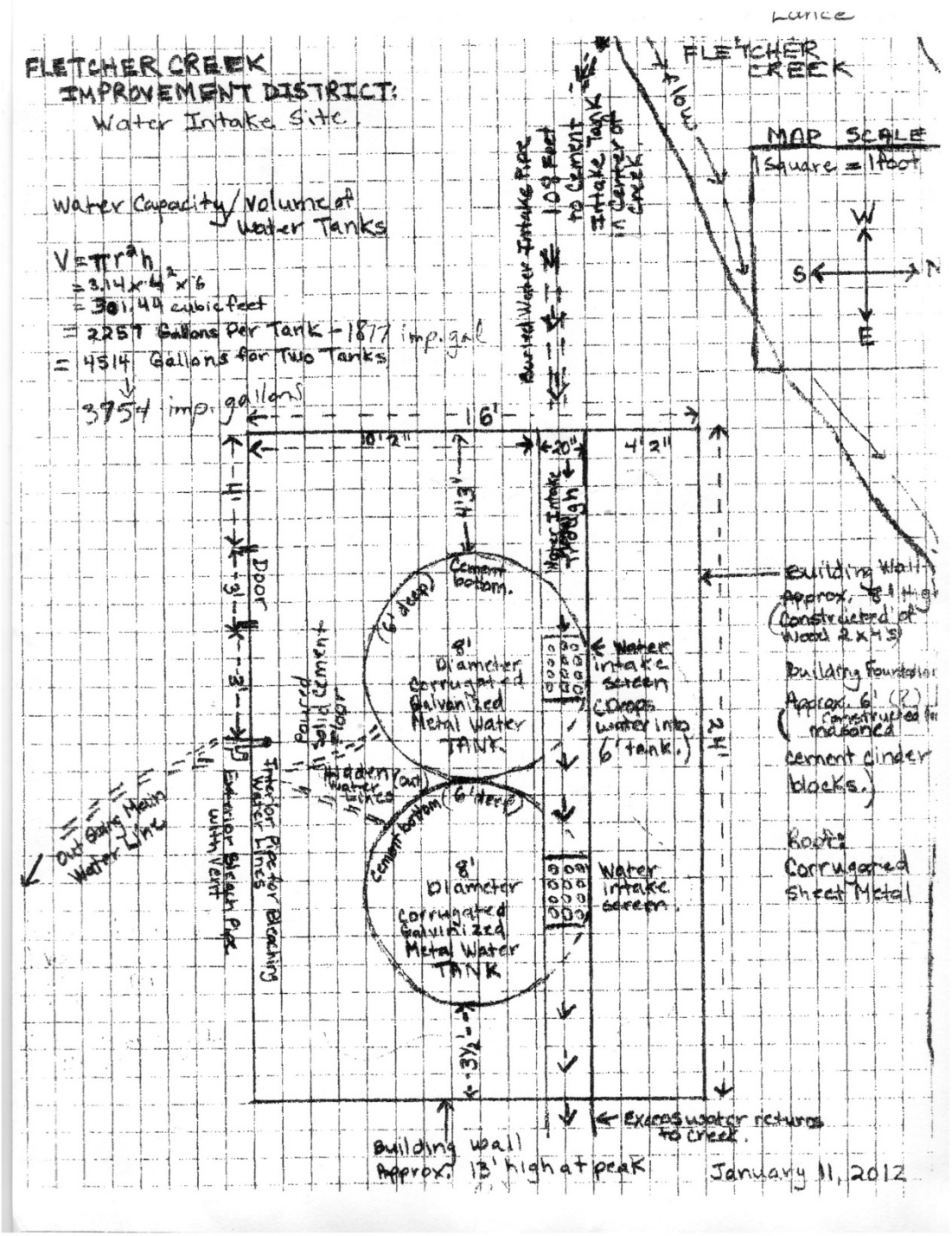


Figure 2 – Existing Intake Sketch

Part II PROPOSED SYSTEM DESIGN CONSIDERATIONS

2.0 Water Treatment Requirements

In British Columbia, water quality standards for potable water are regulated by *Drinking Water Protection Act* 2001, which provides the basic, minimum framework towards goals for drinking water treatment for pathogens in surface water supply systems. Specific water quality standards, monitoring schedules, applicability and recommended treatments are outlined in the *Drinking Water Protection Regulation* (2003). The objectives outlined in the *Guidelines for Canadian Drinking Water Quality* (Health Canada 2012) are used to provide the treatment parameters for the five treatment objectives (4-3-2-1-0) summarized by the Interior Health Authority:

- 4 - 4-log (99.99%) reduction of viruses
- 3 - 3-log (99.9%) removal or inactivation of Giardia and Cryptosporidium (Oocysts)
- 2 - 2 separate treatment processes (multi-barrier) for surface water supplies
- 1 - Turbidity less than 1 NTU (Nephelometric Turbidity Unit)
- 0 - No total and fecal coliforms (E. Coli)

A 4-log reduction of viruses is recommended for all surface water sources. Reductions can be achieved through either a filtration process to physically remove viruses, or inactivation through chemical or ultraviolet light disinfection. As the effectiveness of ultraviolet light disinfection varies among certain types of viruses, a combination of chlorine disinfection and/or physical filtration in conjunction with ultraviolet disinfection is considered to be the most effective in protecting against viral contamination.

Giardia and Cryptosporidium are large pathogenic microorganisms that can only multiply in the intestinal tracts of humans and other animals. Their cysts/oocysts survive longer than intestinal bacteria, are prevalent in surface waters in Canada, and are more resistant to disinfection. For this reason, it is recommended that treatment achieves at least a 3-log removal or inactivation. Partial inactivation of cysts/oocysts may be achieved through large doses of chlorine, ozone or chlorine dioxide; however, this is impractical. Filtration through 1-micron absolute cartridges is effective at physically removing cysts/oocysts. Ultraviolet disinfection is also considered an effective treatment for microorganisms, provided the system is functioning within the designed parameters for UV Transmittance and UV intensity.

As different treatment methods may prove to be less effective on certain microbiological concerns, the best approach to ensure effective treatment is a multi-barrier one. The efficiency of disinfection systems is dependent on the clarity of water being delivered, and as such, multiple specific treatment technologies may need to be implemented to ensure the clearest water possible. The *Guidelines for Canadian Drinking Water* recommends filtration and one other form of disinfection are used to meet the treatment objectives.

Turbidity is the term used to describe the amount of suspended organic and inorganic material in water. As turbidity increases, the ability of treatment methods to effectively meet treatment parameters decreases. The Canadian guideline on turbidity recommends that turbidity of treated surface water be maintained below 1 nephelometric turbidity units (NTU). Turbidity is effectively

reduced through physical and chemical filtration methods, with a goal to maintain levels as low as possible with minimal fluctuations.

Total coliforms (including fecal coliforms) are found naturally in the environment, but their presence in a water distribution system indicates a failure of the treatment process. E. Coli is the only member of the coliform group found exclusively in the faeces of humans and other animals and their occurrence signifies a recent faecal contamination and possibly the presence of other disease causing bacteria, viruses and protozoa. In order for treated water to be considered free of intestinal disease-causing bacteria, no detectable levels of E.coli, faecal and total coliforms in a 100ml sample is recommended as per the *Drinking Water Protection Regulation* based on the sampling frequency determined by the Environmental Health Officer.

2.1 Water Demands

The designed flow rate of the Fletcher Creek Improvement District water treatment system is based on meeting the domestic consumption flow rates of peak summer demands including irrigation.

Flow data collected by 9dot Engineering Inc. in August and September 2018 utilized an ultrasonic flow meter to illustrate the real-time demand of water consumption for domestic and irrigation purposes. Measured results show an instantaneous peak demand of 70 USGPM, a maximum day demand of 45,844 USGPD and an average day demand of 19,728 USGPD.

The recorded peak flow of 70 USGPM occurred only once during the metering period but flow rates reached 50-60 USGPM on multiple occasions. Metering took place over a mix of hot and mild weather, so the ADD and MDD are indicative of year- round demands with and without irrigation. According to the Design Guidelines, the peak hour demand of the FCID water system is 54.8 USGPM using the recorded ADD of 19,728 USGPD and a peaking factor of 4 for populations under 5000.

To meet peak demands, 9dot recommends a treatment system capable of treating 50 USGPM with 100% redundancy and 100 USGPM with no redundancy along with increased reservoir storage sized to meet the Design Guidelines standards for balancing, emergency, and fire flow storage.

2.2 Treatment System Location, Reservoir Sizing, and Fire Flow Considerations

The proposed treatment system is located at the existing intake, after the existing reservoir tanks. Locating the centralized treatment system at the intake location would provide treated water for all users currently connected to the distribution system including the first user on the intake access road. The distribution system will continue to be pressurized by gravity.

Although servicing the treatment system with electricity is a challenge, locating the reservoir lower down in the distribution system is not feasible when considering required water storage, distribution pressure, and chlorine contact time. A treatment system located at the current intake would require a new single-phase overhead electrical service be installed to supply power to the intake location.

The existing intake structure and reservoir tanks would continue to provide 4,514 USG of untreated water storage prior to the treatment system. 9dot recommends constructing a new 90,000 USG steel-bolted reservoir, which would provide adequate peak demand balancing, emergency, and fire flow

storage. The treated water storage tank would also ensure adequate chlorine contact with the minimum centration possible due to substantial chlorine contact time prior to the first user in the system. This would provide the users of the FCID with an adequate water supply for fire protection in the event of a structure and reduce user's fire insurance rates significantly.

The reservoir size is based on the Fire Underwriter's Survey (FUS) referenced by the Design Guidelines, which require a minimum flow of 3000L/min (792.6 USGPM) for 75 minutes. In order to provide fire flow, the FCID needs to install a minimum of thirteen 6" diameter fire hydrants in the distribution system. The Design Guidelines requires that the fire hydrants have a maximum spacing of 150m in residential areas.

At a minimum, the FCID must add an additional 13,000 USG concrete reservoir to provide adequate balancing and emergency storage but this would not provide adequate storage for fire flow for FCID users and would require internal baffling to achieve chlorine contact.

2.3 Treatment System Components

In order to achieve the IHA treatment requirements and meet the water demands of the FCID while, 9dot is recommending the installation of a water treatment system to provide a flow rate of up to 50 USGPM with equipment redundancy in operation and 100 USGPM with no redundancy. The system design should take into consideration the overall water treatment plant and consumable costs and operational complexity for a location of this size. The system must have the capacity to deal with seasonal turbidity and colour associated with seasonal freshet. The equipment supplier should have local presence and an established relationship and precedence with the IHA. The components of the treatment system must meet NSF certification (or equivalent) and work effectively together to provide a multi-barrier treatment process.

In the event of a power outage, the booster pumps would be inoperable, thus preventing raw water from being delivered to the system. The balancing, emergency. and fire flow storage in the new 90,000 USG reservoir post-treatment system would provide water to the FCID users for approximately 115 hours (4.8 days) based on an Average Day Demand flow rate of 13 USPGM. If only a 13,000 USG reservoir is constructed, the balancing and emergency storage would provide 13 USGPM for approximately 17 hours.

2.4 Back-wash Wastewater Disposal

As part of the multi-media filtration process, back-wash water is produced. The proposed method to effectively accommodate these volumes of wastewater is an engineered sub-surface back-wash infiltration pit in order to negate potential surface erosion of direct stream influences of turbidity. 9dot's scope as the consultant and project coordinator would include the design of a back-wash infiltration pit.

2.5 Construction Period Engineering Services

Engineering services for the construction and installation period of the proposed water treatment system to include:

- IHA Construction Permit Application
- Coordination with regulatory bodies to deliver information regarding treatment system commissioning and operation;
- Providing a detailed budgetary quote for site preparation, transportation, installation, back-wash pit construction, and clean-up;
- Coordination with sub-contractors to ensure proper installation and tie-in to existing collection/distribution system;
- Coordination with water treatment system Construction Company to deliver design details, inspect progress, monitor quality during construction, and ensure that system is operating as designed once commissioned.
- Final reporting to IHA.

2.6 Site Inspections

Site inspection for the construction and installation period of the proposed water treatment system to include:

- Review of site preparation prior to installation;
- Review of electrical and plumbing tie-in of proposed treatment system to the existing infrastructure;
- Review of final commissioning of system to ensure treatment parameters are achieved and the treatment system is operating as designed.

Part V SCHEDULE

The following schedule provides preliminary dates* for the delivery of the design, construction application and construction of the system as follows:

FCID Review of Design Brief and Budget – May, 2019

The FCID will review the design brief and associated budget at their AGM in May, 2019 to determine if they want to proceed with the construction of the ***Aqua100™*** water treatment system.

Construction Permit Application Submission to IHA – June-July , 2019

If the FCID decides to move forward with the ***Aqua100™*** after the AGM, 9dot and Aqua will finalize and submit the construction permit application to IHA. After the submission to IHA, **the timelines are now dependent on the response from IHA.**

Response from IHA – August-September 2015

An estimated 4-6 weeks is required to receive a response back from IHA. IHA typically responds with a *Conditional Construction Permit* at which time FCID can start construction of the WTP while adhering to all the identified conditions. Should IHA deny the application and require resubmission, an anticipated delay of 4-6 weeks can be expected to address the specific concerns outlined by IHA.

Construction of WTP – October 2019 to January 2020

3-4 months is the anticipated time required for the off-site construction of the ***Aqua100™*** water treatment system.

Civil Works and Transport of WTP to FCID – Feb - April 2020

Timelines for the installation of a new reservoir, electrical service, and transport of the ***Aqua100™*** to the FCID are dependent on the weather and seasonal snowpack.

Commissioning of WTP – May 2020

The estimated time for commissioning is 2-6 weeks. The time required for commissioning is dependent on the type of system implemented and the water quality of the source. Upon completion of the installation phase and inspection by 9dot, commissioning can commence. This is completed in two phases: the initial commissioning phase of the components to provide treatment as per the plant design; and a secondary commissioning phase where data is collected over a period of time determined by the Environmental Health Officer.

9dot will provide a final commissioning report after the initial commissioning phase to confirm that the water treatment plant is operating as designed. This will be included in the Letter of Certification that will be presented to the Interior Health Authority. Interior Health Authority will review all documents and collected data and perform a site inspection. At the discretion of the Interior Health Authority, an Operating Permit will be issued and the Boil Water Advisory would then be rescinded.

**** These dates are for preliminary purposes only and are not contractually binding.***

Part VI APPENDICIES

3.0 Appendix A – Class B Project Budgets

3.1 Design Option 1 – No Fire Flow

The budget shown below is a Class B (+/- 25%) cost estimate to supply and install an Aqua 100 water treatment system and reservoir sized to provide only balancing and emergency storage to the FCID (no fire flow capabilities).

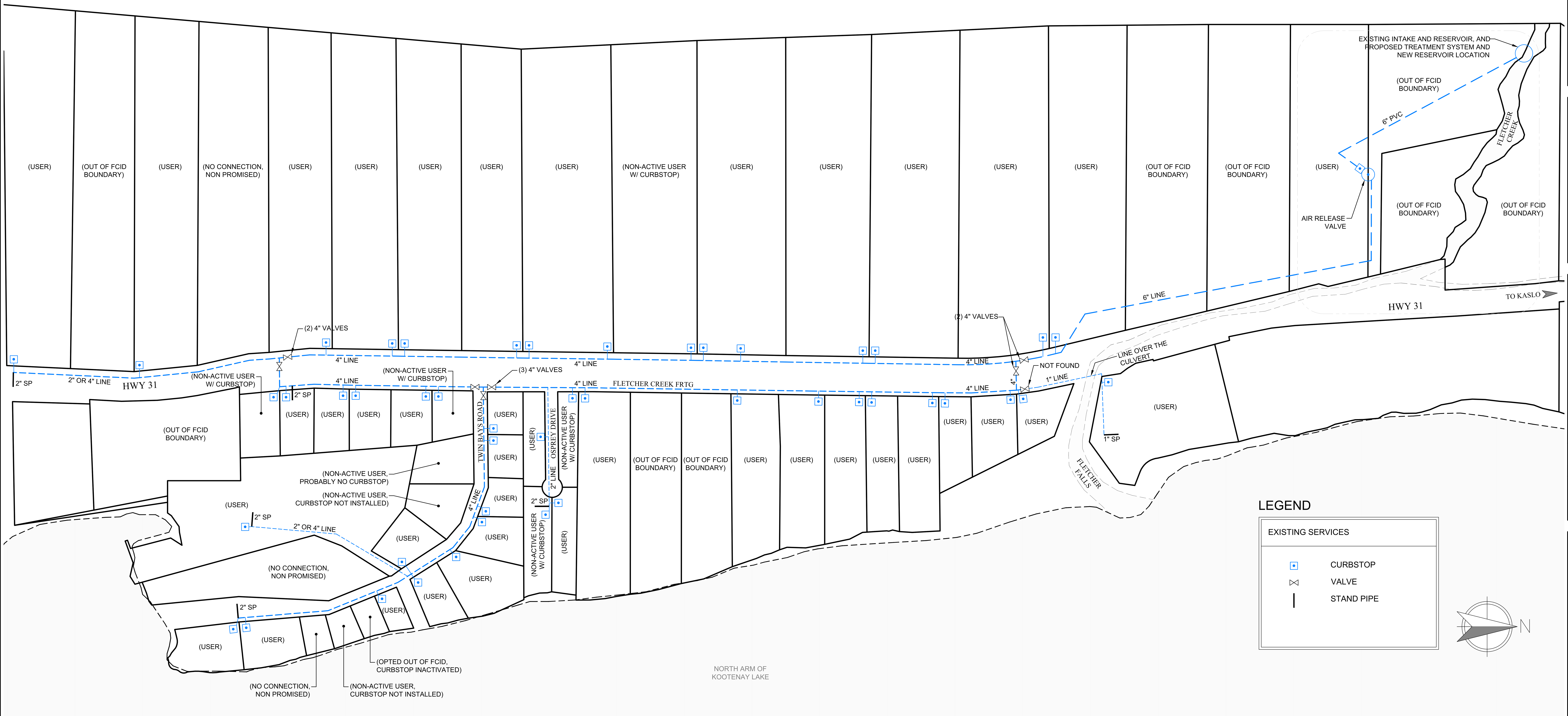
Fletcher Creek Improvement District	
Option 1 - No Fire Flow	
Item	**Cost Estimate**
Treatment System	
Aqua 100 Water Treatment System Including Offsite Construction of System and Shipping to FCID	$175,000.00
Total Treatment System Cost	**$175,000.00**
Civil Works for Treatment System	
Site Preparation and Foundation	$18,000.00
Civil Tie-In of Treatment System	$6,000.00
Backwash Water Disposal Pit	$10,000.00
New Overhead Electrial Service to Intake Location	$72,000.00
Total Civil Works Cost	**$106,000.00**
Reservoir and Distribution Upgrades	
New 13,000 USG Buried Concrete Reservoir	$56,000.00
Civil Works for Foundation, Installation, and Tie In of New Reservoir	$45,000.00
Shipping to FCID	$3,000.00
Total Reservoir and Distribution Costs	**$104,000.00**
Project Overhead and Engineering Costs	
System Commissioning	$4,000.00
Engineering Documentation - O&M Manual & Emergency Response Plan, As-built drawings, Final Report to IHA	$6,000.00
General Conditions (Project insurance, on-site and off-site project management, office administrative support, coordination with contractors to ensure proper installation and tie-in, coordination with treatment system construction compnay to ensure correct operation once commissioned)	$20,000.00
Total Project Overhead and Engineering Costs	**$30,000.00**
Subtotal	**$415,000.00**
Contingency (Class B, 25%)	**$103,750.00**
Total Recommended Budget - No Fire Flow	**$518,750.00**
Approximate Cost per FCID Connection (42 Connections)	**$12,351.19**

3.2 Design Option 2 – Fire Flow

The budget shown below is a Class B (+/- 25%) cost estimate to supply and install an Aqua 100 water treatment system and reservoir sized to provide balancing, emergency, and fire flow storage to the FCID including the required fire hydrants in the distribution system.

Fletcher Creek Improvement District	
Option 2 - Fire Flow	
Item	**Cost Estimate**
Treatment System	
Aqua 100 Water Treatment System Including Offsite Construction of System and Shipping to FCID	$175,000.00
Total Treatment System Cost	**$175,000.00**
Civil Works for Treatment System	
Site Preparation and Foundation	$18,000.00
Civil Tie-In of Treatment System	$6,000.00
Backwash Water Disposal Pit	$10,000.00
New Overhead Electrial Service to Intake Location	$72,000.00
Total Civil Works Cost	**$106,000.00**
Reservoir and Distribution Upgrades	
New 90,000 USG Steel Bolted Reservoir	$320,000.00
Civil Works for Foundation, Installation, and Tie In of New Reservoir	$80,000.00
Fire Hydrants (required every 150m in distribution system, 13 total required.)	$106,600.00
Shipping to FCID	$8,000.00
Total Reservoir and Distribution Costs	**$514,600.00**
Project Overhead and Engineering Costs	
System Commissioning	$4,000.00
Engineering Documentation - O&M Manual & Emergency Response Plan, As-built drawings, Final Report to IHA	$6,000.00
General Conditions (Project insurance, on-site and off-site project management, office administrative support, coordination with contractors to ensure proper installation and tie-in, coordination with treatment system construction compnay to ensure correct operation once commissioned)	$30,000.00
Total Project Overhead and Engineering Costs	**$40,000.00**
Subtotal	**$835,600.00**
Contingency (Class B, 25%)	**$208,900.00**
Total Recommended Budget - Fire Flow	**$1,044,500.00**
Approximate Cost per FCID Connection (42 Connections)	**$24,869.05**

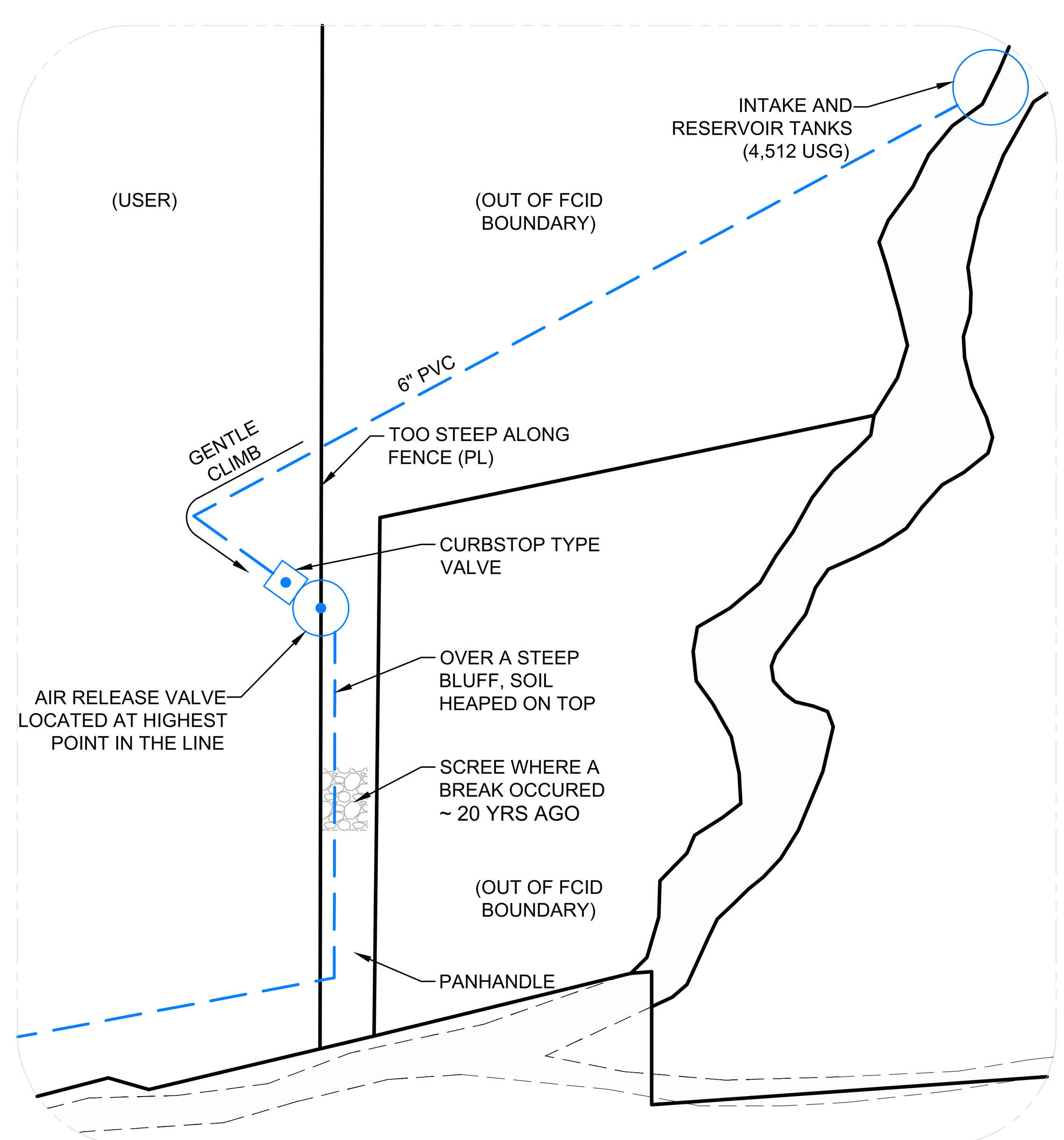
4.0 Appendix B – FCID Site Plan



1 AREA PLAN
C1.0 SCALE: N.T.S.

LEGEND

EXISTING SERVICES	
▫	CURBSTOP
⋈	VALVE
|	STAND PIPE



2 INTAKE PLAN
C1.0 SCALE: N.T.S.

NOTES:

DRAWING IS NOT TO SCALE AND IS NOT A LEGAL SURVEY.

No.	Date	Revision
A1	2019 04/07	UPDATED INTAKE DETAILS

No.	Date	Issue
A	2019 02/11	PRELIMINARY

DO NOT SCALE DRAWINGS
Written dimensions shall govern.

All dimensions to be verified on site by the contractor/builder. Report all errors or additions to the owner or designer prior to proceeding with the work

9dot ENGINEERING INC.

Stamp
PRELIMINARY

Project
FLETCHER CREEK IMPROVEMENT DISTRICT

Drawing
SITE PLANS

Date 07APR2019	Project No. 18-010		
Designed 9dot	Drawing File 18-010		
Drawn JK	Scale AS NOTED		
Checked LP	Sheet No. C1.0	Issue/Rev. A1	
Approved			

5.0 Appendix C – *Aqua100™* WTP Brochure

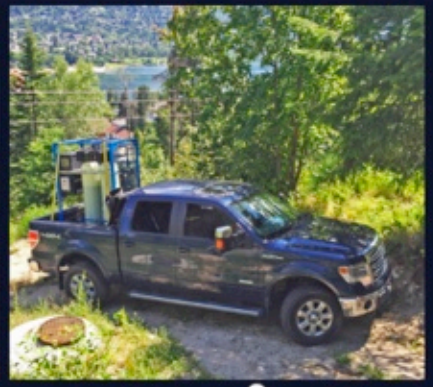
Aqua

Potable Water Treatment Systems

Packaged Treatment Systems

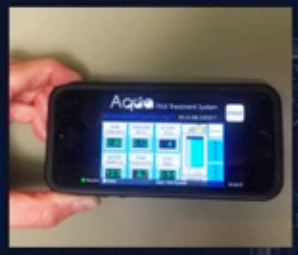
Aqua Water Systems are designed for a range of water quality and flow rates and our Pilot Systems ensure the right system for your application.

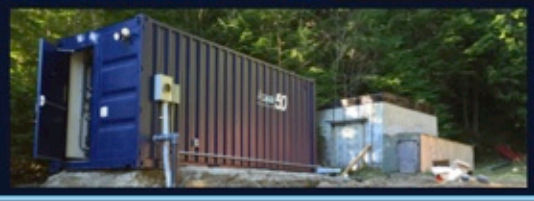
Pilot Systems



- Economical
- NSF Certified
- 15 - 200 US gpm
- Remote Monitoring
- Provincially Approved
- Engineered System
- Municipal, Residential or Private Sector
- Surface or Ground Water
- Modular, Compact & Versatile
- Proprietary Coagulation Process
- Integral Alarm Notification System
- Low Operational & Consumable Costs

Point of Entry





6.0 Appendix D – *Aqua100™* WTP Quotation

Aqua Diversities Inc.

Suite 304-625 Front Street
Nelson, BC | V1L 4B6
www.aquadiversities.com

BUDGET QUOTATION

Project: Fletcher Creek Improvement District **Project No.**: 18-010
Date: April1, 2019
Engineer On Record: Steven Thomson, PENG. 9dot Engineering Inc.

Thank you for this opportunity to provide a quotation for our pre-engineered proprietary packaged treatment system that has been selected for your water treatment project.

AquaDiversities Waterworks Inc. is a dynamic company providing innovative and economical water and wastewater treatment solutions. Consulting, design, construction, equipment sales, operation and maintenance are handled by a small qualified team with low overhead allowing us to offer economical and personal service. We work with our sister company 9dot Engineering Inc. or other firms to implement systems.

The specified package will include an insulated shipping container that is pre-plumbed, pre-wired. The package will include all treatment equipment, valves, instrumentation, controls for fully automatic operation, shipping, start-up and training. For installation the plant will require an IHA construction permit application, as well as an engineered pad or foundation, connections for raw water, treated water, backwash supply, waste and power (Not in scope.)

Terms of Payment

10% of contract price with issue of purchase order or contract, 15% of contract price upon receipt of approved shop drawings, 65% of contract price upon delivery to package plant to the site and 10% of contract price after completion of commissioning/training.

Standard Warranty

- 12 month period commencing from date of commissioning of the plant - 18 months from date of shipment, whichever is earlier

Budget Price: CDN $175,000.00 excluding all applicable taxes

Delivery can usually be made within 8-10 weeks following approval of final shop drawings.

For more information on our Company and our range of products and services visit our web site at ***www.aquadiversities.com***

Aqua Diversities Inc.
Suite 304-625 Front Street
Nelson, BC | V1L 4B6
www.aquadiversities.com

Quote for Pre-Packaged Cartridge Filter & UV System

Plant Type: Aqua 100™ Water Treatment Plant (WTP) (2 modules each rated at 50 USgpm) with booster pump and DeNOM™ remote-control packages.

The Aqua 100™ WTP treatment process begins with raw water from the existing reservoirs enters the WTP where booster pumps develop the necessary pressure for the WTP components. Immediately following the pumps is provision to chemically dose an NSF certified filter aid that will convert dissolved solids (including colour) into suspended solids, which than can be filtered out in the treatment process. The filter aid will be automatically mixed into the flow of water through an in-line static mixer following the dosing portal. Water continues to flow into two backwashing Nextsand™ filter vessels plumbed in parallel, which provide pre-filtration for the next stage of the system.

From the Nextsand™ filters, the treatment process continues with 2 banks of filters in parallel: 1-micron nominal bag filters, 1-micron nominal cartridge and 1-micron absolute cartridge filters. The 1-micron bag filter and 1-micron nominal cartridges are pre-filters that provide reduced particulate loading on the 1-micron absolute Municipally rated LT2 validated cartridge filters. The EPA has developed the LT2 ESWTR (LT2 Rule) to improve your drinking water quality and provide additional protection from disease-causing microorganisms and contaminants.

Aqua has incorporated the Harmsco Municipal LT2 filters into the design of this system as they have a higher solids loading and are approved for higher flow rates and are capable of a higher allowable pressure differential (30 PSI instead of 17 PSI) which greatly reduces the consumable costs in addition to the competitive pricing Aqua receives and passes onto customers.

Water then flows through the Trojan 50 USEPA certified UV units that are plumbed in parallel. Each UV unit is certified for treatment of up to 50 US gallons per minute (gpm). The amount of water being delivered to the UV units will be determined by the control switch setting and monitored by the flow meter alarm to ensure that the flow rate does not exceed 50 gpm per unit.

A chlorine-dosing pump injects NSF 60 certified Sodium Hypochlorite 6% or 12% chlorine disinfectant into the flow of water post UV treatment before it is discharged into the in-line static mixer. The in-line static mixer is designed to adequately mix the treated water with the chlorine injection to achieve the most accurate reading of chlorine dose concentration prior to delivery into the storage/equalization tanks.

Pressure transducers monitor pressure differential across the filters and online turbidimeters and a chlorine analyser monitor water quality.

System Controls

The system will be electronically controlled by the DeNOM™ electronic control system (Proprietary Program Logic Controller - PLC and Human Machine Interface - HMI) that has a touch screen in the WTP building and is also accessible by smart phones remotely.

The system flow is dictated by a control settings on the HMI that allows operators to choose between four settings: **OFF, A**, **B**, or **A+B**. This allows either train of treatment to be operated separately for splitting of hours on equipment to deliver 50 USGPM with 100% redundancy or 100 USGPM with no redundancy. The following table illustrates operation of treatment system components on the four available settings of the control switch:

Table No. 2 - Control Switch Operation

Setting	Booster Pump (BP) Operational	UV Units Operational	Filter Train Operational*
OFF	None	None	None
A	BP_A	UV_A	One or both
B	BP_B	UV_B	One or both
A+B	BP_A and BP_B	UV_A & UV_B	One or both

*Filter train selection is a manual operation performed by the operator by selecting the corresponding train valve to open/close.

The A or B or A + B control switch is controlled via low voltage wires from a level switch located in the new reservoir. As the water level in the tanks drop and rise, the corresponding booster pump(s) are energised and de-energised.

The backwashing nextsand™ filters are programmed to backwash according the amount determined during the commissioning phase.

The UV units are plugged into receptacles designated for either setting ‘A’ or setting ‘B’. This allows for an easy exchange of units should either be required to be taken off-line for servicing, replacement, or change-out to the backup unit that is hard plumbed and ready.

The chemical dosing pumps for both the chlorine and the filter aid are also flow controlled and dose at a concentration proportional to the flow rate by the proprietary DeNOM™ electronic control system. When the system flow is changed, the dosing pumps automatically adjust to increase dosage amount to meet increased flow demand, ensuring the target chemical dosages are achieved.

Solenoid valves on the UV will close automatically if the UV senses low UV Intensity or Transmittance indicating mechanical failure or poor water quality. This prevents undertreated water from continuing through the treatment process.

A low-pressure cut-out switch will protect the booster pump(s) from running dry in the event of source water becoming unavailable.

Adequate chlorine contact time is achieved in the reservoir (Not in scope) prior to entering the distribution system.

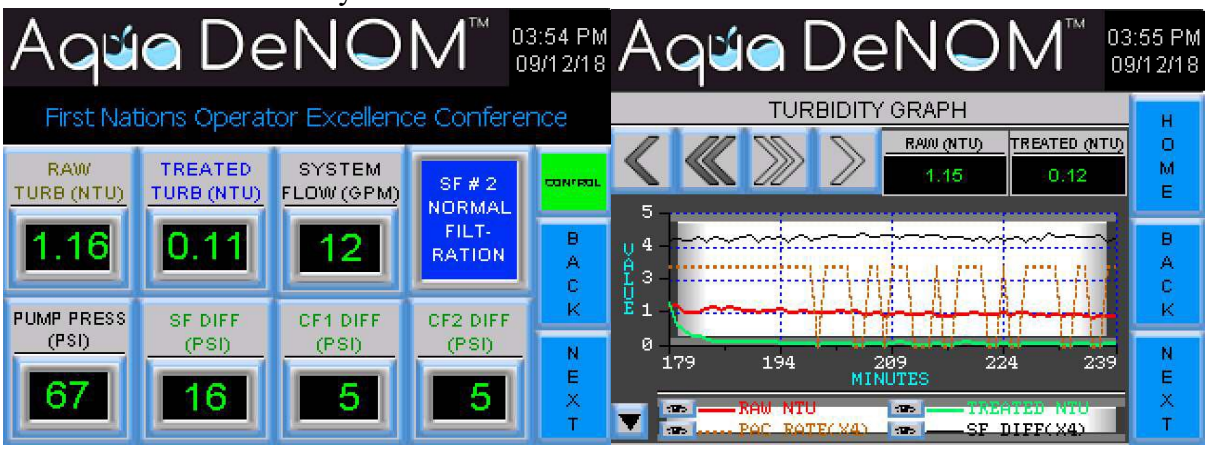
Testing/Monitoring

As part of the treatment system monitoring program to ensure water quality is maintained in accordance with the Drinking Water Protection Regulation, routine testing is required and data recorded for reference and monthly submission to the local Environmental Health Officer (EHO). Testing and data logging can be automated with on-line equipment or completed manually by the operator. UV Transmittance and UV Intensity are typically monitored and alarmed via sensors in the USEPA validated UV units.

Raw and treated water sample ports within the water treatment system provide information for water quality.

The DeNOM™ control system provides a real time readout of the system, equipment control and provides data logging that can be emailed daily. Remote access via smart phones is included.

Screenshots for a similar system:



Alarms/Back-up Power Supply

The DeNOM™ electronic control system will provide the following alarms:

1. Flow meter alarm for flow exceedances
2. Power on/off message to alert operator of power failures.
3. Low Raw EQ tank volume
4. Low Treated EQ tank volume
5. High Turbidity
6. High pressure differential across filters
7. Low Cl2 residule
8. UV Alarm - UVT, Lamp Failure

A disconnect for a back-up power supply (generator) is incorporated into the electrical panel of the treatment plant with a plug installed to utilize a generator supplied by the FCID. In order to effectively run the sensitive electronics of the UV system and prevent damage to the equipment, we recommend that the generator supplied by the group provide true sine-wave power.

Emergency lighting is installed in the treatment system building.

System Operation and Maintenance

The Environmental Health Officer, based on system complexity and people served, dictates operator certification requirements. AquaDiversities Inc. will submit the application for EOCP classification on the behalf of FCID. AquaDiversities Inc. recommends that the daily system operator obtain their EOCP Level 1 Certification or higher.

A separate Operation and Maintenance contract with Aqua can be negotiated with FCID to provide supplementary operator support, additional training to on-site maintenance staff to achieve their provincial operator certification, monthly visits by a certified operator to oversee system operation and sampling protocol, and a reduced cost on consumables purchased through Aqua.

Manufacturing

The system will be fabricated in Nelson, BC with all materials and equipment supplied by AquaDiversities Inc. The system will be pressure tested upon fabrication.

Components will be NSF61 certified or suitable equipment for water treatment systems.

Start-up and Training

A qualified field service representative (FSR) will be onsite to perform the full-time equivalent of 3 days for commissioning and training including, but not limited to, the following:

- Coordinate with the client for specific requirements of the installation contractor in respect to plumbing and electrical tie-in of the WTP;
- Provide full start-up services including equipment configuration and calibration;
- Conduct initial commissioning to have the system operational and delivering treatment to meet the parameters set out by the Canadian Drinking Water Guidelines;
- Instruct the system operator on maintaining Operator Log Sheets for data collection and providing a detailed monitoring program.
- Coordinate and attend IHA inspection

Onsite training is provided to ensure the owner's staff is instructed in the proper use and maintenance of the system and associated equipment. One hard copy of the Operation and Maintenance Manual will be provided in addition to one digital copy.

Testing Equipment

USEPA approved hand-held testing equipment will be utilized for on-site turbidity and free chlorine measurements as well as calibration of the online (inline) chlorine and tubidity analyzers.

Operation and Maintenance Manual

A comprehensive Operation and Maintenance (O&M) Manual is provided to outline system operation, maintenance, data collection, and sampling protocol. The O&M manual includes a detailed Emergency Response Plan (ERP), which provides instructions and contact information to the operator in the event of an emergency. This manual ensures safe operation with a consistent approach to water treatment and provides all the necessary information from both the system and equipment manufactures'.

Local Presence

On-site local presence for installation, commissioning, training and ongoing operational support will be provided by AquaDiversities Inc. located in Nelson, BC. Operation and maintenance contracts are available and are recommended. (Currently not in scope.)

DELIVERABLES

The following equipment and services are included with the ***Aqua100™*** treatment plant outlined in this proposal:

Building

*Modified Shipping Container (No siding):

- 1 - 36" steel door
- 1 - 24" X 36" vinyl window
- Wood studs for walls and ceiling
- Spray-foam insulation walls/ceiling (R8)
- ½" birch plywood (painted)
- **Electrical panel
- Exterior motion activated light
- Interior emergency lighting
- Interior wet rated fluorescent lighting
- Surface mounted GFI electrical outlets
- Electric baseboard heater (GFI protected)
- Sink
- Shelving
- Spray in polyethylene floor

*Alternatively, a stick-frame building with Hardy Plank siding can be supplied in place of a shipping container.

**A 60-amp minimum service is required to WTP.

Water Treatment System

- 2 - Backwashing multi-media vessels (nextsand ™)
- 2 - Bag housing and 4 filters
- 2 – Harmsco Municipal 1 Micron filter housings and 4 filters
- 2 – Harmsco Municipal 1 Micron absolute housings and 4 filters
- 2 - 50 gpm UV Units
- 2 - UV Solenoid Valves
- 1 - UV CoMMcentre
- 1 - Hand held chlorine analyzer
- 1 - Chlorine dosing pump
- 2 – 50gpm booster pumps
- 1 - Chlorine Analyzer
- 1 - Filter aid dosing pump
- 1 - Spare dosing pump
- 2 - Inline static mixers
- 1 - Hand held turbidimeter
- 2 – Online (Inline) Turbidimeters
- 1 - Inline flow meter
- 1 – DeNOM™ Control System
- 1 - Free standing dehumidifier
- 1 - 5 gallon carboy of Cl2
- All interconnecting plumbing
- All Interconnecting electrical

* DeNOM™ remote control/ monitoring and alarm notification system is subject to having Telus Wireless service or an available landline.

The water treatment system also includes:

- A comprehensive Operation and Maintenance Manual including an Emergency Response Plan
- Full-time equivalent of 3 days commissioning and training services
- As-Built drawings
- Final reports to IHA
- EOCP classification
- EQ tank volume EQ tank volume PLC control system for fully automatic operation
- Stamped drawings by an P. Eng.
- Shipping to site

Exclusions

- Internet service and or cell phone booster;
- Any upgrades required to collection and distribution system;
- Back-up power supply (Generator);
- Engineered foundation or pad;
- Landscaping and site clean-up;
- Disposal and handling of any and all waste produced;
- Disposal and handling of any and all drainage/runoff/ backwash and process water;
- Any guarantee or warranty on civil, mechanical and electrical components installed by other contractors;
- Any and all consumables for any and all proposed systems, unless otherwise noted in this proposal;
- Operators for operations of any and all proposed systems;
- Any additional costs incurred to meet the requirements set out by IHA that may be required as a part of the construction application;
- Building Permit or associated works;
- Backwash water disposal

I trust this meets your needs and will be pleased to provide any further information you may require.

Regards

Nathan Ward
Water Quality Technologist, CEO
AquaDiversities Inc.
Office: 250-509-2222 Cell: 250-777-2019
www.AquaDiversities.com
Suite 304-625 Front Street, Nelson, BC | V1L 4B6

7.0 Appendix E – Source Water Sample Results

CERTIFICATE OF ANALYSIS

REPORTED TO	Aqua Diversities Inc. 304-625 Front St Nelson, BC V1L 4B6		
ATTENTION	Nathan Ward	**WORK ORDER**	8080818
PO NUMBER		**RECEIVED / TEMP**	2018-08-09 08:00 / 6°C
PROJECT	General Potability	**REPORTED**	2018-08-16 16:07
PROJECT INFO	Fletcher Creek	**COC NUMBER**	B71196

Introduction:

CARO Analytical Services is a testing laboratory full of smart, engaged scientists driven to make the world a safer and healthier place. Through our clients' projects we become an essential element for a better world. We employ methods conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts. CARO is accredited by the Canadian Association for Laboratories Accreditation (CALA) to ISO 17025:2005 for specific tests listed in the scope of accreditation approved by CALA.

Big Picture Sidekicks

You know that the sample you collected after snowshoeing to site, digging 5 meters, and racing to get it on a plane so you can submit it to the lab for time sensitive results needed to make important and expensive decisions (whew) is VERY important. We know that too.

We've Got Chemistry

It's simple. We figure the more you enjoy working with our fun and engaged team members; the more likely you are to give us continued opportunities to support you.

Ahead of the Curve

Through research, regulation knowledge, and instrumentation, we are your analytical centre for the technical knowledge you need, BEFORE you need it, so you can stay up to date and in the know.

If you have any questions or concerns, please contact me at estclair@caro.ca

Authorized By:

Eilish St.Clair, B.Sc., C.I.T.
Client Service Representative

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Aqua Diversities Inc.	**WORK ORDER**	8080818
PROJECT	General Potability	**REPORTED**	2018-08-16 16:07

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Fletcher Creek (8080818-01) | Matrix: Water | Sampled: 2018-08-08 12:00						
Anions						
Chloride	< 0.10	AO ≤ 250	0.10	mg/L	2018-08-10	
Fluoride	< 0.10	MAC = 1.5	0.10	mg/L	2018-08-10	
Nitrate (as N)	**0.020**	MAC = 10	0.010	mg/L	2018-08-10	
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2018-08-10	
Sulfate	**6.7**	AO ≤ 500	1.0	mg/L	2018-08-10	
General Parameters						
Alkalinity, Total (as CaCO3)	**101**	N/A	1.0	mg/L	2018-08-14	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A	1.0	mg/L	2018-08-14	
Alkalinity, Bicarbonate (as CaCO3)	**101**	N/A	1.0	mg/L	2018-08-14	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2018-08-14	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2018-08-14	
Carbon, Total Organic	**1.23**	N/A	0.50	mg/L	2018-08-09	
Chemical Oxygen Demand	< 20	N/A	20	mg/L	2018-08-10	
Colour, True	< 5.0	AO ≤ 15	5.0	CU	2018-08-09	
Conductivity (EC)	**207**	N/A	2.0	µS/cm	2018-08-14	
Cyanide, Total	< 0.0020	MAC = 0.2	0.0020	mg/L	2018-08-10	
pH	**7.91**	7.0-10.5	0.10	pH units	2018-08-15	HT2
Temperature, at pH	**23.0**	N/A		°C	2018-08-16	HT2
Turbidity	**0.21**	OG < 1	0.10	NTU	2018-08-10	
Calculated Parameters						
Hardness, Total (as CaCO3)	**98.5**	None Required	0.500	mg/L	N/A	
Langelier Index	**-0.03**	N/A	-5.0	-	2018-08-16	
Solids, Total Dissolved	**105**	AO ≤ 500	1.00	mg/L	N/A	
Total Metals						
Aluminum, total	**0.0132**	OG < 0.1	0.0050	mg/L	2018-08-14	
Antimony, total	< 0.00020	MAC = 0.006	0.00020	mg/L	2018-08-14	
Arsenic, total	< 0.00050	MAC = 0.01	0.00050	mg/L	2018-08-14	
Barium, total	**0.0111**	MAC = 1	0.0050	mg/L	2018-08-14	
Boron, total	**0.0093**	MAC = 5	0.0050	mg/L	2018-08-14	
Cadmium, total	**0.000016**	MAC = 0.005	0.000010	mg/L	2018-08-14	
Calcium, total	**30.2**	None Required	0.20	mg/L	2018-08-14	
Chromium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2018-08-14	
Cobalt, total	< 0.00010	N/A	0.00010	mg/L	2018-08-14	
Copper, total	< 0.00040	AO ≤ 1	0.00040	mg/L	2018-08-14	
Iron, total	**0.018**	AO ≤ 0.3	0.010	mg/L	2018-08-14	
Lead, total	**0.00024**	MAC = 0.01	0.00020	mg/L	2018-08-14	
Magnesium, total	**5.59**	None Required	0.010	mg/L	2018-08-14	
Manganese, total	**0.00094**	AO ≤ 0.05	0.00020	mg/L	2018-08-14	
Mercury, total	< 0.000010	MAC = 0.001	0.000010	mg/L	2018-08-14	
Molybdenum, total	**0.00070**	N/A	0.00010	mg/L	2018-08-14	

TEST RESULTS

REPORTED TO	Aqua Diversities Inc.	**WORK ORDER**	8080818
PROJECT	General Potability	**REPORTED**	2018-08-16 16:07

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Fletcher Creek (8080818-01) | Matrix: Water | Sampled: 2018-08-08 12:00, Continued						
Total Metals, Continued						
Nickel, total	< 0.00040	N/A	0.00040	mg/L	2018-08-14	
Potassium, total	**0.48**	N/A	0.10	mg/L	2018-08-14	
Selenium, total	**0.00079**	MAC = 0.05	0.00050	mg/L	2018-08-14	
Sodium, total	**0.65**	AO ≤ 200	0.10	mg/L	2018-08-14	
Strontium, total	**0.190**	N/A	0.0010	mg/L	2018-08-14	
Uranium, total	**0.000682**	MAC = 0.02	0.000020	mg/L	2018-08-14	
Zinc, total	< 0.0040	AO ≤ 5	0.0040	mg/L	2018-08-14	
Microbiological Parameters						
Coliforms, Total	**≥ 33**	MAC = 0	1	CFU/100 mL	2018-08-09	
Background Colonies	**> 200**	N/A	200	CFU/100 mL	2018-08-09	
E. coli	**≥ 1**	MAC = 0	1	CFU/100 mL	2018-08-09	

Sample Qualifiers:

HT2 The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Aqua Diversities Inc.	**WORK ORDER**	8080818
PROJECT	General Potability	**REPORTED**	2018-08-16 16:07

Analysis Description	Method Ref.	Technique	Location
Alkalinity in Water	SM 2320 B* (2011)	Titration with H2SO4	Kelowna
Anions in Water	SM 4110 B (2011)	Ion Chromatography	Kelowna
Carbon, Total Organic in Water	SM 5310 B (2011)	Combustion, Infrared CO2 Detection	Kelowna
Chemical Oxygen Demand in Water	SM 5220 D* (2011)	Closed Reflux, Colorimetry	Kelowna
Coliforms, Total in Water	SM 9222* (2006)	Membrane Filtration / Chromocult Agar	Kelowna
Colour, True in Water	SM 2120 C (2011)	Spectrophotometry (456 nm)	Kelowna
Conductivity in Water	SM 2510 B (2011)	Conductivity Meter	Kelowna
Cyanide, SAD in Water	ASTM D7511-12	Flow Injection with In-Line UV Digestion and Amperometry	Kelowna
E. coli in Water	SM 9222* (2006)	Membrane Filtration / Chromocult Agar	Kelowna
Hardness in Water	SM 2340 B* (2011)	Calculation: 2.497 [total Ca] + 4.118 [total Mg] (Est)	N/A
Langelier Index in Water	SM 2330 B (2010)	Calculation	N/A
Mercury, total in Water	EPA 245.7*	BrCl2 Oxidation / Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)	Richmond
pH in Water	SM 4500-H+ B (2011)	Electrometry	Kelowna
Solids, Total Dissolved in Water	SM 1030 E (2011)	Calculation: 100 x ([Cations]-[Anions])/([Cations]+[Anions])	N/A
Total Metals in Water	EPA 200.2* / EPA 6020B	HNO3+HCl Hot Block Digestion / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	Richmond
Turbidity in Water	SM 2130 B (2011)	Nephelometry	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Glossary of Terms:

RL	Reporting Limit (default)
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
>	Greater than the specified Result
>=	Greater than or equal to the specified Result
°C	Degrees Celcius
AO	Aesthetic Objective
CFU/100 mL	Colony Forming Units per 100 millilitres
CU	Colour Units (referenced against a platinum cobalt standard)
MAC	Maximum Acceptable Concentration (health based)
mg/L	Milligrams per litre
NTU	Nephelometric Turbidity Units
OG	Operational Guideline (treated water)
pH units	pH < 7 = acidic, ph > 7 = basic
µS/cm	Microsiemens per centimetre
ASTM	ASTM International Test Methods
EPA	United States Environmental Protection Agency Test Methods
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Aqua Diversities Inc.	**WORK ORDER**	8080818
PROJECT	General Potability	**REPORTED**	2018-08-16 16:07

General Comments:

The results in this report apply to the samples analyzed in accordance with the Chain of Custody document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued unless otherwise agreed to in writing. The quality control (QC) data is available upon request