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January 16, 2015
File No. 1476-01

Alberni-Clayoquot Regional District
3008 5th Avenue
Port Alberni, B.C.
V9Y 2E3

Attention: **Mr. Russell Dyson**
Chief Administrative Officer

Dear Sirs:

Re: Bamfield Drinking Water Treatment - Pilot Testing Program

In October 2014 the Alberni-Clayoquot Regional District authorized Koers & Associates Engineering Ltd. (Koers) to coordinate, develop and oversee the water treatment pilot testing program for Bamfield. Historically the Sugsaw Lake source is considered to have relatively low turbidity and alkalinity, but elevated colour. The raw water contains organic concentrations that have led to disinfection by-products formation when chlorinated. Pilot testing is necessary to ensure the chosen treatment technology can successfully treat Sugsaw Lake water, Bamfield's single drinking water source.

The overall objectives of the pilot testing program are as follows.

Table 1: Pilot Testing Program Objectives

Pilot Testing Program Objectives	
Demonstrate stable and reliable performance of the proposed treatment processes before proceeding with a full scale plant.	Verify coagulant type and injection rates for Bamfield's specific water quality characteristics.
Provide the operators a better understanding of the treatment process before the design and implementation of a full scale plant.	Satisfy Ministry of Health and grant funding bodies that proper design due-diligence has been completed.
Measure the quality and quantity of waste residuals and the potential for their recovery and disposal.	Verify the overall turbidity, colour, organic carbon (total & dissolved), THM and HAA reduction.

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Treatment Process & Pilot Plant Description

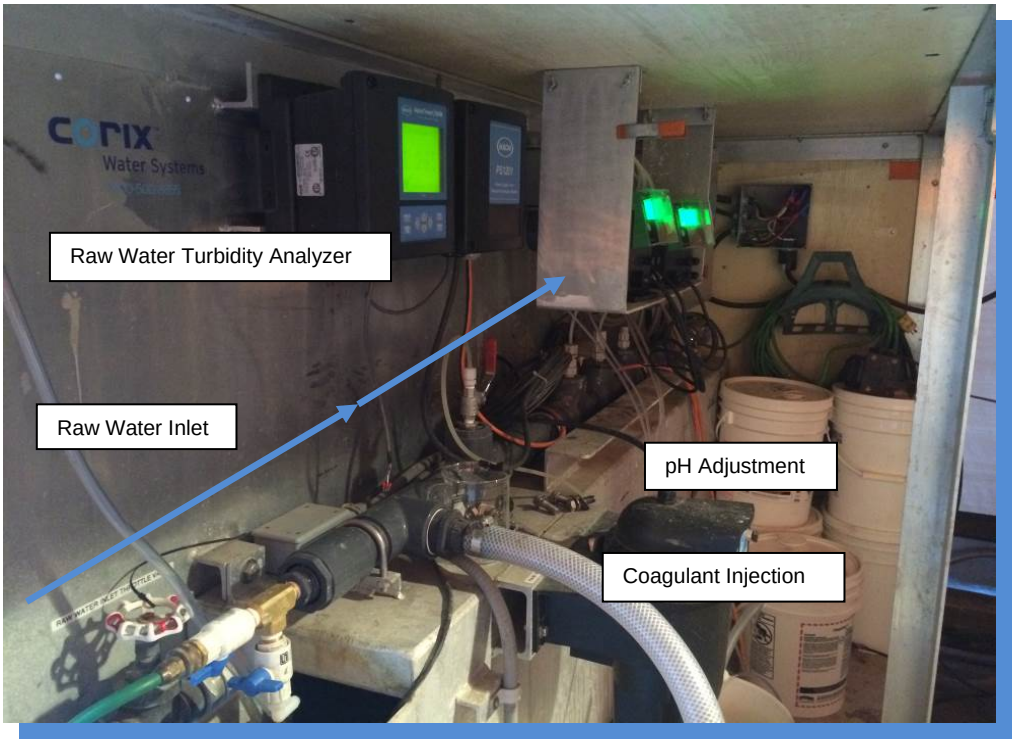
Typical treatment processes for treating surface water with elevated colour are dissolved air floatation (DAF) followed by gravity media filtration.

The DAF pilot plant consisted of three modules. Module No. 1 contained the raw water header and chemical injection equipment, Module No. 2 contained the mixing/flocculation tanks and DAF cell and module No. 3 contained the 100mm dia. filter column, backwash holding tank and pump.

Module No. 1 – Raw Water Turbidity Monitoring and Chemical Injection

The photo below shows the raw water header, where turbidity is measured and the chemical agents (coagulant & pH adjustment) are added.

Figure 1: Module 1 – Raw Water Header and Chemical Injection



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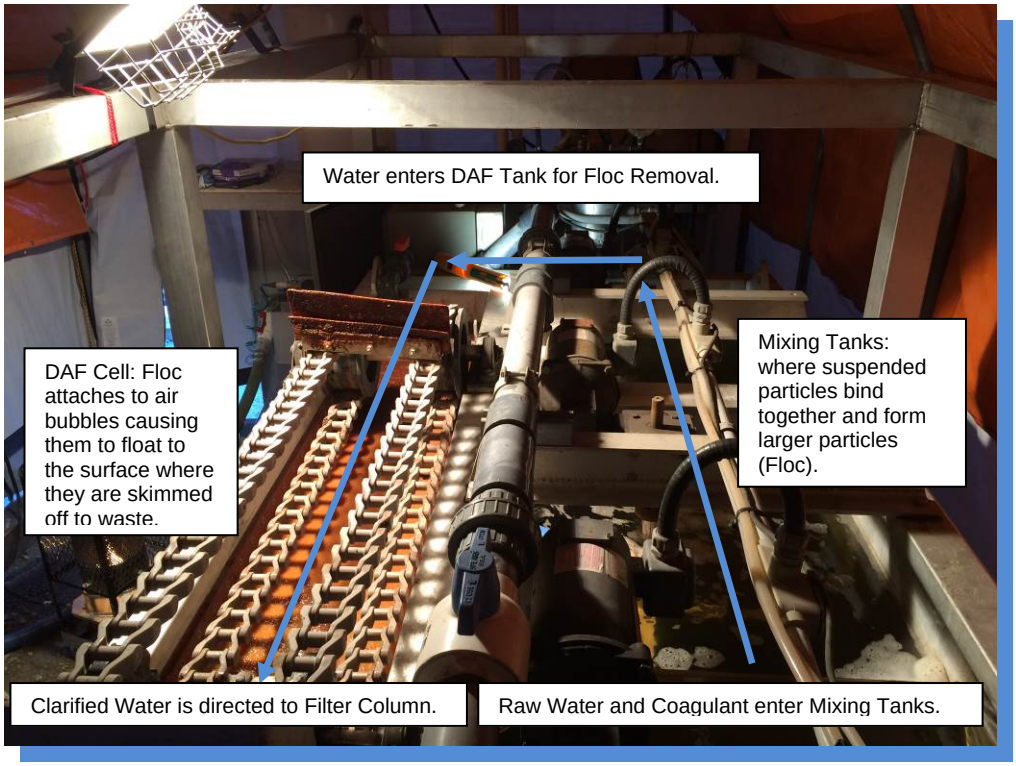
Module No. 2 – Dissolved Air Floatation (DAF) Equipment

The DAF equipment includes slow mixing tanks where the coagulant is gently mixed with the raw water to encourage suspended solids to bind together to form larger particles (flocculation). The DAF equipment includes an air saturator where a cloud of very fine air bubbles is introduced and attach to the particles (floc) causing them to rise to the surface where they are skimmed off.

Figure 2: Module 2 - Coagulation, Flocculation and Floatation



Finally the water is directed to Module No. 3 where it is filtered to remove the remaining particulate matter and filtered water turbidity is recorded.

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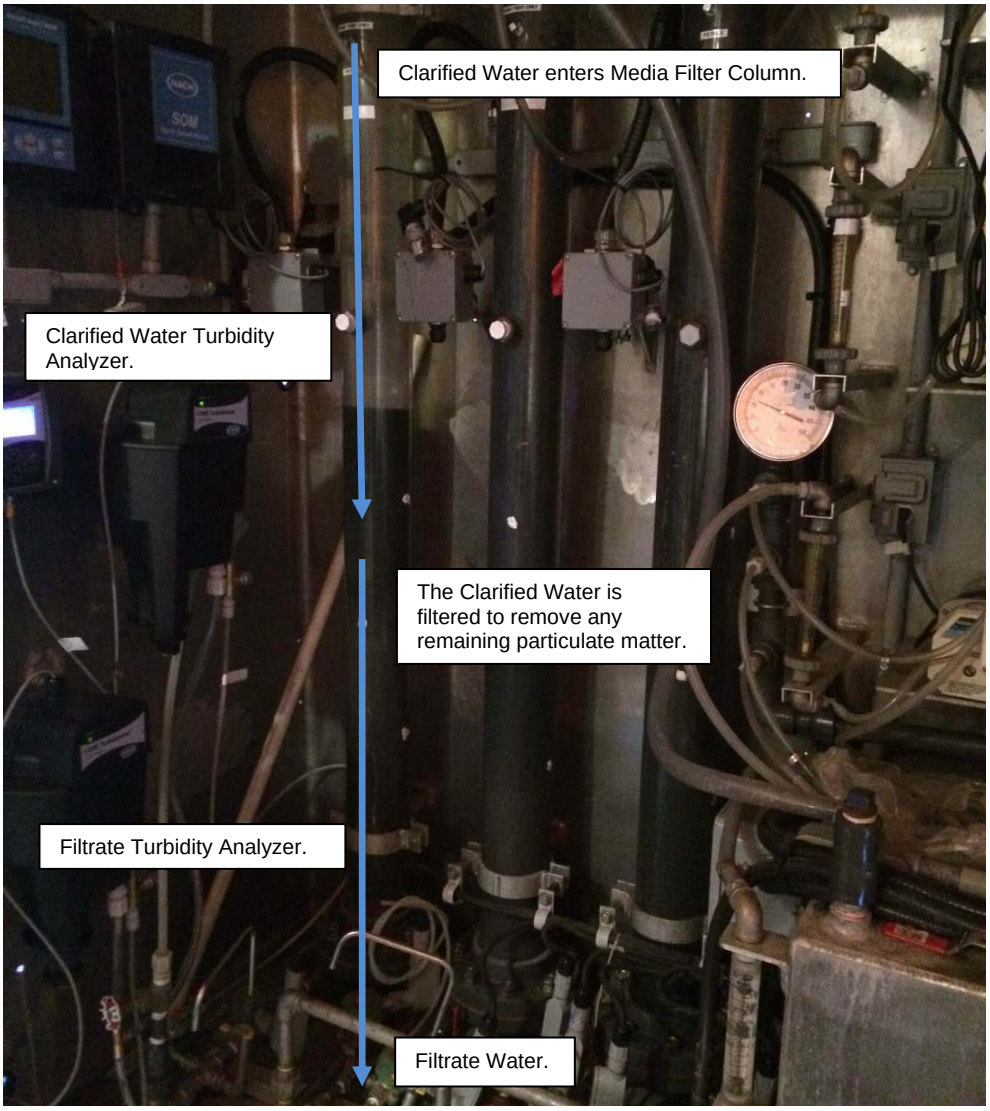
Module No. 3 – Filter Column (Filtration) and Treated Water Turbidity Monitoring

Module No. 3 consists of gravity dual-media filtration system where the clarified water enters above the filter column and passes downward through the dual-media bed. The filter column is cleaned by backwashing upward through the dual-media bed and collected for disposal.

Figure 3: Module 3 - Media Filtration and Turbidity Monitoring



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Water Quality Testing Protocol

A water quality testing protocol was developed specifically for Bamfield's piloting program. The protocol consisted of sampling from multiple locations at predetermined frequencies. Raw water samples were taken at the inlet of the pilot plant, along with clarified samples taken after the DAF cell and the filtered samples following the media filter column. The results are used to verify treatment effectiveness.

The Guidelines for Canadian Drinking Water Quality (GCDWQ) is the primary reference for potability and set out the maximum acceptable concentrations and aesthetic objectives for water which is delivered to consumers. For Bamfield, an introduction to some of the parameters used to assess the capacity of raw water to form disinfection by-products, is provided below.

UV Transmittance (UVT) - UVT is a measure of light transmitted through a material. For the purpose of this program ultra-violet light will be measured at a wavelength of 254 nm and a pathlength of 1-cm. The GCDWQ have not set a minimum standard for UVT. However, low UVT can be an indication of high organic content which can react with chlorine and create disinfection by-products such as trihalomethanes (THMs) and haloacetic acids (HAAs), which may pose health risks (suspected carcinogen). Disinfection by-product formation potential is generally higher in surface water, like Sugsaw Lake, compared to groundwater because of higher organic content.

Colour - Hues in water may result from natural minerals and vegetation origins, such as humus material and tannins or coloured wastes from a variety of industries such as logging and mining. Color in water is reported as true colour and apparent colour. True colour is usually due to colloidal organic compounds only and apparent colour is due to a combination of coloured suspended matter and colloidal organic compounds. Although the GCDWQ do not have a maximum acceptable concentration for colour, they have set an aesthetic objective (AO) of <15 true colour units (TCU).

Historic and recent colour levels have regularly exceeded the AO established in the GCDWQ. The concern with elevated colour and organics is they may react with chlorine and create disinfection by-products such as THMs and HAAs, which over many years of exposure above the maximum acceptable concentration may lead to an increased risk of cancer.

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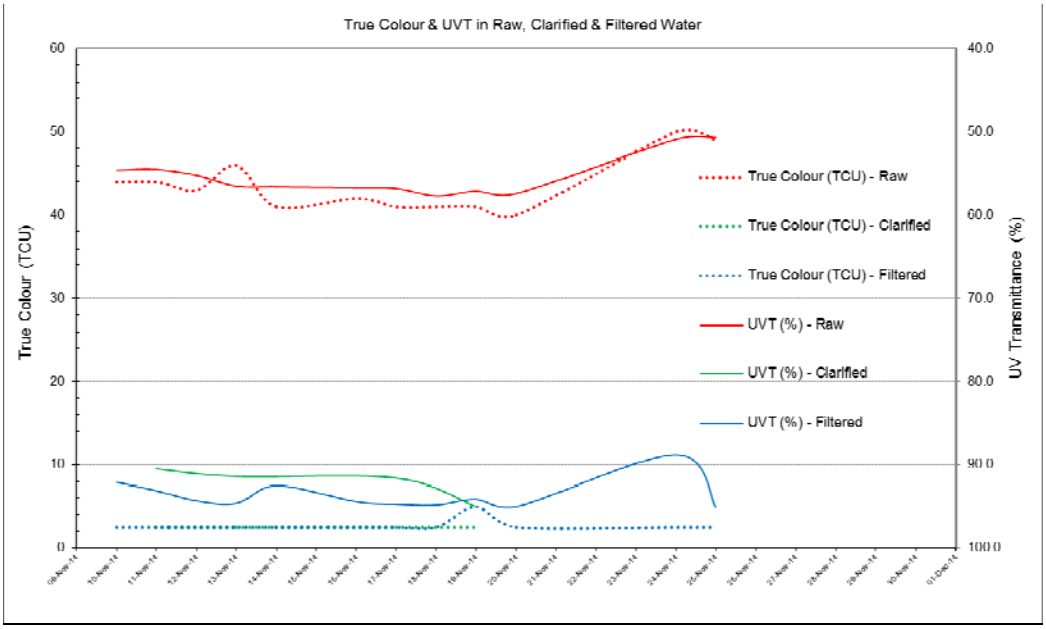
As identified in the graph below, colour in the raw water was reduced to below the detection limits for the majority of the pilot testing program. Raw water samples collected during the course of this pilot program measured colour between 40 and 50 TCU and historic raw water data indicated colour in the 30 to 50 TCU range. The graph below shows that the filtered water was consistently 5 TCU or less. The data also shows the significant increase in UV Transmittance and its relationship with colour.

Figure 4: True Colour and UV Transmittance (UVT)



Organic Carbon - Total Organic Carbon (TOC) is the covalently bonded carbon in a wide variety of organic compounds found in runoff containing decaying vegetation. TOC is used as a surrogate measure of the capacity of the drinking water to form disinfection byproducts, such as THMs. Dissolved Organic Carbon (DOC) is the dissolved fraction of TOC. Currently, the GCDWQ do not have MAC limits for TOC but the US Environmental Protect Agency (EPA) recommend that TOC be less than 2.0 mg/L to inhibit the formation of disinfection by-products.

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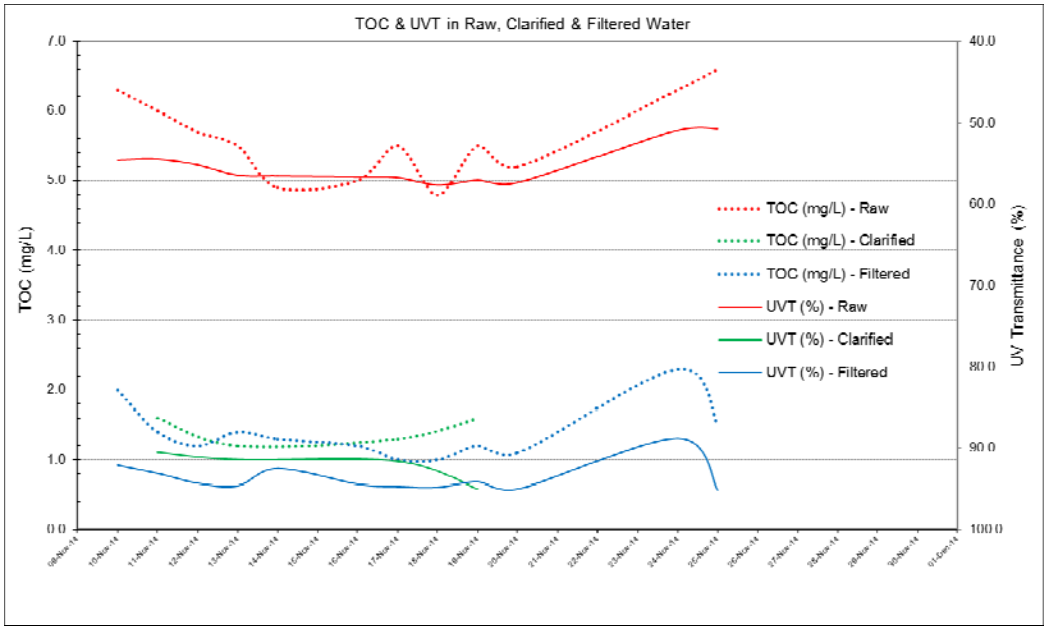
Therefore, it is desirable to reduce TOC concentrations in the treated water to less than 2.0 mg/L, in order to reduce the precursors associated with disinfection by-product formation. Similar to colour, the pilot plant was effective in reducing TOC in the raw water.

During the course of this pilot program the TOC concentrations measured between 5.0 mg/L and 6.5 mg/L and historic raw water data indicated TOC in the 5 mg/L to 6 mg/L range. As shown below, the TOC concentrations in the filtered water were consistently less than the 2.0 mg/L target.

Figure 5: Total Organic Carbon (TOC) & UV Transmittance (UVT)



Turbidity - Insoluble particles of soil, organics, microorganisms, and other materials impede the passage of light through water by scattering and absorbing rays. This interference of light passage is referred to as turbidity. Turbidity is measured in Nephelometric Turbidity Units (NTU), where low NTU is associated with low levels of scattering and adsorption of light, and therefore low amounts of particles in the water.

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Turbidity is important to control in water supplies for both health and aesthetic reasons. Suspended matter can harbour microorganisms, such as cryptosporidium and giardia, protecting them from disinfection processes. These microorganisms can cause outbreaks of illness. For conventional and direct filtration treatment systems, a maximum acceptable concentration of less than or equal to 0.3 NTU in at least 95% of measurements either per filter cycle or per month and never to exceed 1.0 NTU has been established in the GCDWQ in order to achieve health-based pathogen removal goals.

However, filtration systems should be designed and operated to reduce turbidity levels as low as reasonable achievable and strive to achieve a treated water turbidity target of less than 0.1 NTU (GCDWQ).

The turbidity was measured by analyzers supplied by Corix and were recorded manually in the field. Turbidity was reduced from 1 - 2 NTU in the raw water to less than 0.1 NTU in the filtered water (Corix Pilot Study Report 2015).

pH - pH is the measurement of hydrogen ion concentration, indicating how basic or acidic a water sample is. The GCDWQ recommend that the pH be maintained near neutral, between 6.5 and 8.5 to help prevent corrosion.

The raw water samples indicated the pH was within the 6.5 - 8.5 operational guideline established in the GCDWQ. As a result of the coagulation process the pH did drop below the 6.5 guideline in the filtered samples. However, the pH of the water can be increased by either adding caustic or soda ash. Caustic is recommended as soda ash comes in powder form which will require daily mixing and preparation by the operator (Corix Pilot Study Report 2015).

Aluminum - Conventional treatment processes frequently use aluminum salts as coagulants to remove colour and turbidity. Removal of naturally occurring organic matter can reduce the formation of disinfection by-products. For conventional treatment plants using aluminum based coagulants, the GCDWQ have set an operational guideline (OG) value of less than 0.1 mg/L for total aluminum. These values are based on a 12 month running average of monthly samples.

In a single sample aluminum concentrations were measured above the recommended operational guideline. In order to avoid higher levels of aluminum, it is necessary to maintain the pH of the water in the recommended range during the DAF process. Although caustic was added during the pilot study, the dosage added was insufficient. The addition of more caustic in the water would have helped to raise the pH of the water to the desired values (Corix Pilot Study Report 2015).

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Iron & Manganese – The presence of iron and manganese in drinking water can be objectionable for a number of reasons. Traces of iron and manganese can cause staining of bathroom fixtures, can impart a brownish colour to laundered clothing, and can affect the taste of water. Therefore, the GCDWQ have set aesthetic objectives (AO) for iron and manganese. The concentrations in treated water are to be less than 0.3 mg/L for iron and 0.05 mg/L for manganese.

During the course of this pilot program the iron and manganese concentration in the raw water were less than the AO. Nevertheless the treatment process showed the ability to reduce iron and manganese concentrations should there be an event in the source water.

Disinfection By-products – Disinfection by-products can be formed when chlorine reacts with natural organic compounds that originate from decaying vegetation. The most common types are THMs consisting of chloroform, bromodichloromethane, dibromochloromethane and bromoform and HAAs consisting of bromoacetic acid, chloroacetic acid, dibromoacetic, dichloroacetic acid and trichloroacetic acid.

The GCDWQ have set maximum acceptable concentrations for both THMs and HAAs. The GCDWQ require a MAC of 0.1 mg/L for THM and 0.08 mg/L for HAA based on a locational running annual average of a minimum of quarterly samples taken in the distribution system.

The approach to reduce exposure to THMs and HAAs is generally focused on removing organic matter from the water before chlorine is added.

In addition to operating the pilot plant, ACRD staff also conducted a disinfection by-product formation simulation. Twenty litres of raw and filtered water were put in pails and chlorinated then left for 10 days. Samples were extracted at the 3rd day and again on the 10th. The chlorine residual in the pails were maintained between 2.0 mg/L and 6.0 mg/L.

Chlorine had to be added daily to the raw water sample as it was difficult to maintain a chlorine residual over the first couple days. The elevated chlorine demand in the raw water samples may be due to high organic content. No additional chlorine was required in the filtrate samples, indicating a reduced chlorine demand in the filtered water.

A lower chlorine demand in the treated water will result in reduced chlorine consumption.

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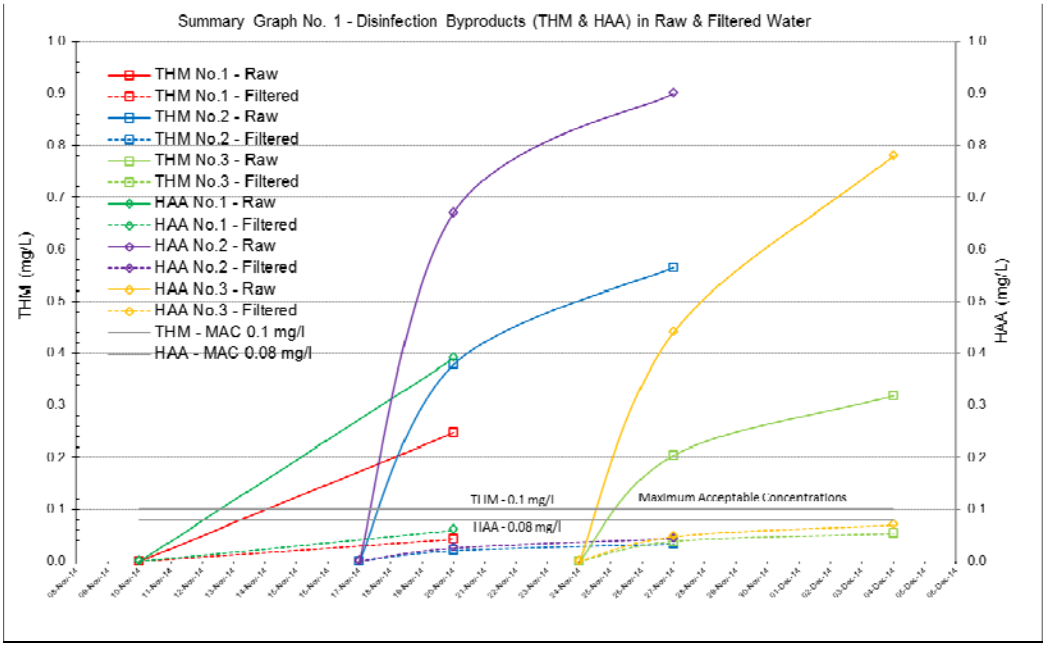
The graph below summarizes the data collected during the disinfection by-product formation simulation.

Figure 6: Total Trihalomethanes (THM) & Haloacetic Acids (HAA)



The simulation data clearly and effectively shows the disinfection by-product formation reduction in the filtered water to below the GCDWQ limits. Reducing the disinfection by-product's precursors has proven effective at reducing THM and HAA formation in Sugsaw Lake.

Surface Water Treatment Objectives

In addition to disinfection by-product formation reduction, a minimum level of treatment for microbial contaminants must be provided.

The Surface Water Treatment objectives are intended to provide the basic framework for treatment of drinking water supplies in British Columbia. These treatment objectives are meant to address microbiological parameters including enteric viruses, pathogenic bacteria, Giardia cysts and Cryptosporidium oocysts.

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The Surface Water Treatment Objectives are as follows:

- 4-log reduction or inactivation of viruses.
- 3-log reduction or inactivation of Giardia and Cryptosporidium.
- Two treatment processes for surface water (one process usually being filtration unless a filtration deferral is granted).
- Less than or equal to (≤) one nephelometric turbidity unit (NTU) of turbidity.
- Zero E. coli and fecal coliform.

These drinking water treatment objectives provide a minimum performance target for water suppliers to meet so they produce microbiologically safe drinking water.

Table 2: Microbial Treatment Requirements

Potential Pathogens	Removal / Inactivation
Cryptosporidium	3 log (99.9%)
Giardia	3 log (99.9%)
Viruses	4 log (99.99%)
Bacteria	100%

For conventional treatment, such as DAF, the average potential removal credits for giardia, cryptosporidium and viruses are shown below. These potential credits are based on treated water meeting the specified turbidity value of 0.3 NTU.

Table 3: Average Removal Credits for Conventional Treatment

Treatment Process	Cryptosporidium removal credit	Giardia removal credit	Virus removal credit
Conventional Treatment	3.0 log	3.0 log	2.0 log

Under the multi-barrier approach to drinking water treatment, physical pathogen removal will be used in conjunction with disinfection to achieve or exceed the overall treatment goals. Below are the anticipated removal credits for a DAF followed by chlorine disinfection.

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Table 4: Overall Anticipated Treatment Credits

Treatment Process	Cryptosporidium removal credit	Giardia removal credit	Virus removal credit
Conventional Treatment	3.0 log	3.0 log	2.0 log
Chlorine Disinfection	*Limited*	*Limited*	4.0 log
Overall Treatment Credits	**3.0 log**	**3.0 log**	**6.0 log**

DAF, in addition to chlorination will provide an additional barrier of protection to the existing Sugsaw Lake drinking water source. The use of several barriers is effective in preventing potential pathogens from reaching the consumer. Overall treatment will be achieved by using a combination conventional treatment and chlorine disinfection to remove bacteria, protozoa (3-log inactivation of cryptosporidium and giardia) and viruses (4-log inactivation of hepatitis A). In addition to the barriers noted above, the treated water turbidity target in the filtered water will be 0.3 NTU.

Based on the information presented, the DAF treatment process followed by chlorination should achieve the specified filtration and microbiological targets identified in the Surface Water Treatment objectives.

Summary

- The pilot testing program demonstrated stable and reliable performance of the proposed treatment processes and provided the operators a better understanding of the treatment process before the implementation of a full scale plant.

- The pilot testing program verified the overall turbidity, colour, organic carbon (total & dissolved) reduction in the filtered water. The elevated colour and TOC and low UVT in the raw water can be an indication of high organic content. These can react with chlorine and create disinfection by-products such as THMs and HAAs, which may pose health risks.

- TOC is used as a surrogate measure of the capacity of the drinking water to form disinfection by-products, we would expect a reduction in disinfection by-product formation. This agrees with the results obtained during the disinfection by-product simulation test discussed in the report.

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Summary Con't

- Disinfection by-product formation simulation tests were performed on chlorinated raw water and chlorinated filtrate water to further estimate the actual disinfection by-product formation reduction.

- The approach to reduce exposure to THMs and HAAs is generally focused on removing organic matter from the water before chlorine is added. Reducing the disinfection by-product's precursors has proven effective at reducing THM and HAA formation.

- As a result of the coagulation process the pH in the filtered water dropped below the 6.5 guideline and aluminum concentration was above the recommended operational guideline. However, this can be easily controlled by increasing the pH adjustment chemical dosages (Corix Pilot Study Report 2015).

- The recent raw water samples for colour was typically higher than historic data indicating the pilot test was performed during a period of poor water quality. Giving more confidence that the proposed treatment process will perform adequately year-round.

- The DAF treatment process followed by chlorination should achieve the specified filtration and microbiological targets identified in the Surface Water Treatment objectives.

Please feel free to contact the undersigned if you have any questions.

Yours truly,

Koers & Associates Engineering Ltd.

Ken Doll, PEng
Project Engineer

Chris Downey, PEng
Project Manager

Enclosures: Corix Pilot Study Report (Rev A) January 14, 2015
Preliminary Construction Cost Estimate (January 16, 2015)

Pilot Study Report – Rev A

BAMFIELD, BRITISH COLUMBIA

ALBERNI-CLAYOQUOT REGINAL DISTRICT

Creating Solutions

Building Partnerships

Community

Environment

Sustainability

Submitted To:

Koers & Associates Engineering Ltd.

Submitted By:

Corix Water Systems Inc.

January 14, 2015

BAMFIELD PILOT STUDY REPORT

CORIX PROJECT NUMBER - 17901

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APPENDIX

- Pilot Plant Data

INTRODUCTION

The following report summarizes the Dissolved Air Flotation (DAF) Pilot Study conducted for pilot testing at Bamfield. The pilot study was performed from Nov 8th to Nov 25th, 2014 to assess the efficacy of DAF water treatment in order to meet the desired water quality. The study was conducted using alum/PAC for coagulation.

The treated water quality goals from the DAF process are as follows:

Turbidity <0.1 NTU

Colour <5 TCU

Iron <0.1 mg/L

Mn <0.05 mg/L

Aluminum <0.1 mg/L

Chlorine demand -Minimized

UVT-Minimized

TOC/DOC reduction resulting in < 0.08 mg/L THM

< 0.06 mg/L HAA

The above treated water quality goals are in conformance with the *Guidelines for Canadian Drinking Water Quality*.

During pilot study the raw water had low turbidity (0.3 – 0.6 NTU), high colour (40-50 TCU), low alkalinity (< 20 mg/L) and low pH (6.6 – 7.1). Water temperature was in the range 11°C - 13°C.

The DAF pilot plant was operated under varying process parameters to determine the efficiency of the process and the optimum operating conditions for the raw waters being tested. The operating parameters and raw data are summarized in the daily log sheets and are included in the Appendix.

The pilot plant consists of three modules: chemical addition; flocculation and dissolved air flotation. The units can be operated over a wide range of operating conditions.

The aim of the pilot study was to meet the following treated water quality goals and filter production goals and to identify design parameters for a full scale DAF plant.

For this pilot study, clarified and filtered water turbidity were monitored and measured as an indication of the process efficiency for meeting goals. Samples were collected daily and sent to the laboratory for further analysis. The sample test results are all provided in the Appendix.

Design Parameters

The pilot study program was designed to provide a good level of comfort that the proposed process will meet the water quality and performance goals. It provided substantiated data to accurately assess the performance of the DAF system and to support design recommendations for the following:

- Primary coagulant(s) and coagulation conditions
- Soda Ash dosing for pH adjustment
- Flocculation time, flocculation energy input and number of flocculation stages
- DAF cell loading rate and recycle rate/air requirements.

Design parameters resulting from data collected for this study have been summarized at the end of this report.

PILOT PLANT STUDY

Task 1 - Mobilize, Set up and Commission

The pilot plant measured raw and filtered water turbidity using on-line Hach 1720E turbidimeters with a common SC200 Controller. These were calibrated before plant run. The raw water and DAF effluent were also sampled and sent to the external laboratory for measurement of various parameters such as colour, TOC, Trihalomethanes etc.

Task 2 - Optimize Coagulation Chemistry

The following settings were used in this task: a raw flow of 70 L/min (18.5 Usgpm), flocculation detention time of 8 - 10 minutes, DAF loading rate of 5 - 6 Usgpm/ft^2, a recycle rate of 6% to 9%, and air loading rates of 6 - 12 mg/L.

During the initial phase, polyaluminum Chloride (PAC) was initially used as a coagulant. The coagulant was then switched to alum in order to test two different types of coagulants. The coagulants were tested with a dosage ranging from 20 – 60 mg/L. After setting the dosing pump and allowing time for the system to settle, a visual inspection was made of the floc in the second flocculation stage. The flocc size and amount was noted and then the pump was adjusted to the new dosing rate. The turbidity of the clarified and filtered water was also measured

The optimum dose chosen was based on the best flocc produced at the lowest coagulant concentration. It was found that PAC is more preferable as a coagulant than alum in terms of process performance. The clarified water following the use of PAC was consistently less than 1NTU and the filtered water was less than 0.3NTU.

Task 3 – Flocculation

This task was performed to identify the optimum flocculation conditions for the DAF process. For the first set of trials, the coagulant dose and the DAF cell operating parameters were varied using a surface loading of 3.3 to 3.7 Usgpm/ft^2. The flocculation conditions were varied and DAF effluent turbidity was monitored.

First, different flocculator speed settings were tested (measured as a percentage of total speed input). The raw and clarified water was then tested for a number of parameters including turbidity, pH, colour etc.

Task 4 – DAF Cell Surface Loading and Air Loading (Recycle Rate)

During this task, the DAF surface loading was varied from 3.3 Usgpm/ft^2 to 5 Usgpm/ft^2, and the air loading was varied in stages from 12 mg/L down to 6 mg/L. DAF surface loading was adjusted by varying the DAF bypass flow rate thereby ensuring raw water flow and flocculation conditions were kept constant.

Flow:	70 L/min
Coagulant Recommended:	PAC
Recycle Rate:	6% - 9%
pH Control:	Caustic
Mechanical Flocculation:	2 stages
GT (mixing energy):	30,000 to 70,000
DAF Loading:	8-12 m/h (3.3 -5 Usgal/ft^2)
Air Loading:	<14mg/L (<12% recycle)

Task 5 – Filtration

Clarified water was fed to filter columns which operates on a constant flow, rising head principle. Filtered water was collected in an integral filtered water tank, which also provided backwash storage and then flows to waste.

Continuous, on-line filtered water turbidity was manually recorded for the filters and the filters were run under stable conditions in automatic mode. Backwashing was done from the backwash tank using the integral backwash pump. The backwash sequence was manually controlled. The design parameters for the filtration pilot unit are as follows:

FILTRATION		per Column			
No of filter columns -		3			
Filter column diameter		100	mm	(4	inch)
Max surface loading		11.10	m/hr	(4.5	USgpm/ft^2)
Max flow per filter		1.50	L/min	(0.40	USgpm)
Media depth		0.9	m	(3	ft)
Backwash rate		39	m/hr	(16	USgpm/ft^2)
Backwash Frequency:		Once every 20 hours of plant run			
Filter Media:					
450 mm:	1.0 mm anthracite, UC 1.5				
450 mm:	0.45-0.55 mm sand, UC 1.45				

RESULTS AND DISCUSSION

Table 1: Summary of Pilot Plant Water Quality Test Results by External Laboratory

Parameter	Date	Raw Water	DAF Clarified Water	Filtered Water	Treated Water Quality Goal
Colour – Apparent (Colour Units)	Nov 10	55		5	
	Nov 11	54	7	< 5	
	Nov 12	55		< 5	
	Nov 13	48	8	< 5	
	Nov 14	48		< 5	
	Nov 16	47		< 5	
	Nov 17	51	9	< 5	
	Nov 18	48		< 5	
	Nov 19	48	5	6	
	Nov 20	46		6	
	Nov 24	58		9	
Colour – True (Colour Units)	Nov 10	44		< 5	< 5
	Nov 11	44	< 5	< 5	< 5
	Nov 12	43		< 5	< 5
	Nov 13	46	< 5	< 5	< 5
	Nov 14	41		< 5	< 5
	Nov 16	42		< 5	< 5
	Nov 17	41	< 5	< 5	< 5
	Nov 18	41		< 5	< 5
	Nov 19	41	< 5	5	< 5
	Nov 20	40		< 5	< 5
	Nov 24	50		< 5	< 5
DOC – Dissolved Organic Carbon	Nov 10	6		1.6	

(mg/L)					
	Nov 11	6.4	1.5	1.5	
	Nov 12	6.2		1.3	
	Nov 13	5.6	1.1	1.2	
	Nov 14	5.6		1.2	
	Nov 16	5.6		1.3	
	Nov 17	5.5	1.3	1.1	
	Nov 18	5.4		1.2	
	Nov 19	5.9	1.2	1	
	Nov 20	5.5		1.4	
	Nov 24	6.3		1.7	
TOC – Total Organic Carbon (mg/L)	Nov 10	6.3		2	
	Nov 11	6	1.6	1.4	
	Nov 12	5.7		1.2	
	Nov 13	5.5	1.1	1.4	
	Nov 14	4.9		1.3	
	Nov 16	5		1.2	
	Nov 17	5.5	1.3	1	
	Nov 18	4.8		1	
	Nov 19	5.5	1.6	1.2	
	Nov 20	5.2		1.1	
	Nov 24	6.3		2.3	
pH at 25 deg C	Nov 10	6.6		6.1	6.5 – 8.0
	Nov 11	6.6	5.8	6.0	6.5 – 8.0
	Nov 12	6.6		5.8	6.5 – 8.0
	Nov 13	6.6	5.9	5.6	6.5 – 8.0
	Nov 14	6.6		5.2	6.5 – 8.0
	Nov 16	6.9		6.2	6.5 – 8.0
	Nov 17	7.0	5.9	6.0	6.5 – 8.0
	Nov 18	6.8		5.9	6.5 – 8.0
	Nov 19	6.6	5.8	5.8	6.5 – 8.0

	Nov 20	6.7		5.8	6.5 – 8.0
	Nov 24	7.1		6.1	6.5 – 8.0
UV Transmittance (%/cm)	Nov 10	54.6		92.1	
	Nov 11	54.5	90.5	93.1	
	Nov 12	55.2		94.3	
	Nov 13	56.5		94.6	
	Nov 14	56.6		92.5	
	Nov 16	56.7		94.4	
	Nov 17	56.8	91.6	94.7	
	Nov 18	57.7		94.8	
	Nov 19	57.1	95	94.1	
	Nov 20	57.4		95	
	Nov 24	50.9		88.8	
Iron (mg/L)	Nov 11		0.007	0.004	< 0.3
	Nov 17	0.093	0.009	0.003	< 0.3
	Nov 19	0.089	< 0.002	< 0.002	< 0.3
	Nov 20	0.087		0.003	< 0.3
Manganese (mg/L)	Nov 11		<0.001	< 0.001	< 0.05
	Nov 17	0.0037	< 0.001	< 0.001	< 0.05
	Nov 19	0.003	< 0.001	< 0.001	< 0.05
	Nov 20	0.0023		0.0012	< 0.05
Total Trihalomethanes (mg/L)	Nov 13	0.378		0.021	<0.08
	Nov 20	0.247		0.043	<0.08
	Nov 27	0.565		0.034	<0.08
	Nov 27	0.204		0.048	<0.08
	Dec 4	0.319		0.054	<0.08
Total Halo Acetic Acids (mg/L)	Nov 13	0.67		0.026	<0.06
	Nov 20	0.39		0.06	<0.06

	Nov 27	0.9		0.044	<0.06
	Nov 27	0.44		0.039	<0.06
	Dec 4	0.78		0.07	<0.06
Aluminum (mg/L)	Nov 17	0.17	0.34	0.076	< 0.1
	Nov 19	0.16	0.29	0.14	< 0.1
	Nov 20	0.15		0.075	< 0.1
Alkalinity (mg/L)	Nov 20	< 20		< 20	
	Nov 24	< 20		< 20	

Table 2: Summary of Test Results for Waste Discharges during the Pilot Study

Parameter	Date	Raw	Float	Backwash
T-Aluminum (mg/L)	Nov 20	0.16	2,300	19
	Nov 25*	3,300*		11
pH	Nov 20	6.9	5.2	6.3
	Nov 25*	5.1		6.2
Total Suspended Solids (mg/L)	Nov 20	< 5	12,000	85
	Nov 25*	46,000*		74
Turbidity (NTU)	Nov 20	< 0.5	950	12.4
	Nov 25	1,500*		10.3
Iron (mg/L)	Nov 25	119*		0.404
Manganese (mg/L)	Nov 25	2.56*		0.0181

**Sample is suspected to be mislabeled as "Waste Discharge-Raw". The values indicate that the sample was for "Float Waste Discharge". The test results for TSS, Turbidity, Iron and Manganese were very high and unlikely to be present in Raw Water.*

All data (from both field and external laboratory tests) are collected and shown in the Appendix at the end of this report. Table 1 summarizes the pilot plant water quality test results done by an external laboratory. Both colour and turbidity removals were good. Colour levels reduced from over 44 TCU in the raw water to less than 5 TCU in the clarified water. The apparent colour in the clarified water increased from <5 to about 9 towards the end of the pilot study although the true colour was less than 5 TCU. The increase in apparent colour may have been due the delay in colour measurement from sample collection to the actual measurement in the laboratory. This delay may have caused more colour to be generated in the water from any suspended solids in the clarified water. Apparent colour of 9 is still much less than *Canadian Drinking Water Guideline* of 15 TCU and hence it is not a concern. Turbidity (measured in the field) was reduced from around 1-2 NTU to less under 0.1 NTU. The TOC levels were reduced from 5.5 to less than 1.5 mg/L. The UV transmittance increased from 56% to higher than 92%. The iron and manganese levels were all within the drinking water guidelines. Except for one test result which was slightly higher in the HAA in the treated effluent (>0.06 mg/L); for all other trials, when the plant was optimized, the results were meeting the treated water quality objectives.
From the pilot study, it was found that PAC is more preferable as a coagulant than alum in terms of process performance. PAC is often found to be more suitable as a coagulant when the alkalinity of the raw water is low. The optimum PAC dosage was found to be in the range of 40 – 60 mg/L.

The only parameter which was not optimized during the pilot study was pH. Since the focus of the pilot study was colour removal, pH was not adjusted to 6.5-8 in order to meet the drinking water guidelines. This resulted in high aluminum concentration in the treated water. The pH of the water can be increased by either adding caustic or soda ash. Caustic is recommended for convenience as soda ash comes in powder form which will require daily mixing and preparation by the operator. In terms of capital cost soda ash will be more expensive as it will require a mixer for mixing chemicals. It will also increase the operating cost as well as lifecycle cost in terms of power consumption and labour for daily chemical mixing. Soda ash is preferable in remote locations where chemical storage or delivery are a concern. Hence caustic is recommended. The caustic should be added at the plant inlet along with PAC at the static mixer to ensure proper chemical mixing. This will also ensure that plant pH is adjusted to the desired levels during the DAF process.
It is expected that once the caustic dosage is increased to maintain a pH of 6.8 – 6.9 in the 2nd stage of the flocculator in the DAF process, the aluminum solubility is expected to be reduced to a level within

the drinking water guidelines. The solubility of aluminum in water increases as the pH of the water drops below 6.8. During the pilot study, the pH was consistently below 6.8 and thus the aluminum solubility in the water was very high. This resulted in higher aluminum concentrations in the water. In order to avoid higher levels of aluminum, it is necessary to maintain the pH of the water in the recommended range during the DAF process. Although caustic was added during the pilot study, the dosage added was insufficient. The addition of more caustic in the water would have helped to raise the pH of the water to the desired values. Since a lot of the parameters during the pilot study were controlled manually, it was not possible to maintain the pH to the desired range. As an additional note, it should also be stated that where pH is properly controlled Corix water treatment plants all operate with low levels of aluminum.

A full scale plant shall have much more automation and control compared to a pilot plant which will help to control these parameters better and achieve the target values comfortably.

The filtration unit of the pilot study ran well within all acceptable design parameters. Operating data from the pilot study was collected to provide basis for the design of full-scale DAF water treatment plant. The recommended design parameters for the full-scale plant are as follows:

Flow Rate:

DAF Flow:	26 m^3/h (115 US gpm)
Filter Flow:	26 m^3/h (115 US gpm)
DAF Recycle Flow:	2.7 m^3/h (12 US gpm) @ 57 m (190 ft) TDH

Hydraulic Loading:

DAF Clarifier:	9.3 $m^3/m^2/h$ (3.8 US gpm/ft^2)
Saturator:	21 US gpm/ft^2
Filter:	8.6 $m^3/m^2/hr$ (3.5 US gpm/ft^2)

Detention Time:

Flocculation:		19 min
DAF Clarifier:		16 min
Filter:		9.5 min
	Total:	44.5 min

Backwash Frequency:	Once every 20 - 24 hours of plant run
Backwash per filter (Water Only):	133 m^3/h (585 US gpm) @ 13.7m (45 ft) TDH
Backwash Per Filter (During Air Scour)	

Water: 26.1 m^3/h (115 US gpm)

Air: 0.91 m^3/min/m^2 (98 scfm)

Estimated Wastewater generated from float discharge: 0.5m^3/h

Estimated Wastewater generated from each filter backwash: 25 m^3

CONCLUSION AND RECOMMENDATION

The Corix pilot DAF plant at Bamfield provided key information regarding the suitability of the use of DAF process in order to meet treatment objectives. The findings from the study are summarized as follows:

1. The DAF process was found to be effective in the reduction of turbidity, colour, THMs and HAAs to the desired goals.

2. The iron and manganese concentrations in the raw water was not significantly high. Nevertheless the DAF process brought down the iron and manganese concentrations further.

3. The DAF process brought down the pH and alkalinity to less than the desired goals. It is expected that the caustic dosage increase will help to elevate the pH to the desired levels.

4. The DAF process elevated the aluminum concentrations in the treated water above the desired goals. It is expected that the caustic dosage increase will help to elevate the pH and also reduce the aluminum concentrations to the desired levels.

5. Waste stream from the DAF process will represent approximately 5-10% of the incoming raw water flow.

It is expected that in a larger plant with its improved hydraulic flows and optimized design/operation, it will generally provide improved removal efficiencies than what is experienced during the pilot program when operating under similar raw water conditions.

Appendix – Pilot Study Data

North Island Laboratories
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Certificate of Analysis

Report To: Regional District of Alberni & Clayoquot
Ken Doll - Koers Engineering

Lab Number: 115721
Date Reported: 21 Nov 14
Date Completed: 21 Nov 14
Date Received: 10 Nov 14 16:14

Sampled By:
Sampling Date: 10 Nov 14 0:00

Test	Result	Units	Detection Limit
115721-01 BWS Pilot Plant Raw			
Colour - Apparent	55	Colour Units	5 Colour Units
Colour - True	44	Colour Units	5 Colour Units
DOC - Dissolved Organic Carbon	6	mg/L	0.5 mg/L
pH at 25 C	6.6	pH Units	pH Units
Total Organic Carbon	6.3	mg/L	0.5 mg/L
UV Transmittance	54.6	%/cm	0.1 %/cm
115721-02 BWS Pilot Plant Filtered			
Colour - Apparent	5	Colour Units	5 Colour Units
Colour - True	<5	Colour Units	5 Colour Units
DOC - Dissolved Organic Carbon	1.6	mg/L	0.5 mg/L
pH at 25 C	6.1	pH Units	pH Units
Total Organic Carbon	2	mg/L	0.5 mg/L
UV Transmittance	92.1	%/cm	0.1 %/cm

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115721-01

Test	Method	Analyst	Date
Colour - Apparent	Spectrophotometer, APHA 2120 C -modified	NIsL	11/13/2014
Colour - True	Spectrophotometer, APHA 2120 C -modified	NIsL	11/13/2014
DOC - Dissolved Organic Carbo	Exova Subcontract Exova Subcontract	EXL	11/20/2014
pH at 25 C	Electrometric, APHA 4500 B -modified	NIsL	11/13/2014
pH at 25 C	Electrometric, APHA 4500 B -modified	NIsL	11/12/2014
Total Organic Carbon	Exova Subcontract, Ch.34 SSSA BookSeries5-modified	EXL	11/19/2014
UV Transmittance	APHA 5910 B -modified	NIsL	11/13/2014

Approved By: Catherine Black

Catherine Black, Owner/Operator

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Certificate of Analysis

Report To:	Regional District of Alberni & Clayoquot Ken Doll - Koers Engineering	Lab Number:	115755
		Date Reported:	21 Nov 14
		Date Completed:	21 Nov 14
		Date Received:	12 Nov 14 15:51

Sampled By: John
Sampling Date: 11 Nov 14 0:00

Test	Result	Units	Detection Limit
115755-01 BWS Pilot Plant Raw Tuesday			
Colour - Apparent	54	Colour Units	5 Colour Units
Colour - True	44	Colour Units	5 Colour Units
DOC - Dissolved Organic Carbon	6.4	mg/L	0.5 mg/L
T-Iron	0.123	mg/L	0.002 mg/L
T-Manganese	0.0042	mg/L	0.001 mg/L
pH at 25 C	6.6	pH Units	pH Units
.	.		
Total Organic Carbon	6	mg/L	0.5 mg/L
UV Transmittance	54.5	%/cm	0.1 %/cm
115755-02 BWS Pilot Plant Filtered Tuesday			
Colour - Apparent	<5	Colour Units	5 Colour Units
Colour - True	<5	Colour Units	5 Colour Units
DOC - Dissolved Organic Carbon	1.5	mg/L	0.5 mg/L
T-Iron	0.004	mg/L	0.002 mg/L
T-Manganese	<0.0010	mg/L	0.001 mg/L
pH at 25 C	6.0	pH Units	pH Units
.	.		
Total Organic Carbon	1.4	mg/L	0.5 mg/L
UV Transmittance	93.1	%/cm	0.1 %/cm
115755-03 BWS Pilot Plant Clarified Tuesday			
Colour - Apparent	7	Colour Units	5 Colour Units
Colour - True	<5	Colour Units	5 Colour Units
DOC - Dissolved Organic Carbon	1.5	mg/L	0.5 mg/L
T-Iron	0.007	mg/L	0.002 mg/L

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115755-03	**BWS Pilot Plant Clarified**	**Tuesday**	
T-Manganese	<0.0010	mg/L	0.001 mg/L
pH at 25 C	5.8	pH Units	pH Units
.	.		
Total Organic Carbon	1.6	mg/L	0.5 mg/L
UV Transmittance	90.5	%/cm	0.1 %/cm

115755-01

Test	Method	Analyst	Date
.		EXL	
Colour - Apparent	Spectrophotometer, APHA 2120 C -modified	NIsL	11/13/2014
Colour - True	Spectrophotometer, APHA 2120 C -modified	NIsL	11/13/2014
DOC - Dissolved Organic Carbo	Exova Subcontract Exova Subcontract	EXL	11/20/2014
pH at 25 C	Electrometric, APHA 4500 B -modified	NIsL	11/13/2014
T-Iron	Exova Subcontract, ICP, APHA 3120B - modified	EXL	11/19/2014
T-Manganese	Exova Subcontract, ICP, APHA 3120B	EXL	11/19/2014
Total Organic Carbon	Exova Subcontract, Ch.34 SSSA BookSeries5-modified	EXL	11/19/2014
UV Transmittance	APHA 5910 B -modified	NIsL	11/13/2014

Approved By: Catherine Black

Catherine Black, Owner/Operator

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Report To:	Regional District of Alberni & Clayoquot Ken Doll - Koers Engineering	Lab Number:	115754
		Date Reported:	21 Nov 14
		Date Completed:	21 Nov 14
		Date Received:	12 Nov 14 15:22

Sampled By: John
Sampling Date: 12 Nov 14 0:00

Test	Result	Units	Detection Limit
115754-01 BWS Pilot Plant Raw Wednesday			
Colour - Apparent	55	Colour Units	5 Colour Units
Colour - True	43	Colour Units	5 Colour Units
DOC - Dissolved Organic Carbon	6.2	mg/L	0.5 mg/L
pH at 25 C	6.6	pH Units	pH Units
Total Organic Carbon	5.7	mg/L	0.5 mg/L
UV Transmittance	55.2	%/cm	0.1 %/cm
115754-02 BWS Pilot Plant Filtered Wednesday			
Colour - Apparent	<5	Colour Units	5 Colour Units
Colour - True	<5	Colour Units	5 Colour Units
DOC - Dissolved Organic Carbon	1.3	mg/L	0.5 mg/L
pH at 25 C	5.8	pH Units	pH Units
Total Organic Carbon	1.2	mg/L	0.5 mg/L
UV Transmittance	94.3	%/cm	0.1 %/cm

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115754-01

Test	Method	Analyst	Date
Colour - Apparent	Spectrophotometer, APHA 2120 C -modified	NIsL	11/13/2014
Colour - True	Spectrophotometer, APHA 2120 C -modified	NIsL	11/13/2014
DOC - Dissolved Organic Carbo	Exova Subcontract Exova Subcontract	EXL	11/20/2014
pH at 25 C	Electrometric, APHA 4500 B -modified	NIsL	11/13/2014
Total Organic Carbon	Exova Subcontract, Ch.34 SSSA BookSeries5-modified	EXL	11/19/2014
UV Transmittance	APHA 5910 B -modified	NIsL	11/13/2014

Approved By: Catherine Black

Catherine Black, Owner/Operator

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Certificate of Analysis

Report To: Regional District of Alberni & Clayoquot
Ken Doll - Koers Engineering

Lab Number: 115785
Date Reported: 27 Nov 14
Date Completed: 27 Nov 14
Date Received: 13 Nov 14 15:35

Sampled By:
Sampling Date: 13 Nov 14 0:00

Test	Result	Units	Detection Limit
115785-01 BWS Pilot Plant Raw Thursday			
Colour - Apparent	48	Colour Units	5 Colour Units
Colour - True	46	Colour Units	5 Colour Units
DOC - Dissolved Organic Carbon	5.6	mg/L	0.5 mg/L
T-Iron	0.056	mg/L	0.002 mg/L
T-Manganese	<0.0010	mg/L	0.001 mg/L
pH at 25 C	6.6	pH Units	pH Units
.	.		
Total Organic Carbon	5.5	mg/L	0.5 mg/L
UV Transmittance	56.5	%/cm	0.1 %/cm
115785-02 BWS Pilot Plant Filtered Thursday			
Colour - Apparent	<5	Colour Units	5 Colour Units
Colour - True	<5	Colour Units	5 Colour Units
DOC - Dissolved Organic Carbon	1.2	mg/L	0.5 mg/L
T-Iron	<0.002	mg/L	0.002 mg/L
T-Manganese	<0.0010	mg/L	0.001 mg/L
pH at 25 C	5.9	pH Units	pH Units
.	.		
Total Organic Carbon	1.4	mg/L	0.5 mg/L
UV Transmittance	94.6	%/cm	0.1 %/cm
115785-03 BWS Pilot Plant Clarified Thursday			
Colour - Apparent	8	Colour Units	5 Colour Units
Colour - True	<5	Colour Units	5 Colour Units
DOC - Dissolved Organic Carbon	1.1	mg/L	0.5 mg/L
T-Iron	<0.002	mg/L	0.002 mg/L

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115785-03	**BWS Pilot Plant Clarified**	**Thursday**	
T-Manganese	<0.0010	mg/L	0.001 mg/L
pH at 25 C	5.6	pH Units	pH Units
.	.		
Total Organic Carbon	1.2	mg/L	0.5 mg/L
UV Transmittance	91.4	%/cm	0.1 %/cm

115785-01

Test	Method	Analyst	Date
.		EXL	
Colour - Apparent	Spectrophotometer, APHA 2120 C -modified	NIsL	11/14/2014
Colour - True	Spectrophotometer, APHA 2120 C -modified	NIsL	11/14/2014
DOC - Dissolved Organic Carbo	Exova Subcontract Exova Subcontract	EXL	11/24/2014
pH at 25 C	Electrometric, APHA 4500 B -modified	NIsL	11/13/2014
T-Iron	Exova Subcontract, ICP, APHA 3120B - modified	EXL	11/25/2014
T-Manganese	Exova Subcontract, ICP, APHA 3120B	EXL	11/25/2014
Total Organic Carbon	Exova Subcontract, Ch.34 SSSA BookSeries5-modified	EXL	11/21/2014
UV Transmittance	APHA 5910 B -modified	NIsL	11/14/2014

Approved By: Catherine Black

Catherine Black, Owner/Operator

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Report To: Regional District of Alberni & Clayoquot
Ken Doll - Koers Engineering

Lab Number: 115800
Date Reported: 27 Nov 14
Date Completed: 27 Nov 14
Date Received: 14 Nov 14 14:29

Sampled By:
Sampling Date: 14 Nov 14 0:00

Test	Result	Units	Detection Limit
115800-01 BWS Pilot Plant Raw Friday			
Colour - Apparent	48	Colour Units	5 Colour Units
Colour - True	41	Colour Units	5 Colour Units
DOC - Dissolved Organic Carbon	5.6	mg/L	0.5 mg/L
pH at 25 C	6.6	pH Units	pH Units
Total Organic Carbon	4.9	mg/L	0.5 mg/L
UV Transmittance	56.6	%/cm	0.1 %/cm
115800-02 BWS Pilot Plant Filtered Friday			
Colour - Apparent	<5	Colour Units	5 Colour Units
Colour - True	<5	Colour Units	5 Colour Units
DOC - Dissolved Organic Carbon	1.2	mg/L	0.5 mg/L
pH at 25 C	5.2	pH Units	pH Units
Total Organic Carbon	1.3	mg/L	0.5 mg/L
UV Transmittance	92.5	%/cm	0.1 %/cm

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115800-01

Test	Method	Analyst	Date
Colour - Apparent	Spectrophotometer, APHA 2120 C -modified	NIsL	11/14/2014
Colour - True	Spectrophotometer, APHA 2120 C -modified	NIsL	11/14/2014
DOC - Dissolved Organic Carbo	Exova Subcontract Exova Subcontract	EXL	11/24/2014
pH at 25 C	Electrometric, APHA 4500 B -modified	NIsL	11/14/2014
Total Organic Carbon	Exova Subcontract, Ch.34 SSSA BookSeries5-modified	EXL	11/21/2014
UV Transmittance	APHA 5910 B -modified	NIsL	11/14/2014

Approved By: Catherine Black

Catherine Black, Owner/Operator

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Certificate of Analysis

Report To: Regional District of Alberni & Clayoquot
Ken Doll - Koers Engineering

Lab Number: 115844
Date Reported: 27 Nov 14
Date Completed: 27 Nov 14
Date Received: 17 Nov 14 15:45

Sampled By:
Sampling Date: 16 Nov 14 0:00

Test	Result	Units	Detection Limit
115844-01 BWS Pilot Plant Raw Sunday			
Colour - Apparent	47	Colour Units	5 Colour Units
Colour - True	42	Colour Units	5 Colour Units
DOC - Dissolved Organic Carbon	5.6	mg/L	0.5 mg/L
pH at 25 C	6.9	pH Units	pH Units
Total Organic Carbon	5	mg/L	0.5 mg/L
UV Transmittance	56.7	%/cm	0.1 %/cm
115844-02 BWS Pilot Plant Filtered Sunday			
Colour - Apparent	<5	Colour Units	5 Colour Units
Colour - True	<5	Colour Units	5 Colour Units
DOC - Dissolved Organic Carbon	1.3	mg/L	0.5 mg/L
pH at 25 C	6.2	pH Units	pH Units
Total Organic Carbon	1.2	mg/L	0.5 mg/L
UV Transmittance	94.4	%/cm	0.1 %/cm

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115844-01

Test	Method	Analyst	Date
Colour - Apparent	Spectrophotometer, APHA 2120 C -modified	NIsL	11/18/2014
Colour - True	Spectrophotometer, APHA 2120 C -modified	NIsL	11/18/2014
DOC - Dissolved Organic Carbo	Exova Subcontract Exova Subcontract	EXL	11/24/2014
pH at 25 C	Electrometric, APHA 4500 B -modified	NIsL	11/18/2014
Total Organic Carbon	Exova Subcontract, Ch.34 SSSA BookSeries5-modified	EXL	11/21/2014
UV Transmittance	APHA 5910 B -modified	NIsL	11/18/2014

Approved By: Catherine Black

Catherine Black, Owner/Operator

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Certificate of Analysis

Report To: Regional District of Alberni & Clayoquot
Ken Doll - Koers Engineering

Lab Number: 115846
Date Reported: 26 Nov 14
Date Completed: 26 Nov 14
Date Received: 17 Nov 14 16:27

Sampled By:
Sampling Date: 17 Nov 14 0:00

Test	Result	Units	Detection Limit
115846-01 BWS Pilot Plant Raw Monday			
T-Aluminum	0.17	mg/L	0.005 mg/L
Colour - Apparent	51	Colour Units	5 Colour Units
Colour - True	41	Colour Units	5 Colour Units
DOC - Dissolved Organic Carbon	5.5	mg/L	0.5 mg/L
T-Iron	0.093	mg/L	0.002 mg/L
T-Manganese	0.0037	mg/L	0.001 mg/L
pH at 25 C	7.0	pH Units	pH Units
.	.		
Total Organic Carbon	5.5	mg/L	0.5 mg/L
Total Suspended Solids	<5.0	mg/L	5 mg/L
Turbidity	<0.5	NTU's	0.5 NTU's
UV Transmittance	56.8	%/cm	0.1 %/cm
115846-02 BWS Pilot Plant Clarified Monday			
T-Aluminum	0.34	mg/L	0.005 mg/L
Colour - Apparent	9	Colour Units	5 Colour Units
Colour - True	<5	Colour Units	5 Colour Units
DOC - Dissolved Organic Carbon	1.3	mg/L	0.5 mg/L
T-Iron	0.009	mg/L	0.002 mg/L
T-Manganese	<0.0010	mg/L	0.001 mg/L
pH at 25 C	5.9	pH Units	pH Units
.	.		
Total Organic Carbon	1.3	mg/L	0.5 mg/L
Total Suspended Solids	<5.0	mg/L	5 mg/L
Turbidity	0.9	NTU's	0.5 NTU's
UV Transmittance	91.6	%/cm	0.1 %/cm

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115846-02 BWS Pilot Plant Clarified Monday

115846-03 BWS Pilot Plant Filtered Monday

T-Aluminum	0.076	mg/L	0.005 mg/L
Colour - Apparent	<5	Colour Units	5 Colour Units
Colour - True	<5	Colour Units	5 Colour Units
DOC - Dissolved Organic Carbon	1.1	mg/L	0.5 mg/L
T-Iron	0.003	mg/L	0.002 mg/L
T-Manganese	<0.0010	mg/L	0.001 mg/L
pH at 25 C	6.0	pH Units	pH Units
.	.		
Total Organic Carbon	1	mg/L	0.5 mg/L
Total Suspended Solids	<5.0	mg/L	5 mg/L
Turbidity	<0.5	NTU's	0.5 NTU's
UV Transmittance	94.7	%/cm	0.1 %/cm

115846-01

Test	Method	Analyst	Date
.		EXL	
Colour - Apparent	Spectrophotometer, APHA 2120 C -modified	NIsL	11/18/2014
Colour - True	Spectrophotometer, APHA 2120 C -modified	NIsL	11/18/2014
DOC - Dissolved Organic Carbo	Exova Subcontract Exova Subcontract	EXL	11/24/2014
pH at 25 C	Electrometric, APHA 4500 B -modified	NIsL	11/18/2014
T-Aluminum	Exova Subcontract, ICP-MS,USEPA 200.8-modified	EXL	11/24/2014
T-Iron	Exova Subcontract, ICP, APHA 3120B - modified	EXL	11/24/2014
T-Manganese	Exova Subcontract, ICP, APHA 3120B	EXL	11/24/2014
Total Organic Carbon	Exova Subcontract, Ch.34 SSSA BookSeries5-modified	EXL	11/21/2014
Total Suspended Solids	Gravimetric,dried @103-105C,TSS EPA 160.2-modified	NIsL	11/21/2014
Turbidity	Nephelometric, APHA 2130 B -modified	NIsL	11/18/2014
UV Transmittance	APHA 5910 B -modified	NIsL	11/18/2014

Approved By: Catherine Black

Catherine Black, Owner/Operator

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Certificate of Analysis

Report To:	Regional District of Alberni & Clayoquot Ken Doll - Koers Engineering	Lab Number:	115857
		Date Reported:	26 Nov 14
		Date Completed:	26 Nov 14
		Date Received:	18 Nov 14 13:14

Sampled By: Bruce
Sampling Date: 18 Nov 14 0:00

Test	Result	Units	Detection Limit
115857-01 BWS Pilot Plant Raw			
Colour - Apparent	48	Colour Units	5 Colour Units
Colour - True	41	Colour Units	5 Colour Units
DOC - Dissolved Organic Carbon	5.4	mg/L	0.5 mg/L
pH at 25 C	6.8	pH Units	pH Units
Total Organic Carbon	4.8	mg/L	0.5 mg/L
UV Transmittance	57.7	%/cm	0.1 %/cm
115857-02 BWS Pilot Plant Filtered			
Colour - Apparent	<5	Colour Units	5 Colour Units
Colour - True	<5	Colour Units	5 Colour Units
DOC - Dissolved Organic Carbon	1.2	mg/L	0.5 mg/L
pH at 25 C	5.9	pH Units	pH Units
Total Organic Carbon	1	mg/L	0.5 mg/L
UV Transmittance	94.8	%/cm	0.1 %/cm

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115857-01

Test	Method	Analyst	Date
Colour - Apparent	Spectrophotometer, APHA 2120 C -modified	NIsL	11/18/2014
Colour - True	Spectrophotometer, APHA 2120 C -modified	NIsL	11/18/2014
DOC - Dissolved Organic Carbo	Exova Subcontract Exova Subcontract	EXL	11/24/2014
pH at 25 C	Electrometric, APHA 4500 B -modified	NIsL	11/18/2014
Total Organic Carbon	Exova Subcontract, Ch.34 SSSA BookSeries5-modified	EXL	11/21/2014
UV Transmittance	APHA 5910 B -modified	NIsL	11/18/2014

Approved By: Catherine Black

Catherine Black, Owner/Operator

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Certificate of Analysis

Report To: Regional District of Alberni & Clayoquot
Ken Doll - Koers Engineering

Lab Number: 115897
Date Reported: 28 Nov 14
Date Completed: 28 Nov 14
Date Received: 19 Nov 14 15:49

Sampled By:
Sampling Date: 19 Nov 14 0:00

Test	Result	Units	Detection Limit
115897-01 BWS Pilot Plant Raw			
T-Aluminum	0.16	mg/L	0.005 mg/L
Colour - Apparent	48	Colour Units	5 Colour Units
Colour - True	41	Colour Units	5 Colour Units
DOC - Dissolved Organic Carbon	5.9	mg/L	0.5 mg/L
T-Iron	0.089	mg/L	0.002 mg/L
T-Manganese	0.003	mg/L	0.001 mg/L
pH at 25 C	6.6	pH Units	pH Units
.	.		
Total Organic Carbon	5.5	mg/L	0.5 mg/L
UV Transmittance	57.1	%/cm	0.1 %/cm
115897-02 BWS Pilot Plant Clarified			
T-Aluminum	0.29	mg/L	0.005 mg/L
Colour - Apparent	5	Colour Units	5 Colour Units
Colour - True	<5	Colour Units	5 Colour Units
DOC - Dissolved Organic Carbon	1.2	mg/L	0.5 mg/L
T-Iron	<0.002	mg/L	0.002 mg/L
T-Manganese	<0.0010	mg/L	0.001 mg/L
pH at 25 C	5.8	pH Units	pH Units
.	.		
Total Organic Carbon	1.6	mg/L	0.5 mg/L
UV Transmittance	95.0	%/cm	0.1 %/cm
115897-03 BWS Pilot Plant Filtered			
T-Aluminum	0.14	mg/L	0.005 mg/L
Colour - Apparent	6	Colour Units	5 Colour Units

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115897-03 BWS Pilot Plant Filtered

Colour - True	5	Colour Units	5 Colour Units
DOC - Dissolved Organic Carbon	1	mg/L	0.5 mg/L
T-Iron	<0.002	mg/L	0.002 mg/L
T-Manganese	<0.0010	mg/L	0.001 mg/L
pH at 25 C	5.8	pH Units	pH Units
.	.		
Total Organic Carbon	1.2	mg/L	0.5 mg/L
UV Transmittance	94.1	%/cm	0.1 %/cm

115897-01

Test	Method	Analyst	Date
.		EXL	
Colour - Apparent	Spectrophotometer, APHA 2120 C -modified	NIsL	11/21/2014
Colour - True	Spectrophotometer, APHA 2120 C -modified	NIsL	11/21/2014
DOC - Dissolved Organic Carbo	Exova Subcontract Exova Subcontract	EXL	11/26/2014
pH at 25 C	Electrometric, APHA 4500 B -modified	NIsL	11/21/2014
T-Aluminum	Exova Subcontract, ICP-MS,USEPA 200.8-modified	EXL	11/25/2014
T-Iron	Exova Subcontract, ICP, APHA 3120B - modified	EXL	11/25/2014
T-Manganese	Exova Subcontract, ICP, APHA 3120B	EXL	11/25/2014
Total Organic Carbon	Exova Subcontract, Ch.34 SSSA BookSeries5-modified	EXL	11/25/2014
UV Transmittance	APHA 5910 B -modified	NIsL	11/21/2014

Approved By: Catherine Black

Catherine Black, Owner/Operator

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Certificate of Analysis

Report To: Regional District of Alberni & Clayoquot
Ken Doll - Koers Engineering

Lab Number: 115924
Date Reported: 4 Dec 14
Date Completed: 4 Dec 14
Date Received: 20 Nov 14 16:35

Sampled By:
Sampling Date: 20 Nov 14 0:00

Test	Result	Units	Detection Limit
115924-01 BWS Pilot Plant Raw Thursday			
Alkalinity	<20	mg/L (CaCO3)	20 mg/L (CaCO3)
T-Aluminum	0.15	mg/L	0.005 mg/L
Colour - Apparent	46	Colour Units	5 Colour Units
Colour - True	40	Colour Units	5 Colour Units
DOC - Dissolved Organic Carbon	5.5	mg/L	0.5 mg/L
T-Iron	0.087	mg/L	0.002 mg/L
T-Manganese	0.0023	mg/L	0.001 mg/L
pH at 25 C	6.7	pH Units	pH Units
Total Organic Carbon	5.2	mg/L	0.5 mg/L
UV Transmittance	57.4	%/cm	0.1 %/cm
115924-02 BWS Pilot Plant Filtered Thursday			
Alkalinity	<20	mg/L (CaCO3)	20 mg/L (CaCO3)
T-Aluminum	0.075	mg/L	0.005 mg/L
Colour - Apparent	6	Colour Units	5 Colour Units
Colour - True	<5	Colour Units	5 Colour Units
DOC - Dissolved Organic Carbon	1.4	mg/L	0.5 mg/L
T-Iron	0.003	mg/L	0.002 mg/L
T-Manganese	0.0012	mg/L	0.001 mg/L
pH at 25 C	5.8	pH Units	pH Units
Total Organic Carbon	1.1	mg/L	0.5 mg/L
UV Transmittance	95.0	%/cm	0.1 %/cm

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115924-01

Prelim sent Nov 26 2014

Test	Method	Analyst	Date
Alkalinity	Titration to 4.5, APHA 2320 B -modified	NIsL	11/21/2014
Colour - Apparent	Spectrophotometer, APHA 2120 C -modified	NIsL	11/21/2014
Colour - True	Spectrophotometer, APHA 2120 C -modified	NIsL	11/21/2014
DOC - Dissolved Organic Carbo	Exova Subcontract Exova Subcontract	EXL	12/1/2014
pH at 25 C	Electrometric, APHA 4500 B -modified	NIsL	11/21/2014
T-Aluminum	Exova Subcontract, ICP-MS,USEPA 200.8-modified	EXL	11/27/2014
T-Iron	Exova Subcontract, ICP, APHA 3120B - modified	EXL	11/27/2014
T-Manganese	Exova Subcontract, ICP, APHA 3120B	EXL	11/27/2014
Total Organic Carbon	Exova Subcontract, Ch.34 SSSA BookSeries5-modified	EXL	11/27/2014
UV Transmittance	APHA 5910 B -modified	NIsL	11/21/2014

Approved By: Catherine Black

Catherine Black, Owner/Operator

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Certificate of Analysis

Report To: Regional District of Alberni & Clayoquot
Ken Doll - Koers Engineering

Lab Number: 115927
Date Reported: 4 Dec 14
Date Completed: 4 Dec 14
Date Received: 20 Nov 14 16:56

Sampled By:
Sampling Date: 20 Nov 14 0:00

Test	Result	Units	Detection Limit
115927-01 Raw Sample Pail #1 10 Day			
Bromoacetic Acid	<2.0	ug/L	2 ug/L
Bromochloroacetic Acid	3.4	ug/L	2 ug/L
Chloroacetic Acid	<2.0	ug/L	2 ug/L
Dibromoacetic Acid	<2.0	ug/L	2 ug/L
Dichloroacetic Acid	125	ug/L	2 ug/L
Trichloroacetic Acid	265	ug/L	2 ug/L
Total Halo Acetic Acids	390	ug/L	ug/L
Bromodichloromethane	0.005	mg/L	0.001 mg/L
Bromoform	<0.001	mg/L	0.001 mg/L
Chloroform	0.242	mg/L	0.001 mg/L
Dibromochloromethane	<0.001	mg/L	0.001 mg/L
Total Trihalomethanes	0.247	mg/L	0.001 mg/L
115927-02 Filtered Sample Pail #1 10 Day			
Bromoacetic Acid	<2.0	ug/L	2 ug/L
Bromochloroacetic Acid	2.2	ug/L	2 ug/L
Chloroacetic Acid	<2.0	ug/L	2 ug/L
Dibromoacetic Acid	<2.0	ug/L	2 ug/L
Dichloroacetic Acid	18.3	ug/L	2 ug/L
Trichloroacetic Acid	39.3	ug/L	2 ug/L
Total Halo Acetic Acids	60	ug/L	ug/L
Bromodichloromethane	0.003	mg/L	0.001 mg/L
Bromoform	<0.001	mg/L	0.001 mg/L
Chloroform	0.04	mg/L	0.001 mg/L
Dibromochloromethane	<0.001	mg/L	0.001 mg/L
Total Trihalomethanes	0.043	mg/L	0.001 mg/L

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115927-02 Filtered Sample Pail #1 10 Day

115927-03 Raw Sample Pail #2 3 Day

Bromoacetic Acid	<2.0	ug/L	2 ug/L
Bromochloroacetic Acid	3.3	ug/L	2 ug/L
Chloroacetic Acid	<2.0	ug/L	2 ug/L
Dibromoacetic Acid	<2.0	ug/L	2 ug/L
Dichloroacetic Acid	182	ug/L	2 ug/L
Trichloroacetic Acid	480	ug/L	2 ug/L
Total Halo Acetic Acids	670	ug/L	ug/L
Bromodichloromethane	0.008	mg/L	0.001 mg/L
Bromoform	<0.001	mg/L	0.001 mg/L
Chloroform	0.37	mg/L	0.001 mg/L
Dibromochloromethane	<0.001	mg/L	0.001 mg/L
Total Trihalomethanes	0.378	mg/L	0.001 mg/L

115927-04 Filtered Sample Pail #2 3 Day

Bromoacetic Acid	<2.0	ug/L	2 ug/L
Bromochloroacetic Acid	<2.0	ug/L	2 ug/L
Chloroacetic Acid	<2.0	ug/L	2 ug/L
Dibromoacetic Acid	<2.0	ug/L	2 ug/L
Dichloroacetic Acid	9.8	ug/L	2 ug/L
Trichloroacetic Acid	16.5	ug/L	2 ug/L
Total Halo Acetic Acids	26	ug/L	ug/L
Bromodichloromethane	0.002	mg/L	0.001 mg/L
Bromoform	<0.001	mg/L	0.001 mg/L
Chloroform	0.019	mg/L	0.001 mg/L
Dibromochloromethane	<0.001	mg/L	0.001 mg/L
Total Trihalomethanes	0.021	mg/L	0.001 mg/L

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115927-01

HE: Raw Sample Pail #2 is labelled 10 day; COC indicated it should be 3 day

Test	Method	Analyst	Date
Bromoacetic Acid	Exova Subcontract,US EPA 552.3	EXL	12/3/2014
Bromochloroacetic Acid	Exova Subcontract Exova Subcontract	EXL	12/3/2014
Bromodichloromethane	Exova Subcontract-EPA 8260B/5035 - modified	EXL	11/27/2014
Bromoform	Exova Subcontract-EPA 8260B/5035 - modified	EXL	11/27/2014
Chloroacetic Acid	Exova Subcontract Exova Subcontract	EXL	12/3/2014
Chloroform	Exova Subcontract-EPA 8260B/5035 - modified	EXL	11/27/2014
Dibromoacetic Acid	Exova Subcontract Exova Subcontract	EXL	12/3/2014
Dibromochloromethane	Exova Subcontract-EPA 8260B/5035 - modified	EXL	11/27/2014
Dichloroacetic Acid	Exova Subcontract Exova Subcontract	EXL	12/3/2014
Total Halo Acetic Acids	Exova Subcontract Exova Subcontract	EXL	12/3/2014
Total Trihalomethanes	Exova Subcontract-EPA 8260B/5035 - modified	EXL	11/27/2014
Trichloroacetic Acid	Exova Subcontract Exova Subcontract	EXL	12/3/2014

Approved By: Catherine Black

Catherine Black, Owner/Operator

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Certificate of Analysis

Report To: Regional District of Alberni & Clayoquot
Ken Doll - Koers Engineering

Lab Number: 115925
Date Reported: 4 Dec 14
Date Completed: 4 Dec 14
Date Received: 20 Nov 14 16:44

Sampled By:
Sampling Date: 20 Nov 14 0:00

Test	Result	Units	Detection Limit
115925-01 Waste Discharges Raw Thursday			
T-Aluminum	0.16	mg/L	0.005 mg/L
pH at 25 C	6.9	pH Units	pH Units
Total Suspended Solids	<5.0	mg/L	5 mg/L
Turbidity	<0.5	NTU's	0.5 NTU's
115925-02 Waste Discharges Float Thursday			
T-Aluminum	2,300	mg/L	0.005 mg/L
pH at 25 C	5.2	pH Units	pH Units
Total Suspended Solids	12,000	mg/L	5 mg/L
Turbidity	950	NTU's	0.5 NTU's
115925-03 Waste Discharges Backwash Thursday			
T-Aluminum	19	mg/L	0.005 mg/L
pH at 25 C	6.3	pH Units	pH Units
Total Suspended Solids	85	mg/L	5 mg/L
Turbidity	12.4	NTU's	0.5 NTU's

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115925-01

prelim sent Nov 26 2014

Test	Method	Analyst	Date
pH at 25 C	Electrometric, APHA 4500 B -modified	NIsL	11/21/2014
T-Aluminum	Exova Subcontract, ICP-MS,USEPA 200.8-modified	EXL	11/27/2014
Total Suspended Solids	Gravimetric,dried @103-105C,TSS EPA 160.2-modified	NIsL	11/21/2014
Turbidity	Nephelometric, APHA 2130 B -modified	NIsL	11/21/2014

Approved By: 

Catherine Black, Owner/Operator

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Certificate of Analysis

Report To: Regional District of Alberni & Clayoquot
Ken Doll - Koers Engineering

Lab Number: 115963
Date Reported: 5 Dec 14
Date Completed: 5 Dec 14
Date Received: 24 Nov 14 13:07

Sampled By:
Sampling Date: 24 Nov 14 0:00

Test	Result	Units	Detection Limit
115963-01 BWS Pilot Plant Raw Water			
Alkalinity	<20	mg/L (CaCO3)	20 mg/L (CaCO3)
Colour - Apparent	58	Colour Units	5 Colour Units
Colour - True	50	Colour Units	5 Colour Units
DOC - Dissolved Organic Carbon	6.3	mg/L	0.5 mg/L
pH at 25 C	7.1	pH Units	pH Units
Total Organic Carbon	6.3	mg/L	0.5 mg/L
UV Transmittance	50.9	%/cm	0.1 %/cm
115963-02 BWS Pilot Plant Filtered Water			
Alkalinity	<20	mg/L (CaCO3)	20 mg/L (CaCO3)
Colour - Apparent	9	Colour Units	5 Colour Units
Colour - True	<5	Colour Units	5 Colour Units
DOC - Dissolved Organic Carbon	1.7	mg/L	0.5 mg/L
pH at 25 C	6.1	pH Units	pH Units
Total Organic Carbon	2.3	mg/L	0.5 mg/L
UV Transmittance	88.8	%/cm	0.1 %/cm

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115963-01

Test	Method	Analyst	Date
Alkalinity	Titration to 4.5, APHA 2320 B -modified	NIsL	11/28/2014
Colour - Apparent	Spectrophotometer, APHA 2120 C -modified	NIsL	11/25/2014
Colour - True	Spectrophotometer, APHA 2120 C -modified	NIsL	11/25/2014
DOC - Dissolved Organic Carbo	Exova Subcontract Exova Subcontract	EXL	12/1/2014
pH at 25 C	Electrometric, APHA 4500 B -modified	NIsL	11/25/2014
Total Organic Carbon	Exova Subcontract, Ch.34 SSSA BookSeries5-modified	EXL	11/27/2014
UV Transmittance	APHA 5910 B -modified	NIsL	11/25/2014

Approved By: Catherine Black

Catherine Black, Owner/Operator

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Certificate of Analysis

Report To:	Regional District of Alberni & Clayoquot Ken Doll - Koers Engineering	Lab Number:	116018
		Date Reported:	5 Dec 14
		Date Completed:	5 Dec 14
		Date Received:	25 Nov 14 16:04

Sampled By: Bruce
Sampling Date: 25 Nov 14 0:00

Test	Result	Units	Detection Limit
116018-01 BWS Pilot Plant Raw Tuesday			
T-Aluminum	0.20	mg/L	0.005 mg/L
Colour - Apparent	62	Colour Units	5 Colour Units
Colour - True	49	Colour Units	5 Colour Units
DOC - Dissolved Organic Carbon	7	mg/L	0.5 mg/L
T-Iron	0.13	mg/L	0.002 mg/L
T-Manganese	0.0046	mg/L	0.001 mg/L
pH at 25 C	6.7	pH Units	pH Units
.	.		
Total Organic Carbon	6.6	mg/L	0.5 mg/L
Total Suspended Solids	<5.0	mg/L	5 mg/L
UV Transmittance	50.7	%/cm	0.1 %/cm
116018-02 BWS Pilot Plant Filtered Tuesday			
T-Aluminum	0.057	mg/L	0.005 mg/L
Colour - Apparent	<5	Colour Units	5 Colour Units
Colour - True	<5	Colour Units	5 Colour Units
DOC - Dissolved Organic Carbon	1.8	mg/L	0.5 mg/L
T-Iron	0.003	mg/L	0.002 mg/L
T-Manganese	0.0011	mg/L	0.001 mg/L
pH at 25 C	6.1	pH Units	pH Units
.	.		
Total Organic Carbon	1.5	mg/L	0.5 mg/L
UV Transmittance	95.1	%/cm	0.1 %/cm

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116018-01

Test	Method	Analyst	Date
.		EXL	
Colour - Apparent	Spectrophotometer, APHA 2120 C -modified	NIsL	11/27/2014
Colour - True	Spectrophotometer, APHA 2120 C -modified	NIsL	11/27/2014
DOC - Dissolved Organic Carbo	Exova Subcontract Exova Subcontract	EXL	12/4/2014
pH at 25 C	Electrometric, APHA 4500 B -modified	NIsL	11/26/2014
T-Aluminum	Exova Subcontract, ICP-MS,USEPA 200.8-modified	EXL	12/2/2014
T-Iron	Exova Subcontract, ICP, APHA 3120B - modified	EXL	12/2/2014
T-Manganese	Exova Subcontract, ICP, APHA 3120B	EXL	12/2/2014
Total Organic Carbon	Exova Subcontract, Ch.34 SSSA BookSeries5-modified	EXL	12/2/2014
Total Suspended Solids	Gravimetric,dried @103-105C,TSS EPA 160.2-modified	NIsL	11/28/2014
UV Transmittance	APHA 5910 B -modified	NIsL	11/27/2014

Approved By: Catherine Black

Catherine Black, Owner/Operator

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Certificate of Analysis

Report To:	Regional District of Alberni & Clayoquot Ken Doll - Koers Engineering	Lab Number:	116019
		Date Reported:	5 Dec 14
		Date Completed:	5 Dec 14
		Date Received:	25 Nov 14 16:12

Sampled By:
Sampling Date: 25 Nov 14 0:00

Test	Result	Units	Detection Limit
116019-01 Waste Discharges Raw Tuesday			
T-Aluminum	3,300	mg/L	0.005 mg/L
T-Iron	119	mg/L	0.002 mg/L
T-Manganese	2.56	mg/L	0.001 mg/L
pH at 25 C	5.1	pH Units	pH Units
.	.		
Total Suspended Solids	46,000	mg/L	5 mg/L
Turbidity	1500	NTU's	0.5 NTU's
116019-02 Waste Discharges Backwash Tuesday			
T-Aluminum	11	mg/L	0.005 mg/L
T-Iron	0.404	mg/L	0.002 mg/L
T-Manganese	0.0181	mg/L	0.001 mg/L
pH at 25 C	6.2	pH Units	pH Units
.	.		
Total Suspended Solids	74	mg/L	5 mg/L
Turbidity	10.3	NTU's	0.5 NTU's

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116019-01

Test	Method	Analyst	Date
.		EXL	
pH at 25 C	Electrometric, APHA 4500 B -modified	NIsL	11/26/2014
T-Aluminum	Exova Subcontract, ICP-MS,USEPA 200.8-modified	EXL	12/2/2014
T-Iron	Exova Subcontract, ICP, APHA 3120B - modified	EXL	12/2/2014
T-Manganese	Exova Subcontract, ICP, APHA 3120B	EXL	12/2/2014
Total Suspended Solids	Gravimetric,dried @103-105C,TSS EPA 160.2-modified	NIsL	11/28/2014
Turbidity	Nephelometric, APHA 2130 B -modified	NIsL	11/26/2014

Approved By: Catherine Black

Catherine Black, Owner/Operator

North Island Laboratories
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Certificate of Analysis

Report To: Regional District of Alberni & Clayoquot
Ken Doll - Koers Engineering

Lab Number: 116092
Date Reported: 16 Dec 14
Date Completed: 16 Dec 14
Date Received: 27 Nov 14 16:58

116092-01 Raw Sample Pail #2 10 Day

Sampled By:
Sampling Date: 27 Nov 14 0:00

Test	Result	Units	Drinking Water Guideline
Bromoacetic Acid	<2.0	ug/L	
Bromochloroacetic Acid	3.3	ug/L	
Chloroacetic Acid	<2.0	ug/L	
Dibromoacetic Acid	<2.0	ug/L	
Dichloroacetic Acid	273	ug/L	
Trichloroacetic Acid	619	ug/L	
Total Halo Acetic Acids	900	ug/L	
Bromodichloromethane	0.01	mg/L	0.016 MAC
Bromoform	<0.001	mg/L	
Chloroform	0.555	mg/L	
Dibromochloromethane	<0.001	mg/L	
Total Trihalomethanes	0.565	mg/L	0.100 MAC

116092-02 Filtered Sample Pail #2 10 Day

Sampled By:
Sampling Date: 27 Nov 14 0:00

Test	Result	Units	Drinking Water Guideline
Bromoacetic Acid	<2.0	ug/L	
Bromochloroacetic Acid	<2.0	ug/L	
Chloroacetic Acid	<2.0	ug/L	
Dibromoacetic Acid	<2.0	ug/L	
Dichloroacetic Acid	15.6	ug/L	
Trichloroacetic Acid	28.8	ug/L	
Total Halo Acetic Acids	44	ug/L	

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North Island Laboratories
• 2755 B Moray Avenue, Courtenay, B.C. V9N 8M9 Tel: (250) 338-7786 Fax: (250) 338-7553

116092-02 Filtered Sample Pail #2 10 Day

Sampled By:

Sampling Date: 27 Nov 14 0:00

Test	Result	Units	Drinking Water Guideline
Bromodichloromethane	0.003	mg/L	0.016 MAC
Bromoform	<0.001	mg/L	
Chloroform	0.031	mg/L	
Dibromochloromethane	<0.001	mg/L	
Total Trihalomethanes	0.034	mg/L	0.100 MAC

116092-03 Raw Sample Pail #3 3 Day

Sampled By:

Sampling Date: 27 Nov 14 0:00

Test	Result	Units	Drinking Water Guideline
Bromoacetic Acid	<2.0	ug/L	
Bromochloroacetic Acid	3.5	ug/L	
Chloroacetic Acid	4.3	ug/L	
Dibromoacetic Acid	<2.0	ug/L	
Dichloroacetic Acid	174	ug/L	
Trichloroacetic Acid	253	ug/L	
Total Halo Acetic Acids	440	ug/L	
Bromodichloromethane	0.005	mg/L	0.016 MAC
Bromoform	<0.001	mg/L	
Chloroform	0.199	mg/L	
Dibromochloromethane	<0.001	mg/L	
Total Trihalomethanes	0.204	mg/L	0.100 MAC

116092-04 Filtered Sample Pail #3 3 Day

Sampled By:

Sampling Date: 27 Nov 14 0:00

Test	Result	Units	Drinking Water Guideline
Bromoacetic Acid	<2.0	ug/L	
Bromochloroacetic Acid	<2.0	ug/L	
Chloroacetic Acid	<2.0	ug/L	

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116092-04 Filtered Sample Pail #3 3 Day

Sampled By:

Sampling Date: 27 Nov 14 0:00

Test	Result	Units	Drinking Water Guideline
Dibromoacetic Acid	<2.0	ug/L	
Dichloroacetic Acid	17.1	ug/L	
Trichloroacetic Acid	31.1	ug/L	
Total Halo Acetic Acids	48	ug/L	
Bromodichloromethane	0.003	mg/L	0.016 MAC
Bromoform	<0.001	mg/L	
Chloroform	0.036	mg/L	
Dibromochloromethane	<0.001	mg/L	
Total Trihalomethanes	0.039	mg/L	0.100 MAC

116092-01

Test	Method	Analyst	Date
Bromoacetic Acid	Exova Subcontract,US EPA 552.3	EXL	12/16/2014
Bromochloroacetic Acid	Exova Subcontract Exova Subcontract	EXL	12/11/2014
Bromodichloromethane	Exova Subcontract-EPA 8260B/5035 - modified	EXL	12/8/2014
Bromoform	Exova Subcontract-EPA 8260B/5035 - modified	EXL	12/8/2014
Chloroacetic Acid	Exova Subcontract Exova Subcontract	EXL	12/16/2014
Chloroform	Exova Subcontract-EPA 8260B/5035 - modified	EXL	12/8/2014
Dibromoacetic Acid	Exova Subcontract Exova Subcontract	EXL	12/11/2014
Dibromochloromethane	Exova Subcontract-EPA 8260B/5035 - modified	EXL	12/8/2014
Dichloroacetic Acid	Exova Subcontract Exova Subcontract	EXL	12/11/2014
Total Halo Acetic Acids	Exova Subcontract Exova Subcontract	EXL	12/16/2014
Total Trihalomethanes	Exova Subcontract-EPA 8260B/5035 - modified	EXL	12/8/2014
Trichloroacetic Acid	Exova Subcontract Exova Subcontract	EXL	12/11/2014

Approved By: 

Catherine Black, Owner/Operator

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Certificate of Analysis

Report To: Regional District of Alberni & Clayoquot
Ken Doll - Koers Engineering

Lab Number: 116208
Date Reported: 18 Dec 14
Date Completed: 18 Dec 14
Date Received: 4 Dec 14 15:43

116208-01 Raw Sample Pail #3 10 Day

Sampled By:
Sampling Date: 4 Dec 14 0:00

Test	Result	Units	Drinking Water Guideline
Bromoacetic Acid	<2.0	ug/L	
Bromochloroacetic Acid	3.7	ug/L	
Chloroacetic Acid	6.6	ug/L	
Dibromoacetic Acid	<2.0	ug/L	
Dichloroacetic Acid	272	ug/L	
Trichloroacetic Acid	500	ug/L	
Total Halo Acetic Acids	780	ug/L	
Bromodichloromethane	0.007	mg/L	0.016 MAC
Bromoform	<0.001	mg/L	
Chloroform	0.312	mg/L	
Dibromochloromethane	<0.001	mg/L	
Total Trihalomethanes	0.319	mg/L	0.100 MAC

116208-02 Filtered Sample Pail #3 10 Day

Sampled By:
Sampling Date: 4 Dec 14 0:00

Test	Result	Units	Drinking Water Guideline
Bromoacetic Acid	<2.0	ug/L	
Bromochloroacetic Acid	<2.0	ug/L	
Chloroacetic Acid	<2.0	ug/L	
Dibromoacetic Acid	<2.0	ug/L	
Dichloroacetic Acid	23.7	ug/L	
Trichloroacetic Acid	46.5	ug/L	
Total Halo Acetic Acids	70	ug/L	

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Canadian Drinking Water Guidelines as listed on Dec. 5th, 2005 and are subject to change. Method uncertainties for specified analyses are available upon request.

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116208-02 Filtered Sample Pail #3 10 Day

Sampled By:

Sampling Date: 4 Dec 14 0:00

Test	Result	Units	Drinking Water Guideline
Bromodichloromethane	0.004	mg/L	0.016 MAC
Bromoform	<0.001	mg/L	
Chloroform	0.05	mg/L	
Dibromochloromethane	<0.001	mg/L	
Total Trihalomethanes	0.054	mg/L	0.100 MAC

116208-01

Test	Method	Analyst	Date
Bromoacetic Acid	Exova Subcontract,US EPA 552.3	EXL	12/18/2014
Bromochloroacetic Acid	Exova Subcontract Exova Subcontract	EXL	12/18/2014
Bromodichloromethane	Exova Subcontract-EPA 8260B/5035 - modified	EXL	12/12/2014
Bromoform	Exova Subcontract-EPA 8260B/5035 - modified	EXL	12/12/2014
Chloroacetic Acid	Exova Subcontract Exova Subcontract	EXL	12/18/2014
Chloroform	Exova Subcontract-EPA 8260B/5035 - modified	EXL	12/12/2014
Dibromoacetic Acid	Exova Subcontract Exova Subcontract	EXL	12/18/2014
Dibromochloromethane	Exova Subcontract-EPA 8260B/5035 - modified	EXL	12/12/2014
Dichloroacetic Acid	Exova Subcontract Exova Subcontract	EXL	12/18/2014
Total Halo Acetic Acids	Exova Subcontract Exova Subcontract	EXL	12/18/2014
Total Trihalomethanes	Exova Subcontract-EPA 8260B/5035 - modified	EXL	12/12/2014
Trichloroacetic Acid	Exova Subcontract Exova Subcontract	EXL	12/18/2014

Approved By: Catherine Black

Catherine Black, Owner/Operator

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Canadian Drinking Water Guidelines as listed on Dec. 5th, 2005 and are subject to change. Method uncertainties for specified analyses are available upon request.

(ALUMINUM SULFATE) PAC POLY ALUMINUM CHLORIDE

Project:	BAMFIELD
Date:	Nov 8, 2014

	L/min	L/min		mg/L(mL/h)		NTU	NTU	
Time	Flow rate	Recycle rate	Recycle %	Coag	RW turb	Clar Turb	Filt turb	Note
14:43	70	6	8.6	110 (347)	0.46	4.8	NA	STRUGGLING W/ START-UP ISSUES - CLEAN FEED
15:02								SWITCHED TO DOSATRON PUMP 1
15:25						13.8		CLEANED CHECK VALVES ON PUMPS
15:51				95(321)		20		95 mg/L DOSAGE
16:26								PRIMED DOSATRON PUMP
16:40				85(288)				
17:14				80(271)				
17:30				75(254)				
17:45				70(237)				
17:54				120(407)				
18:25				130(441)				
18:43				140(475)				
19:10				30 (100)				SWITCHED TO ALUM
19:17				50(327)		10		
20:23						2.87		
20:31				40(261)		3.04		
21:15						3.6		RESULT - STILL FLOCCING ON ITSELF - NEEDS ALKALINITY

Project:
Date: Nov 9

↓1 ↓.1

Time	Flow rate	Recycle rate	Recycle %	Coag	RW turb	Clar Turb	Filt turb	Note
8:25	70	6 <	8.6	PAC	0.5+	–		Running 2 floc mixers only to reduce
				30(102)				detention (Testing) time.
								Increase Floc 2 speed ~~65~~ 60%.
9:00				30		4.5		Good but loose floc formed.
9:25								Cooks procedure!
9:30				40(137)				Increase due to Low Colour, Insufficient floc
10:00								No floc
10:02				30(102)				Adjust back to 30
10:30								No floc
10:47								Increase both mixer speeds slightly
								But better floc formation
10:48								Increase close to 35
11:30								No improvement
								Increase close to 50
11:53				40(261)				Switched To Alum
11:55				.5(200)				Add Caustic Soda
12:00								Turn on Off Caustic Soda
12:02								Switched To PAC
12:04				50(169)				PAC
12:06				.5(200)				Caustic Soda
12:47				1 (400)				" " " ↑
13:19				1.5(603)		1.3	.10	" " " ↑
13:49				55(186)		1.4	.07	PAC ↑ 50/1.5
14:13				50(169)		1.37	.066	PAC ↓
14:38								Clarified PH = 6
14:39				2(840)		1.34	.050	Caustic ↑
14:49								No Alkilinity Left (Clarified)
15:10								Clarified pH = 6.10
								Raw pH = 6.45

CAUSTIC → 10g / L
= 1%

Project:	BAMFIELD
Date:	Nov 9

Time	Flow rate	Recycle rate	Recycle %	Coag ↓ PAC	~~RW turb~~ CAUSTIC	Clar Turb	Filt turb	Note
15:20	70	6	8.6%	50		1.48	0.65	Caustic ↑ to 3 ml/L
								pH = No alk in clarified
15:50						1.3	0.78	PH = 7.2 CLARIFIED
15:55					2 (840)			CAUSTIC ↓
16:00								UVT CLARIFIED = 79.8 FILTERED = 93.6
16:15						1.78	0.33	
16:25						1.60	0.39	
16:30					1.5 (630)		~~0.459~~	CAUSTIC ↓
16:45				45 (152)		1.15	0.159	PAC ↓
17:00						2.02	0.080	PH 7.13 CLARIFIED
17:15						1.277	0.0625	
								SHUT DOWN FILTRATION AIR COMP (CLEAN SKIMMER
								SHUT DOWN RAW WATER, CHEM VALVE AIR VALVE, MIXER VALVE
END OF DAY				45	1.5	1.277	0.0625	
8:30	NOV 10, 2014		DAY 1			1.69	~~0.106~~	START UP
04:48	"	"	"	"	"	1.46		START FILTER
10:01						1.473	0.0671	
10:10								CHANGED SKIMMER TO 1m EVERY FOUR M.
								FROM 2m EVERY EIGHT M.
10:35						1.456	0.150	
10:35					1.0 (420)			CAUSTIC ↓
10:50								PH 7.27 CLARIFIED
11:05						1.08	0.08	
11:35						0.798	0.0556	TOOK DAILY SAMPLES, WEEKLY SAMPLES
12:05						0.764	0.0479	DAY 1
12:05						0.701	0.0416	STARTED FLOC TANK 1
12:50							~~0.0434~~	
13:30						0.762	0.0434	

Raw Water = 0.420 NTU

Project: Nov 10, 2014 Cont'd Day 1
Date: Ramfield

Time	Flow rate	Recycle rate	Recycle %	Coag (PAC)	RW turb (Caustic)	Clar Turb	Filt turb	Note
1345	70	6	8.6	45	1	0.806	0.071	
1400						0.741	0.0453	
1400								Floc Drives ↑ 50/25/15 From 30/25/15
1430						0.799	0.0456	
1445					.75(315)	0.756	0.0443	Caustic ↓
1515				40(135)		0.691	0.0437	PAC ↓
1545				35(119)		0.644	0.0432	PAC ↓
1615				40(135)		0.792	0.0466	PAC ↑ PH = 7.03 Clarified
1700	End of Day			40	.75	1.049	0.1505	
								Filter Run Time Today = 7 HRS
	Nov 11, 2014 Day 2							Waste Tank = 125 L
0745	Start Up							
0805	Start Up Filtration							
0810	70	6	8.6	40	.75	0.803	0.1758	Raw PH = 7.57 Raw Turb = 0.30
0825							405	Clarified PH = 7.36 Clarified Temp = 10.4°C
0830					1	1.045	0.1052	Caustic ↑
0845						1.356	0.0880	
0900						0.999	0.0800	Floc Drives ↓ to 30/20/10 From 50/25/15
0915						1.128	0.1017	
0930								Floc Drives ↑ To 35/25/15 From 30/20/10
0930				45		1.304	0.1483	PAC ↑
0945						1.384	0.2118	
1000						1.315	0.2612	Floc Drives ↑ 45/35/20 From 35/25/15
1015						0.996	0.2290	
1030						0.793	0.1212	
1045						0.8820	0.1032	

Project:	BANFIELD
Date:	NOV 11 CONT'D DAY 2

PAC CAUSTIC

Time	Flow rate	Recycle rate	Recycle %	Coag	~~BW turb~~	Clar Turb	Filt turb	Note
11 00	70	6	8.6	45	1	0.769	0.0707	
11 15						0.801	.0669	
11 17	70	4.8	6.8					INSTALLED SMALLER ORIFICE 5/64 FROM 3/32
11 30						0.795	0.0686	
11 45						0.811	0.0701	
12 00	70	6	8.6			0.822	0.0679	
12 02							.0665	RE-INSTALLED 3/32 ORIFICE
12 03				50				PAC ↑
12 15						0.805	0.0665	
12 30						0.807	0.0673	
13 00						0.666	0.0464	
13 05								FLOC DRIVES ↑ TO 55/35/20 FROM 45/30/20
13 30						0.778	0.0395	TOOK DAILY SAMPLES DAY 2
13 45						0.664	0.0382	
14 00						0.582	0.0386	CLARIFIER PH = 7.36 TEMP = 12.5
14 15						0.615	0.0387	FLOC DRIVE ↑ 60/40/20 FROM 55/35/20
14 30						0.666	0.0389	
14 45						0.627	0.0389	
15 00						0.636	0.0425	
15 15						0.657	0.0423	FLOC DRIVE ↓ 55/35/20 FROM 60/40/2
15 30						0.641	0.0401	
15 45	70	6	8.6	50	1	0.610	0.0394	
	END OF DAY							
								FILTER RUN TIME TODAY = 7HR 40M
								TOTAL = 14 HR 40M
								WASTE TANK = 140 L TOTAL

Project:	BAMFIELD
Date:	NOV 12, 2014 DAY 3

PAC CAUSTIC

Time	Flow rate	Recycle rate	Recycle %	Coag	~~RW turb~~	Clar Turb	Filt turb	Note
0850	70	6	8.6	50	1			START UP
0935						0.866		START FILTERING
0945						0.868	0.136	RAW WATER TURB = ~~0.41~~ 0.53
1000						0.724	0.054	RAW WATER PH = 8.25, 13.0°C
1015						0.676	0.040	
1030						0.653	0.036	CLARIFIED PH = 7.23, 13.1°C
1045						0.568	0.035	
1050						~~0.473~~	~~0.034~~	RAW WATER PH = 7.78, 13.0°C
1100						0.673	0.035	
1115						0.631	0.036	
1130						0.636	0.051	CLEANED FLOW GUAGE ON FILTER UNIT.
1145						0.620	0.036	
1200						0.616	0.037	TOOK DAILY SAMPLES DAY 3
1210								STOPPED RUNNING PAC
1215				ALUM				STOPPED FILTERING
1220	70	6	8.6	50	1	~~4.89~~		STARTED RUNNING ALUM
1300						4.89		LARGE FLOC, CLARIFIED PH = 6.75
1301						~~6.79~~		FLOC PUMPS ↑ 70/45/20 FROM 55/35/20
1330					2	6.79		CAUSTIC ↑
1345				70		6.23		ALUM ↑ NO COLOUR REMOVAL
1400						6.37		NO ALKALINITY
1415				80				ALUM ↑
1430					3	6.27		CAUSTIC ↑ PH CLARIFIED = 6.61
1445				100		7.00		ALUM ↑
1500				40				ALUM ↓ FLOC PUMPS 40/30/20 FROM 70/45/20
1515						6.55		
1530						6.00		
1545						5.00		SHUT OFF MIXER # 1 ↑ 50/20
1610				30				ALUM ↓

Project:	Bamfield
Date:	Nov 12, 2014 Day 3

Time	Flow rate	Recycle rate	Recycle %	Alum Coag	Caustic ~~RW turb~~	Clar Turb	Filt turb	Note
1630	70	6	8.6	20	3	5.34	—	Alum ↓ ~~Floc Drive↑ 80/20~~
1638						6.20	~	Floc Drive↑ 80/20
1700	70	6	8.6	20	3	5.36	—	Clarified PH = 7.09
								End Of Day
								Waste Tank = 150 L Total
								Filter Run Time Today = 4H, 40M
								Total = 19H, 20M.
	Nov 13, 2014			Day 4				
				PAC	Caustic			Raw Water Turb = 0.60
0830	70	6	8.6	50	1	—	—	Start Up Switch To PAC
0850								Start PAC + Caustic
0940						1.58		Set Up To Optimum Settings So Far"
0950								Start Filtering
1010						1.00	0.063	
1030						0.90	0.040	
1105						0.84	0.033	Took Daily Samples Day 4
1135						0.76	0.034	
1145						0.727	0.035	Raw PH = 9.77, 12.7°C
1200						0.774	0.035	Clarified PH = 8.85, 13°C
1215						0.644	0.036	
1215				60		0.656	0.036	PAC ↑
1300						0.609	0.038	
1315				50	0.5	0.843	0.039	PAC ↓ Caustic ↓
1330						1.112	0.048	
1344						1.163	0.072	

Project:	RAMFIELD
Date:	NOV 13, 2014 CONTD.

DAY 4

PAC CAUSTIC

Time	Flow rate	Recycle rate	Recycle %	Coag	~~RW turb~~	Clar Turb	Filt turb	Note
1400	70	6	8.6	50	0.5	0.760	0.079	
1415					1	0.608	0.061	CAUSTIC ↑
1430						0.575	0.051	
1445						0.620	0.049	
1500					1.5	0.630	0.050	CAUSTIC ↑
1515						0.656	0.077	
1530						0.674	0.058	
1545					2.0	0.654	0.045	CAUSTIC ↑
1600						0.602	0.057	
1615						0.635	0.058	
1630	70	6	8.6	50	2.0	0.563	0.059	END OF DAY
								WATER LEVEL 25" FROM TOP OF FILTER
								FILTER RUN TIME TODAY = 6H 40M
								TOTAL = 26 H
								WASTE TANK = 175 L TOTAL
	NOV 14, 2014			DAY 5		PAC		
0830	70	6	8.6	50	2.0			RAW WATER LINE FROZEN.
0940								START UP CLARIFIER.
1000						1.500	—	RAW WATER TURBIDITY = 0.57
1005						1.112		START FILTERING
1015						0.860	0.143	
1020					1.0			CAUSTIC ↓ = OPTIMUM SETTINGS =
1030						0.730	0.075	RAW WATER PH = 8.6, 12.3°C
1045						0.571	0.088	
1100						0.571	0.079	

Project: BAMFIELD.

Date: NOV. 14, 2014 DAY 5

RAW WATER TURB = 0.73

Time	Flow rate	Recycle rate	Recycle %	Coag	RW turb	Clar Turb	Filt turb	Note
1115	70	6	8.6	50	1	0.615	0.063	TOOK DAILY SAMPLES
1125								MIXING SPEED ↑ 65/40/20 FROM 55/35/20
1130						0.569	0.072	
1130								CLARIFIED PH = 8.09, 12.3°C
1145						0.560	0.055	
1215					0.74	0.560	0.056	
1230				45		0.585	0.057	
1240				45		0.610		PAC ↓
1245						0.610	0.057	
1300						0.600	0.126	
1315						0.533	0.066	
1330						0.568	0.066	
1345						0.568	0.070	
1345				50		0.595	—	BACK TO OPTIMUM SETTINGS
1400						0.649	—	BACKWASH 10 MIN
1415						0.645	0.222	
1430						0.543	0.085	
1445						0.555	0.053	
1500						0.564	0.046	
1515						0.579	0.043	
1530						0.616	0.040	
1545						0.522	0.036	
1600						0.524	0.036	
1615						0.527	0.037	
								END OF DAY
								2 HRS ON FILTER.
								190 L IN WASTE TANK

COULD HAVE RUN FILTER LONGER, BUT COULD NOT GET BELOW 0.06 NTU

30 HRS TOTAL ON FILTER

Project: BAMFIELD
Date: NOV 16 DAY 6

RAW WATER TURB = 0.59

Time	Flow rate	Recycle rate	Recycle %	PAC Coag	CAUSTIC ~~RW turb~~	Clar Turb	Filt turb	Note
0700	70	6	8.6	50	1			START "OPTIMUM SETTINGS"
0800						0.80	—	START FILTERING
0815						0.595	0.042	
0830						0.460	0.039	
0900						0.463	0.039	
0930						0.425	0.037	
1000						0.409	0.038	
1030						0.418	0.037	
1100						0.437	0.036	RAW WATER PH = 7.08 11.7°C
1130						0.451	0.036	
1200						0.427	0.036	CLARIFIED PH = 6.43 12.1°C
1230						0.381	0.036	
1300						0.371	0.036	~~RAW WATER PH = 10.1 11.8°C~~
1330						0.395	0.036	~~CLARIFIED PH = 9.15 12.1°C~~
1400						0.396	0.036	TOOK DAILY SAMPLES
1430						0.467	0.036	END OF DAY 6
1500						0.446	0.036	

WASTE TANK = 210L

FILTER RUN TIME TODAY = 7 HRS

TOTAL = 9 HRS

Project: BAMFIELD

Date: Nov 17, 2014 DAY 7

PAC CAUSTIC

RAW WATER TURB = 0.61

Time	Flow rate	Recycle rate	Recycle %	Coag	~~RW turb~~	Clar Turb	Filt turb	Note
0730	70	6	8.6	50	1			START OPTIMUM SETTINGS
0745						1.208		
0800						0.809		START FILTERING
0815						0.625	0.059	
0845						0.844	0.036	CLARIFIED PH = 6.13, 11.7°C
0900						0.914	0.037	
0930						0.848	0.039	RAW WATER PH = 7.25, 11.6°C
1000						0.943	0.039	
1003						~~0.809~~	~~0.039~~	FLOWRATE JUMPED UP - REDUCED -
1030						0.809	0.039	
1100						0.736	0.036	
1130						0.723	0.035	
1200						0.717	0.034	TOOK DAILY SAMPLES
1230						0.676	0.038	& WEEKLY SAMPLES
1300						0.694	0.035	
1330						0.675	0.034	
1350					1.25	~~0.664~~	~~0.035~~	CAUSTIC ↑
1400						0.664	0.035	
1430						0.639	0.032	
1500						0.607	0.034	END OF DAY 7
								FILTERS RUN TODAY = 7 HRS
								TOTAL = 16 HRS
								WASTE TANK = 240 L

Project: BAMFIELD

Date: Nov 18 Day 8 PAC CAUSTIC

RAW WATER TURB = 0.60

Time	Flow rate	Recycle rate	Recycle %	Coag	~~RW turb~~	Clar Turb	Filt turb	Note
0700	70	6	8.6	50	1			START CLARIFIER - OPTIMUS SET
0730						1.033		START FILTERING
0745						0.490	0.068	
0845						0.557	0.033	RAW WATER PH = 6.77, 11.6°C
0900						0.747	0.033	CLARIFIED PH = 5.95, 11.7°C
0915						0.473	0.033	
0945						0.483	0.034	
1000						0.466	0.034	TOOK DAILY SAMPLES
1030						0.487	0.035	
1100						0.464	0.035	
~~1130~~						0.445	0.037	
1200						0.436	0.038	
1300						0.426	0.039	
1330						0.459	0.041	
1400						0.466	0.094	
1430						0.482	0.039	
1500						0.509	0.046	END OF DAY
								FILTER RUN TODAY = 7.5 HRS
								TOTAL = 23.5
								WASTE TANK = 250L

Project: BAUFIELD

Date: Nov 19, 2014 Day 9

PAC CAUSTIC

RAW WATER TURB = 0.61

Time	Flow rate	Recycle rate	Recycle %	Coag	~~BW turb~~	Clar Turb	Filt turb	Note
0730	70	6	8.6	50	1			START OPTIMUM SETTINGS
0750						0.800		START FILTERING
0800						0.614	0.257	
0815						0.821	0.047	
0830						0.790	0.042	
0900						0.721	0.042	
0930						0.760	0.046	
1000						0.824	0.051	
1030						0.777	0.055	
1100						0.810	0.059	FILTER RUN TIME TOTAL = 18 HRS
1130						0.790	0.061	
1200						0.773	0.064	
1230					0.75	1.067	0.066	CAUSTIC ↓
1235								BACKWASH FILTER.
1245								START FILTERING
1320						0.727	0.043	RAW PH = 6.84, 11.0°C
1330						0.727	0.040	CLARIFIED PH = 6.40, 11.2°C
1345				45				PAC ↓
1400						0.710	0.039	
1420				40				PAC ↓
1430						0.682	0.039	
1500						0.685	0.040	
1530						0.695	0.044	END OF DAY 9
								WASTE TANK = 260 L
								FILTER RUN TIME = 2.75 HRS.

Project: BAMFIELD

Date: NOV 20, 2014 DAY 10

PAC/CAUSTIC

RAW WATER TURB = 0.51

Time	Flow rate	Recycle rate	Recycle %	Coag	~~RW turb~~	Clar Turb	Filt turb	Note
0730	70	6	8.6	40	0.75			START CLARIFIER
0750						0.883		START FILTERING
0800						0.822	0.268	
0815						1.019	0.045	
0830						1.231	0.047	
0840				50	1			PAC ↑ CAUSTIC ↑ "OPTIMUM"
0900						1.244	0.052	
0930						0.996	0.046	
1000				~~55~~	~~1.25~~	0.950	0.038	
1010				55	1.25			PAC ↑ CAUSTIC ↑
1030						0.914	0.037	
1100						0.954	0.035	RAW WATER PH = 6.65, 11.8°C
1130						0.800	0.033	TOOK DAILY SAMPLES
1200						0.784	0.033	CLARIFIED PH = 5.93, 12.1°C
1230						0.776	0.033	
1300						0.760	0.033	
1400					1.5	0.775	0.033	CAUSTIC ↑
1430						0.771	0.034	
1500						0.739	0.033	
1600						0.755	0.033	END OF DAY
								FILTER RUN TIME TODAY = 8.2 HRS
								TOTAL = 10.95 HRS
								WASTE TANK = 270L

Project: BAMFIELD

Date: Nov 24, 2014 Day 11

PAC CAUSTIC

RAW WATER TURB = 0.56

Time	Flow rate	Recycle rate	Recycle %	Coag	~~RW turb~~	Clar Turb	Filt turb	Note
0845								START
0915	70	6	8.6	50	1	0.732		"OPTIMUM SETTINGS"
0930						0.915		START FILTERING
1000						~~3.52~~		FLOC DRIVE ↑ 60/35/20
1015						1.372	0.036	
1030						1.261	0.036	CLARIFIED PH = 5.85, 11.5°C
1045					2	1.072	0.037	CAUSTIC ↑
1100						0.983	0.038	RAW PH = 6.29, 11.4°C
1115						0.955	0.038	
1125						~~0.832~~	~~0.036~~	FLOC DRIVE #3 OFF
1130						0.832	0.036	FLOC DRIVE #3 ON
1145						0.784	0.041	
1210						0.785	0.086	TOOK DAILY SAMPLES
1230						0.780	0.090	TOOK WEEKLY SAMPLES
								END OF DAY
								WASTE TANK = 280 L
								FILTER RUN TIME TODAY 3 HRS
								TOTAL: 14 HRS

Project: BAMFIELD

Date: NOV 25, 2014 DAY 12

PAC CAUSTIC

RAW WATER TURB 0.57

Time	Flow rate	Recycle rate	Recycle %	Coag	~~RW turb~~	Clar Turb	Filt turb	Note
0700	70	6	8.6	60	2			START
0710								BACKWASH FILTER 10 MINS
0730						0.657		START FILTERING
0745						0.851	0.201	
0800						1.000	0.085	
0830						0.662	0.037	
0900						0.646	0.038	RAW WATER pH = 6.88, 11.5°C
0930								CLARIFIER pH = 7.89, 11.7°C
0930					3	0.657	0.037	CAUSTIC ↑
1000						0.531	0.035	
1030						0.487	0.034	
1100						0.508	0.033	
1130						0.497	0.032	TOOK DAILY SAMPLES
1200						0.515	0.033	
								END OF PROJECT
	70	6	8.6	60	2			FINAL OPTIMUM SETTINGS
								FLOC DRIVES 55/35/20
								SKIMMER 2M OFF, 1M ON

TRANSMITTAL LETTER

KOERS & ASSOCIATES ENGINEERING LTD.
Consulting Engineers

PO BOX 790
194 MEMORIAL AVENUE
PARKSVILLE, BC V9P 2V7
FAX: 250-248-5362 TEL: 250-248-3151

Date: January 29, 2015 Job No: 1476

TO

Name: Russell Dyson
Firm: Alberni Clayoquot Regional District
Address: 3008 5th Avenue
City: Port Alberni

FROM

Name: Ken Doll, PEng
Email: kdoll@koers-eng.com

Total number of pages including cover letter: 7

SUBJECT: BAMFIELD WATER TREATMENT FACILITY – BUILDING CANADA FUND

Please see enclosed documents for inclusion with the New Building Canada Fund – Small Communities Fund application:

1. Updated Preliminary Cost Estimate including Preliminary Operations & Maintenance costs.
2. Preliminary Location Plan for the proposed Bamfield water treatment facility.
3. Preliminary Water Treatment Equipment Layout Drawings.

Please feel free to contact me if you have any questions or concerns.

Ken Doll, PEng

Enclosures:

PRELIMINARY CONSTRUCTION COST ESTIMATE - CLASS C (+/- 30%)

Bamfield Water Treatment Facility
Dissolved Air Floatation (DAF), Gravity Filtration (GF) & Ultraviolet Disinfection Equipment (UV)

KOERS ENGINEERING LTD.
Consulting Engineers

Project: Bamfield WTP **Date:** 29-Jan-15

Client: Alberni Clayquot Regional District

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	EXTENSION
1.0	**GENERAL REQUIREMENTS**				
1.1	GENERAL REQUIREMENTS	ls	1	$50,000	$50,000
2.0	**SITE WORK**				
2.1	SEDIMENT & EROSION CONTROL AND DEWATERING	ls	1	$5,000	$5,000
2.2	CLEARING & GRUBBING	ls	1	$5,000	$5,000
2.3	STANDARD EXCAVATION & DISPOSAL	ls	1	$10,000	$10,000
2.4	SITE GRADING & DRAINAGE	ls	1	$25,000	$25,000
2.5	PAVING & PAINTING	ls	1	$30,000	$30,000
2.6	HYDRAULIC SEEDING & SITE RESTORATION	ls	1	$10,000	$10,000
3.0	**WATER TREATMENT FACILITY**				
3.1	BUILDING STRUCTURE	ls	1	$200,000	$200,000
3.2	FOUNDATION PREPARATION FOR BUILDING	ls	1	$15,000	$15,000
3.3	HVAC & PERIMETER DRAINS	ls	1	$25,000	$25,000
3.4	SECURITY FENCING & GATE	ls	1	$25,000	$25,000
4.0	**WATER TREATMENT EQUIPMENT**				
4.1	DAF, GF, UV & CHEMICAL INJECTION EQUIPMENT	ls	1	$430,000	$430,000
4.2	BACKWASH, RINSE & FLOAT TANKS & PIPING	ls	1	$40,000	$40,000
5.0	**MISCELLANEOUS WATER & STORM DRAINAGE**				
5.1	INLET/OUTLET PIPING & VALVES	ls	1	$25,000	$25,000
5.2	RAW/TREATED WATER TIE-INS & PIPING/VALVES	ls	1	$15,000	$15,000
5.3	INSTALLATION OF TREATMENT EQUIPMENT	ls	1	$20,000	$20,000
5.4	PROCESS PIPING INSIDE WTP	ls	1	$35,000	$35,000
5.5	BOOSTER PUMP REPLACEMENT	ls	1	$25,000	$25,000
5.6	METER & FLOW CONTROL VALVE	ls	1	$15,000	$15,000
5.7	STORM DRAINAGE UPGRADES	ls	1	$15,000	$15,000
6.0	**ELECTRICAL & CONTROLS**				
6.1	ELECTRICAL & LIGHTING	ls	1	$75,000	$75,000
6.2	INSTRUMENTATION & CONTROLS	ls	1	$40,000	$40,000
6.3	CONTROL PANEL	ls	1	$20,000	$20,000
6.4	COMMISSIONING & TRAINING	ls	1	$25,000	$25,000
				SUB-TOTAL	**$1,180,000**
				ENGINEERING & CONTINGENCY (30%)	**$354,000**
				TOTAL ESTIMATED COSTS (EXCLUDING GST)	**$1,534,000**

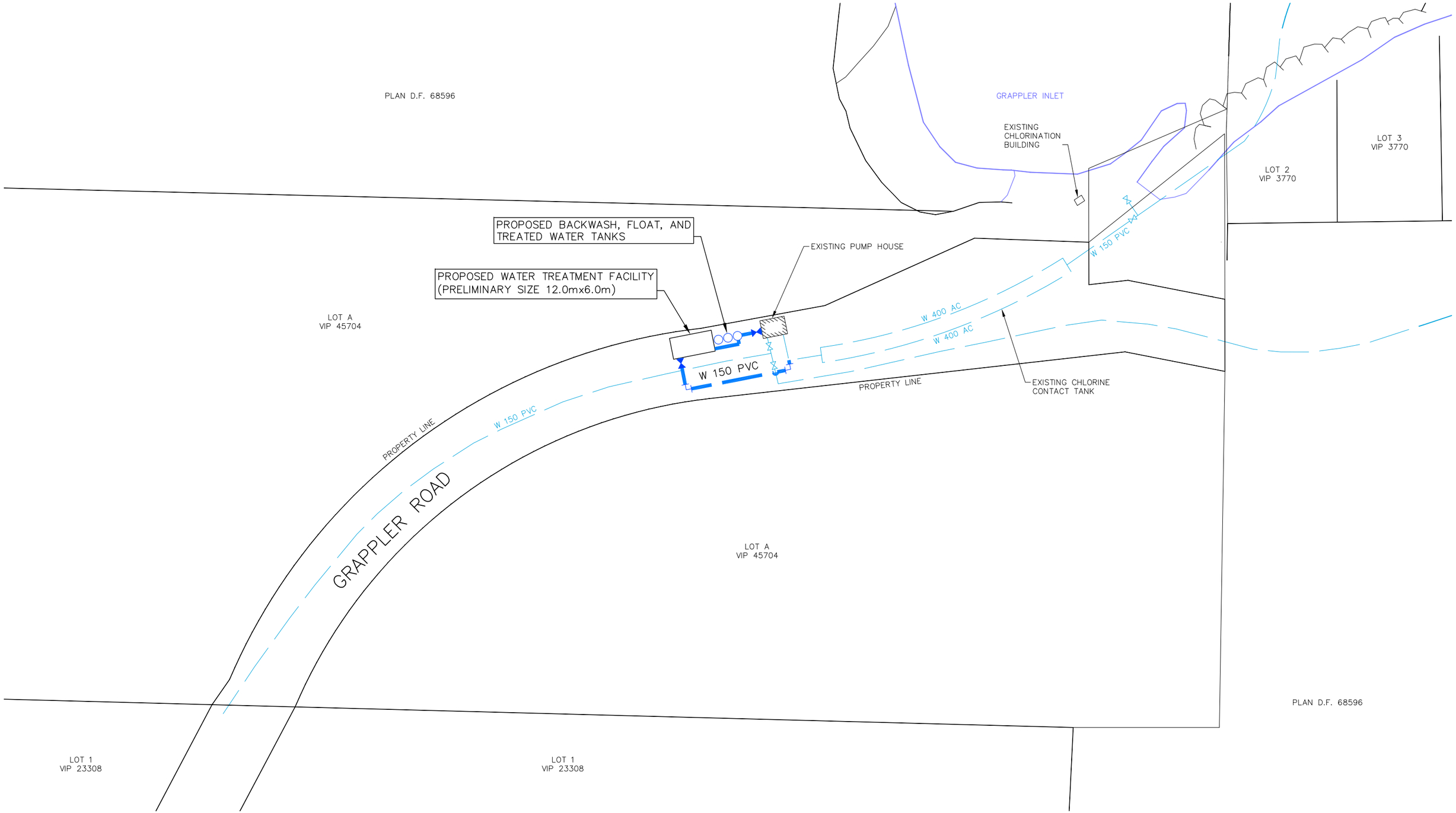
PRELIMINARY O&M COST ESTIMATE - CLASS C (+/- 30%)

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	EXTENSION
7.0	**ANNUAL OPERATING COSTS**				
7.1	ANNUAL POWER CONSUMPTION & CHEMICAL USAGE (Based on 2006-2012 Average Annual Consumption)	m^3	52,000	$0.15	**$7,800**
7.2	ANNUAL STAFF REQUIREMENTS	hrs	700	$50.00	**$35,000**
8.0	**ANNUAL MAINTENANCE COSTS (2% of Capital Cost)**	%	2%	$1,180,000	**$23,600**
	TOTAL ESTIMATED ANNUAL O&M COSTS (EXCLUDING TAXES)				**$66,400**

Notes:

1.) This cost estimate was prepared by Koers & Associates Engineering Ltd. for the Alberni Clayquoat Regional District. The material in it reflects the best judgment of Koers & Associates in light of the information available to it at the time of preparation. Any use which a Third Party makes of this estimate, or any reliance on decisions to be made upon it, are the responsibility of such parties. Koers & Associates accepts no responsibility for damages, if suffered by any Third Party as a result of the decision made or actions based on this estimate.

2.) Class C Estimate - An estimate prepared with limited site information and based on probable conditions affecting the project. It represents the total of all identifiable project costs and is used for program planning, to establish a more specific definition of clients needs and to obtain preliminary project approval. In accordance with the Auditor General for Local Government.



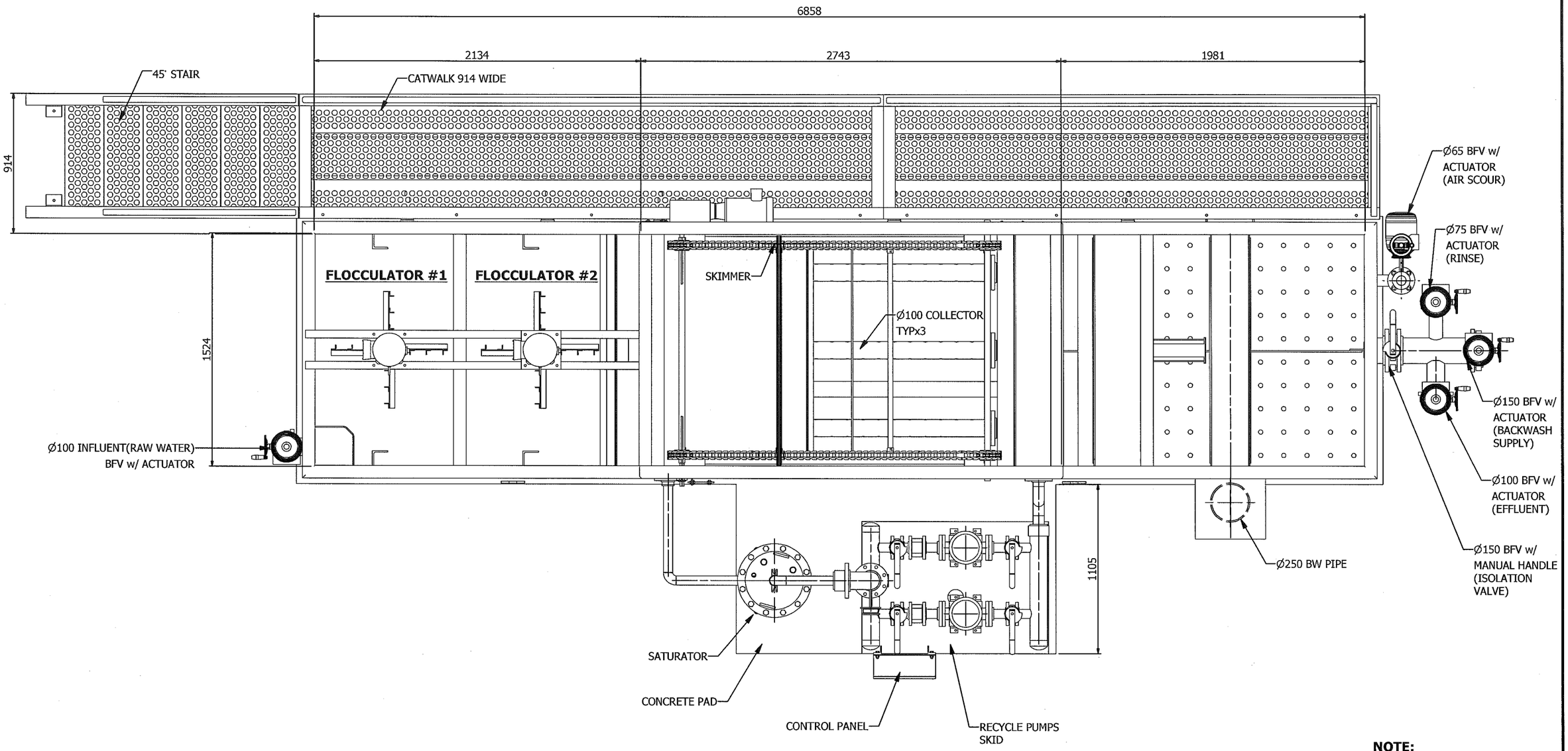
KOERS & ASSOCIATES ENGINEERING LTD.
Consulting Engineers
P.O. Box 790, 194 Memorial Ave. Ph: 250-248-3151
Parksville, BC V9P 2G8 www.koers-eng.com Fax: 250-248-5362

CLIENT: ALBERNI–CLAYOQUOT REGIONAL DISTRICT

PROJECT: PILOT TESTING FOR BAMFIELD WATER SYSTEM

TITLE: PROPOSED WATER SYSTEM MODIFICATIONS

APPROVED	SCALE 1:1000
DATE JANUARY 2015	DWG No. 1467–01
PROJECT No. 1467	



TOP VIEW

NOTE:

DIMENSIONS ARE IN MILLIMETER

REV	DESCRIPTION	BY	CHK'D	APP'D	DATE

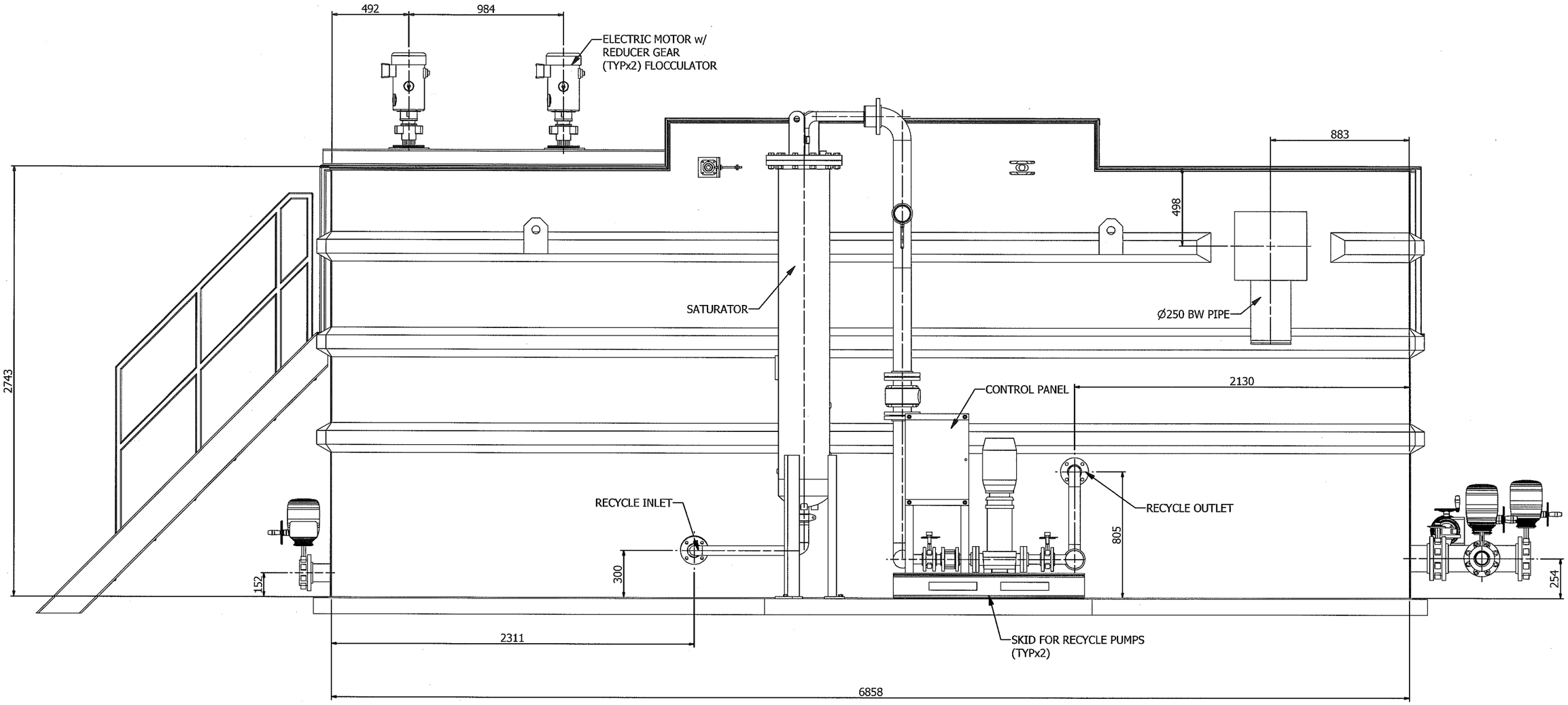
REVISIONS

CORIX Water Systems
19900 84th AVENUE LANGLEY, B.C., CANADA V2I 3C2
PHONE : 604-455-3630 TOLL FREE : 1-800-500-8855
www.corix.com

DRAWN	JL
DESIGN	KB
CHECKED	KB
APPROVED	JY
DATE	JAN. 13/2015
SCALE	NTS

BAMFIELD DAF WTP
(REF #1301-0190)
CORIX DAF - 115
MECHANICAL PLAN LAYOUT
SHEET 1 OF 4

DRAWING NO. 14054-01 REV -



ELEVATION VIEW (LEFT SIDE)

REV	DESCRIPTION	BY	CHK'D	APP'D	DATE

REVISIONS

NOTE

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19900 84th AVENUE LANGLEY, B.C., CANADA V2I 3C2
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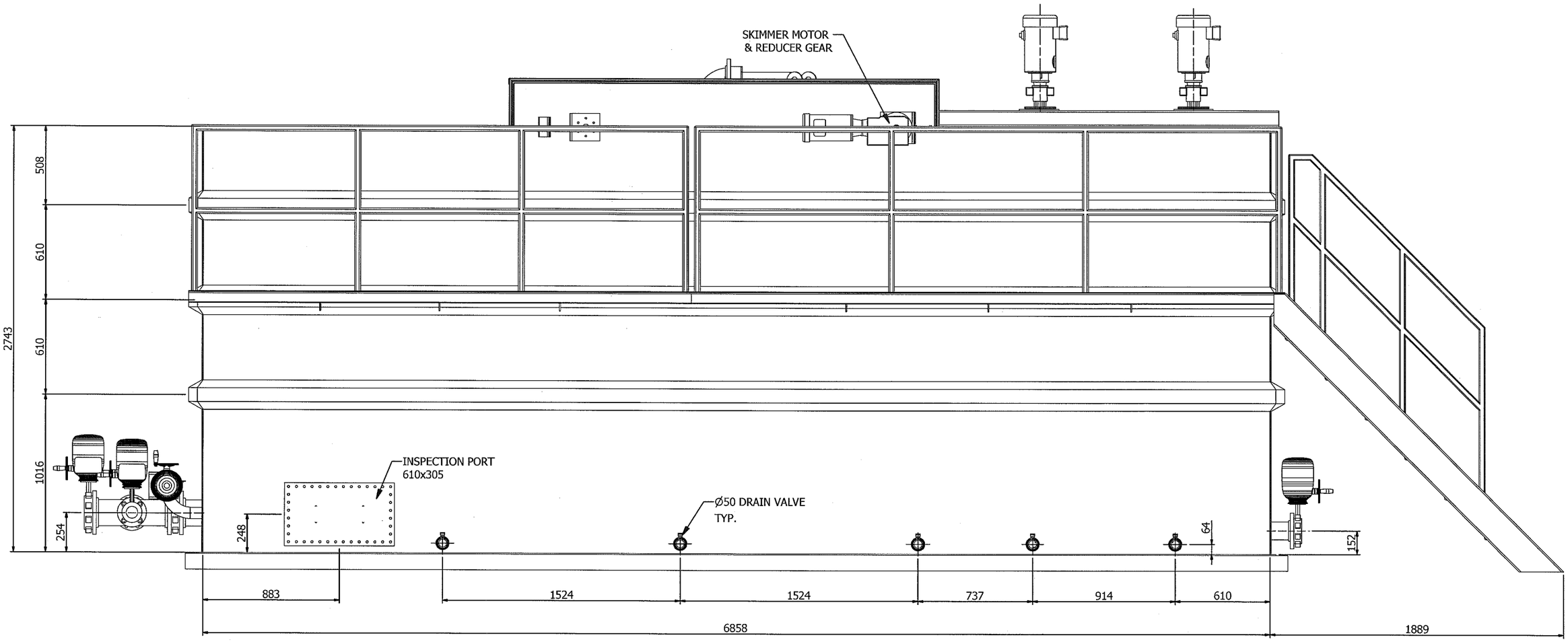
DRAWN	JL
DESIGN	KB
CHECKED	KB
APPROVED	JY
DATE	JAN. 13/2015
SCALE	NTS

BAMFIELD DAF WTP
(REF #1301-0190)
CORIX DAF - 115
MECHANICAL PLAN LAYOUT
SHEET 2 OF 4

DRAWING NO. 14054-01 REV -



ELEVATION VIEW (RIGHT SIDE)

REV	DESCRIPTION	BY	CHK'D	APP'D	DATE

REVISIONS

NOTE

CORIX Water Systems
19900 84th AVENUE LANGLEY, B.C., CANADA V2I 3C2
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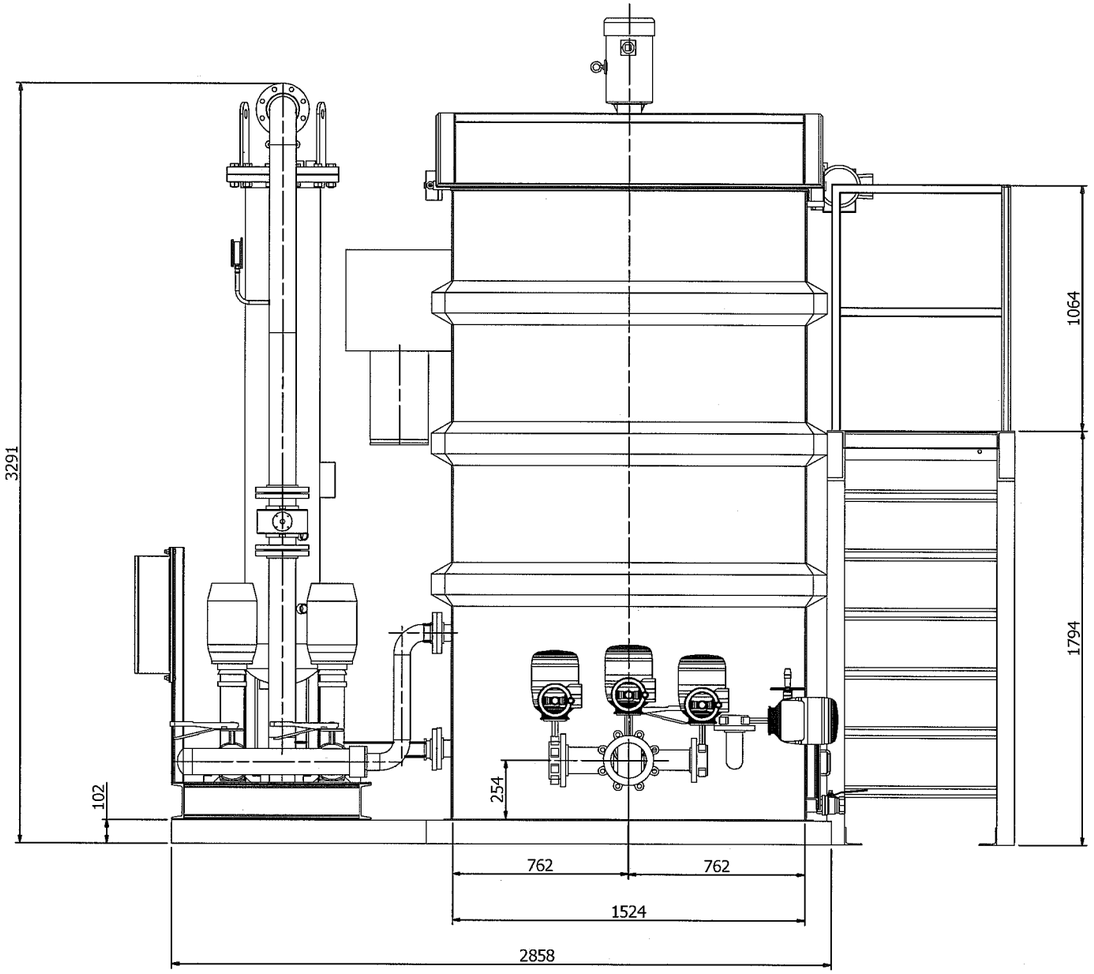
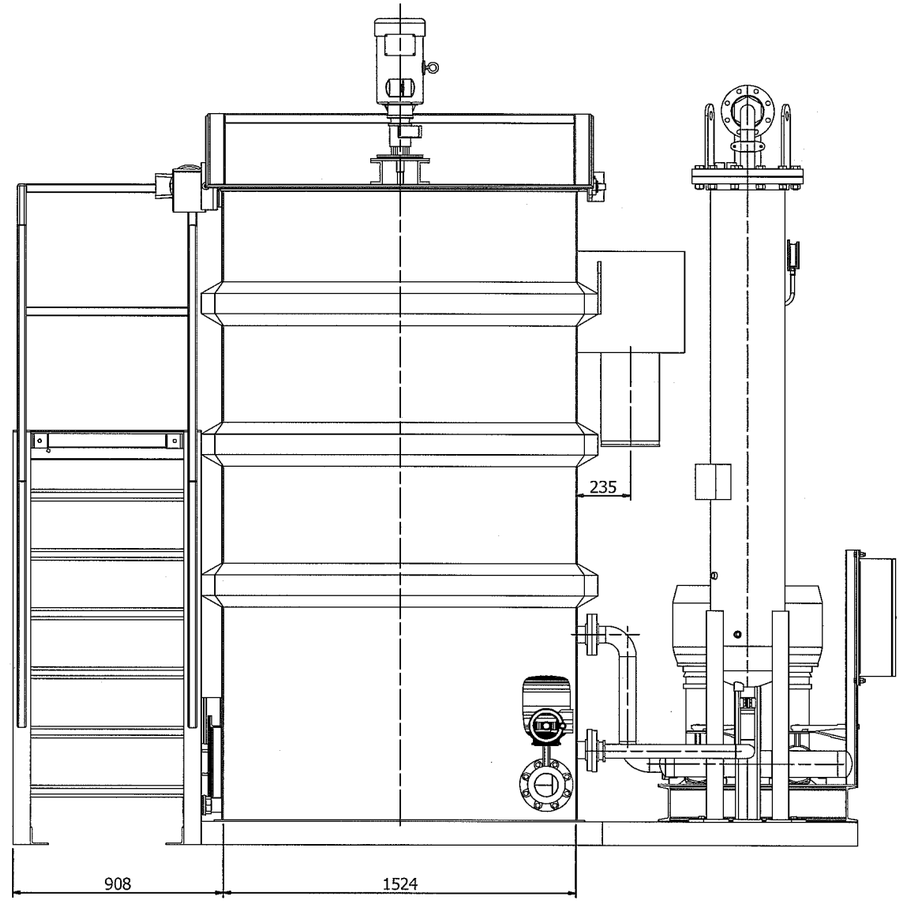
DRAWN	JL
DESIGN	KB
CHECKED	KB
APPROVED	JY
DATE	JAN. 13/2015
SCALE	NTS

BAMFIELD DAF WTP
(REF #1301-0190)
CORIX DAF - 115
MECHANICAL PLAN LAYOUT
SHEET 3 OF 4

DRAWING NO. 14054-01 REV -



FRONT VIEW



BACK VIEW

REV	DESCRIPTION	BY	CHK'D	APP'D	DATE

REVISIONS

NOTE

CORIX Water Systems
19900 84th AVENUE LANGLEY, B.C., CANADA V2I 3C2
PHONE : 604-455-3630 TOLL FREE : 1-800-500-8855
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DRAWN	JL
DESIGN	KB
CHECKED	KB
APPROVED	JY
DATE	JAN. 13/2015
SCALE	NTS

BAMFIELD DAF WTP
(REF #1301-0190)
CORIX DAF - 115
MECHANICAL PLAN LAYOUT
SHEET 4 OF 4

DRAWING NO. 14054-01 REV -