ALBERNI-CLAYOQUOT REGIONAL DISTRICT

ALBERNI VALLEY REGIONAL WATER STUDY UPDATE

FINAL REPORT

September 2010

KOERS & ASSOCIATES ENGINEERING LTD.
Consulting Engineers

Parksville, BC

Serving Vancouver Island since 1987

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Consulting Engineers

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September 16, 2010
File: 0919-Final Report

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

Attention: **Mr. Mike Irg**
Manager of Planning and Development

Dear Sirs:

Re: Alberni Valley Regional Water Study Update
Final Report

We are pleased to submit 11 bound copies of our final report and a digital copy.

A first draft of the report was presented on April 22, 2010 to a Committee comprising Regional Board members, members of the two improvement districts, members of the City of Port Alberni, and representatives of the Tseshaht and Hupacasath First Nations. Feedback was also invited from the Vancouver Island Health Authority (VIHA) and a meeting was held with VIHA officials to discuss the report and VIHA comments on June 3, 2010.

A second draft report, incorporating feedback received, was submitted on July 2, 2010 and presented to the Regional District Board on July 28, 2010. A public open house was held on July 28 at Echo Centre providing updated information and an opportunity for feedback from the public. The second draft report has also been on the regional district website since July 2.

The City and both improvement districts must make water treatment improvements to meet the new (2008) VIHA water treatment requirements, mandated under the Drinking Water Protection Act.

The report presents and compares regional options and individual water supply and treatment upgrading options to meet these requirements. It is now urgent that an early decision is made on whether there can be agreement on a regional approach. If a regional approach is not considered feasible, each party needs to provide VIHA with a plan and schedule to become compliant with the new water treatment requirements on a timely basis.

…/2

September 16, 2010
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Alberni-Clayoquot Regional District
Mr. Mike Irg

We would be pleased to assist in the process leading to implementation of the required improvements.

Yours truly,

KOERS & ASSOCIATES ENGINEERING LTD.

D.A. Koers, P.Eng.
Project Manager

ALBERNI-CLAYOQUOT REGIONAL DISTRICT
ALBERNI VALLEY REGIONAL WATER STUDY UPDATE

EXECUTIVE SUMMARY

This report updates the previous Alberni Valley Regional Water Study, carried out by Koers & Associates Engineering Ltd. in 1995, to account for:

- New VIHA (Vancouver Island Health Authority) surface water treatment requirements.
- Major changes in population and water use projections.
- Additional regional water source options.
- Available water conservation initiatives to reduce water demands.
- Cost comparisons of local versus regional solutions.
- Current Approval requirements.

Regional Service Area

The regional service area is the same as for the 1995 study.

Presently serviced entities include:

- City of Port Alberni, including Ahahswinis Reserve # 1, and providing bulk water to Tsahaheh Reserve # 1
- Beaver Creek Improvement District (BCID)
- Cherry Creek Improvement District (CCID)

Future service areas include:

- Sproat Lake
- Bell/Stuart Road
- Klehkoot Reserve # 2
- McCoy Lake
- Alberni Reserve # 2
- Beaufort

Existing Water Supply Systems

The existing water supply systems all have surface water supplies: China Creek and Bainbridge Lake (gravity) for the City of Port Alberni, Stamp River (pumped) for BCID, and Cold Creek (gravity) for CCID. All water supplies have sufficient capacity for growth to 2050. The City of Port Alberni has a licenced emergency water supply source on the Somass River (pumped), which is able to supply about 50% of the projected City demands.

Each water supply is chlorinated, but none meet the new VIHA surface water treatment requirements. BCID has been issued with a new Operating Certificate requiring compliance with the new VIHA treatment requirements by April 30, 2011. CCID has been issued with a new Operating Certificate requiring compliance with the new VIHA treatment requirements by September 1, 2013, with preliminary design having been completed by April 2011. The City of Port Alberni has not yet been issued with a new Operating Certificate, pending the completion of the current regional water study update and the submission of a plan for compliance.

Unless water treatment improvements are made in each jurisdiction, the systems will be in contravention of the B.C. Drinking Water Protection Act.

Population and Water Demand Projections

The total Alberni Valley population is projected to grow from 25,000 in 2009 to between 30,000 and 35,000 people by the year 2050. This is considerably less than the projection in the 1995 report of 54,000 people for the year 2020.

All three water systems have universal metering. Per capita demands in the present water systems are in line with, or slightly lower than in other Vancouver Island municipal systems with universal metering, and show a continuing decline over the past 5 years. There is considered to be additional opportunity to further reduce per capita water use. Water demand projections in this study have used a range of maximum day per capita demands from 0.80 to 1.00 m^3/day/cap, down from a range of 1.25 – 1.45 used in the 1995 report.

The resulting range of year 2050 maximum day water demand projections for this report is a low of 24,000 m^3/day and a high of 35,000 m^3/day. For purposes of this report, we have used a year 2050 supply capacity demand of 30,000 m^3/day.

Regional Water Sources

The following have been considered as primary or secondary regional water supply source:

- China Creek/Bainbridge Lake
- Great Central Lake
- Sproat Lake
- Somass River

The Sproat Lake source was not considered in the 1995 report as it was not thought to be available due to capacity needed by the pulp mill and concern about the deteriorating state of the wood stave water supply main. Catalyst Paper now projects it will have sufficient spare capacity to accommodate regional water demands, and the supply main has been replaced with a buried HDPE main.

Groundwater has not been considered as an option for regional water supply in the Alberni Valley, as there is no credible expectation of the presence of a large aquifer in the valley. A large-scale and costly exploration program would be required to prove this out. Forestry and gravel extraction operators in the area have reported that they have not found large volumes of year-round subsurface water in the gravel deposits in the lower China Creek and Bainbridge Lake drainages. Several deep wells drilled in the Beaver Creek area have encountered large quantities of water that is entirely not suitable for drinking water.

Drinking Water Quality Criteria

Drinking water quality legislation in Canada is developed on a provincial level, administered by regional authorities under a Drinking Water Officer, as governed by the Drinking Water Protection Act and the Drinking Water Protection Regulation. On Vancouver Island this is the Vancouver Island Health Authority (VIHA).

In March 2008 VIHA adopted the 4-3-2-1 treatment rule for surface water, which specifies a minimum of 99.99% (4-log) removal of viruses, 99.9% (3-log) removal of *Cryptosporidium* and *Giardia*, a minimum of 2 separate treatment processes, usually filtration and disinfection, and maximum 1 NTU turbidity in the finished water supply. BCID has been required to comply with the new VIHA rules by April 30, 2011 and CCID by September 1, 2013. The City has not yet been given a schedule for compliance, pending completion of the regional water study update and the submission of a plan for compliance.

The policy allows for the operation of two separate disinfection systems in lieu of filtration if source water turbidity is consistently below 1 NTU and E.Coli is within acceptable limits on a consistent basis, subject to approval by the Drinking Water Officer based on ongoing monitoring results and the absence of other parameters of concern. When turbidity exceeds 1 NTU, subsequent disinfection processes become less effective due to shielding of microbes by particles that contribute to turbidity.

Water quality for each of the proposed regional sources is excellent when compared to the Canadian Drinking Water Quality Guidelines, with the exception of seasonal turbidity and colour for China Creek, Bainbridge Lake, and Somass River.

Regional Water Supply Strategy

The regional water supply options have been developed to meet the following strategies:

1. Maximize the use of the China Creek/Bainbridge Lake gravity supply by using it as the primary source for all regional options.

2. Establish a secondary source of consistently low turbidity (< 1 NTU), to automatically take the place of the China Creek/Bainbridge supply during periods when it threatens to or exceed 1 NTU.

3. If a filtration deferral is not approved by VIHA for the primary source, then filtration treatment will be added to that source in lieu of double disinfection.

In developing this strategy it is expected that Great Central Lake and Sproat Lake will meet the requirements for a year-round filtration deferral. The China Creek and Bainbridge supplies will operate with fail-safe shut-off provisions when turbidity threatens to exceed 1 NTU, allowing these sources to operate without filtration but with double disinfection (UV and Chlorination) when turbidity is less than 1 NTU. The Somass River supply will not qualify for a filtration deferral and will require filtration immediately.

Proposed Regional Water Supply Options

Four regional water supply options have been considered for comparison. To remain on the conservative side, we have used the cost of low density membrane filtration with chemical addition, but minimal other pre-conditioning processes in all options (ie. no sedimentation or dissolved air flotation).

	Primary Supply	**Secondary Supply**
Option I	China Creek/Bainbridge Lake	None
Option II	China Creek/Bainbridge Lake	Sproat Lake
Option III	China Creek/Bainbridge Lake	Somass River
Option IV	China Creek/Bainbridge Lake	Great Central Lake

Option I requires immediate filtration treatment, followed by chlorination for the combined China Creek/Bainbridge Lake supply at the existing chlorination station site and internal upgrading of the Port Alberni distribution system on Third Avenue to supply water to BCID and CCID. BCID and CCID will be supplied by a pump station and supply main to the nearest existing or proposed reservoir. The existing chlorinated Somass River source would be available for emergency supply.

Option II requires double disinfection (UV and Chlorination) at China Creek/Bainbridge and at the Sproat Lake supply. The Sproat Lake supply will require source approval from VIHA and pumping from the end of the Mill supply main at Stamp Avenue. A pump station will be required at Huff and King to backfeed from the Sproat Lake source to the Cowichan Reservoirs during winter operation. An agreement will be required between the regional water authority and Catalyst Paper to safeguard long term public water supply requirements, to set the cost of using Catalyst infrastructure, and to transfer a portion of Catalyst's water licence. The requirements to connect for BCID and CCID are the same as for Option I.

Option III requires double disinfection at the China Creek/Bainbridge supply and immediate filtration and chlorination at the Somass supply. The Somass supply will require the conversion of the existing pump station to a low lift station and a new high lift station, upgrading of watermains from the intake to Compton Road and along Johnston from Helen to the Johnston reservoir. A pump station will be required at Huff and King to backfeed from the Somass source to the Cowichan Reservoirs during winter operation. The requirements to connect for BCID and CCID are the same as for Option I.

Option IV requires double disinfection (UV and Chlorination) at China Creek/Bainbridge and at the Great Central Lake. The Great Central source will require source approval from VIHA and a water licence from MoE and requires pumping. A 15 km long supply main will be required from Great Central Lake into the Beaver Creek system, and upgrading from Beaver Creek into the Johnston pumped zone. A pump station will be required at Huff and King to backfeed from the Great Central Lake source to the Cowichan Reservoirs during winter operation. The BCID system can connect to the supply main without pumping, but the CCID system will still require a pump station and supply main.

The review of regional options includes the infrastructure required to interconnect and supply the serviced areas for projected growth to the year 2050. No provision has been included for distribution piping and reservoir upgrading to suit internal distribution or fire protection needs.

The regional water supply options include capacity for projected growth to the year 2050 in all of the future possible service areas, such as Sproat Lake, Bell/Stuart Road, Klehkoot Reserve # 2, McCoy Lake, Alberni Reserve # 2 and Beaufort. It is anticipated that the Bell/Stuart Road area and Klehkoot Reserve # 2 will be serviced as extensions from the Tsahaheh Reserve # 1 via the bulk water connection from the City of Port Alberni, as is being proposed by others. Alberni Reserve # 2 would be serviced from extension of the City of Port Alberni distribution system. The Sproat Lake, McCoy Lake and Beaufort areas will require connecting mains from the various regional options, once a decision is made to service these areas. At present, no allowance has been made in the regional option comparisons for connecting these areas to the proposed regional water supply, other than providing capacity in the water supply and treatment facilities. Likewise, no provision has been included for internal distribution piping and reservoir requirements for any of these areas.

Independent Water Supply Options

Port Alberni

The report reviews three options for upgrading the existing City of Port Alberni system to allow for growth to 2050 and to comply with the new VIHA treatment requirements. All three options include the existing China Creek/Bainbridge Lake supply as the primary supply source.

Option PA I keeps the China Creek/Bainbridge Lake source as the only compliant source (with the existing Somass source as a non-compliant emergency source). The source would require immediate filtration and chlorination treatment. As the design demand would be about 85% of the regional demand, no internal system upgrading will be required.

Option PA II adds the Sproat Lake source as a secondary source. Both sources would require double disinfection (UV and Chlorination).

Option PA III adds the Somass River source as a secondary source. The Somass source would require filtration and chlorination treatment immediately.

Beaver Creek Improvement District

Beaver Creek has had its own supply and water treatment assessment completed by Koers & Associates in early 2010. It considers several options. For comparison purposes, to compare equitably with the regional option treatment estimates, we have used the cost of the low density membrane filtration process with chemical conditioning but minimum other pre-treatment processes, followed by chlorination. The costs include the required upgrading of the Stamp River intake and pump station, and have been directly quoted from the BCID study.

Cherry Creek Improvement District

We have not been supplied with a recent water supply upgrading study for the CCID, which we assume is underway. We have been supplied with limited system information by the CCID and its consultant McGill Associates Engineering Ltd.

From the information obtained it is clear that CCID will also require filtration treatment and chlorination, but likely not upgrading of its intake on Cold Creek, and it will not require pumping. As turbidity levels are likely to be consistently lower than those in the BCID supply, due to the mitigating effects of upstream Lacy Lake and the intake impoundment, we have used the lower cost direct filtration process for cost estimates.

Approvals

Approvals for water works on Vancouver Island are governed by VIHA under the Ministry of Health Drinking Water Protection Act and the Drinking Water Protection Regulation.

Approvals include source approval for any new source, treatment system approval for any proposed treatment system, and detailed design approval of any piping, pumping, and reservoir systems.

In the case of some of the Alberni Valley regional options, these anticipate the approval of double disinfection in lieu of filtration for low turbidity sources. This approval is required at an early stage, and needs to be based on an extended monitoring period.

Any new water supply would require a water licence. In the case of the Sproat Lake supply, this is expected to take the form of transfer of a portion of the Catalyst licence to the regional water authority.

Cost Comparisons

Total capital costs for all regional and local options are shown in Table 8. Total costs for the regional options have been proportioned to each of the three existing water systems on the basis of 2025 relative population estimates. All regional option estimates include an assumed capital cost contribution of $500,000 from each of BCID and CCID to Port Alberni for the use of its infrastructure. A capital cost contribution for use of Catalyst infrastructure and water licence for regional option II will be the subject of negotiation, subject to a satisfactory agreement to safeguard long term public water supply interests.

Table 8 also lists the estimated net present value of the total phased capital costs and 25 years of operation and maintenance costs, using a discount rate of 3%.

Analysis

On the basis of total capital costs, Regional Option II, China Creek with Sproat Lake, at an estimated cost of $10,643,500, is by far the most attractive regional option. The next lowest cost option is Regional Option I (China Creek/ Bainbridge Lake on its own).

The City's, BCID's, and CCID's estimated share of the capital cost of Regional Option II is significantly less than their go-it-alone costs.

The capital costs of Regional Option III (China Creek with Somass River) is estimated at $22,649,550 and IV (China Creek with Great Central Lake) at $22,906,800.

Capital costs are eligible for senior government funding when funding programs are available. Such funding would have very significant impacts on the comparison of capital costs, particularly when considering the cost of go-it-alone options for BCID and CCID, as they are not eligible for senior government funding under their present form of organization.

Senior government funding has not been considered in the capital cost comparisons presented in Table 8.

A net present value (NPV) (or total life cycle cost) assessment has been included in the comparison of options, which considers capital costs and operation and maintenance costs of the various options over a 25 year period. These are included in the summary in Table 8.

On the basis of total life cycle costs (NPV), the cost of Regional Option II is also much lower than that of the other regional options.

The impact of high operation and maintenance costs over the lifetime of a project is most pronounced when considering the go-it alone costs for BCID and CCID. Because both systems will require immediate filtration treatment on their own, the high operation and maintenance cost of such systems has a dramatic impact on the total life cycle costs comparison for the improvement districts.

As can be seen from Table 8, the life cycle costs for the BCID and CCID go-it-alone systems are at least double their chare of the estimated life cycle costs for Regional Option II.

The estimated life cycle costs for Port Alberni (Option PA II) on its own is slightly lower than the City's share of estimated life cycle costs for Regional Option II.

Water Conservation

In 2008 the Province of B.C. set out new provincial water priorities in the Living Water Smart plan. The plan sets goals for water conservation and initiates action on a new water governance model, which not only addresses the opportunities and implications of surface water and groundwater governance, but also how municipalities will be required to conserve water and become more efficient and sustainable with respect to its use of the water resource.

The plan considers healthy water and watersheds vital to B.C.'s economy, and needs to be in place to safeguard water for the long term. The plan includes, among many other initiatives, regulating groundwater supplies, encouraging communities to do watershed management planning, and to require active water conservation initiatives by communities, such that by 2020 water use will be 33 percent more efficient (in other words, 50% of new municipal water needs will be acquired through conservation).

The provincial government has gone on record of stating that it will enforce these initiatives onto municipalities and regional districts by tying grant approvals to proven records of compliance with the B.C. Water Plan.

Section 11 of this report deals with how municipalities can conserve water and presents a review of the literature on what communities in B.C. have achieved and what type of conservation initiatives may work in the Alberni Valley.

Conclusions

The following conclusions may be drawn from the work presented in this report:

1. The existing water treatment systems for the City of Port Alberni, the Beaver Creek Improvement District and the Cherry Creek Improvement District will be in contravention of the B.C. Drinking Water Protection Act unless improvements are made to meet the new 2008 Vancouver Island Health Authority (VIHA) water treatment requirements.
2. The proposed Alberni Valley regional water system is designed to meet the new treatment requirements and would service the existing water systems of the City of Port Alberni, including Ahahswinis Reserve # 1 and Tsahaheh Reserve # 1, and the Beaver Creek and Cherry Creek Improvement Districts, as well as potential future service areas for the Sproat Lake, Bell/Stuart Road, McCoy Lake and Beaufort communities, and the Klehkoot Reserve # 2 and Alberni Reserve # 2.
3. The existing water systems in the Alberni Valley all have surface water supplies and have sufficient capacity for growth to the year 2050. They all have chlorination treatment, but none meet the new VIHA surface water treatment requirements. The BCID and CCID have been issued with an Operating Certificate amendment specifying compliance with the new VIHA treatment requirements by April 30, 2011 and September 1, 2013, respectively. The City of Port Alberni has been requested to present a plan for compliance following completion of the regional water study update.
4. The present Alberni Valley population is estimated at 25,000 people. The high growth rate projected in the 1995 study has been downgraded substantially from 2.4% to an average of 0.5 – 0.75% per annum. This results in a design population of between 30,000 and 35,000 people for the year 2050.
5. All three water systems have universal metering. Per capita water demands are similar, if not slightly lower, than most municipal systems on Vancouver Island, and are showing a gradual annual reduction during the past 5 years.
6. As a result of water conservation measures through universal metering and increasing public awareness, target water demands for future projections have been downgraded from a range of 1.25 – 1.45 m^3/day/cap used in the 1995 report to a range of 0.80 – 1.00 m^3/day/cap for the new 2050

projections. This is expected to result in a year 2050 maximum day demand of 30,000 m^3/day, down more than 50% from the 2020 design demand projected in the 1995 report.

7. The 1995 report considered three regional water supply sources, ie. China Creek/Bainbridge Lake, Great Central Lake and the Somass River. The present update report considers these three sources plus Sproat Lake, as Catalyst Paper has expressed an interest in transferring some of its excess water supply capacity to a regional water supply authority or the City, and a new buried HDPE supply main has been installed from the Sproat Lake intake to the Mill, within close proximity to the City water distribution system.
8. Groundwater has not been considered as part of a regional water supply option, as information to-date has not indicated the presence of a large good quality aquifer in the valley and the cost of an extensive exploration program cannot be justified. Information obtained from a local well driller indicates the existence of drilled wells in the Beaver Creek area that accessed large quantities of water entirely unsuitable for drinking water.
9. Drinking water quality legislation is developed provincially under the provisions of the Drinking Water Protection Act and Regulation. On Vancouver Island, the regional authority administering this legislation is the Vancouver Island Health Authority (VIHA). In March 2008, VIHA adopted the 4-3-2-1 treatment rule for surface water, which aims to provide drinking water year-round with less than 1 NTU turbidity and a dual barrier treatment system, usually filtration followed by disinfection. Alternatively, when a source can provide raw water consistently below 1 NTU turbidity, two disinfection systems in series, capable of 4-log (99.99% removal of viruses) and 3-log (99.9%) removal of *Giardia* and *Cryptosporidium* may be approved to comply with the new rule.
10. Four regional water supply options have been compared, namely:

	Primary Supply	Secondary Supply
Option I	China Creek/Bainbridge Lake	None
Option II	China Creek/Bainbridge Lake	Sproat Lake
Option III	China Creek/Bainbridge Lake	Somass River
Option IV	China Creek/Bainbridge Lake	Great Central Lake

11. Local supply options (the above options, except Great Central Lake for the City, the Stamp River source with filtration for BCID, and the Cold Creek source with filtration for CCID) were compared against the cost of participating in the regional options.
12. Based on total capital costs, Regional Option II, China Creek/Bainbridge Lake with Sproat Lake as secondary source, is by far the most attractive option. This assumes that a filtration deferral can be obtained for both sources, and that filtration treatment would not be required until sometime after the year 2035.

13. The capital cost comparison of the individual options show that the cost for the City, BCID and CCID to proceed on their own is considerably higher for each than the cost of joining Regional Option II.
14. Government funding has not been considered in the cost estimates presented in the draft report. A regional or a local City supply and treatment system improvement qualifies for government funding, whereas the improvement districts do not qualify for such funding, unless they organize under a regional local service area function.
15. On the basis of Net Present Value (NPV) of the phased capital costs and the full cost of operation and maintenance of the supply and treatment systems over 25 years, Regional Option II is also much lower than the other regional options.
16. When considering NPV estimates for the go-it-alone options for the two improvement districts, it becomes very clear that operation and maintenance costs of individual filtration treatment plants have a large additional cost implication. The NPV of capital and operation and maintenance costs over 25 years for the go-it-alone options for the improvement districts is almost double the proportional share of those costs in a regional system context.
17. In 2008 the Province of B.C. set out new provincial water priorities in the Living Water Smart Plan. The province has set a goal that by 2020 water use in the province will be 33% more efficient, with the implication that each municipality or regional district will need to meet this objective. Section 11.0 of this report deals with a discussion on how municipalities can conserve water, presents an overview of what communities in B.C. have achieved to-date, and which type of initiatives may work in the Alberni Valley.
18. A public Open House was held on July 28, 2010 at the Echo Centre to provide information on the second draft report and to solicit feedback from the public. A summary of the feedback received is included in Appendix B.

Recommendations

Based on the conclusions reached in this study, we recommend that:

1. The City of Port Alberni, the Beaver Creek Improvement District and the Cherry Creek Improvement District immediately start discussions on how to meet the new VIHA water treatment requirements, established under the provisions of the B.C. Drinking Water Protection Act.
2. In order to keep initial capital and operation and maintenance costs to a minimum, a regional water supply system is established in the Alberni Valley, adopting the following strategies:
   - Maximize the use of the China Creek/Bainbridge Lake gravity supply.
   - Establish a secondary source with year-round low turbidity, such as Sproat Lake or Great Central Lake, which automatically comes on line when China Creek and Bainbridge Lake turbidity threatens to equal or

exceed 1 NTU, assuming VIHA will approve these sources for a filtration deferral.

- Provide each source with double disinfection, UV radiation followed by chlorination, with sufficient property available to expand to add filtration treatment at a later date, when such is mandated.

3. Regional Option II – China Creek/ Bainbridge Lake with Sproat Lake as the secondary source be selected as the preferred regional water supply system, on the basis of obtaining a filtration deferral for both sources, so that the high capital and ongoing operation and maintenance expense of filtration treatment can be postponed to beyond the year 2035.
4. The water quality data collection in support of the application to VIHA for a filtration deferral, in particular raw water turbidity at China Creek/Bainbridge Lake and Sproat Lake, continue for at least one full year.
5. Additional raw water quality data be collected, starting at the earliest convenience, on both the China Creek/Bainbridge Lake and Sproat Lake sources, including UVT for the future sizing of UV reactors, E.Coli, total bacteria, organic carbon, and regular general drinking water quality parameter scans, in further support of the filtration deferral application, and that VIHA be consulted on which parameters to be included in the ongoing monitoring.
6. Discussions start as soon as possible between the ACRD, City, BCID and CCID about the feasibility of forming a regional water authority, and the selection of the preferred regional water supply option.
7. If a Sproat Lake secondary supply is to be considered for regional or City water supply development, discussions should take place as soon as possible with Catalyst Paper to explore the conditions and costs for transfer of a portion of the water licence and for the use of existing Catalyst infrastructure, such as the intake, pump station and water supply main, and to determine the conditions necessary to protect long term public water supply interests.
8. Source approval for Sproat Lake to be applied for to VIHA.
9. A schedule for implementation is established to be submitted to VIHA relative to the implementation dates currently specified in the individual Operational Certificates.
10. Government support and funding sources be explored for the preferred option, and using every available opportunity to apply for funding.
11. The regional district and/or City meet with the appropriate authorities to clarify the objectives of the B.C. Water Plan, and to determine the base line against which water conservation goals are to be measured.
12. A water conservation plan is prepared for the proposed regional water supply system, along the lines discussed in Section 11.0 of this report, and designed to comply with or surpass the provincial objectives.

Table 8. Capital Cost and Net Present Value Summaries - Filtration Treatment Postponed to after 2035 26-Aug-10

	Regional Options	Year of	Capital Cost & NPV Summary			
		Implementation	Total	Port Alberni	BCID	CCID
I	**China Creek/Bainbridge Alone**	2011				
	Cost with Filtration	Total Capital Cost	19,798,450	12,922,219	3,602,050	3,274,181
	NPV Capital Costs and 25 years of O&M	**NPV**	**35,243,653**	**26,380,000**	**4,767,000**	**4,097,000**
II	**China Creek/Bainbridge and Sproat Lake**	2011				
	Cost with Filtration Deferral on both sources	Total Capital Cost	10,643,500	5,491,067	2,652,649	2,499,784
	NPV Capital Costs and 25 years of O&M	**NPV**	**18,946,726**	**13,358,000**	**2,974,000**	**2,614,000**
III	**China Creek/Bainbridge and Somass River**	2011				
	Cost with Filtration Deferral on China Cr/Bainbridge	Total Capital Cost	22,649,550	13,582,517	4,705,225	4,361,807
	NPV Capital Costs and 25 years of O&M	**NPV**	**40,318,958**	**30,435,000**	**5,325,000**	**4,559,000**
IV	**China Creek/Bainbridge and Great Central Lake**	2011				
	Cost with Filtration Deferral on both sources	Total Capital Cost	22,906,800	15,776,050	3,762,913	3,367,837
	NPV Capital Costs and 25 years of O&M	**NPV**	**37,802,535**	**28,545,000**	**4,780,000**	**4,056,000**
	Go-It-Alone Options					
PA I	**Port Alberni with China Creek/Bainbridge Alone**	Total Capital Cost		15,610,000		
	NPV Capital Costs and 25 years of O&M	**NPV**		**27,787,701**		
PA II	**Port Alberni with China Cr/Bainbridge and Sproat Lake**	Total Capital Cost		7,910,000		
	NPV Capital Costs and 25 years of O&M	**NPV**		**14,080,763**		
PA III	**Port Alberni with China Cr/Bainbridge and Somass River**	Total Capital Cost		16,030,000		
	NPV Capital Costs and 25 years of O&M	**NPV**		**28,535,353**		
Beaver Creek ID. (Stamp River Source)		Total Capital Cost			4,600,000	
	NPV Capital Costs and 25 years of O&M	**NPV**			**8,188,560**	
Cherry Creek ID. (Cold Creek Source)		Total Capital Cost				3,100,000
	NPV Capital Costs and 25 years of O&M	**NPV**				**5,518,378**

ALBERNI-CLAYOQUOT REGIONAL DISTRICT
ALBERNI VALLEY REGIONAL WATER STUDY UPDATE

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APPENDICES

1.0 INTRODUCTION

1.1 Background

Koers & Associates Engineering Ltd. completed the original Alberni Valley Regional Water Study in 1995 (1). That study considered a 2.4% per annum population growth rate and a 2020 design population of 54,000 people in the Alberni Valley service area, and recommended a regional water supply system consisting of the existing China Creek/Bainbridge Lake gravity supply and a new pumped supply from Great Central Lake at a capital cost in 1995 dollars of $49,500,000 over 25 years.

Since then, the population in the service area has steadily declined and there has been no progress towards the implementation of a regional water supply system.

In 2008, the Vancouver Island Health Authority (VIHA) implemented new treated water quality requirements for surface water sources within its jurisdiction (2), which has a major impact on each of the existing community water systems in the Valley. VIHA required all community water systems with a surface water source to submit a plan to become compliant with the new requirements within a reasonable time frame. It has since issued new operating certificates for the two improvement district water systems in the Alberni Valley requiring compliance with the new regulations by April 30, 2011 for the Beaver Creek Improvement District (BCID) and September 1, 2013 for the Cherry Creek Improvement District (CCID). The City of Port Alberni's operating certificate has not yet been amended, pending the outcome of the regional water study update.

Koers & Associates was retained in June 2009 to update the 1995 Regional Water Study and make recommendations as to how the community water systems in the Valley can best meet the new requirements in the context of a regional water system, and provide cost comparisons with go-it-alone options.

1.2 Scope and Objectives

The primary objectives of this study are as follows:

- Revisit the review of regional water supply options in the 1995 report.
- Update population and water demand projections.
- Apply the new VIHA finished surface water quality requirements to each water supply option.
- Review applicable treatment technologies for each option.
- Determine the most cost effective and secure method of obtaining an adequate long term supply of good quality drinking water for the Alberni Valley region, based on total capital and operation and maintenance costs.

- Compare the total cost of regional options with the total cost of continuing as independent water systems.
- Outline approval requirements for the proposed options.
- Discuss practical and cost-effective measures to further improve water conservation in the Alberni Valley.

1.3 Data Sources and Bibliography

References and data sources used in the preparation of this report are listed in Section 13.0 and cross referenced in the text of this report by bracketed number.

1.4 Acknowledgements

Koers & Associates Engineering Ltd. is very appreciative of the assistance provided by staff of the Alberni-Clayoquot Regional District, the City of Port Alberni, and the Beaver Creek and Cherry Creek Improvement Districts.

In particular we thank Mike Irg, Director of Planning ACRD, Guy Cicon, P.Eng., and Ken Watson, P.Eng., respectively City Engineer and City Manager of the City of Port Alberni.

We wish to also acknowledge the assistance provided by Larry Cross of Catalyst Paper, Alberni Division, John Baldwin of the Water Stewardship Division of MOE, and John Spencer and Stephanie Hutchinson of VIHA.

2.0 REGIONAL SERVICE AREA

The service area for the proposed regional water system has not changed from that which was considered for the 1995 regional water study. The service area is shown on Figure 1. The service area for the proposed Alberni Valley Regional Water System includes the City of Port Alberni, the Beaver Creek and Cherry Creek Improvement Districts, the Sproat Lake, McCoy Lake, Bell/Stuart Road, and Beaufort proposed future service areas, and the following First Nation Reserves: Tsahaheh # 1, Ahahswinis # 1, Klehkoot # 2, and Alberni # 2.

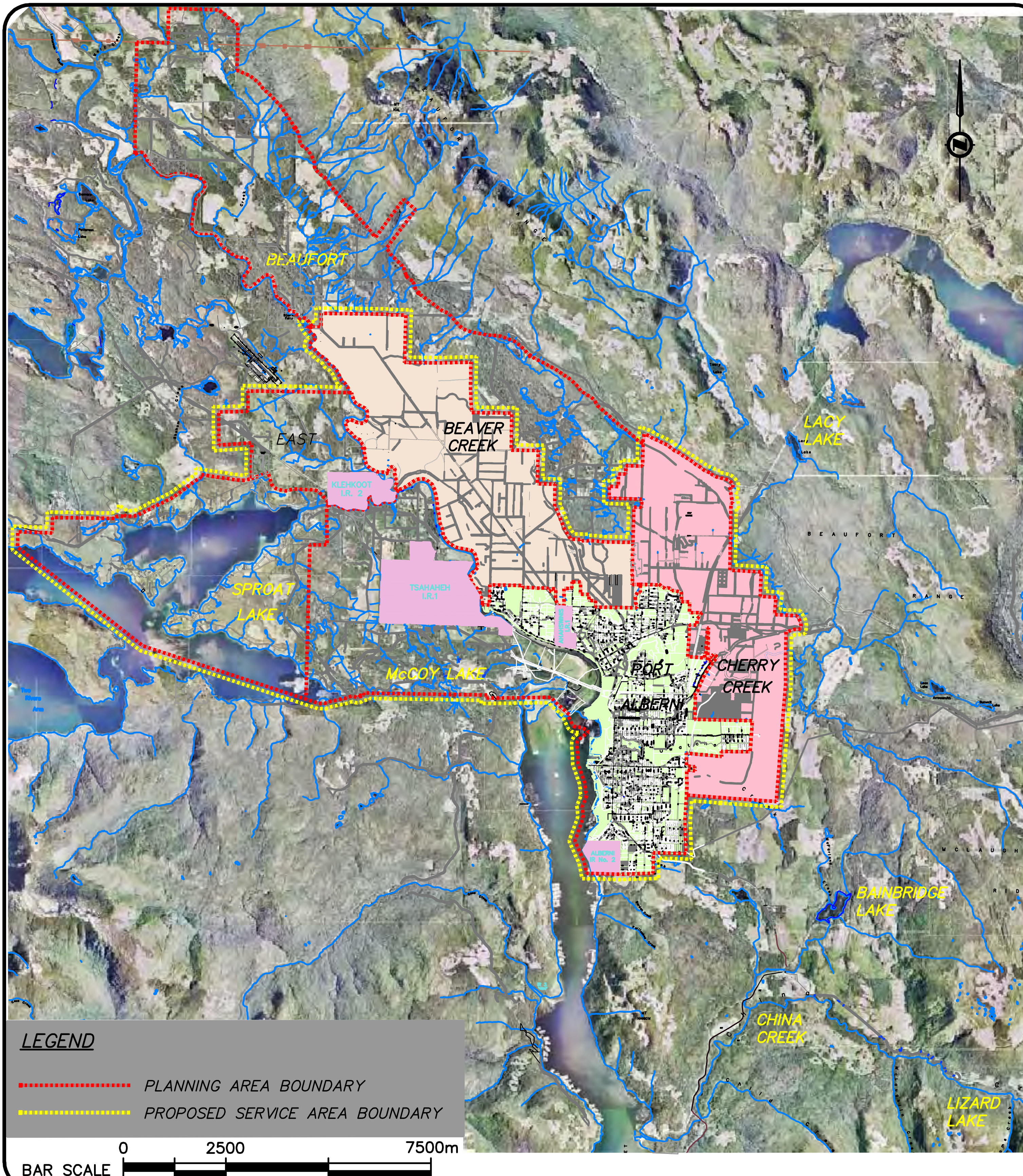
Of these entities, the City of Port Alberni and the Beaver Creek and Cherry Creek Improvement Districts have separate and independent community water supply and distribution systems. Properties on the Ahahswihis # 1 reserve are serviced from the City of Port Alberni distribution system. The Tsahaheh # 1 reserve has its own distribution system and purchases bulk water through two metered connections to the City of Port Alberni distribution system.

There are several private water systems with VIHA operating certificates which utilize Sproat Lake as their water source. These are the Anchor Bay Water Society on Asher Road with 18 connections, the Lake Shore Campground at 9752 Lakeshore Road with 34 connections, the Sproat Lake Mobile Home Park at 10325 Lakeshore Road with 93 connections, the Tall Timbers Holiday Park at 10324 Lakeshore Road with 107 connections, the Dockside at Sproat Lake at 6397 Salal Road with 8 connections, the West Bay Hotel at 10695 Lakeshore Road and the Fish and Duck Pub at 8571 Bothwell Road. All other occupied properties in the potential service areas have individual water supplies either from wells or from the lakes.

We understand there is a current proposal to service the Bell/Stuart Road area and the Klehkoot # 2 reserve from an extension of the Tsahaheh # 1 reserve water system. Any future water service to Alberni # 2 reserve would be as an extension of the City of Port Alberni distribution system.

Any regional system to be considered for the Alberni Valley would accommodate the areas presently serviced by a water system, including the proposed extension to Bell/Stuart Road and Klehkoot and future service to Alberni # 2 reserve. The remaining unserviced areas, namely the Sproat Lake, McCoy Lake and Beaufort areas could develop independent water systems or become part of the regional service area, with feasibility depending on the regional option chosen. Regardless, such areas would be required to build their own supply mains, distribution systems, and related pump stations and reservoirs.

Figure 1. Proposed Service Area.
See following page.



ALBERNI–CLAYOQUOT REGIONAL DISTRICT

ALBERNI VALLEY REGIONAL WATER STUDY UPDATE

SUBJECT	PROPOSED SERVICE AREA
APPROVED	
DATE	FEBRUARY 2010
JOB No.	0919
SCALE	SEE BAR SCALE
DWG No.	FIG. 1

The proposed regional supply system will be sized, for purposes of this report, to accommodate growth for all of the above service areas, but on the basis of maximum day water demand only. Each participant in the regional supply system would have to provide its own reservoirs for hourly peak demands and fire flows. Should areas opt out of the regional supply system proposal, the final sizing and cost sharing would be based on only those who participate.

3.0 EXISTING WATER SUPPLY SYSTEMS

3.1 General

Table 1 shows an updated list of existing community water systems and selected details and reported capacities of the supply system and storage components. The location and extent of the systems, including source location and size of supply main piping and reservoirs are shown in Figure 2.

Table 1. Existing Water System Statistics

Area	Supply				Balancing Storage			
	Type	Description	Capacity m^3/day	Licence m^3/day	Description	Volume m^3	TWL m	Depth m
City of Port Alberni	Surface	China Creek	24,500	24,450	Cowichan 1&2	18,000	158/146	5
	Surface	Bainbridge L	13,800	9,790	Burde	6,750	86.8	5
	Surface	Somass R	17,000	13,565	Johnston	9,000	66.8	5
					Arrowsmith	250	173.6	5
		Total	55,300	47,805	Total	34,000		
Beaver Creek ID	Surface	Stamp River	3,430	6,225	North Tank	275	106	3
					South Tank	1,135	106	3
					Total	1,410		
Cherry Creek ID	Surface	Cold Creek	3,430	5,145	Intake Pond	6,953	212	2.6
GRAND TOTAL			62,160	59,282				

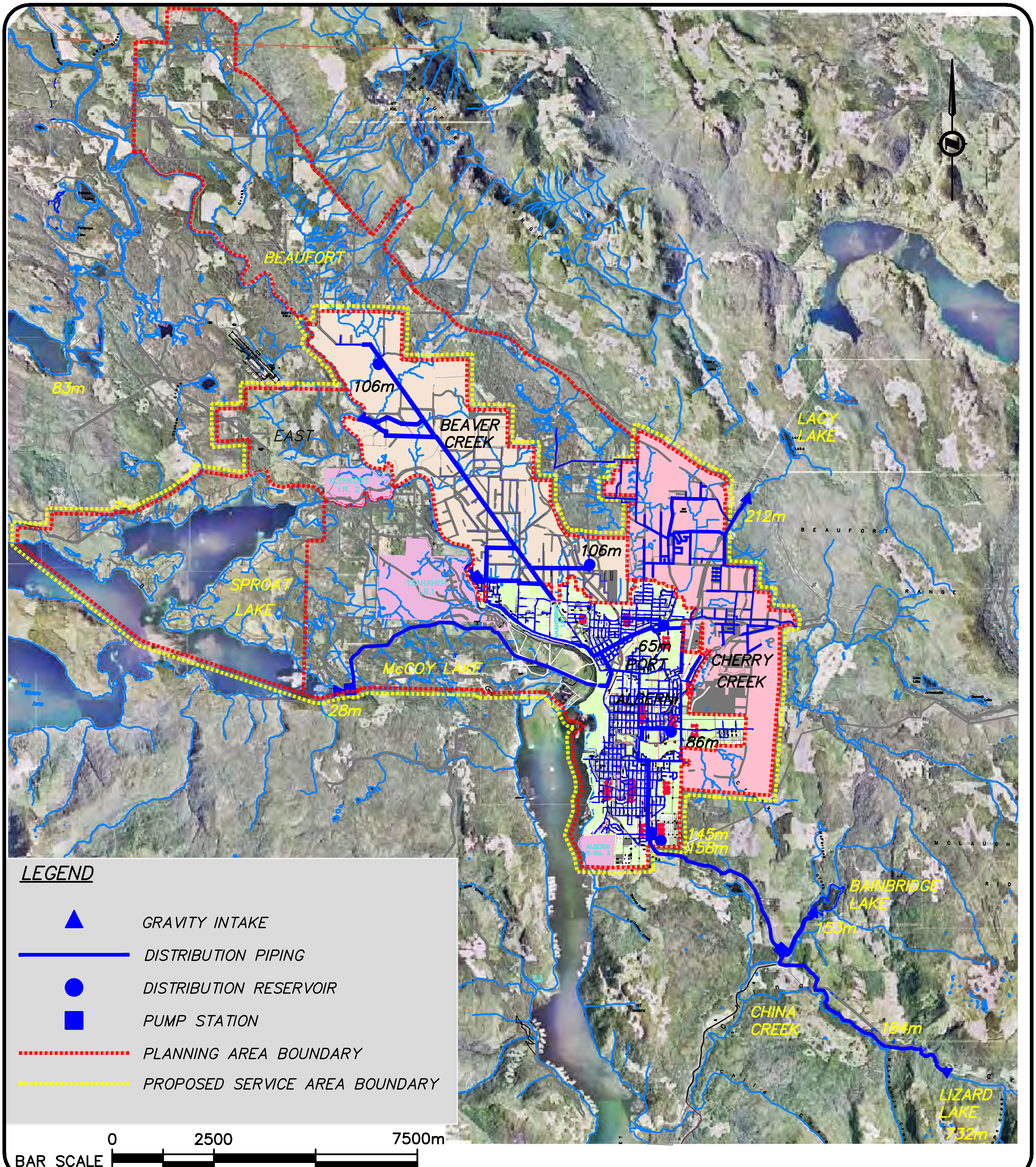
Each existing water system is described in more detail below, with emphasis on those works installed since 1995.

Figure 2. Existing Water Systems.
See following page.

3.2 City of Port Alberni

The City of Port Alberni is supplied from a surface water intake on China Creek, supplemented by stored water in Bainbridge Lake. The China Creek intake consists of a dam across the river at elevation 184 m. In 2005 the Bainbridge pump station was upgraded with the replacement of the two pumps having a capacity of 182 lps per pump. During 2007 – 2009, the existing 80 year old steel supply main from the China Creek intake impoundment to the Bainbridge pump station was replaced with a high density polyethylene (HDPE) main.

In 2005, the Hupacasath First Nation established a hydro-electric generating station on China Creek, taking water upstream from the water supply intake, and discharging downstream of the intake. An agreement between the City of Port Alberni and the Hupacasath First Nation (3) governs the joint use of the Creek with appropriate priority provisions for water supply and fisheries release.



ALBERNI–CLAYOQUOT
REGIONAL DISTRICT

ALBERNI VALLEY
REGIONAL WATER STUDY UPDATE

SUBJECT	EXISTING WATER SYSTEMS		
APPROVED		SCALE	SEE BAR SCALE
DATE	FEBRUARY 2010	DWG No.	FIG. 2
JOB No.	0919		

The China Creek watershed above the intake is 5,700 ha in area. A dam on Lizard Lake provides an off-line watershed storage volume of 545,000 m^3 that is released during the summer if creek flows drop below minimum values.

The China Creek supply is subject to frequent turbidity spikes in response to high runoff. When turbidity threatens to exceeds 1 NTU, the supply from China Creek is shut down and water is then drawn from Bainbridge Lake, which has a live storage volume of 1,230,000 m^3. Water from Bainbridge Lake can flow to the City distribution system by gravity to the Lower and Upper Cowichan reservoirs, or by pumping under high demands. A pump station at the Lower Cowichan reservoir can transfer water to the Upper Cowichan Reservoir as well.

The water supply is chlorinated at the Bainbridge pump station. The total licenced capacity is 34,240 m^3/day (24,450 from China Creek and 9,790 from Bainbridge). The hydraulic capacity of the supply system is 24,500 m^3/day from China Creek and 15,700 m^3/day from Bainbridge Lake.

The City maintains an emergency source on the Somass River, with a licenced capacity of 13,565 m^3/day and a hydraulic capacity of the pump station of 17,000 m^3/day. This source of water is chlorinated. It is only used in emergency conditions because of poor water quality in the summer months from fish runs and agricultural runoff upstream.

The City water distribution system is divided into several pressure zones, controlled by the main distribution reservoirs at Upper and Lower Cowichan, Burde Street, and Johnston Street, most of which are interconnected by pressure reducing valve stations. The various pressure zones originated as the system developed with merging of separate systems after amalgamation of North and South Alberni, further complicated by the variable topography and the presence of several deep ravines with few road crossings.

The Johnston Street pump station supplies a higher pressure zone in North Port Alberni without the backup of a control reservoir, and is sized to provide fire flows. Since 1995 the City has made several improvements to the distribution system. The distribution system was strengthened by the implementation of several looping mains, such as the Rogers Creek Crossing to the Johnston Street Reservoir and the Wood Avenue water main upgrade, while merging three isolated sections of the 122 m pressure zone into a single zone, and eliminating many dead end water mains. Re-chlorination was added at the Johnston reservoir to better manage chlorine residual throughout the distribution system and allowing lower chlorine dosage rates at the Bainbridge pump station.

Since 1995 the City has also incorporated the Sahara Heights and Arrowsmith Heights Water Users Communities, and integrated the distribution systems of these areas with the City's water system.

The City completed universal metering of all residential connections in 2005 and is now fully metered.

3.3 Beaver Creek Improvement District

The Beaver Creek Improvement District (BCID) takes its water from a single 450 mm diameter corrugated metal pipe infiltration gallery in the bed of the Stamp River at the foot of McKenzie Road.

From the intake, the water is pumped into the distribution system by means of four parallel vertical turbine pumps with a total capacity of 52 lps (700 igpm), including standby. The total licensed withdrawal is 3,114 m^3/day on average and 6,228 m^3/day maximum over 24 hours. Water is chlorinated at the pump house using a proportional feed gas chlorinator. A hypo chlorination system is located at the North Reservoir to maintain residual at the extreme end of the system.

Operation and maintenance of the Stamp River intake is an ongoing concern. The infiltration gallery is subject to clogging of the gravels surrounding the pipe, necessitating ongoing backflushing. This maintains its capacity, preventing a low level alarm in the wet well which would trigger an automatic shutdown of the pumps. Daily flushing is required during the peak (summer) demands, reducing to weekly during the low (winter) demands.

During the winter months, heavy rainfall events cause the Stamp River to become laden with silt. This results in high turbidity in the water supply and sediment deposition in the distribution mains and reservoirs. Raw water turbidity limits the effectiveness of chlorine disinfection, rendering the water potentially unsafe to drink.

Boil water advisories have been issued several times a year in response to high turbidity levels. In recent years a continuously recording in-line turbidity meter was installed. The meter shuts down the pumps in the event of the turbidity level exceeding the pre-determined limit, while the system is supplied by water from the storage reservoirs.

The distribution system contains 41.3 km of pipe, ranging in diameter from 100 mm to 300 mm. The main reservoir is the reinforced concrete South Reservoir with a capacity of 1,135 m^3. It is designed for the addition of three more cells of identical capacity, to be added when needed. The North Reservoir is a bolted steel reservoir with a capacity of 390 m^3.

All services are metered.

An emergency connection between BCID and the City of Port Alberni distribution systems is located at the intersection of Falls Road and Georgia Street. However, the interconnection can provide service to only a small area within BCID due to the City's lower operating pressure (80 psi vs Beaver Creek's 110 psi), the location of isolation valves, and lack of looped water mains within the BCID system.

3.4 Cherry Creek Improvement District

The Cherry Creek Improvement District (CCID) takes its water from an intake impoundment on Cold Creek which flows from Lacy Lake, with a licensed withdrawal of 5,145 m^3/day and annual licensed storage of 616,750 m^3 (500 acre-feet).

The Cold Creek intake impoundment has a volume of 6,953 m^3 and a top water level of 212 m. Water is chlorinated at the intake using a hypochlorination system.

The watershed for Lacy Lake and Cold Creek is rather small and steep, resulting in almost a total absence of runoff during most summers, during which times the water supply has to rely entirely on storage in Lacy Lake. The water supply is subject to high turbidity events during high runoff.

The distribution system consists of piping ranging from 200 mm to 25 mm diameter. The distribution system is divided into 3 pressure zones. There are many dead end mains due to topography and pressure zone boundaries, preventing looping. The system does not have a distribution reservoir, thus all peak hour and fire demands are supplied from the Cold Creek impoundment, and are limited by the small diameter piping at the extremities of the system.

All services are metered.

4.0 DESIGN CRITERIA

The 1995 report considered a design period of 25 years to project population growth and water demands to service a proposed regional water supply system. At that time, a doubling of population was predicted over that period.

This has not materialized and instead a reduction in total Alberni Valley population has occurred over the first 15 years of that planning period.

A design period of 40 years, projecting to the year 2050, is considered more appropriate for long term regional water service planning.

4.1 Population Projections

4.1.1 Historical Data

The average annual population growth rates shown Table 2 have been derived from BC Stats records, based on census data, for the proposed Alberni Valley Water Supply system participants.

Table 2. Historical Annual Population Growth Rates (%)

	Port Alberni	Beaver Creek	Cherry Creek	Sproat Lake	Beaufort	First Nations Reserves*
1996-2001	-1.13	-1.52	-1.31	-0.36	-0.35	0.22
2001-2006	-0.22	0.31	-0.16	0.11	-1.06	3.60
1996-2006	-0.68	-0.61	-0.73	-0.13	-0.71	1.89
2009 Est. Population	17,878	2,337	1,776	2,088	483	588

The total estimated Alberni Valley service area population in 2009 is 25,150 people.

*Growth rates based on census figures for total First Nations population in ACRD, including west coast.

4.1.2 Growth Projections

City of Port Alberni planning staff projects a long term growth rate of 0.5 – 0.75% per annum. Similar projections would appear to be appropriate for the ACRD or the CCID. Recent projections carried out by Koers & Associates for the BCID indicate a long term growth rate of 0.84%.

No estimates have been available in the various jurisdictions of the build-out populations within current boundaries, in accordance with maximum densities allowed within the current OCP land use categories.

With the low projected growth rates, it is unlikely that build-out populations will be reached within the project design period.

It is proposed that for the range of population estimates for the design year 2050 the highest estimate should be based on the highest suggested planning growth rate for Port Alberni (0.75%), 1.00% for BCID, CCID, Sproat Lake, and the First Nations Reserves, and 0.5% for Beaufort. It is proposed that the lowest estimate for water system planning should be based on the lowest suggested growth rate of 0.5% per annum for all jurisdictions.

It is noted that the range of growth rates suggested for the various jurisdictions does not follow the trend of declining populations in all but the first nations reserves over the past two census periods (see table above), but is considered more realistic than the 1995 projections while still remaining on the conservative side.

4.1.3 Design Population Estimates

The foregoing assumptions result in the range of population estimates shown in Table 3. For comparison, the populations used for the 2020 projection in the 1995 Alberni Valley Water Study are listed on the right hand side of the table:

Table 3. Population Growth Projection to 2050

Jurisdiction	High Estimate 2050	Low Estimate 2050	2020 Previous Projection
City of Port Alberni	23,339	21,409	37,481
Beaver Creek ID	3,520	2,830	6,315
Cherry Creek ID	2,916	2,344	5,500
Sproat Lake	3,140	2,524	4,685
Beaufort	593	593	204
First Nations Reserves	911	732	Included in above
Total Alberni Valley	**34,419**	**30,432**	**54,185**

It should be noted that only permanent residential population estimates have been reported. There has been no attempt to estimate the equivalent populations for seasonal, commercial, industrial or institutional development. The rationale used here is that the mix of these types of development, as compared to that mix over the past 10 years, is not expected to change substantially over the design period. It should be kept in mind that the Catalyst Mill has its own independent water supply for industrial use, which does not enter into this equation.

It is felt that the use of residential population estimates will provide a reliable and stable basis for water demand forecasting for this project.

Using the methodology and growth rates presented herein results in a year 2050 design population for an Alberni Valley-wide Regional Water Supply system between 30,400 and 34,400 people. This compares to a present population in the service area of 25,150.

The newly projected population range for the year 2050 of between 30,000 and 35,000 indicates a very significant reduction from the design population of 54,185 which was projected for the year 2020 design horizon in the original 1995 Alberni Valley Regional Water Study. This will have a significant downward effect on the sizing of a future regional water system for the Alberni Valley.

4.2 Water Demand Projections

4.2.1 Design Demand Conditions

All existing water systems in the Alberni Valley service area operate surface water supplies, which are subject to increased turbidity during heavy rainfall events. Beaver Creek and Cherry Creek each have a single source of supply, and excess raw water turbidity has resulted in boil water orders, as disinfection is not fully effective under such conditions. Both systems have been ordered to comply with the new VIHA 4-3-2-1 treated drinking water quality rule within only a few years, which means filtration treatment, in addition to an improved disinfection system, at very high capital and annual operation and maintenance costs.

The City of Port Alberni can avoid high turbidity in its distribution system by switching from the China Creek Supply to Bainbridge Lake, which is not subject to the same turbidity spikes as China Creek. However, based on recent continuous turbidity records, it will not be able to meet the new VIHA requirements at all times, but this strategy will significantly extend the time that source turbidity is less than 1 NTU. The compliant use of this gravity source can be maximized by adding UV disinfection ahead of the existing chlorination.

One of the objectives of a new regional supply will be to provide a sufficiently large backup source with consistent raw water turbidity less than 1 NTU, which can be used during periods of high turbidity in the Bainbridge Lake supply to provide a water supply for the entire Valley service area that can meet the new VIHA 4-3-2-1 treated drinking water quality rule without the high cost of filtration, subject to VIHA approval of a filtration waiver.

Thus, the two design water demand conditions that will need to be met by the new regional water supply system are the following:

A. Maximum Day Demand during summer: when China Creek/ Bainbridge Turbidity < 1 NTU.

B. Maximum Day Demand during fall/winter/spring: when China Creek/Bainbridge Turbidity > 1 NTU.

Table 4 shows a summary of the daily water production records, allowing the determination of maximum day system demand. Maximum day demands need to be supplied from source, whereas peak hour demand is supplemented from distribution system storage.

Table 4. Historical Water Demand

Max Day Per Capita (m^3/day/cap)	**Summer**			
Year	Port Alberni Population	Avg. Day Demand	Max Day Demand	Max Day Per Cap
2005	17,571	11,915	22,181	1.26
2006	17,614	12,475	20,650	1.17
2007	17,400	12,437	21,834	1.25
2008	17,311	10,905	18,347	1.06
2009	17,878	11,346	20,555	1.15
	Beaver Creek Population	Avg. Day Demand	Max Day Demand	Max Day Per Cap
2005	2,253	1,128	2,929	1.30
2006	2,284	1,290	3,400	1.49
2007	2,306	1,274	3,705	1.61
2008	2,328	1,269	3,423	1.47
2009	2,337	1,332	3,300	1.41
	Cherry Creek Population	Avg. Day Demand	Max Day Demand	Max Day Per Cap
2005	1,728	1,090	2,372	1.37
2006	1,740	1,307	2,216	1.27
2007	1,752	1,211	2,555	1.46
2008	1,764	1,044	2,251	1.27
2009	1,776	875	1,843	1.04

The Cherry Creek water system does not record daily water use. McGill & Associates Engineering Ltd. has provided their best estimates of average annual and maximum day water use for the Cherry Creek

Improvement District, as shown in Table 4.

Population estimates are based on residential service connection records supplied by the BCID and CCID, multiplied by 2.4.

4.2.2 Design Values For Maximum Day Per Capita Demand

From the historical data presented above, it would appear that there is considerable variation in per capita maximum day demands between the various water systems, however, the City and CCID indicate a significant downward trend. The average weighted per capita value for these three systems in 2009 is 1.17 m^3/day. Year-to-year variations occur due to climatic factors, ie. drier and wetter summers, affecting outdoor water use. It is not known why the BCID and CCID per capita demands are so different. Different sprinkling restrictions and metering rate structures may explain. Given the fact that the lower CCID values seem to cancel out the higher BCID values, the weighted average of 1.17 m^3/day would appear to be a reasonable estimate for the current maximum day per capita demand across the service area.

The design per capita maximum day demand that was established for the 1995 Alberni Valley study was 1.45 m^3/day for the City and 1.25 m^3/day for the rural areas.

The reduction in per capita water use, encouraged through demand side management, will need to play a major role in supporting responsible stewardship of our water resources. Water use in our part of the world is considerably higher than that in other developed regions, and we believe that there is still a considerable way to go before a practical water conservation target is reached. The opportunities for further reductions in per capita water use are considerable. Serious water conservation efforts must be built into the development of any modern water supply system, if for no other reason than to sustain potentially dwindling fresh water resources due to the effects of global warming or climate change. Initiatives like the B.C. Living Water Smart Program and the University of Victoria Water Sustainability Project under the Polis Project on Ecological Governance indicate that major efforts are building in this province towards water conservation.

It is recommended that a conservation target is established for purposes of major supply infrastructure planning for the Alberni Valley. A conservatively achievable target may be set at 1.0 m^3/day per capita. A more aggressive target is likely achievable. Universal water metering has been implemented in all member systems, but the most significant opportunity for related water use reduction (through increasing block water rates) has not been fully implemented.

In Port Alberni residential water users pay a flat rate of \$0.37 per m^3, regardless of the amount of water used, plus a fixed system charge of \$10.48 per month. Commercial users are charged a declining block rate, as follows:

First 1,133 m^3 per quarter	\$0.370 per m^3
Next 2,266 m^3 per quarter	\$0.293 per m^3
Next 6,666 m^3 per quarter	\$0.239 per m^3
Over 9,066 m^3 per quarter	\$0.206 per m^3

Plus a monthly fixed charge based on the size of water meter.

In Beaver Creek the basic residential and commercial water rate is \$28.00 per month for the first 54.5 m^3. Additional water use is charged at the flat rate of \$5.00 per 4.55 m^3 or part thereof (a 72.5% premium), plus a \$4.00 administration charge per billing period. Summer sprinkling restrictions are in place between June 15 and September 30, with odd numbered addresses allowed to sprinkle only on odd numbered calendar days and only between the hours of 8:01 pm and 9:59 am and even numbered addresses allowed the same hours of sprinkling on even numbered calendar days.

Effective July 1, 2010, Cherry Creek changed its basic residential water rate to a three-tiered increasing block rate as follows:

First 100 m^3 per quarter	\$60
101 – 125 m^3 per quarter	\$0.25 per m^3
126 – 165 m^3 per quarter	\$0.50 per m^3
Greater than 165 m^3 per quarter	\$0.75 per m^3

Summer sprinkling regulations are not normally in place.

The City has a four-stage graduated water restrictions schedule which is implemented only during years when a water shortage becomes apparent. Stages 1 – 3 restrict lawn watering between the hours of 6 am to 10 am and 6 pm to 10 pm, with Stage 1 allowing three days per week watering based on odd or even numbered addresses, with no watering on Wednesdays, Stage 2 allowing two days per week watering, with no watering on Mondays, Thursdays and Fridays, Stage 3 allowing watering one day per week, Saturdays or Sundays based on odd or even numbered addresses. For Stage 4 all lawn watering is prohibited.

Thus, it may be possible to realistically target a larger reduction, with additional demand side management measures in place. A discussion on what will be a realistically achievable target should take place before the required design capacity for the regional water supply is finalized.

The establishment of a lower conservation water use target fits within the objectives of the B.C. Living Water Smart Program, designed to reduce water use and achieve more sustainable water consumption habits in communities across the province. Various water conservation strategies are discussed in more detail in Section 11.0 of this report.

For purposes of establishing a range of design demands for the supply infrastructure, for use in this report, the following calculations are based on a high per capita value of 1.00 and a low value of 0.80 m^3/day.

4.2.3 Projected Water Demands - 2050

A high-low range of maximum day water demand projections is presented using the range of projected populations from the previous Discussion Paper and the above mentioned range of per capita maximum day water demands, respectively:

Year 2050 Population	Per Capita Demand (m^3/day)	Design Demand (m^3/day)
34,419 (high)	1.00 (high)	34,419
34,419	0.80 (low)	27,535
30,432 (low)	1.00 (high)	30,432
30,432	0.80 (low)	24,346

These estimates include all water use from residential, seasonal, commercial, industrial and institutional development, as well as any unaccounted for water, such as unmetered public use and system leakage.

It is recommended that for planning purposes, a design demand close to the average of the four calculated values is used, namely 30,000 m^3/day.

4.2.4 New Surface Water Source Capacity

The future regional water supply source will likely utilize the existing China Creek/Bainbridge Lake supply source, as was also recommended in the 1995 report. Existing capacity appears to be sufficient to meet 2050 maximum demand conditions during the summer time. A secondary source will be required to supplement the gravity supply from China Creek/Bainbridge Lake when turbidity exceeds 1 NTU during the non-summer months, in order to avoid the need for filtration treatment.

A. Based on Summer Maximum Day Demands:

Using the combined available licensed capacity of 34,240 m^3/day for China Creek and Bainbridge Lake, the 2050 summer design demand requirements indicate surplus capacity available as follows:

Design Demand	Surplus Capacity
30,000 m^3/day	4,240 m^3/day

B. Based on Winter Maximum Day Demands:

Maximum monthly recorded winter demands, based on 2005 – 2009 City of Port Alberni records, are an average of 0.72 m^3/day/cap over the month. This seems extremely high, and may be due to a long established habit of letting water lines run in winter to prevent freezing. It is expected that with additional conservation measures and increased public awareness, a reasonable winter demand target should be 0.6.

The maximum licenced capacity of the Bainbridge Lake source is 9,790 m^3/day.

As Bainbridge Lake will not be able to supply consistently low turbidity water, the new low turbidity source will need to be sized to meet the full maximum winter demand of 20,000 m^3/day in 2050.

It should be noted that the capacity of the Bainbridge Supply, in terms of gravity carrying capacity (13,824 m^3/day) of the pipeline into the City and the installed pumping capacity (25,488 m^3/day), is much larger than the current Bainbridge Lake water licence (9,790 m^3/day). The City has been regularly supplying water from Bainbridge Lake at average rates greater than 12,000 m^3/day (in excess of the licence) during wet months when China Creek was not used due to high turbidity. Under those conditions the lake would still be overflowing. For now, we have assumed that the maximum use of Bainbridge is limited by the licence. Based on favourable operating experience, it is expected that additional licence will be available on Bainbridge Lake for winter operation.

Sproat Lake and Great Central Lake water quality data available to-date indicate low turbidity and low colour, and raw water microbiological characteristics consistent with meeting the VIHA 4-3-2-1 treated drinking water quality rule, with a filtration deferral.

4.3 Potential for Water Conservation

Universal metering was implemented in Port Alberni in 2005. Even though this was not accompanied by an increasing block water rate structure, the simple fact that people were now paying for water used on a volumetric basis, resulted in immediate pronounced reductions in per capita water use.

Whereas in the City the average per capita use in the years just prior to completion of the 1995 water report was 1,120 litres per day and the maximum day use as high as 1,780 litres, the corresponding values since universal metering in 2005 have averaged 660 lpcd and 1,200 lpcd, representing reductions of 41% and 33%, respectively. The weighted regional per capita demands have decreased from a maximum day of 1,650 lpcd pre-1995 to 1,170 lpcd after 2005, or a reduction of 29%. This lower reduction in regional water use is thought to be due to the fact that the improvement districts already had metering in place before 1995. Part of the overall reduction in per capita water use is also due to reduced industrial/commercial activity over the past 15 years, although this has not been specifically quantified.

Current per capita water use in the Alberni Valley is towards the low end of the range for similar size communities on Vancouver Island that have implemented universal metering. Even so, water use is still considerably higher than in comparable modern communities in parts of the world where water is scarcer, or more expensive. One reason for the higher water use is the fact that home sites in North America are generally much larger than those in other parts of the world, requiring more water for summer irrigation.

One of the main reasons North American water use habits have been more wasteful than in other parts of the world is the fact that municipal water supply is being subsidized to a large extent, such that the extremely low cost of water to the consumers is only a fraction of the cost of bringing that water to the home. In B.C. water rates and water related taxes will have to dramatically rise to pay for the recently mandated very capital intensive improvements such as filtration and ultraviolet disinfection.

This provides great opportunities to achieve reductions in water use habits by pricing water at the actual cost of production and also by incrementally charging for excessive use through increasing block water rates.

Thus, we believe that further reductions in water use are achievable, and these have already been accounted for to some extent in the lower range of water demand projections presented earlier in this section.

Whether or not the provincial objective of 50% of new water supply capacity to be created through water conservation can be achieved depends on the starting point adopted. If, for instance, the starting point for Port Alberni is the water use prior to 1995, over 65% of the provincial objective has already been achieved (1,780 to 1,200 lpcd), and would be fully met if the maximum day per capita demand drops to 890 lpcd, a target that may be achievable. If however the starting point is post-2005, then to achieve the provincial objective, the per capita maximum day water demand would have to drop from 1,200 lpcd to a future demand of 600 lpcd. Such a large additional reduction may not be achievable.

The subject of water conservation is discussed in more detail in Section 11.0 of this report.

5.0 REGIONAL WATER SOURCES

5.1 Sources Considered

For the projected 40-year regional maximum day water demand of about 30,000 m^3/day, the following sources can provide sufficient water:

China Creek/Bainbridge Lake
Sproat Lake
Somass River
Great Central Lake

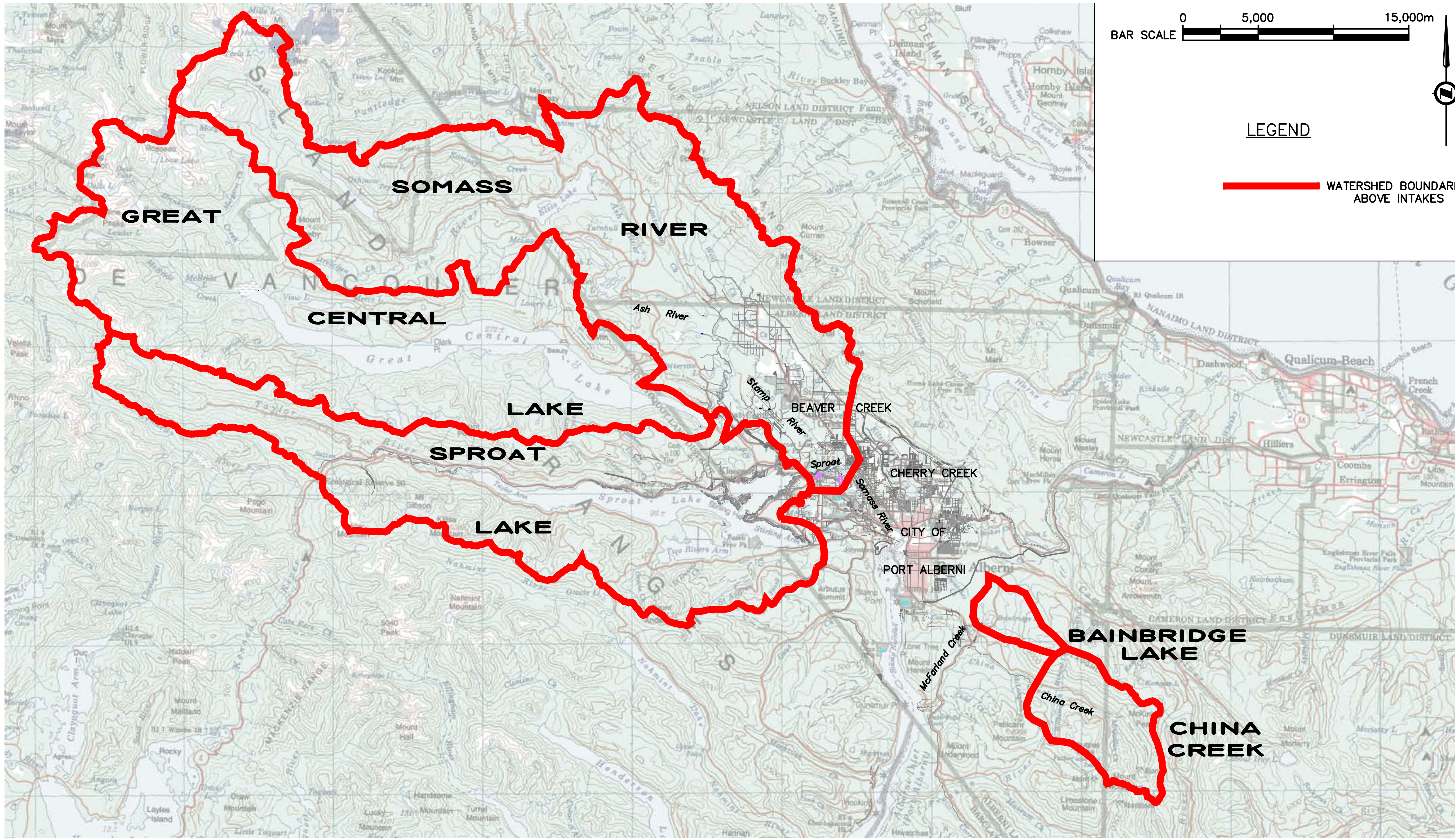
The watershed boundaries for these lakes and streams are shown on Figure 3.

Figure 3. Watershed Boundaries.
See following page.

Because of significantly lower projected regional water demands, the existing **China Creek/Bainbridge Lake** supply will have sufficient capacity and licence to supply the projected regional demands on its own to the year 2050.

In the 1995 report, the **Sproat Lake** source was not considered as a long term regional source due to the fact that it was not expected that there would be sufficient spare capacity, and the fact that the old wood stave mill supply main was in need of replacement. The supply main has now been replaced with a buried high density polyethylene pipeline, and downsizing and improved water management at the mill has resulted in there being sufficient spare capacity for regional water supply, particularly given the greatly reduced regional water demands relative to those projected in 1995. Use of the Sproat Lake source and mill supply main would require a water use agreement with Catalyst Paper, and the transfer of a portion of the water licence from Catalyst to the Regional District or the City of Port Alberni. From initial discussions with local Catalyst staff there appears to be reason to believe that there is interest in such agreement, however, details regarding conditions, access, costs and short and long term security of supply, independent of labour disputes, job action or picket lines at the mill will need to be negotiated very carefully. Use of the Sproat Lake source for regional supply would require source approval from VIHA, which, given the fact that it already is an approved source for existing drinking water systems along the lake, is expected to be granted.

The **Somass River** source would have sufficient capacity for such demand, but the current licence is not sufficient. The higher susceptibility to turbidity of the river and difficulty in protecting the upstream watershed from additional deterioration would require filtration treatment and disinfection to be in compliance with the new 4-3-2-1 VIHA treatment requirements.



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CLIENT	ALBERNI–CLAYOQUOT REGIONAL DISTRICT
PROJECT	ALBERNI VALLEY REGIONAL WATER SUPPLY STUDY UPDATE

TITLE	WATERSHED BOUNDARIES		
APPROVED		SCALE	SEE BAR SCALE
DATE	MARCH 2010	DWG No.	FIG 3
JOB No.	0919		

File: H:\0002 Alberni Clayoquot RD\0919 Alberni Valley Water Study Update\03 Drawings\Watershed\FIG\FIG 3.dwg Plot Time: Sep 09, 2010 – 9:22am User: pblain

Any use of **Great Central Lake** for regional water supply would require a new water licence. It is expected that adequate licence would be available for a regional public water supply, should this source be selected. Source approval would also need to be obtained from VIHA, which is expected to be granted.

The **existing sources for BCID and CCID**, the Stamp River intake and the Cold Creek intake, respectively, are not considered suitable for use in a regional water supply scheme as they are relatively small and will require filtration treatment due to seasonal turbidity issues. Even for use during low turbidity periods, UV treatment would have to be added to each to become VIHA compliant. Because the water from these sources is not needed to supplement available regional sources and the expense of such improvements, these sources should only be considered for the BCID and CCID go-it-alone options or as standby emergency sources.

Groundwater has not been considered as an option for regional water supply in the Alberni Valley. Gravel deposits in the lower China Creek, Bainbridge Lake areas have been found to be relatively shallow. Although they contain significant volumes of water in the spring, winter and fall, this water disappears during the summer, and no large volumes of subsurface water have been encountered by forestry and gravel extraction operators in the area. No formal large-scale groundwater exploration programs have been conducted in the Valley according to a locally experienced well driller (Jim Fyfe, 2010).

The presence of significant groundwater sources in the valley cannot be discounted, according to this well driller. However, the volumes required for a significant regional back-up source, in the order of 230 lps (3,000 igpm), would require a large well field, with wells in the 500 – 600 gpm range. Such wells have not been found in the area to-date.

According to another local well driller (Ed Walcot, 2010), several wells drilled in the Beaver Creek area have found large quantities of water at depth but the water had an extremely high sodium content and contained several other constituents well in excess of Canadian drinking water quality guidelines, such as arsenic, boron, iron and manganese.

At this time, it does not appear to be justified to spend considerable capital on a well exploration program that would have to target several potential but yet unidentified areas.

5.1.1 China Creek and Bainbridge Lake

The China Creek watershed tributary to the water intake has an area of 57.0 km^2. The 5,000 m^3 intake pool is controlled by a concrete dam at crest elevation 184 m. Lizard Lake is an earthfill dam controlled storage impoundment which discharges into China Creek upstream of the City intake. The lake has a top water level of 723 m with 545,000 m^3 of live storage and constitutes the only regulated storage within the China Creek watershed.

Bainbridge Lake drains to McFarland Creek, which in turn drains to China Creek below the City's intake. This lake provides the second source of water to the City, with the lake level controlled by a small earthfill dam at elevation 150 m. The catchment area of the lake is 13.1 km^2 and the live storage volume is 1,230,000 m^3.

The lower 11 km of China Creek is an important fisheries resource with a substantial run of steelhead and coho salmon. Fish run upstream primarily in the summer and thus the maintenance of minimum flow in the lower reaches of the creek is essential. A minimum flow of 5 cfs (cubic feet per second) is specified at the mouth of China Creek.

In 2005, the Hupacasath First Nation (HFN) developed a 5.6 MW run of river micro hydro-electric power plant on China Creek. The intake is approximately 2.0 km upstream from the City's water intake at elevation 300 m. The penstock is approximately 4,250 m long from the intake to the powerhouse located on China Creek downstream of the City's water intake.

A Memorandum of Understanding was entered into between HFN and the City of Port Alberni on March 24, 2004 (3), which establishes a process to ensure the continued supply of the required volume and quality of water to the City's intake, provides for full support from the City for the power generation proposal, achieves a process for effective functioning of the intakes so as to ensure the required water volumes first for the City and then to HFN, and to fulfil the minimum fish flow requirements of the water licence.

Active logging operations are being carried out in the watershed. Many previously logged areas are now covered in second growth timber. The main forestry companies operating in the China Creek watershed are Island Timberlands (formerly Weyerhaeuser), which owns or manages 93% of the watershed, and Timberwest. Proper forest management can prevent the occurrence of undue erosion, allowing water quality impacts to be reduced to a minimum and enabling water supply and forest harvesting to proceed within the same watershed.

A watershed assessment was carried out by Streamline Environmental Consulting Ltd. on behalf of Weyerhaeuser in 2005 (4), which reported on the general condition of the watershed, identified impacts of past forest development activities on the condition of streams, and provided guidance to develop appropriate management strategies for future forest operations in the watershed while minimizing such impacts. The forest companies and the City regularly meet to discuss forest harvesting plans and strategies to mitigate adverse effects on water quality at the China Creek and Bainbridge Lake intakes. In general, this has resulted in reasonable protection of the public water supply, and the City should continue to strive for stricter control measures in the watershed, if not future ownership.

Mining exploration in the watershed has taken place and the potential exists for further mining activity that could impact water quality, particularly in the case of surface mining. Within a relatively small watershed such as China Creek, an extensive mining operation would have a significant and potentially negative impact on fisheries and drinking water quality and the two uses are likely not compatible.

The China Creek watershed is accessible to recreational pursuits via the many logging roads. This increases the risk of water supply contamination from pathogenic organisms.

The City holds water licenses on China Creek and Bainbridge Lake to allow diversion of 24,450 and 9,790 m^3/day, respectively, for a total of 34,240 m^3/day. With the replacement of the old supply main the capacity of the supply main system is now estimated at 38,300 m^3/day.

The ability to increase watershed yield at the China Creek intake is limited to the raising of Lizard Lake by 7.3 m to provide an additional volume of 14,600 m^3/day.

Coarse screening is provided at the China Creek intake and Bainbridge Lake intake. Chlorination using chlorine gas is provided at the Bainbridge pumping station.

5.1.2 Sproat Lake

Sproat Lake is the second largest lake in the Somass River watershed with a surface area of 4,300 ha, and a drainage area of 350 km^2. The mean water level elevation of the lake is 28 m, with normal level fluctuations within 1 m above and below full storage level (FSL), and extreme high level of 3 m above FSL.

The outlet into Sproat River is controlled by a permanent metal V-notch weir maintained by Catalyst Paper. The Catalyst Mill water supply main has its intake at Stirling Arm at a depth of about 5 m, from where the water is pumped into a 1350 mm diameter HDPE buried pipeline that replaced the old woodstave main in 2003. Pressure at the mill is maintained at 45 psi.

The lake has been characterized as a well flushed body of water which is oligotrophic (low in nutrients, not subject to algal blooms) and therefore has excellent quality and clear water. It is expected that use of this source by a regional public water system would qualify for a filtration deferral from VIHA and that source approval for a regional system would be granted, as available water quality records show that Sproat Lake water meets the Canadian Drinking Water Quality Guidelines, and other domestic systems are in use under VIHA jurisdiction. It is likely that an ongoing water quality monitoring program will be required to support such approval.

Sproat Lake serves as the water supply for Catalyst's pulp mill as well as many individual residences, five private water systems and two commercial developments along the eastern shores. Because of the development around the eastern lake shore, water levels are not allowed to fluctuate greatly.

The lake is important for the rearing of sockeye salmon and many other fish species, and has a high recreational value.

Catalyst Paper holds a water licence to divert 260,000 m^3/day of water from Sproat Lake for industrial purposes and to store 25,000,000 m^3. Over the past 15 years the pulp mill has reduced its water demands through conservation driven by the expense of secondary effluent treatment processing and by reduced activity in the forestry sector resulting in the shut down of two lines of paper machines. The mill expects to operate at water demands in the order of 100,000 m^3/day or less over the long term.

Catalyst Paper has indicated an interest in negotiating a water use agreement for purposes of regional or City water supply. Important issues that would need to be resolved in such agreement are transfer of a suitable portion of the water licence for domestic water supply use, security of supply independent of labour disputes in the mill, provisions for supply during annual mill maintenance shutdown, vulnerability to power failure, cost of use and maintenance of the pump station and pipeline, and availability of property at the Stamp Avenue terminus of the supply main for a regional water pump station and water treatment plant.

5.1.3 Somass River

The Somass River, which flows into the Alberni Canal at Port Alberni, originates from the confluence of the Stamp River, which discharges from Great Central Lake and the Sproat River, which discharges from Sproat Lake. The total watershed area is 1,426 km^2, with extreme maximum and minimum flows of 1,130 m^3/s and 21.6 m^3/s, respectively near the mouth.

The Somass River basin is extremely important habitat for steelhead and many salmon species, especially sockeye and spring. The area has a long history of First Nations settlement and use, especially the lower Somass and the sockeye spawning lakes.

The majority of the basin is forested lands, with the exception of the lower Stamp/Somass and the residential portion of Sproat Lake. These forest lands are either private (Island Timberlands) or under the control of BC Timber Sales, an independent organization within the Ministry of Forests.

Work began in 2008 on the development of a Somass Basin Water Management Plan, expected to be completed in 2010. A multi-party forum has been established with representation from First Nations, government agencies, water licensees, and local stakeholders to carry out the planning.

The City holds a water licence on the Somass River allowing the diversion of 13,565 m^3/day, about 0.73% of the minimum recorded flow. It is believed that additional licence to divert water for regional or municipal water supply purposes can be obtained, because of the ability to increase storage on Great Central Lake. This will be subject to the provisions in the Somass Basin Water Management Plan.

The existing City water intake consists of a screened bank-type intake sump and pumping station containing three vertical turbine pumps. The installed capacity of the pump station and intake is 17,000 m^3/day, about 25% more than the current licenced volume.

Currently, the Somass water supply is on emergency standby, as the raw water quality cannot meet the Canadian Drinking Water Quality Guidelines (CDWQG) with chlorination only. Any use of this source as it presently exists would need to be accompanied by a boil water advisory.

Because of regular turbidity issues and multiple land uses in the upstream watershed that may have adverse effects on water quality, any approved use of the Somass River source in an ongoing regional or municipal water supply context would require the installation of filtration treatment, followed by disinfection.

The most suitable location for a filtration plant near the Somass intake would be across the road on City-owned land in the old gravel pit. The current pumping station would be converted to a low lift station to pump the water into the treatment plant. The treatment plant train would operate by gravity, and the finished water would be pumped into the distribution system from the clearwell by a high lift pump station.

5.1.4 Great Central Lake

Great Central Lake is the largest lake within the Somass River watershed with a surface area of about 5,000 ha, and a drainage area of approximately 930 km^2. The top storage level elevation of the lake is 83 m.

The level is controlled by a dam fitted with mechanically operated slide gates, which discharge into the Stamp River. Control and operation of the dam is in the process of being transferred from Catalyst Paper to the Hupacasath First Nation. The zero storage level elevation is 80 m, but in practice cannot be drawn down below 81 due to minimum water level requirements for the pump supply to the Robertson Creek fish hatchery. The lake has an additional wooden crib dam controlled outlet into Robertson Creek via Boot Lagoon, which in turn discharges into the Stamp River.

Although some development proposals have been discussed over the past 15 years, and ownership and control over the dam is being transferred to the Hupacasath First Nation, these will have no significant effect on the ability to use Great Central Lake as a regional water supply for the Alberni Valley.

Apart from Island Timberlands logging operations and the B.C. Hydro plant, the watershed is generally undeveloped, except for some very limited recreational development along the shore, such as a wilderness lodge and boating operation for ferry hikers to the west end of the lake for access to Della Falls. There are several houseboats at the east end of the lake.

An intake on this lake is expected to deliver year-round high quality drinking water within the GCDWQ for all physical and chemical parameters. As such it is believed that this source will qualify for a filtration deferral. The use of this source requires the construction of a 17.5 km long pipeline to connect the source to the City's distribution system on Johnston Street.

It is expected that no additional storage will be required to support a water licence for a regional water system for the projected 40 year demands, as this would require less than 0.3 m of storage being easily replenished annually. Fisheries and Oceans Canada are known to be interested in a scheme that would provide for withdrawal of 14.2 m^3/s (500 cfs) of water from Great Central Lake at depth for discharge into the Stamp River to achieve lower water temperatures during salmon runs. Whether or not such a fisheries diversion can be economically provided as part of a regional water supply system would need to be investigated if this is the preferred source.

It is expected that a water licence and source approval for regional water supply would be readily granted.

5.2 Drinking Water Quality Criteria

Drinking water quality legislation in Canada is developed on a provincial level, with different regulations in place for each province and territory. Health Canada has developed the Guidelines for Canadian Drinking Water Quality (GCDWQ) (5) which each province can choose to incorporate into their regulations as they see fit. The GCDWQ criteria are updated continually, with the latest issue dated 2008.

In British Columbia, no specific water treatment processes are specified, but water delivered to consumers must meet a specified standard as determined by the local Drinking Water Officer (DWO). Where raw water does not meet the standard, treatment is required.

B.C. drinking water legislation is governed by the Drinking Water Protection Act (DWPA) (6) and the Drinking Water Protection Regulation (DWPR) (7).

5.2.1 Drinking Water Protection Act

The DWPA (2001) authorizes the DWOs to stipulate directives that must be followed by the public water purveyor. The DWOs are organized into five regional authorities. For Vancouver Island this is the Vancouver Island Health Authority (VIHA). Typically VIHA requires that drinking water must be treated to a level that satisfies the GCDWQ.

On March 7, 2008 VIHA adopted Policy # 3.3 the "Drinking Water Treatment for Surface Water" policy (2), currently more often referred to as the "4-3-2-1 Rule", which specifies the following treatment and water quality requirements for all surface water drinking water supplies:

- Minimum 4-log (99.99%) removal/inactivation of viruses.
- Minimum 3-log (99.9%) removal/inactivation of *Cryptosporidium* and *Giardia.*
- Minimum of two separate treatment processes, usually filtration and disinfection.
- Maximum 1 NTU turbidity in finished water supply.

Policy # 3.3 further states that a water system may be permitted to operate without filtration (filtration deferral) if the following conditions are met:

- Daily average source water turbidity must be 1 NTU or less for 95% of the days and not above 5 NTU on more than 2 days in a 12 month period.
- *Escherichia coli* must be 20/100 ml or less in 90% of source water samples.
- Two primary disinfectants are provided, which together achieve a 4-log removal/inactivation of viruses and 3-log removal/ inactivation in *Giardia* and *Cryptosporidium*.

Policy # 3.3 further states that the DWO may require additional/alternative treatment to address any of the following:

- High bacterial counts or risk of fecal contamination of source water.
- High organic matter that may result in unacceptable levels of disinfection by-products.
- Chemical or other contaminants that may affect potability.

5.2.2 Drinking Water Protection Regulation

The DWPR (last amended Dec, 2008) is a component of the DWPA. It lists monthly sampling requirements from public water systems based on population size. The DWPR also specifies the acceptable limits for microbiological parameters in the finished treated water, as follows:

- No detectable fecal coliform bacteria per 100 ml.
- No detectable *Escherichia coli* per 100 ml.
- Little or no detectable total coliform bacteria, depending on the frequency of samples taken:
    - If only 1 sample was taken in a 30 day period, no detectable total coliform per 100 ml is permitted.
    - If more than 1 sample was taken in a 30 day period, at least 90% of samples are to have no detectable total coliform bacteria and no sample to have more than 10 total coliform bacteria per 100 ml.

Water quality for the four potential long-term regional water sources is excellent, and well within the physical and chemical criteria specified in the Guidelines for Canadian Drinking Water Quality (GCDWQ), with the exception of turbidity and colour during high runoff in China Creek, Bainbridge Lake, and Somass River, and bacterial and possible chemical contamination in the Somass River. Typical parameters for the four source waters are listed in Table 5 with comparison shown to GCDWQ criteria.

Turbidity spikes occur in the China Creek/Bainbridge and Somass River supply during high rainfall/runoff events. Storm events during 2006 – 2009 have caused short-term turbidity spikes in the Bainbridge supply with peaks from 5 – 27 NTU, generally of only a few days duration, but sometimes lasting 3-4 weeks during prolonged storm periods, before returning to <1 NTU. During the great majority of storm events in those years, the turbidity remained below 1 NTU, as shown in the attached turbidity records (see Appendix A). The average percentage of time turbidity in the Bainbridge Lake supply has exceeded 1 NTU is 6.7% over the 2006 – 2009 period, with the average annual exceedance as low as 1.2% in 2008 and as high as 11.1% in 2006.

Table 5. Comparison of Water Quality (typical)

Parameter	China Creek/ Bainbridge	Sproat Lake	Somass River	Great Central Lake	GCDWQ
pH (units)	7.5	7.3	7.1	7.2	6.5-8.5
Colour (TCU)	5	5	4	3	15
Hardness (as mg/l CaCO3)	25	25	18	15	0-50 soft
Alkalinity (as mg/l CaCO3)	24	26	20	20	-
Total Organic Carbon (mg/l)	1.6	1.1	-	-	-
Total Iron (mg/l)	0.06	0.01	0.06	0.03	0.3
Total Manganese (mg/l)	<0.01	<0.01	0.008	-	0.05
Chloride (mg/l)	1.0	1.2	1.0	-	250
Conductivity (μmhos/cm)	62	62	43	32	-

Very few formal turbidity readings have been taken historically in Sproat Lake, or on the mill supply from Sproat Lake. Any readings that we have seen have been less than 1 NTU. The Sproat Lake Community Association has taken regular secchi disc readings in various parts of Sproat Lake. Readings generally were in the range of 10–15 m, indicating very clear water with low colour and turbidity.

The City of Port Alberni installed a continuous reading turbidity meter on the water supply to its lagoons which is connected to the Catalyst Mill supply main, which pumps Sproat Lake water from Stirling Arm to the mill. Continuous turbidity readings are available on the Sproat Lake supply starting late January 2010. To-date these have consistently been well below 1 NTU, varying between 0.29 and 0.56 NTU (See records in Appendix A). It is considered unlikely that turbidity at the Stirling Arm intake will exceed 1 NTU, except in the case of a landslide close to the intake. The paper making process is very sensitive to turbidity, and the Catalyst Mill has not needed to treat the Sproat Lake water for turbidity, and has not reported turbidity in Sproat Lake to be an issue. Stirling Arm will be fairly isolated from turbidity events in the main part of the Lake, as it is outside of the main flow path through the lake.

No known turbidity measurements are available from Great Central Lake, however, it is expected to generate good quality raw water supply with turbidity consistently less than 1 NTU.

There is no known record of turbidity measurement in the Somass River, but from observation and from upstream turbidity records on the Stamp River, it is clear that 1 NTU is exceeded regularly during prolonged storm events.

5.3 Water Treatment Processes

The following sections present a brief review of the potential water treatment processes suitable for the proposed regional water source options and for the individual supply options. A brief discussion is included on future trends in treatment technology that may impact site planning.

Treatment options for lowering turbidity, disinfection and water stabilization are identified for the Alberni Valley sources. Based on currently available water quality parameters, the characteristics of the various source waters are quite similar and well within the CDWQG, with the exception of seasonal turbidity levels and microbiological characteristics. As such, this review of treatment options assumes that organics in the water and possible harmful disinfection by-products will not be an issue for any of the sources, and it must be recognized that final treatment process selection must be based on at least a full year of water quality data for the source and a pilot plant investigation using source water to define the optimum process train.

5.4 Turbidity

Turbidity is the primary parameter of concern that must be addressed in order to make the Alberni Valley surface water sources suitable for drinking. This applies to China Creek, Bainbridge Lake, Somass River, Stamp River, and Cold Creek. Recent turbidity records for these sources (with the exception of the Somass River) are included in Appendix A.

As these sources exceed 1 NTU of turbidity seasonally during heavy rainfall, a particulate removal and filtration process must be provided to keep turbidity levels in the finished water below 1 NTU at all times. Filtration may be avoided if a low turbidity secondary source is available and when the primary source is has continuous turbidity monitoring in place with automatic shut off when turbidity approaches 1 NTU.

The large lake sources identified for potential regional supply options, such as Great Central Lake and Sproat Lake appear to provide consistent year-round raw water at turbidity less than 1 NTU. Both these sources are expected to qualify for a filtration deferral, based on continuous turbidity monitoring results, at least until such time that policy changes dictate filtration on all surface sources. For these sources, the current VIHA policy calls for primary UV disinfection of the unfiltered source, followed by secondary chlorination.

The various particulate removal processes used at water treatment plants are dependent on the maximum turbidity levels that need to be treated. Generally, the processes that are effective at higher turbidity levels have a higher capital cost and/or operating costs than the technologies that can only treat lower turbidity levels.

As a general guide, the following turbidity limitations apply for the various treatment processes:

Process	Maximum Turbidity (NTU)
Slow Sand Filtration	10
In-line Filtration	10
Direct or Rapid Filtration	25
High Density Membranes	50
Dissolve Air Flotation	100
Low Density Membranes	>100
Conventional Treatment	>100
Actiflo®	>100

5.4.1 Slow Sand Filtration

Slow sand filtration generally involves the running of water through relatively shallow beds of sand without the addition of chemicals. Slow sand filtration, because of its large surface area requirements, only applies to go-it-alone options for BCID and CCID. Any of the City sources or regional sources would require filter bed areas in the order 10,000 to 20,000 m^2, depending on achievable filter loading rates. These would need to be covered or protected and require additional area, likely at least double the filter area, for additional plant and site circulation. Slow sand filtration has therefore not been considered as a regional treatment option.

5.4.2 Conventional Treatment

Conventional treatment consists of coagulation, flocculation and sedimentation followed by media filtration. This process is used to remove the finer suspended solids and colloidal particles, based on the principle that particles settle in water at greater rates as the particle size and density increases. Coagulation is the addition of a chemical coagulant to the water to encourage suspended solids to bind together to form larger and sometimes more dense particles. A variety of coagulants are used with different properties. Bench scale tests are required to determine the most appropriate coagulant for a particular water and to determine the optimum coagulant dosage. The flocculation process involves gentle mixing of the water-coagulant mixture at low energy to encourage further particle aggregation and larger flocs. The water then undergoes sedimentation, where the floc settles out from the water. The rate at which the floc settles out can be enhanced by increasing particle size and density. The addition of inclined plates or tubes to the sedimentation tanks increases the efficiency of the settling process. Floc collected is removed from the bottom of the sedimentation tanks, while the clarified water overflows to the next purification process.

Filtration is usually used as a final particulate removal step. Media filtration involves passing water through a granular media bed which removes the particles. The media bed is usually composed of different grain-sized materials such as crushed sand and anthracite that are stacked to form varying pore spaces for water to travel through. A polymer is often used to enhance the filtration process.

5.4.3 Dissolved Air Flotation (DAF)

Dissolved air flotation is a solids separation process and is often used to replace sedimentation to remove low density particles such as algae and suspended solids with smaller particle sizes. DAF introduces a cloud of very fine air bubbles that attach to particle flocs to lower their effective density and make them rise rapidly to the surface of the water. The floc is then skimmed from the surface. The DAF step is then followed by a filtration step, similar to the conventional treatment process described below.

Conventional treatment with or without DAF is one of the more expensive types of treatment, as it is effective on waters with high turbidity and high colloidal content, requiring pre-treatment by coagulation-flocculation and sedimentation or DAF. Because of generally lower turbidity in the available lake sources for the Alberni Valley regional water supply this type of treatment is not expected to be necessary.

5.4.4 Direct filtration

This process is applicable for raw water sources that have a sufficiently low turbidity, such that the normal primary steps of removing larger particles from the water through settling or flotation is unnecessary. In such situations the process can rely solely on filtration, with coagulation and flocculation added to the raw water to generate larger sized floc, and removed immediately via mixed media filtration. This sequence of treatment steps is referred to as Direct or Rapid filtration.

For some waters flocculation can also be omitted. Coagulation followed immediately by filtration is referred to as in-line filtration. With this process, the chemical coagulant is used primarily to de-stabilize the particles in the raw water to promote their attachment and retention by the filter media. Both direct and in-line filtration require smaller footprints and have lower capital costs and operation and maintenance costs that conventional treatment.

Drawbacks for this type of treatment are that it is only suitable for lower turbidity conditions, as excessive particulates in the water can blind the media, eventually leading to particulates breaking through the media into the next stages of treatment. Both processes are also difficult to control under rapidly changing conditions.

Direct filtration treatment is expected to be appropriate for the Bainbridge, Somass River, Great Central Lake and Sproat Lake source waters, and possibly for the Stamp River and Cold Creek sources.

5.4.5 Membrane Filtration

Membranes are thin sheets or tubes of natural or synthetic material that are selectively permeable to substances in solution. Membrane treatment involves water passing through the pores of a membrane, with suspended and/or dissolved solids being physically strained out of the water stream.

Membranes for drinking water typically come in a collection of fine filaments mounted into cartridges or racks. For more turbid waters, the racks are less densely packed with membranes to provide more space for solids. Lower membrane density comes with a greater capital cost, as more membranes are needed for a specific production rate, thus high-density membranes are preferred when their use is possible.

A number of membrane technologies exist that are designed for a variety of applications. For most water treatment applications, the different types of membranes can be generally classified by pore size. From order of largest pore size to smallest, the different membrane treatments are: microfiltration, ultrafiltration, nanofiltration, and reverse osmosis. Microfiltration, with pore sizes ranging from 10 to 0.1 µm in diameter, is employed to remove bacteria and colloidal particles. Ultrafiltration, with pore sizes ranging from 0.1 to 0.01 µm, is used to remove bacteria, some viruses, and some organic compounds. Nanofiltration, with pore sizes ranging from 0.01 to 0.001 µm, remove all viruses and many larger compounds and so are often considered for such applications as water softening. Reverse osmosis, with pore sizes as small as 0.001 µm in diameter, is used to desalinate brackish water. Water quality and the target objective for membrane use must be evaluated to select an appropriate membrane. Membranes with pores too large will allow undesirable particles to pass through the membrane. Conversely, membranes with pores too small usually require pre-treatment to remove larger particles upstream and also require increasing energy input.

High-density microfiltration or ultrafiltration treatment systems are expected to be appropriate for all Alberni Valley sources. As these technologies have limited ability to remove dissolved organic compounds, it is typically necessary to provide flocculant dosing prior to membrane filtration in the process stream, when dissolved organics in the raw water are a threat to form harmful disinfection by-products. The inappropriate use of coagulants can shorten the life of membranes. Pilot studies are typically required to verify to what extent particle removal can be improved when a coagulant is used and to monitor the impact on membrane condition and performance.

It is expected that all regional and local source waters will be suitable for membrane filtration treatment, mostly of the microfiltration variety.

5.4.6 Actiflo®

Actiflo® is the proprietary name for a ballasted flocculation and high-rate settling process. Ballasted flocculation refers to a process in which heavy carrier particles, called micro-sand, are injected into the process following coagulation. With the aid of an added polymer, the floc particles bind to the micro-sand and settle out at a faster rate.

This system will produce a more dilute but constant waste stream than the traditional coagulation-flocculation-sedimentation process. Almost all micro-sand is recycled by pulling sand from the waste stream via hydrocyclones.

Two of the main advantages of the Actiflo® process are that it has proven highly effective at maintaining consistent treatment during very significant and sudden turbidity events and that its high loading capacity allows it to treat greater flows of water within a limited available plant footprint.

The Actiflo® process is typically followed by a filtration step, as described under the conventional treatment process.

5.5 Disinfection

A key treatment component for the regional and local water sources is the disinfection strategy for the control and protection from microbiological contamination, such as viruses, bacteria and protozoa. Disinfection credits will be granted by VIHA for filtration, but primary disinfection is still required to ensure that all microbiological removal objectives will be met. It is also prudent to include redundancy to act as a double barrier against microbiological contaminants should a problem occur in the treatment process.

When the treatment strategy involves a filtration waiver, as will be the case for the regional lake source proposals, a dual disinfection process will be required.

Secondary disinfection should also be included to ensure that a disinfectant residual is present in the distribution system to protect the microbiological quality of the water as it travels from treatment process to consumer. Chlorine in the form of free chlorine or combined chlorine (chloramines), will be required for secondary disinfection.

The following primary and secondary disinfection options are available:

5.5.1 Free Chlorine

Free chlorine is very effective in destroying viruses and bacteria and is generally used too achieve the virus inactivation component of the disinfection strategy. Chlorine is less effective in inactivating *Giardia* and not at all effective in inactivating *Cryptosporidium*. Therefore, if only free chlorine is used for disinfection, the water treatment process will require a particulate removal process that achieves the entire inactivation/removal objective for *Cryptosporidium*. Conventional treatment or membrane filtration can achieve this objective, but without another disinfectant step, this would not provide a double barrier against *Giardia* and particularly not against *Cryptosporidium*.

The formation of harmful disinfection byproducts (DBPs) must be considered for all surface waters. DBPs are generated from a reaction between chlorine and organic material. Trihalomethanes (THMs) and haloacetic acids (HAAs) are the most common DBPs associated with chlorination, and are currently addressed in the Guidelines for Canadian Drinking Water Quality. Guidelines for other DBPs are currently under development. Based on available data to-date, the organic carbon content of the Alberni Valley surface water sources is very low and it is therefore not expected that DBPs will be an issue. However, monitoring for DBP potential should continue following implementation of the new treatment process.

Chlorine can be delivered or generated on site. For a treatment plant the size of a regional supply, the following options are available:

- Delivery of 12% sodium hypochlorite solution
- 0.8% sodium hypochlorite generation on site
- Delivery of chlorine gas in 68 kg or tonne containers

For the local improvement districts the first and the third options (68 kg cylinders only) would apply.

Each form of chlorine has its advantages and disadvantages and associated costs that should be evaluated during the treatment process design.

5.5.2 Chloramines

Chloramines are also referred to as combined chlorine, and are generated by adding ammonia to chlorinated water. Chloramines are a weaker oxidant than free chlorine, but produce a more stable and longer lasting residual, which is useful in systems where it has been difficult to maintain free chlorine residual across the distribution system.

A challenge is that the ammonia and free chlorine must be mixed at a specific ratio to avoid taste and odour problems. Chloramines are often an environmental concern in B.C. due to their higher stability, as they are more likely to reach fish bearing streams should a there be a water main break. Environmental agencies have been reluctant to approve chloramination proposals, and for this reason, we recommend that this process is not used in the Alberni Valley.

5.5.3 UV and Free Chlorine

Ultraviolet (UV) irradiation has become an accepted technology used to inactivate protozoa such as *Cryptosporidium* and *Giardia*. Water is passed through a reactor tube containing lamps holding mercury gas. The gas is excited by energizing the lamps, which emits UV light into the water. UV targets the DNA of the protozoa which destroys their ability to reproduce, effectively rendering them harmless.

UV is less effective at inactivating some viruses, such as adenovirus. Much higher doses are needed to treat such viruses, greatly increasing the cost. Also, UV does not leave a residual. Therefore, it is recommended that UV disinfection is accompanied by secondary chlorine disinfection to achieve virus inactivation and to produce chlorine residual in the distribution system. In the case of using a surface water supply with a filtration waiver, UV followed by chlorine is a requirement of the new VIHA 4-3-2-1 surface water treatment policy (double barrier disinfection).

UV reactors are produced in two types: medium pressure (MP) lamp and low pressure-high output (LPHO) lamp reactors. LPHO lamps contain a smaller volume of mercury gas at a lower pressure and are more energy efficient, but require many more lamps for the same UV dose as MP reactors. This means that each LPHO reactor contains more lamps and has a larger footprint than a MP reactor of the same disinfection capacity.

5.6 pH Stabilization

The pH of most of the Alberni Valley source waters is slightly alkaline of neutral. Hardness and alkalinity are low. This may result in mildly corrosive water, which may benefit from some form of stabilization treatment.

One available stabilization process is the limestone contactor where water is passed through a chamber containing limestone ($CaCO_3$) stones, boosting the alkalinity of the water by dissolving some of the limestone. The disadvantage for larger systems is the large size of the chamber and associated cost and footprint requirement.

Another method is alkalinity adjustment using soda ash (Na_2CO_3), or sodium carbonate. Hydrated lime may also be used, but is more difficult to handle. Both compounds are sold in solid form and must be dissolved into a slurry before injection into the treated water. Alkalinity can also improve the effectiveness of coagulant chemicals, reducing process chemical requirements. It is recommended that the need for alkalinity stabilization be established as part of the pilot program for testing the best method of water treatment.

5.7 Treatment Plant Locations and Scenarios

The most suitable location for a filtration plant on the China Creek supply would be just upstream from the Bainbridge pumping station, where both gravity mains could flow into the treatment plant, or near the Cowichan Reservoirs. For treatment at Bainbridge, all treated water will need to be pumped, to recover the lost pressure head, which can be accomplished in the existing pump station, with relatively minor upgrading.

The most suitable location for a filtration plant on the Somass River supply would be at the existing pump house. The existing pump station would be converted to a low lift pump station to pump the raw water to the treatment plant, and a new high lift pump station would be incorporated into the treatment plant to pump the treated water into the system.

A filtration plant for the Sproat Lake source, if required, would be located as an extension of the proposed pump station and disinfection plant at the terminus of the mill supply main on Stamp Avenue. The mill supply main would have sufficient pressure to provide gravity flow through the treatment plant, with the pump station supplying sufficient pressure to pump treated water into the distribution system on Stamp Avenue.

A filtration plant for the Great Central Lake source, if required, would be located as an extension of the proposed pump station and disinfection plant near the Great Central Lake intake. A low lift pump station would be added to provide flow to the treatment plant.

It is premature at this time to draw definitive conclusions regarding process design and costs, as base watershed data are incomplete. Data collection for treatment process design requires baseline water quality data over a full year, followed by pilot plant studies using water from the source.

For current cost estimating purposes, we have assumed that coagulation and high density membrane filtration or direct filtration with minimal pre-treatment or conditioning will be suitable for the filtration step.

It is further assumed that for the Sproat Lake and Great Central Lake sources and the China Creek/Bainbridge Lake source backed up by Sproat Lake or Great Central Lake, filtration deferrals and source approvals for Sproat Lake and Great Central Lake will be approved by VIHA. This will allow the first phase treatment plant for those sources to consist of dual disinfection, with provision for future expansion to add a filtration process, as outlined in the following sections. Ongoing water quality monitoring for turbidity and other key drinking water quality parameters are expected to be required in support of VIHA approvals for

The capital cost and 25-year life cycle cost estimates assume that filtration treatment will not be mandated until after 2035.

6.0 REGIONAL WATER SUPPLY OPTIONS

6.1 Water Supply and Treatment Strategy

The China Creek/Bainbridge Lake source is a gravity supply, and has sufficient licence and capacity to supply the entire Alberni Valley Region for the next 40 years. Major funds have been invested in the past three years to replace the 80-year old China Creek supply main to the Bainbridge Lake connection.

Although it will not be able to meet the new VIHA treated water quality criteria year round, it will be able to do so for the great majority of the year. For this reason the following water supply strategy is proposed:

1. ***The primary strategy for the development of Regional and City water supply options should be to maximize the use of the China Creek/Bainbridge Lake water supply source.***

   The current VIHA surface water treatment policy allows the consideration of a filtration deferral, at the discretion of the Medical Health Officer, when turbidity is less than 1 NTU and disinfection is carried out in two stages: UV primary disinfection, followed by secondary chlorination, and when other bacteriological raw water criteria are met. Under this strategy, raw water turbidity would be monitored continuously and would be automatically shut off when approaching 1 NTU, first for the China Creek supply, then for the Bainbridge Lake supply.

2. ***The secondary strategy for the development of Regional and City water supply options should be to establish a secondary water supply source which can supply water with consistently low turbidity (< 1 NTU), and which can automatically be called on line when the primary source turbidity threatens to exceed 1 NTU. This would require VIHA approval of a filtration deferral for the primary and secondary sources, as provided for under VIHA Policy 3.3. The secondary source options are Sproat Lake, Somass River and Great Central Lake.***

3. ***If a filtration deferral is not approved for the primary or secondary water source, the secondary strategy should be to add filtration treatment to the primary water source. In this case the existing Somass River pump station with chlorination treatment would serve as an emergency source that could be activated with a boil water advisory.***

   It is recognized that a filtration deferral, if granted, is not guaranteed to apply forever. Changing raw water conditions and changing surface water treatment policies may result in a future requirement for filtration of all surface water treatment sources. At this time it is assumed that such mandated filtration treatment step will not occur prior to 2035.

The sites required for initial UV and chlorination treatment need to be selected on the basis of providing for sufficient space to allow future expansion of the treatment plant to included filtration.

6.2 Proposed Regional Water Supply Options

Four regional water supply scenarios have been considered, as discussed below. For each option, the distribution system required to carry water from the source(s) to the reservoirs in the City and the two improvement districts was modeled using WaterCAD software and projected maximum day demands for the design year 2050. Improvements necessary were identified, and are included in the cost estimates of each option.

In the case of the Cherry Creek Improvement District, which presently has no distribution reservoir beyond the source impoundment at the Cold Creek intake, the model assumed that the proposed reservoir shown on CCID plans is in place. Piping improvements leading from the CCID pump station on the regional distribution system to the reservoir were identified, but the distribution systems beyond the reservoirs, which would carry the peak hour demands and fire demands, have not been analyzed or identified as part of the regional water supply options. These would continue to be the responsibility of the individual systems.

In the case of the Beaver Creek Improvement District, the regional supply is taken from the BCID pump station on the regional distribution system to the nearest 300 mm diameter main on Compton Road in the City via a new 200 mm diameter main. This will provide adequate supply to the South Reservoir. Beyond that the BCID system will respond the same as with the present supply. For the Option with Great Central Lake, BCID will not require a separate pump station.

For all regional options, it has been assumed that the existing sources for BCID and CCID will not be part of the supply system, as each would require a separate double disinfection treatment system and reliable automated shutdown when turbidity approaches 1 NTU.   Because of the relatively small size of these supplies, compared to the proposed regional sources and the high cost of providing a double UV-chlorination disinfection system this would not provide a corresponding benefit. Consideration may be given to retain these sources for local emergency purposes.

The following regional supply scenarios have been considered:

6.2.1 **Option I. China Creek/Bainbridge Lake** (Refer to Figure 4)

Requirements/assumptions:

- Filtration deferral is not applicable for this source on its own.
- Carry out water quality monitoring, and run pilot treatment plant to determine best water treatment technology.
- Construct filtration plant adjacent to the Bainbridge pump station, using existing chlorination system and capacity of 30,000 m^3/day.
- Construct new 400 mm diameter water main on Third Avenue, from Argyle to Redford (approximate length 1,165 m).
- Upgrade PRV at 3rd and Dunbar from 150 mm to 300 mm diameter.
- Add pump stations for BCID and CCID, and required connecting mains from City distribution system.
- Apply for water licence increase at Bainbridge Lake for winter demands.
- This option does not have a VIHA compliant backup supply, however a chlorinated emergency supply is available at the Somass River intake.

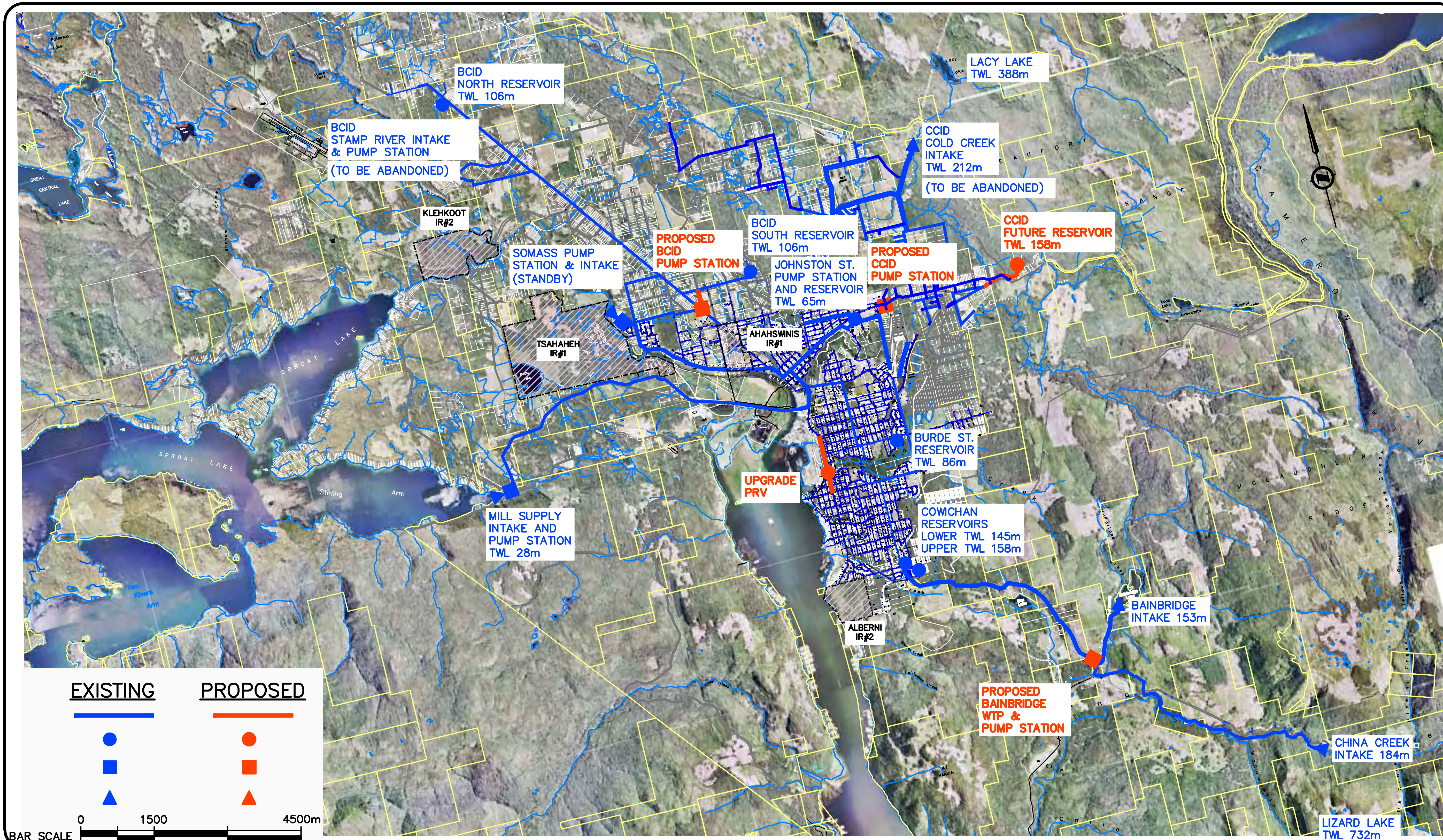
Figure 4. Regional Option I - China Cr/Bainbridge Alone.
See following page.

6.2.2 **Option II. China Creek/Bainbridge Lake and Sproat Lake** (Refer to Figure 5)

Requirements/assumptions:

1. For Primary Source (China Creek/Bainbridge Lake):

- Obtain filtration deferral approval on the basis of continuous turbidity records, providing automatic change-over from China Creek to the Bainbridge Lake supply when China Creek turbidity approaches 1 NTU, and automatic change-over to the Sproat Lake supply when Bainbridge Lake turbidity approaches 1 NTU.
- Add primary UV disinfection to the existing chlorination treatment on the China Creek/Bainbridge Lake supply, and provide piping for future addition of filtration steps for a capacity of 15,000 m^3/day (50% of total to be supplied from China Creek).
- Operate secondary Sproat Lake source during peak demand periods to avoid upgrading of the distribution system between Cowichan and Burde.
- Add pump stations for BCID and CCID, and required connecting mains from City distribution system.
- Apply for water licence increase at Bainbridge Lake for winter demands.



KOERS & ASSOCIATES ENGINEERING LTD.
Consulting Engineers

CLIENT	ALBERNI–CLAYOQUOT REGIONAL DISTRICT
PROJECT	ALBERNI VALLEY REGIONAL WATER SUPPLY STUDY UPDATE

TITLE	REGIONAL OPTION I CHINA CREEK–BAINBRIDGE LAKE ALONE		
APPROVED		SCALE	SEE BAR SCALE
DATE	MARCH 2010	DWG No.	FIG 4
JOB No.	0919		

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2. For Secondary Source (Sproat Lake)

- Obtain source approval on the basis of a water quality monitoring program.
- Obtain filtration deferral approval on the basis of continuous turbidity records.
- Negotiate agreement with Catalyst for regional water supply connection, transfer of a 25,000 m^3/day portion of its water licence to the regional supply authority, and pump station/treatment plant site on mill property, adjacent to Stamp Avenue.
- Construct pump station with primary UV disinfection and secondary chlorination, with piping provided for future addition of filtration steps for a capacity of 15,000 m^3/day (50% of total to be supplied from Sproat Lake).
- Construct connection from mill supply main to pump station and from pump station to the City of Port Alberni 400 mm diameter distribution main on Stamp Avenue.
- Construct pump station at Huff and King Streets with a capacity of 150 lps to allow backfeed from Sproat Lake source to Cowichan Reservoirs during winter demands, when Bainbridge supply is down due to turbidity.

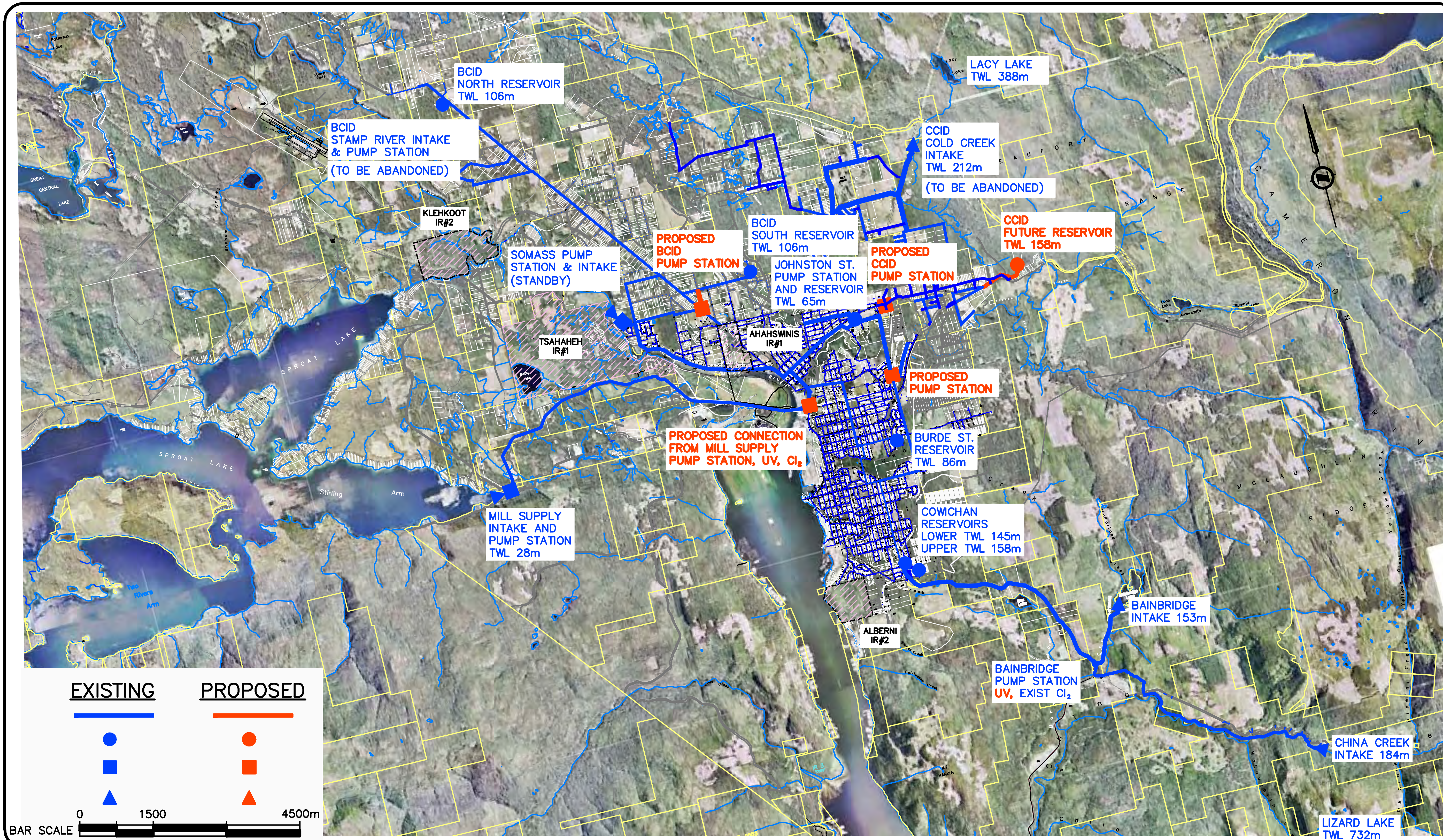
Figure 5. Regional Option II - China Cr/Bainbridge + Sproat Lake.
See following page.

6.2.3 Option III. China Creek/Bainbridge Lake and Somass River (Refer to Figure 6)

Requirements/assumptions:

1. For Primary Source (China Creek/Bainbridge Lake):

- Obtain filtration deferral approval on the basis of continuous turbidity records, providing automatic change-over to the Bainbridge Lake supply when China Creek turbidity approaches 1 NTU, and automatic change-over to the Somass River supply when Bainbridge Lake turbidity approaches 1 NTU.
- Add primary UV disinfection to the existing chlorination treatment on the China Creek/Bainbridge Lake supply, and provide space and piping for future addition of filtration steps for a capacity of 16,400 m^3/day.
- Operate secondary Somass source during peak demand periods to avoid upgrading of the distribution system between Cowichan and Burde.



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Consulting Engineers

CLIENT: ALBERNI–CLAYOQUOT REGIONAL DISTRICT

PROJECT: ALBERNI VALLEY REGIONAL WATER SUPPLY STUDY UPDATE

TITLE: REGIONAL OPTION II
CHINA CREEK–BAINBRIDGE / SPROAT LAKE

APPROVED		SCALE	SEE BAR SCALE
DATE	MARCH 2010	DWG No.	FIG.5
JOB No.	0919		

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- Add pump stations for BCID and CCID, and required connecting mains from City distribution system.
- Apply for water licence increase at Bainbridge Lake for winter demands.

2. For Secondary Source (Somass River):

- Filtration deferral is not applicable.
- Carry out water quality monitoring, and run pilot treatment plant to determine best water treatment technology.
- Construct filtration plant and low lift pump station adjacent to the existing pump station using existing chlorination facilities for a capacity of 13,600 m^3/day (limit of current licence).
- Construct new 300 mm diameter main from Somass intake along Georgia, Pierce and Beaver Creek Roads to Compton Road (approximate length 2,445 m).
- Upgrade 1,400 m of 350 mm AC main along Johnston Road from Helen Street to the Johnston Reservoir with parallel 300 mm diameter main.
- Construct pump station at Huff and King Streets with a capacity of 150 lps to allow backfeed from Somass River source to Cowichan Reservoirs during winter demands, when Bainbridge supply is down due to turbidity.

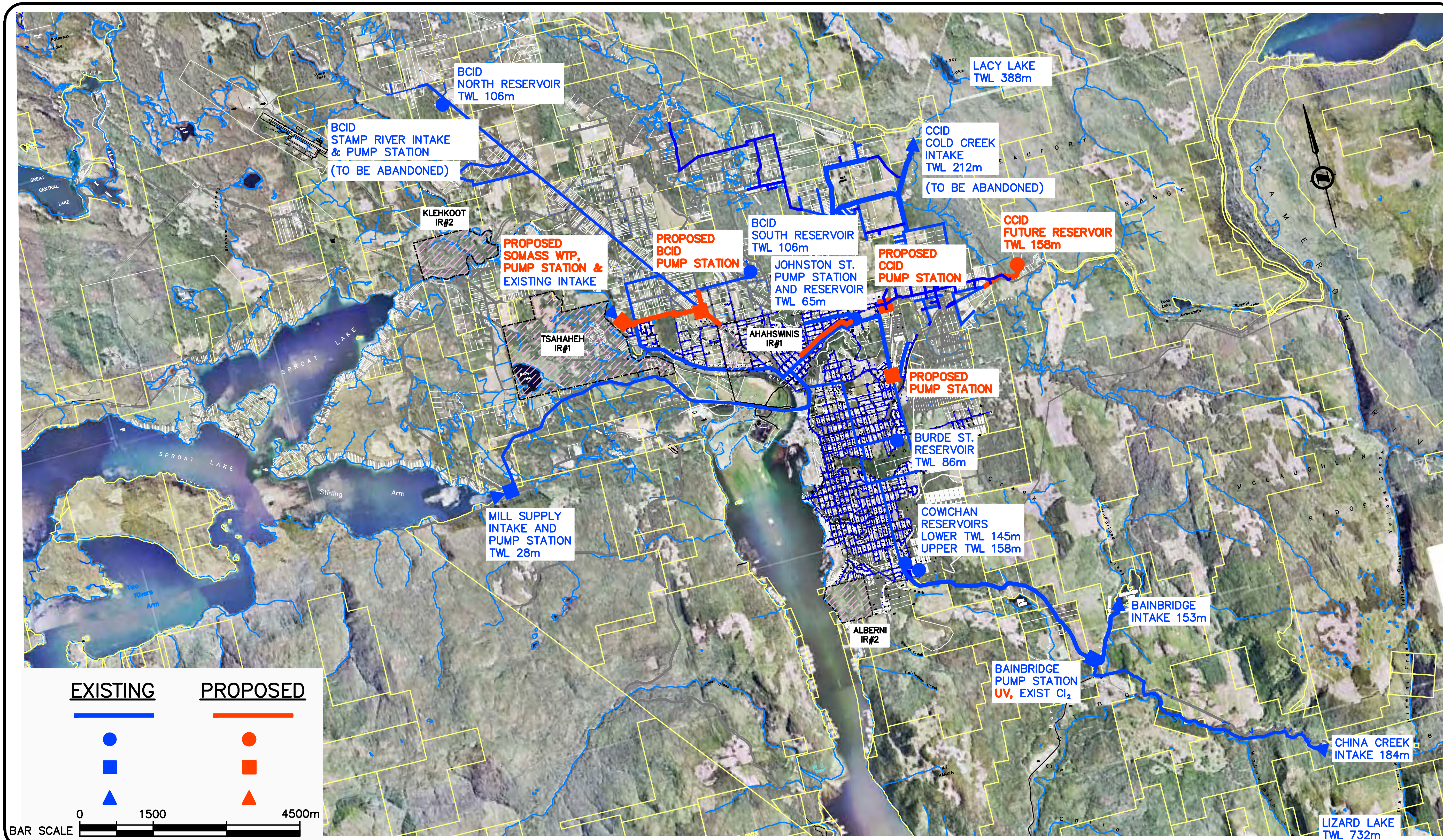
Figure 6. Regional Option III - China Cr/Bainbridge + Somass River.
See following page.

6.2.4 Option IV. China Creek/Bainbridge Lake and Great Central Lake
(Refer to Figure 7)

Requirements/assumptions:

1. For Primary Source (China Creek/Bainbridge Lake):

- Obtain filtration deferral approval on the basis of continuous turbidity records, providing automatic change-over to the Bainbridge Lake supply when China Creek turbidity approaches 1 NTU, and automatic change-over to the Great Central Lake supply when Bainbridge Lake turbidity approaches 1 NTU.
- Add primary UV disinfection to the existing chlorination treatment on the China Creek/Bainbridge Lake supply, designed for future addition of filtration steps.



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CLIENT: ALBERNI–CLAYOQUOT REGIONAL DISTRICT

PROJECT: ALBERNI VALLEY REGIONAL WATER SUPPLY STUDY UPDATE

TITLE: REGIONAL OPTION III
CHINA CREEK–BAINBRIDGE / SOMASS RIVER

APPROVED		SCALE	SEE BAR SCALE
DATE	MARCH 2010	DWG No.	FIG. 6
JOB No.	0919		

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- Operate secondary Great Central Lake source during peak demand periods to avoid upgrading of the distribution system between Cowichan and Burde.
- Add pump station for CCID, and required connecting mains from City distribution system.
- Apply for water licence increase at Bainbridge Lake for winter demands.

2. For Secondary Source (Great Central Lake):

- Obtain source approval on the basis of a water quality monitoring program.
- Obtain filtration deferral approval on the basis of continuous turbidity records.
- Construct pump station with primary UV disinfection and secondary chlorination, designed for future addition of filtration steps.
- Construct supply main to Alberni Valley distribution systems to intersection of Beaver Creek Road and Compton Road.
- Upgrade 1,400 m of 350 mm AC main along Johnston Road from Helen Street to the Johnston Reservoir with parallel 300 mm diameter main.
- Construct pump station at Huff and King Streets with a capacity of 150 lps to allow backfeed from Great Central Lake source to Cowichan Reservoirs during winter demands, when Bainbridge supply is down due to turbidity.

Figure 7. Regional Option IV - China Cr/Bainbridge + Great Central.
See following page.

6.3 First Nations Communities

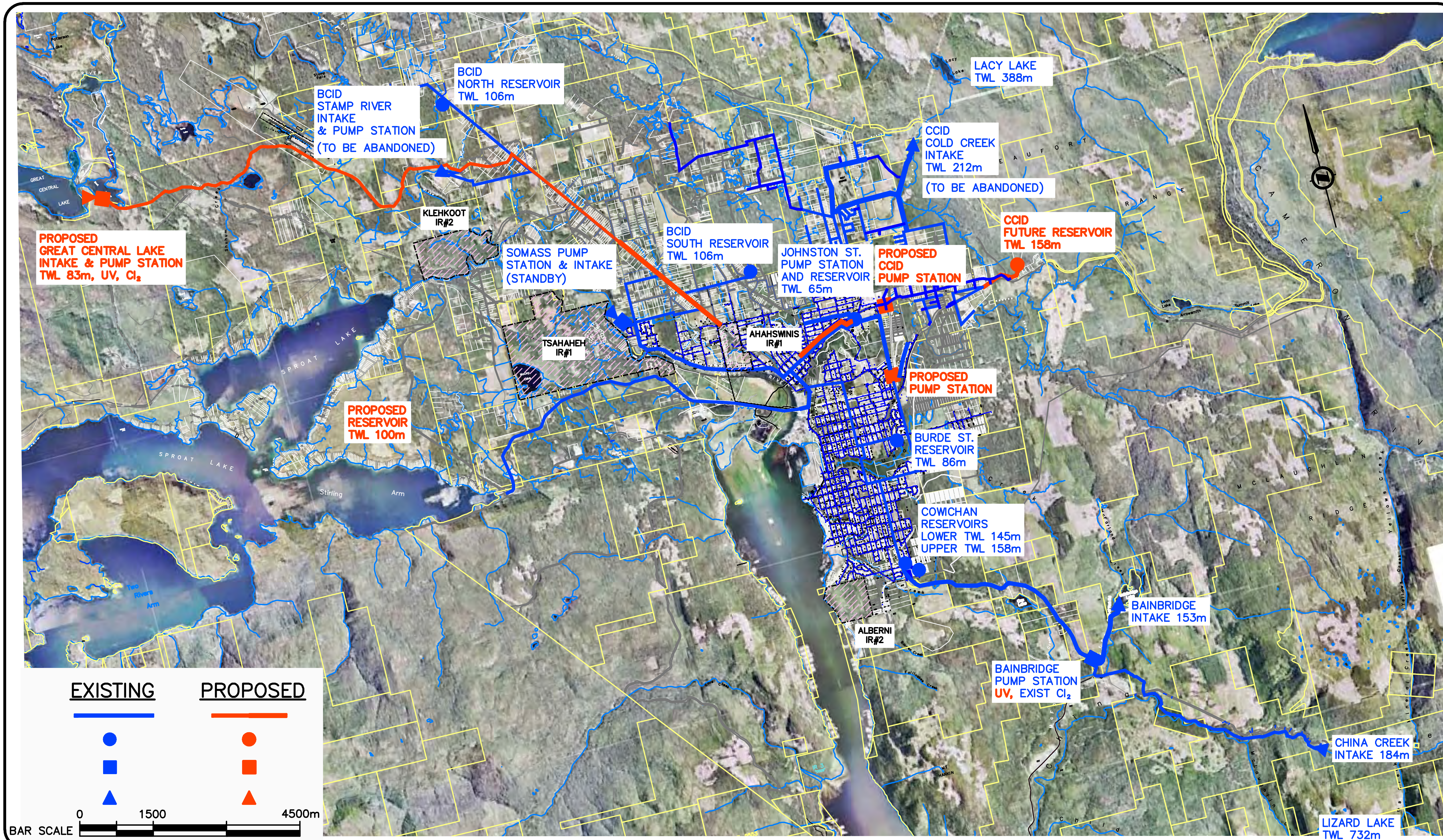
The following First Nations Communities are proposed to receive service from a regional water supply system:

Ahahswinis #1

This Reserve will continue to be serviced from the City's distribution system. The regional supply has been sized to accommodate projected growth to 2050.

Tsahaheh # 1

This Reserve will continue to be serviced from bulk water connections to the City's distribution system. The regional supply has been sized to accommodate projected growth to 2050.



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CLIENT: ALBERNI–CLAYOQUOT REGIONAL DISTRICT

PROJECT: ALBERNI VALLEY REGIONAL WATER SUPPLY STUDY UPDATE

TITLE: REGIONAL OPTION IV
CHINA CREEK–BAINBRIDGE / GREAT CENTRAL LAKE

APPROVED		SCALE	SEE BAR SCALE
DATE	MARCH 2010	DWG No.	FIG. 7
JOB No.	0919		

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Alberni # 2

When developed, this Reserve will be serviced from the City's distribution system. The regional supply has been sized to accommodate growth to 2050.

Klehkoot # 2

As is currently being proposed by others, this Reserve will be serviced from the Tsahaheh # 1 distribution system, from bulk water provided by the City. The regional supply has been sized to accommodate projected growth to 2050.

These same arrangements would apply if the regional supply system does not proceed and the City continues to develop its own supply and distribution system.

6.4 Sproat Lake Community

Each regional supply option has been sized to include service to the residential and commercial properties surrounding the developed portions of Sproat Lake.

For regional supply options I and III, service to the Sproat Lake community would likely be through an extension via the proposed extension to Bell/Stuart and Klehkoot from the Tsahaheh system, or from the Catalyst Paper intake system at Stirling Arm by arrangement with Catalyst Paper, as would be the case for regional supply option II.

For regional supply option IV, a direct connection off the supply main from Great Central Lake would provide service to the Sproat Lake community.

Costs to service Sproat Lake from a regional supply would vary significantly for these two possibilities.

No costs have been included in any of the regional options for service to the Sproat Lake community, except for providing supply source capacity. Until it is known whether or not the residents at Sproat Lake wish to invest in a piped water system and reservoir, it is not considered appropriate to consider the cost of service to Sproat Lake as part of the regional service to already established water systems.

6.5 Bell Road – Stuart Road Community

We understand that service to the Bell/Stuart Road area is being considered by others as part of the proposed extension from the First Nations Reserve Tsaheheh # 1 to Klehkoot # 2.

The regional supply has been sized to accommodate projected growth for this area to 2050. No infrastructure improvements to incorporate this area into the regional supply system have been included in the cost estimates presented in this report, except for providing supply source capacity.

6.6 Beaufort Community

No specific provisions have been included for water service to any part of the Beaufort community as there are no current plans for organized water distribution in the area.

The regional supply source has been sized to accommodate projected growth for this area to 2050.

7.0 INDEPENDENT WATER SUPPLY OPTIONS

7.1 City of Port Alberni

The City is currently not in compliance with the new VIHA surface water treatment rule. The City's water system operating certificate will be modified pending the outcome of the current regional water study update.

The options for the City of Port Alberni continuing to operate its water supply system on its own are essentially the same as the regional supply options, but at about 80% of the capacity of the regional options.

No consideration has been given for a secondary supply from Great Central Lake for the City on its own, as this is not considered a realistic go-it-alone option due to the high cost.

7.1.1 China Creek/Bainbridge Lake Alone

Comparative cost estimates have been provided for the option of using China Creek/Bainbridge Lake with immediate treatment, without a compliant backup source (the Somass River source – with chlorination – is intended to be maintained as a backup, but under this option this would be for emergency purposes only, to be accompanied by a boil water order).

7.1.2 China Creek/Bainbridge and Sproat Lake

The second go-it-alone option included for cost comparison is China Creek/Bainbridge as a primary source and Sproat Lake as the secondary source, both with a filtration deferral, and double disinfection (UV and chlorination).

7.1.3 China Creek/Bainbridge and Somass River

The third option is China Creek/Bainbridge with a filtration deferral and double disinfection with the Somass River and filtration treatment as the secondary source.

7.2 Beaver Creek Improvement District

The Beaver Creek Improvement District (BCID) is currently not in compliance with the new VIHA surface water treatment rule. Moreover, because of regular excessive turbidity events, the BCID system has been under many boil water advisories over the past years. The recent record of turbidity events from the Stamp River supply is included in Appendix A. BCID's operating certificate has been modified to require finished water quality meeting the new VIHA regulations by April 30, 2011.

Koers & Associates completed a review of water supply and treatment options for the BCID in January, 2010 (8).

The report discussed and compared the following three options:

- Continued use of the Stamp River intake with upgrading of the pump station and addition of filtration treatment. Several types of filtration were included.
- The development of a groundwater source.
- Connection to the City of Port Alberni system.

For purposes of comparing with the regional water system proposal the membrane filtration option for the existing Stamp River source was compared against the cost of BCID becoming a part of a regional system. Although cost estimates for groundwater development showed a lower estimated cost, this has not been used in the comparison as the groundwater quantity has not been sufficiently proven. The selection of an appropriate treatment technology will need to be based on a water quality monitoring program and pilot plant testing.

7.3 Cherry Creek Improvement District

The Cherry Creek Improvement District (CCID) is currently not in compliance with the new VIHA surface water treatment rule. Its operating certificate has been modified to require finished water quality within the new regulations by September 1, 2013, with preliminary design work to be completed by April 2011.

We have not been provided with plans on how CCID propose to meet the new VIHA requirement. It is known that source turbidity has exceeded 10 NTU regularly (10 NTU appeared to be the maximum range of the monitoring recorder as the record charts were truncated at that value), and therefore it is expected that there will not be a surface water supply option without the immediate use of filtration treatment. The recent record of turbidity events in the Cold Creek supply is included in Appendix A.

If CCID intends to continue to use the existing source, it is expected that it will require the construction of a filtration plant with as a minimum chlorine disinfection. As the supply is from an impoundment on Cold Creek, turbidity levels will be lower than those at the BCID intake (< 25 NTU). This likely means that direct filtration, which is less costly than membrane filtration, could be the treatment method of choice for CCID to meet the VIHA regulations. The treatment plant will be of very similar size as the BCID plant, but because of the available head, will not require pumping. Thus, the go-it-alone cost for CCID allows for a lower cost than the Beaver Creek treatment plant, due to the expected direct filtration option, the ability to supply the system by gravity, and the assumption that no upgrading of the gravity intake will be required. The selection of an appropriate treatment technology will need to be based on a water quality monitoring program and pilot plant testing.

We are not aware of other CCID go-it-alone options.

8.0 APPROVALS

Approvals for water works on Vancouver Island are governed by the Vancouver Island Health Authority (VIHA), as regulated under the Ministry of Health **Drinking Water Protection Act** and the **Drinking Water Protection Regulation.**

VIHA has published **Guidelines for the Approval of Water Supply Systems**, last revised April 2006 (9).

8.1 Source Approval

Source approval is required for any new water supply source. Approval submissions for new surface water sources must address the following:

- Data on physical, chemical and bacteriological water quality, generally representative of an annual cycle
- Water licence data
- Plans for intake and treatment system
- Supply system details
- Description of the watershed
- Identification of existing and potential sources of contamination
- Details on flood level, safe yield, hydrological data
- Pilot plant studies to confirm the type of treatment
- Determination of level of disinfection by-products
- Water system operations and maintenance procedures
- Emergency response plan
- Ongoing water quality monitoring program

Finished water supplies for public drinking water must be free of pathogenic organisms and their indicators and free of deleterious chemical substances. In addition, the water should have acceptable colour, odour and taste. The source chosen should be one that is least subject to contamination resulting from human or animal activities within the watershed. Every effort should be made to prevent contamination of the source and the source should be protected against access by unauthorized persons.

New water sources for existing systems using surface water must be disinfected, and if necessary filtration treatment added. It is expected that Sproat Lake and Great Central Lake will be approved for use as a regional drinking water supply source.

8.2 Treatment Strategy Approval

Some of the Alberni Valley regional supply options involve the proposed use of a source with year-round low turbidity, providing treatment by double disinfection, initially without a filtration step. This requires approval of a filtration deferral as laid out in VIHA Policy 3.3, to be decided by the Medical Health Officer.

Such approval request will need to be supported with at least a year's worth of data confirming year-round turbidity below 1 NTU, and raw water coliform and E.Coli levels below the specified limits. Other water quality parameters are also likely to come into play when the request for filtration deferral is considered by VIHA. Based on discussions with VIHA staff to-date it is expected that China Creek/Bainbridge Lake, Sproat Lake and Great Central Lake will be approved for a filtration deferral.

It is understood that approval for filtration deferral is subject to the applicant satisfying VIHA that sufficient land is available to expand the water treatment plant to include filtration treatment when it is required in the future.

8.3 Water Licence

Any source that does not have a water licence specific to the use it is needed for requires a water licence for a new use. In the case of the Alberni Valley regional proposals, a water licence for public drinking water would need to be applied for on the Great Central Lake source.

In the case of the Sproat Lake source, transfer of a portion of the Catalyst licence to the Regional authority would be required for the purpose of public drinking water supply.

Additional water licence would be required during the design period for winter use of Bainbridge Lake and for the Somass River option, as the existing licences are not sufficient to meet the future demands within the 40-year design period.

Applications for water licence are to be submitted to the Water Stewardship Division of the Ministry of Environment through Front Desk B.C. with particulars about the source, intended use, quantity, and watershed hydrology.

9.0 CAPITAL AND ANNUAL COST ESTIMATES

9.1 Introduction

The purpose of this report is to recommend a regional water supply system which will meet the needs of the Alberni Valley communities for at least the next 40 years and which fully conforms to the new water quality requirements introduced in 2008 by the Vancouver Island Health Authority. Various scenarios are compared to decide on the most appropriate regional option. Costs that each individual community will face to meet the new VIHA requirements on their own are entered for comparison also. Cost will be a major factor in the decision making process, but it is not necessarily the only consideration.

Capital costs, ie. construction and engineering costs, are based on preliminary layouts of the proposed water supply scenarios. Costs are based on similar projects elsewhere in the province and, where necessary, modified to reflect prevailing local construction conditions.

9.1.1 Construction Cost Estimates

These are an estimate of the successful low bidder's costs for a defined project scope of work. It includes labour, material, equipment, subcontractor costs, prime and subcontractor mark up for overhead and profit.

9.1.2 Contingency

A contingency budget is established within the cost estimates to cover yet-to-be defined project elements. It generally is a percentage of the other items in the cost estimate. The level of contingency depends on the level of development of the design at the time the estimate is made. It reflects the level of confidence in the completeness of the work. It is not intended to cover changes in the scope of the project, but intends to cover detail items that are not currently in the design but will be at the tender time. The amount of the contingency budget should be managed by the owner and the project team through the life of the project and declines as the project approaches the tender day.

At this preliminary stage, an allowance of 20 percent would be considered appropriate.

9.1.3 Engineering, Legal and Administration

The cost of engineering services for major construction projects may include special investigations, preliminary engineering reports, application for government approvals and permits, surveys, foundation explorations, location of conflicting utilities, preparation of construction drawings and specifications, contract administration, inspection, materials testing, plant start up services, operator training and preparation of record drawings. These costs typically range between 15 and 20 percent of project construction costs, depending on the magnitude and complexity of the project. Other costs include administrative and legal services related to the construction project. These costs can range from 5 to 10 percent of construction costs.

For the purposes of present estimates, we have used a total allowance for engineering, administration and legal costs of 20 percent of construction costs.

The total allowance for contingencies, engineering, legal and administrative costs used in all estimates for this study is 40% of construction costs. HST applies to all costs associated with the project. It is understood that the major portion of the HST (in the order of 85%) can be claimed back by municipal and regional governments. The HST has not been included in any estimates.

9.2 Accuracy of Estimates

The precision of a cost estimate is a function of the detail to which the design of a facility has been completed and the techniques used in preparation of the estimates. These can be divided into three categories:

Order of Magnitude. These estimates are approximate and are made without detailed engineering data. Techniques such as cost-capacity curves, scaling or scale-down factors, and ratio factors are used in developing this type of estimate. An order of magnitude estimate is expected to be accurate within a scope of plus 50% and minus 30% of the final costs.

Budget Estimate. This estimate is based on preliminary layouts, and pre-design of main facilities, process flow sheets, and equipment details. A budget estimate is intended to be accurate within plus 30% and minus 15% of the final project cost.

Definitive Estimate. As the name implies, this estimate is based on well-defined engineering plans and specifications as approved for construction. This estimate is expected to be accurate within plus 15% to minus 5%.

The accuracy of the estimates presented in this report is between order of magnitude and budget level estimates, unless otherwise indicated. The intent has been to keep estimates in the higher part of the estimating range and thus the most likely accuracy range of the estimates is within plus 20% and minus 30%.

9.3 Costs over Time

Capital works arising from this report will be carried out in phases, likely over the next 5 - 10 years. The cost of labour and materials during this period will vary in response to the national and local economy and inflationary factors. These variations will affect the actual construction costs during the various phases of the project. The estimates presented in this report have been prepared on the basis of estimated construction costs in mid 2010.

Capital costs expended in the short term are only one aspect of the total project costs. Future capital expenditures and long term operation and maintenance costs are an integral part of the total project costs and thus play an important role in the economic comparison of alternatives.

Long term expenditures must be taken into account when evaluating alternatives in a manner which reflects their comparative value. Future costs incurred for services/commodities would be higher than the current costs for the same service/commodities because of inflation. However, a capital facility is similar to an investment – it appreciates over time. The rate of return (or interest) on this investment must be factored into an evaluation. The technique normally used for such purpose is to evaluate the comparative worth of options on the basis of their net present value, sometimes termed life cycle costing.

The net present value of any facility is the amount which would have to be invested in the base year to cover all future costs, including operation and maintenance costs. Thus, the invested amount would accrue interest while being used to pay for costs in inflated dollars. The net present value (NPV) estimates presented in this year include all capital expenditures to 2035, and thus includes for all options the cost of filtration or double disinfection treatment as the case may be, as well as the estimated cost of operation and maintenance of the water supply and treatment systems over that same 25 year period. Because of prevailing low interest rates, the discount rate used in the NPV estimates is 3%.

9.4 Pipeline Costs

Table 6 lists the base unit prices for installation of water mains that have been used for estimating costs of construction for the pipeline components of each regional water option. Water mains will generally be located in public rights-of-way. The unit prices are based on typical construction conditions assuming common excavation with one metre of cover over the pipe, backfill, compaction and restoration of existing roads and boulevards, supply and installation of pipe, valves, fittings, miscellaneous appurtenances and related concrete work. The prices include an average allowance for rock excavation of 25% of trench excavation, and replacement with imported backfill. The unit prices do not include contingencies or engineering costs.

Table 6. Water Main Unit Construction Costs

Diameter (mm)	Cost ($/m)
200	300
250	325
300	350
350	400
400	450
450	500

9.5 Water Treatment Costs

Water treatment plant capital costs will vary with the level of treatment and process selected, the quality and quantity of water to be treated and the staging of the works.

Pilot plant work to test which processes will perform best for each water source will be required prior to detailed design.

For source options where a filtration deferral has been assumed, initial treatment consists of primary UV followed by secondary chlorine disinfection. It is assumed for the cost comparison in this study that filtration treatment will be not be required within the 25 year period over which the life cycle costing has been developed.

Where a filtration deferral is not applicable, initial treatment has been assumed to consist of low density membrane filtration without sedimentation or dissolved air flotation, preceded by minimal chemical conditioning and followed by chlorination.

UV and chlorine disinfection take place under pressure, and for such installations a single pump station will suffice.

For the China Creek/Bainbridge source, gravity flow can handle most of the demand conditions. The existing pump station at Bainbridge will continue to serve for peak demand conditions.

For the Sproat Lake source, a pump station will be required to connect to the Port Alberni system on Stamp Avenue. Sufficient pressure head is available from the mill pipeline to drive the water through either the UV/Chlorination system and eventually through the filtration plant. The pump station will pump the treated water into the City distribution system on Stamp Avenue.

For the Somass River source, the existing pump station will be converted to a low head pump station to lift the water into the filtration plant. A high head pump station will be incorporated into the treatment building to pump treated water into the distribution system.

For the Great Central Lake source, initially a single pump station will be required to drive the water through the UV/Chlorination system. There is insufficient head to overcome head loss in the UV system and friction head in the long supply main. When filtration is added in the future, the original pump station would be converted to a low head station and a higher head station would be added to pump the treated water into the supply main to the distribution system.

Treatment plant costs have been derived from estimates available from other comparable installations and from the literature.

Treatment and intake and pump station upgrading costs for BCID have been taken from the 2010 Water Source Option & Treatment Study completed in draft form by Koers & Associates.

Treatment costs for CCID have been prorated from the Beaver Creek costs based on proportional capacity, without any provision for upgrading of the intake structure. As this is a gravity structure and is currently providing adequate service, it has been assumed that its condition is acceptable.

In all regional options it has been assumed that the BCID and CCID sources will be abandoned to avoid having to add treatment facilities to these small sources. They may be able to be retained as local emergency supplies.

Cost of property acquisition for treatment plants or pump stations or pipeline rights-of-way has not been included in the cost estimates at this time.

9.6 Total Capital Costs – All Options

Capital costs for each regional and go-it-alone option are shown in Table 7. These include allowances for contingencies, engineering, administration and legal costs. HST is not included.

Table 7. Cost Estimates Regional and Go-It-Alone Options.
See following page.

In the case of regional supply Option II, the secondary supply involves tapping into the existing privately owned Catalyst Mill supply main. The regional system is expected to be required to compensate Catalyst for the use of that main and the mill supply intake pump station at Stirling Arm. Appropriate compensation needs to be arrived at through negotiation. No allowance has been made in the cost estimates for the cost of compensation to Catalyst.

Table 7
COST ESTIMATES FOR REGIONAL OPTIONS

OPTION		
I	**China Creek/Bainbridge Lake Alone**	
	Bainbridge Water Treatment Plant (30,000 cu m/day)	
	Coagulation + Filtration, followed by Chlorination	$11,790,000
	1,165 m of 400 mm dia Watermain on Third Avenue ($450/m)	524,250
	Upgrade PRV at Third and Dunbar to 300 mm diameter	75,000
	Pump Station to BCID (35 lps) Beaver Creek Road at Compton	300,000
	435 m of 200 mm dia. Watermain from Pump Station along Mersey Road ($300/m)	130,500
	Pump Station to CCID (29 lps) Johnston Road at ………………….	300,000
	1,240 m of 200 mm dia. Watermain from Pump Station along Johnston Road ($300/m)	372,000
	SCADA & Instrumentation	150,000
	Miscellaneous Improvements	500,000
	Sub-Total Construction	$14,141,750
	Contingencies @ 20%	2,828,350
	Engineering Design and Construction Services @ 15%	2,121,263
	Administration, Legal @ 5%	707,088
	Total Option I	**$19,798,450**
II	**China Creek/Bainbridge Lake in Combination with Sproat Lake**	
	Pump Station and Water Treatment Plant at Stamp Avenue (20,000 cu m/day)	
	Initial installation UV and Chlorination	$2,500,000
	Capital Charge from Catalyst	
	Water Treatment Plant at Bainbridge (30,000 cu m/day)	
	Initial installation UV and Cl2	2,500,000
	Pump Station at Huff and King (150 lps)	700,000
	Pump Station to BCID (35 lps) Beaver Creek Road at Compton	300,000
	435 m of 200 mm dia. Watermain from Pump Station along Mersey Road ($300/m)	130,500
	Pump Station to CCID (29 lps) Johnston Road at ………………….	300,000
	1,240 m of 200 mm dia. Watermain from Pump Station along Johnston Road ($300/m)	372,000
	SCADA & Instrumentation	300,000
	Miscellaneous Improvements	500,000
	Sub-Total Construction	$7,602,500
	Contingencies @ 20%	1,520,500
	Engineering Design and Construction Services @ 15%	1,140,375
	Administration, Legal @ 5%	380,125
	Total Option II	**$10,643,500**

Table 7 (Continued)
COST ESTIMATES FOR REGIONAL OPTIONS

III China Creek/Bainbridge Lake in Combination with Somass River

Upgrading Intake and Pump Station, Somass River	$300,000
Somass River Water Treatment Plant (20,000 cu m day)	
Coagulation + Filtration, followed by Chlorination	9,430,000
2,445 m of 300 mm dia. Watermain from Somass Intake to Compton Road ($350/m)	855,750
1,400 m of 300 dia. Watermain along Johnston Road from Helen to Johnston Reservoir	490,000
Water Treatment Plant at Bainbridge (30,000 cu m/day)	
Initial installation UV and Cl2	2,500,000
Pump Station to BCID (35 lps)	300,000
435 m of 200 mm dia. Watermain from Pump Station along Mersey Road ($300/m)	130,500
Pump Station to CCID (29 lps)	300,000
1,240 m of 200 mm dia. Watermain from Pump Station along Johnston Road ($300/m)	372,000
Pump Station at Huff and King (150 lps)	700,000
SCADA & Instrumentation	300,000
Miscellaneous Improvements	500,000
Sub-Total Construction	$16,178,250
Contingencies @ 20%	3,235,650
Engineering Design and Construction Services @ 15%	2,426,738
Administration, Legal @ 5%	808,913
Total Option III	**$22,649,550**

IV China Creek/Bainbridge Lake in Combination with Great Central Lake

New Intake and Pump Station, Great Central	$1,200,000
Great Central Water Treatment Plant (20,000 cu m day)	
Initial installation UV and Chlorination	2,500,000
Water Treatment Plant at Bainbridge (30,000 cu m/day)	
Initial installation UV and Chlorination	2,500,000
15,000 m of 450 mm dia. Water Supply Main from Great Central Intake ($500/m)	7,500,000
1,400 m of 300 dia. Watermain along Johnston Road from Helen to Johnston Reservoir	490,000
Pump Station to CCID (29 lps)	300,000
1,240 m of 200 mm dia. Watermain from Pump Station along Johnston Road ($300/m)	372,000
Pump Station at Huff and King (150 lps)	700,000
SCADA & Instrumentation	300,000
Miscellaneous Improvements	500,000
Sub-Total Construction	16,362,000
Contingencies @ 20%	3,272,400
Engineering Design and Construction Services @ 15%	2,454,300
Administration, Legal @ 5%	818,100
Total Option IV	**$22,906,800**

Table 7 (Continued)
COST ESTIMATES FOR GO-IT-ALONE OPTIONS

PA-1 Port Alberni on its own, China Creek/Bainbridge Alone

Bainbridge Water Treatment Plant (25,000 cu m/day)	
Coagulation + Filtration, followed by Chlorination	$10,600,000
SCADA & Instrumentation	150,000
Miscellaneous Improvements	400,000
Sub-Total Construction	11,150,000
Contingencies @ 20%	2,230,000
Engineering Design and Construction Services @ 15%	1,672,500
Administration, Legal @ 5%	557,500
Total Option PA-1	**$15,610,000**

PA-2 Port Alberni on its own, China Creek/Bainbridge with Sproat Lake

Pump Station and Water Treatment Plant at Stamp Avenue (15,000 cu m/day)	
Initial installation UV and Chlorination	$1,750,000
Capital Charge from Catalyst	
Water Treatment Plant at Bainbridge (25,000 cu m/day)	
Initial installation UV and Cl2	2,250,000
SCADA & Instrumentation	250,000
Miscellaneous Improvements	400,000
Sub-Total Construction	4,650,000
Contingencies @ 20%	930,000
Engineering Design and Construction Services @ 15%	697,500
Administration, Legal @ 5%	232,500
Total Option PA-2	**$6,510,000**

PA-3 Port Alberni on its own, China Creek/Bainbridge with Somass River

Upgrading Intake and Pump Station, Somass River	$300,000
Somass River Water Treatment Plant (15,000 cu m day)	
Coagulation + Filtration, followed by Chlorination	8,250,000
Water Treatment Plant at Bainbridge (12,500 cu m/day)	
Initial installation UV and Cl2	2,250,000
SCADA & Instrumentation	250,000
Miscellaneous Improvements	400,000
Sub-Total Construction	$11,450,000
Contingencies @ 20%	2,290,000
Engineering Design and Construction Services @ 15%	1,717,500
Administration, Legal @ 5%	572,500
Total Option PA-3	**$16,030,000**

Table 7 (Continued)
COST ESTIMATES FOR GO-IT-ALONE OPTIONS

BCID	**Beaver Creek on its own, Stamp River (from January 2010 BCID Source Study)**	
	Replacement of Infiltration Gallery, Pump House	$620,000
	Coagulation and Membrane Filtration followed by Chlorination (3,000 cu m/day)	2,620,000
	Sub-Total Construction (2011)	3,240,000
	Contingencies	712,000
	Engineering Design and Construction Services @ 15%	486,000
	Administration, Legal @ 5%	162,000
	Total Option BCID	**$4,600,000**
CCID	**Cherry Creek on its own, Cold Creek**	
	Coagulation and Membrane Filtration followed by Chlorination (2,500 cu m/day)	$2,215,000
	(assumed no intake upgrading required, and gravity flow)	
	Contingencies	443,000
	Engineering Design and Construction Services @ 15%	332,250
	Administration, Legal @ 5%	109,750
	Total Option CCID	**$3,100,000**

For each regional option, the Beaver Creek and Cherry Creek Improvement Districts will be utilizing existing City of Port Alberni water supply and distribution infrastructure, and all parties will be sharing the new regional treatment and supply system upgrading required. Table 7 includes an estimate of capital and NPV cost splits between the three existing water systems, based on proportional population in 2025, which works out to the following cost share percentages:

City of Port Alberni	79.9%
BCID	11.0%
CCID	9.1%

The capital cost splits shown in Table 7 include a nominal one-time capital cost contribution of $500,000 from both BCID and CCID to the City of Port Alberni for use of the City's existing infrastructure in each regional supply option. The actual amount may vary, depending on negotiations for the eventual terms of the regional supply agreement. The present allowance is not based on any discussion between the City and the two Improvement Districts.

The cost of facilities required specifically to bring regional water supply to the BCID and CCID distribution systems, such as the pump stations and connecting mains, has been allocated fully to each of the respective improvement districts.

For comparison purposes the total capital costs and estimated cost splits for all options are summarized in Table 8.

Table 8. Capital Cost and Net Present Value Summaries.
See following page.

9.7 Annual Cost Estimates

Annual costs consist of the cost of amortization of the debt, and the cost to operate and maintain the water supply and treatment system, such as labour (estimated at 35% of total O&M costs), power and chemicals (estimated at 20%), maintenance (estimated at 13%), equipment replacement (estimated at 28%), and residuals disposal (estimated at 3%).

Amortization of capital costs has been calculated over a 25 year period at an average interest rate of 5.0% per annum. As it is not expected that filtration treatment will be mandated within that 25 year period, the cost of filtration treatment has not been factored into the comparative cost estimates, except for the options where sources will not qualify for a filtration deferral.

Annual operation and maintenance costs have been estimated at an average of 3.2% of capital costs for each option. As each regional option considers a primary gravity supply with a pumped secondary supply no differentiation has

Table 8. Capital Cost and Net Present Value Summaries - Filtration Treatment Postponed to after 2035 26-Aug-10

	Regional Options	Year of	Capital Cost & NPV Summary			
		Implementation	Total	Port Alberni	BCID	CCID
I	**China Creek/Bainbridge Alone**	2011				
	Cost with Filtration	Total Capital Cost	19,798,450	12,922,219	3,602,050	3,274,181
	NPV Capital Costs and 25 years of O&M	**NPV**	**35,243,653**	**26,380,000**	**4,767,000**	**4,097,000**
II	**China Creek/Bainbridge and Sproat Lake**	2011				
	Cost with Filtration Deferral on both sources	Total Capital Cost	10,643,500	5,491,067	2,652,649	2,499,784
	NPV Capital Costs and 25 years of O&M	**NPV**	**18,946,726**	**13,358,000**	**2,974,000**	**2,614,000**
III	**China Creek/Bainbridge and Somass River**	2011				
	Cost with Filtration Deferral on China Cr/Bainbridge	Total Capital Cost	22,649,550	13,582,517	4,705,225	4,361,807
	NPV Capital Costs and 25 years of O&M	**NPV**	**40,318,958**	**30,435,000**	**5,325,000**	**4,559,000**
IV	**China Creek/Bainbridge and Great Central Lake**	2011				
	Cost with Filtration Deferral on both sources	Total Capital Cost	22,906,800	15,776,050	3,762,913	3,367,837
	NPV Capital Costs and 25 years of O&M	**NPV**	**37,802,535**	**28,545,000**	**4,780,000**	**4,056,000**
	Go-It-Alone Options					
PA I	**Port Alberni with China Creek/Bainbridge Alone**	Total Capital Cost		15,610,000		
	NPV Capital Costs and 25 years of O&M	**NPV**		**27,787,701**		
PA II	**Port Alberni with China Cr/Bainbridge and Sproat Lake**	Total Capital Cost		7,910,000		
	NPV Capital Costs and 25 years of O&M	**NPV**		**14,080,763**		
PA III	**Port Alberni with China Cr/Bainbridge and Somass River**	Total Capital Cost		16,030,000		
	NPV Capital Costs and 25 years of O&M	**NPV**		**28,535,353**		
Beaver Creek ID. (Stamp River Source)		Total Capital Cost			4,600,000	
	NPV Capital Costs and 25 years of O&M	**NPV**			**8,188,560**	
Cherry Creek ID. (Cold Creek Source)		Total Capital Cost				3,100,000
	NPV Capital Costs and 25 years of O&M	**NPV**				**5,518,378**

been made between options in the average operation and maintenance cost percentage, with the exception of the long supply main for the Great Central Lake option (Option IV), for which operation and maintenance was estimated at 0.5% of capital costs. For the present value calculation, the operation and maintenance costs have been extended over a 25 year period allowing for a 0.75% annual growth rate, to coincide with the amortization period for the capital costs.

9.8 Net Present Value (NPV) Estimates

The net present value calculation is presented alongside the capital cost for each option in Table 8. A discount rate of 3% was used for the NPV calculation, which incorporates all capital costs projected over the next 25 years and the full 25 years of operation and maintenance of the supply and treatment works.

9.9 Senior Government Funding

Cost estimates presented in Table 7 and Table 8 do not include provisions for senior government funding of all or a portion of the proposed regional or local supply and treatment options.

It is likely that some of the costs will qualify for senior government funding, if and when new programs are announced. Affordability of the cost of higher level water treatment will be greatly affected by the availability of such funding.

It is noted that the improvement districts cannot qualify for senior government funding in their present form of organization, but will qualify if they organize as part of a regional district water service. This may have a significant bearing on the cost comparison between regional options versus go-it-alone options.

No senior government funding has been incorporated in the present cost comparisons as the amount of available funding at this time is pure speculation.

10.0 COMPARISON OF COSTS

A total of four regional options have been presented, as outlined in the previous sections. As well, local go-it-alone options have been outlined: three for Port Alberni and one each for BCID and CCID.

10.1 Capital Cost Comparison of Options

Table 7 shows the estimated capital costs for the four regional options and the go-it-alone options. As mentioned previously, the cost split used in the regional options for comparison purposes is based on relative projected populations for 2025, and incorporates a nominal one-time capital cost contribution of $500,000 from BCID and CCID each to the City of Port Alberni for use of its existing infrastructure. Such contribution will likely need adjustment after due consideration of the cost factors by all parties. The capital cost of Regional Option II will need to incorporate a capital cost contribution to Catalyst Paper for use by the regional system of existing Catalyst water supply infrastructure. No such contribution has been included in the current cost estimates as this will need to be determined in negotiations with Catalyst Paper.

On the basis of total capital costs, Regional Option II (China Creek + Sproat Lake) is by far the most attractive regional option at an estimated cost of $10,643,500. The next lowest cost option is Regional Option I (China Creek/Bainbridge Lake on its own) at an estimated cost of $19,798,450.

The capital costs of Regional Options III (China Creek + Somass River) at $22,649,550 and IV (China Creek + Great Central Lake) at $22,906,800 are similar but much higher than Option II and somewhat higher than Option I.

The estimated cost splits show significantly lower costs for Port Alberni and for BCID and CCID for their share of Regional Option II as compared to their lowest go-it alone costs, without considering senior government funding.

Capital costs are eligible for senior government funding when funding programs are available. Any such funding would further favour the comparison of the capital cost of participation in a regional system as compared to the go-it-alone options, particularly for BCID and CCID, as they are not eligible for senior government funding under their present form of organization.

Senior government funding has not been considered in the capital cost comparisons presented in Table 7 and Table 8.

10.2 Comparison based on Life Cycle Costs

Capital costs may be reduced by government funding programs, whereas annual operation and maintenance costs will need to be borne fully by the users. The ongoing operation and maintenance costs, particularly with the need for trained and certified operators for the sophisticated water treatment systems now necessary to meet new water quality regulations, will, over the life of the project, have a much more significant impact on the total cost of the new system to the users than capital costs, especially if these have been reduced by government funding.

For this reason, a net present value (or total life cycle cost) assessment has been included in the comparison of options, which considers capital costs and operation and maintenance costs of the various options over a 25 year period. These are included in the summary in Table 8.

On the basis of net present value (NPV), the cost of Regional Option II is also much lower than any of the other regional options. There appears to be a small advantage for the go-it-alone NPV cost for Port Alberni, compared to its calculated NPV share of the lowest cost regional option, but this will likely not outweigh the larger capital cost advantage of Port Alberni's share of the Regional approach.

The impact of high operation and maintenance costs over the lifetime of a project is most pronounced when considering the go-it alone costs for BCID and CCID. Because both systems will require immediate filtration treatment on their own, the high operation and maintenance cost of such systems have a dramatic impact on the total annual costs. As can be seen from Table 8, the life cycle costs for the BCID and CCID go-it-alone systems are close to double the comparable costs for each in Regional Options I and II and are also considerably higher than for regional options III and IV.

11.0 WATER CONSERVATION

In 2008 the Province of B.C. set out new provincial water priorities in the Living Water Smart plan (10). The plan sets goals for water conservation and initiates action on a new water governance model, which not only addresses the opportunities and implications of surface water and groundwater governance, but also how municipalities will be required to conserve water and become more efficient and sustainable with respect to its use of the water resource.

The plan considers healthy water and watersheds vital to B.C.'s economy, and needs to be in place to safeguard water for the long term. The plan includes, among many other initiatives, regulating groundwater supplies, encouraging communities to do watershed management planning, and to require active water conservation initiatives by communities, such that by 2020 water use will be 33 percent more efficient (in other words, 50% of new municipal water needs will be acquired through conservation).

The provincial government has gone on record of stating that it will enforce these initiatives onto municipalities and regional districts by tying grant approvals to proven records of compliance with the B.C. Water Plan.

This section deals with how municipalities can conserve water and presents a review of the literature on what communities in B.C. have achieved and what type of conservation initiatives may work in the Alberni Valley.

11.1 Indoor Water Use

Within a home, the largest volume of water is used in the bathroom, followed by the laundry room and the kitchen. The pie chart featured in Figure 8, downloaded in 2009 from the Metro Vancouver website (www.metrovancouver.org), shows, on a percentage basis, where water is used inside a typical home. Not noted in the chart is the percentage of water used for drinking and cooking. The Canadian Mortgage and Housing and Corporation estimates this to be approximately 5% of indoor water use. It is assumed this would be included in the 14% associated with water faucets.

A decrease in indoor water use can be achieved by reducing the volume of water used for each component without requiring a reduction in the frequency or duration of use. No change in the behaviour of the user is required. This is achieved by replacing toilets, showerheads, laundry and dishwashing machines with low-flow units, and retrofitting faucets with aerators. The reduction of flows used in the home would result in lower flows in the municipal sanitary sewer system and at the City sewage lagoons. Discussions on the installation of low-flow fixtures, aerators, and low water use appliances is presented below.

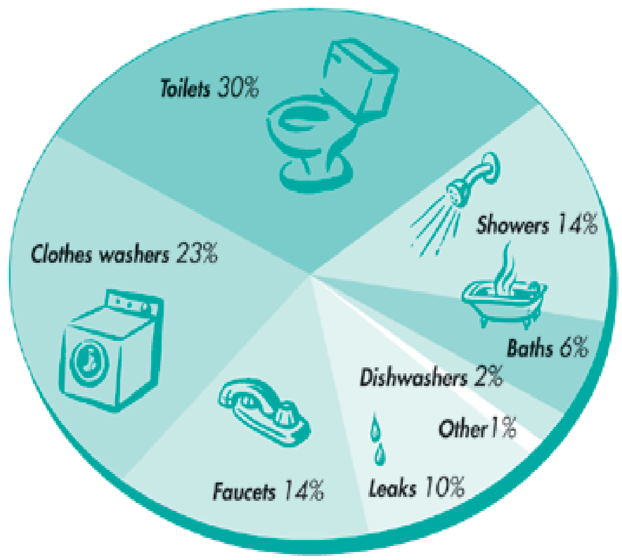


Figure 8. Indoor Water Use for a Typical Home

11.1.1 Toilets

Older toilets use between 13 to 20 litres per flush, compared to as little as 3 litres for a dual flush toilet. Water efficient toilets are available in four types:

- low flow (LF) – 6 litres per flush,
- high efficiency (HE) – less than 4.8 litres per flush,
- dual flush – 6 litres and 3 to 4 litres per flush,
- and flapperless – 6 litres per flush

A dual flush toilet has a two system flush; a 6 litre flush to remove solid waste and a 3 to 4 litre flush to remove liquid waste. Flapperless toilets use a half cylinder 6 L "tipping bucket" fixed near the top of the toilet tank which replaces the use of flappers and flexible seals inside the tank.

As of September 2008, the use of low-flow fixtures in new construction and renovations is addressed by the BC Building Code, Section 10.3, requiring the use of low flow (6 litre or less) toilets and other water-saving plumbing fixtures and fittings including faucets and showerheads.

The reduction of water use in existing homes and businesses can be achieved through replacement of fixtures. Public education campaigns and/or an incentive programs providing a monetary rebate have been used effectively by other agencies to bring about the desired change. A discussion of toilet replacement programs used in other communities on Vancouver Island and the mainland of BC is presented in Section 11.8.1.

11.1.2 Faucets & Showerheads

Standard faucet aerators can allow a flow of up to 16 L/minute whereas low-flow aerators, now required by the BC Building Code, are designed to reduce the flow by almost 50 percent.

Standard shower heads are reported to use between 15 L to 20 L/minute. A typical low-flow showerhead, which is now required by the BC Building Code, uses 9.5 L/minute or less. A further reduction can be achieved with a low-flow showerhead equipped with a shut-off button; allowing the user to interrupt the flow.

A public education campaign and/or distribution of conservation kits consisting of faucet aerators, low flow showerheads, and leak detection dye tablets can be used to bring about water reduction in homes and businesses. The dye tablet, consisting of a few drops of food colouring on a tablet, is placed in the toilet tank. After several minutes, the toilet bowl water is checked for any tinge of colour, which indicates a leak. A discussion on incentive programs used by other BC municipalities is presented in Section 11.8.1.

11.1.3 Appliances

A standard top loading clothes washing machine uses 142 L/load whereas the low-flow front loading model uses 92 L/load. Standard dishwashing machines use 53 L/load whereas low-flow models require only 34 L/load.

Presently there is one rebate program still available for the purchase of a clothes washer. BC Hydro, through its Hydro Power Smart ENERGY STAR Appliance Rebate Program, offers a $50 rebate. The BC Government offered a provincial sales tax exemption, but this program expired on March 31, 2010. A discussion on the Capital Regional District incentive program for residential clothes washing machines is presented in Section 11.8.1.

Garborators require a high volume of water to operate properly. The Alberni Valley could adopt a policy that does not allow for garborator installation in new homes or renovations.

11.2 Potential Indoor Water Use Reduction

Table 9 presents a comparison of the potential reduction in water used inside a home with the installation of water saving fixture and appliances.

The installation of a 6 litre per flush toilet will have the largest water use reduction at 16%; nearly ½ of the total estimated reduction. An additional 3% reduction could be achieved with the installation of a high efficiency or dual flush toilet, which use 20% less water. Homes with toilets that use 20 L or more per flush would experience even larger reductions.

Table 9. Indoor Residential Water Use Reduction

Item	**% of Water Used Inside the Home**		
	Before	**After**	**Reduction**
Fixtures			
Toilet (13 vs 6 litres/flush)	30 %	14 %	16 %
Faucet (16 vs 8 litres/minute)	9 %	5 %	4 %
Shower (15 vs 9.5 litres/minute)	14 %	9 %	5 %
Bath	6 %	6 %	-
Appliances			
Clothes washer (142 vs 92 litres/load)	23 %	15 %	8 %
Dishwasher (53 vs 34 litres/load)	2 %	1 %	1 %
Other			
Cooking & Drinking	5 %	5 %	-
Leaks (1)	10 %	10 %	-
Other	1 %	1 %	-
Total	**100 %**	**66 %**	**34 %** (2)

Note:

1. No allowance has been made for reducing leaks. Some reduction would most likely occur during retrofitting fixtures and appliances. However, if there is no incentive to prevent leaks, over time they would return.

2. For the Alberni Valley water system, it is estimated that a 2% reduction in residential indoor water use will translate into at least a 1% reduction in total annual demand. Therefore a system wide reduction of 34% in residential indoor water use would result in a system wide annual reduction of at least 17%.

The second largest reduction, at 8%, occurs with the installation of a low water-use clothes washer. However, a larger and significantly lower cost option is the combined installation of a low-flow showerhead and faucet aerators, resulting in a 9 % reduction.

The installation of a low water-use dishwasher results in a 1% reduction in total indoor water use. Indoor initiatives resulting in a reduction in water flowing down toilets and sinks would result in reduced flows in the municipal sanitary sewer mains, at pump stations, and at the Port Alberni Lagoons. These reductions would free up capacity to accommodate future growth, extend the service life of each component and reduce system operating and maintenance costs. Elimination of garborators would reduce organic loading on the wastewater treatment process.

11.3 Outdoor Water Use

Water use increases significantly during the summer months. Average summer time use is twice the winter time use. The maximum summertime month demand can be three or more times higher, and the maximum day demand even higher. These demand increases are in response to increased outdoor water use related primarily to lawn and garden watering, and to a much smaller extent swimming pool use, car washing, and cleaning of driveways, exterior of homes, vinyl sundecks, and other miscellaneous outdoor use.

Decreasing Alberni Valley summertime demands would have a significant impact in decreasing overall water use. Every 2% reduction in summertime demand translates into a 1% reduction in the annual demand.

11.3.1 Lawn & Garden Watering

The purpose of irrigation systems is to provide sufficient amounts of water without wastage. It is commonly reported that an average lawn requires less than 25 mm (1 inch) of water per week, to stay green. This equates to 520 ig/week for every 1,000 ft^2 of lawn. Older residential subdivisions will have front and rear yards each greater than 1,000 ft^2. More recent residential subdivisions have smaller front and rear yards compared to older neighbourhoods.

Automatic Irrigation

Automatic irrigation systems with zones and timers can, if set and used properly, significantly reduce the maximum demand and volume of water used compared to manually operated sprinkler systems. However, the opposite can also be true. A water demand analysis of 151 homes in Ontario noted that 10 percent of homes with automatic irrigation systems applied approximately 95 mm of water each week, whereas 90 percent of homes with manual irrigation systems applied on average only 7 mm each week (11).

Proper maintenance, ensuring sprinkler heads are adjusted properly to avoid watering sidewalks and driveways, and adequate stream flow and area coverage, will reduce water wastage. By zoning an irrigation system, each landscaping feature's moisture requirements can be specified and met.

Drip Irrigation System

Drip or micro–irrigation systems deliver water slowly immediately above, on, or below the surface of the soil. Water is applied at a slow and steady rate to water gardens and shrubbery, minimizing water loss due to runoff, wind and evaporation.

These are low pressure (under 30 psi), low volume (under 20 gallons per hour) systems designed to provide precise amounts of water to the root zone of plants. The water efficiency is dependent on the water schedule applied to each plant or area. Landscapes irrigated with these systems may be exempted during water restriction times due to their reduction in water usage.

Automatic Rain/Moisture Sensor Shut-off

An automatic rain shut-off device and moisture sensor can save significant amounts of water in a very short time by overriding the automatic irrigation controller. The device informs the system when rain has provided a sufficient amount of water and turns the system off when it is not required. They are easy to install and adjust, and fit all types of irrigation controllers.

Public education/training programs focusing on the proper installation, operation and maintenance, of these systems could be sponsored by the proposed Alberni Valley regional water supply system. The training would encourage individuals to be accountable for their irrigation systems through proper installation and maintenance, with the intent to reduce the maximum flow demand and overall volume of water used by installing zoned systems, programming to operate during non-peak hours, and being equipped with rain/moisture sensor shut-offs.

11.3.2 Rain Barrel/Cistern

An alternative to using potable water for outdoor use is to capture and store water (generally via roof gutters), in a rain barrel or cistern, to be later used on landscape beds, gardens or lawns.

A rain barrel is a barrel that has been altered for the collection and storage of rainwater. A cistern is a tank very similar to a rain barrel in its function but can store water above or below ground and be incorporated into existing housing structures or added to new construction projects.

The benefits of storing rainwater include the provision of chlorine free water, at ambient temperature, for healthier plants, reduction of storm runoff and reduction in demand on the regional water system.

An incentive program, to promote affordable rain barrels to the public could be partly or fully funded by the Alberni Valley regional water system. This would include a sealed 50 gallon barrel, preferably recycled, equipped with a filter screen, overflow spout, and spigot. The program would promote the use of rainwater for garden watering in place of treated water. A rain barrel program should not be considered an alternate to lawn watering, as a typical single family home lawn (front or backyard) would require the use of 10 or more rain barrels each week to keep it green.

11.3.3 Water Smart Landscaping

Water smart landscaping (xeriscaping) incorporates selection and placement of plants, soil analysis, lawn area reduction, mulching, and garden maintenance to achieve less water use, lower maintenance, enhanced native ecosystems and less use of fertilizers and pesticides.

Xeriscaping is most economical in new developments rather than retrofitting existing lawns and gardens. The site design can be established from the start by determining the appropriate mix of sun and shade to suit the plants, ground contour, soil conditions, retention of native plants, installation of an efficient irrigation system, and the extent of lawn area.

Workshops for water smart landscaping targeting water efficient practices through landscaping could be sponsored by the CVRD. However, xeriscaping can actually lead to increased water use on some properties, as has been experienced in the City of Kelowna, and the USA cities of Alburquerque and Phoenix. The main reason appears to be over-watering due to improper irrigation practices; rather than the plants used. Further information on the Kelowna case study can be obtained from the article by Neal Klassen, City of Kelowna - Water Smart Coordinator published on the waterbucket web site www.waterbucket.ca under water use and conservation.

11.3.4 Vehicle & Home Cleaning

Garden hoses on average deliver 25 litres per minute. If hoses are left running or outside taps leak, the amount of water used can accumulate quickly. Free flow hoses for washing of cars or the cleaning of the driveway/deck/gutters/vinyl siding should be avoided. The washing of cars with a water bucket, equipping hoses with an automatic shut off nozzle, and sweeping instead of hosing down, driveways, especially during the dry summer months, should be encouraged. Leaky hoses and taps should be fixed as soon as they are noticed.

11.4 Potential Outdoor Water Use Reduction

For every 2% reduction in summertime demand in the Alberni Valley water systems, a 1% reduction in annual demand will be realized. This is the same ratio previously noted for indoor water use reduction. The most effective means by which to reduce summertime demand is to reduce lawn watering. This will require an effective education campaign accompanied by public pressure and/or fines for offenders.

Reducing summertime lawn watering can be achieved by implementing and enforcing Stage 2 water restrictions, throughout the Alberni Valley water systems, beginning in May of each year as lawn watering begins with the arrival of warmer, dryer weather. A ban on lawn watering would be the most effective in reducing summertime use. We understand that since the implementation of universal metering in Port Alberni, residents have responded to the paying for volume used by generally letting their lawns go brown, which is evident from the high reduction in water use already achieved.

11.5 Water Use Modification Tools

11.5.1 Public Education

The key to water conservation programs is public education. Public education before, during, and after the implementation of water metering programs can be achieved through the following projects:

- Having representative(s) visit homeowners to monitor summer water restrictions, and provide water reducing tips for indoor and outdoor use. Distribute information on water conservation through water metering and highlight other water reduction initiatives.
- A school-based program where representative visit classrooms and distribute education kits to elementary students. This kit could contain brochures, fun pages, stickers, and story booklets.
- Public campaigns through newspaper, radio, and manned displays at public events.
- Sponsoring efficient irrigation and landscaping training programs for the public and presented by qualified professionals.
- An easy to find, and use, water conservation web site where home water-use facts, water use calculators, links to water conservation web sites, such as www.livingwatersmart.ca, and conservation practices are presented. The regional water system monthly and peak demand should be shown and compared against targets so users can see the

need to reduce; especially during the summer peaks. Several municipalities with extensive water conservation material include the City of Kelowna at www.getwatersmart.com, the City of Surrey at www.surrey.ca, Metro Vancouver at www.metrovancouver.org, and the Capital Regional District at www.crd.bc.ca.

- Contacting high volume users, to conduct a personal audit and follow-up with the user at a later date to confirm/re-evaluate implementation of water conservation practices.

11.6 Water Rates

Utility rate structures should be set to sufficiently generate current and future revenues and cover operation, maintenance, capacity, customer service, and administrative costs. They should also be designed to educate consumers on the cost of the service while reducing their water bills. In order to be used as a conservation tool, they must be connected to the volume of water consumed by each user. This would require universal metering. This is already in place in the City of Port Alberni as well as the two improvement districts.

Six water billing rate structures are listed in Table 10. The flat rate structure does not encourage conservation and is associated with non-metered connections. The other five structures require metering. The declining block structure does not encourage conservation, as the cost per block decreases as use increases. The Time of Use and Seasonal rates are recent structures as a result of automatic meter reading systems. They are considered to be the most appropriate billing structure, as it relates closest to the cost of providing peak water demands. This method has been in use by electrical utilities for some time, but has not yet found much use in the domestic water industry; although the District of Tofino has adopted this rate structure.

Table 10. Water Billing Rate Structures

Rate Structure	Description
1. Flat	Fixed cost regardless of volume used.
2. Declining Block	Successively lower cost per block as larger volumes used.
3. Increasing Block	Successively higher cost per block as larger volumes used.
4. Constant	Cost climb uniformly with volume used.
5. Time of Use	Cost based on time of use with higher cost during peak demand times.
6. Seasonal	Cost based on season with higher cost for summer use.

Water rate policies for 8 Vancouver Island and 2 mainland communities are discussed below. All except for one are fully metered.

11.6.1 Vancouver Island

Capital Regional District (Constant Rate)

The Capital Regional District (CRD) provides bulk water, using a constant rate structure, to its municipalities and local services areas. The bulk rate is the same for each community.

CRD – Saanich, Victoria and, Esquimalt (Constant Rate)

The District of Saanich and City of Victoria/Township of Esquimalt (City of Victoria provides water to Esquimalt) charge based on the volume of water used plus a service connection fee based on the size of the service. CRD issues billings monthly to each municipality, which in-turn issued bills three times a year.

CRD - Oak Bay (Constant Rate)

The District of Oak Bay charges based on the volume of water used plus a service connection fee. Billings are issued three times a year.

Central Saanich (Constant Rate)

The District of Central Saanich charges based on the volume of water used plus a service connection fee which is doubled for non-municipal customers. Billings are issued three times a year.

Town of Sidney (Constant Rate)

The Town of Sidney charges based on a minimum charge or the volume of water used; whichever is greater. Billings are issued three times per year.

CRD - North Saanich (Constant and Declining Rate)

The District of North Saanich charges based on the volume of water used plus a parcel tax. For farmland, a declining block structure is used. Billings are issued three times per year.

Ladysmith (Flat and Constant Rate)

The Town of Ladysmith charges based on the volume of water used plus a service connection fee. Billings are issued quarterly.

District of Tofino (Seasonal and Increasing Rate)

Tofino is the only community with a seasonal (winter vs summer) rate structure. The winter rates apply from October through March. Summer rates apply from April through September. The summer rates are higher to encourage water efficiency during this period of peak-usage and lower availability. Billings are issued quarterly.

11.6.2 BC Mainland

City of Surrey (Flat and Constant Rate)

The City of Surrey adopted a voluntary water metering program in 1998 to assist with the management of the City's water utility and to promote water conservation. Metering is mandatory for all commercial, institutional and industrial users and all new residential construction. Non-metered residential customers are charged a flat rate based on the type of development. Metered customers are charged based on the volume of water used plus a connection fee based on the size of the service. Non-metered billings are issued annually, while metered billings are issued three times per year.

City of Kelowna (Flat, Constant and Increasing Rate)

The City of Kelowna uses three rate structures. Single family residential is charged on an increasing block rate plus a service connection fee. Multi-family and commercial are charged using a constant block rate plus a connection fee based on the size of the service. Firelines are charged based on a flat rate. Irrigation and agricultural land users are charged based on a flat rate per acre.

11.7 Water Audits

Water audits serve as the starting point for the identification of losses and the implementation of useful water efficiency practices. There are numerous water use calculators on the internet such as the one minute calculator at http://goblue.zerofootprint.net. Almost all are developed for residential users to estimate the volume of water they use at home.

The Alberni Valley regional water system could develop a water use calculator for users of the water system allowing them to estimate the volume of water they use seasonally inside and outside the home, followed by estimates on the volume of water than can be conserved with the implementation of water saving fixtures, appliances and practices. The calculator could be developed to permit the user to indicate in which service area they reside. They would then be provided with a comparison with their estimated usage against the calculated service area usage.

Winter per capita water use is very high in Port Alberni. It is recommended the City conduct a water audit to determine the cause of the high winter demands, so that steps can be taken to reduce water use in the winter. A water audit would show whether or not the practice of running water over the winter to prevent freezing is common, or whether system leaks contribute to such high use.

11.8 Conservation Programs

Water conservation programs are becoming more common in BC as the public's awareness that water is a limited resource is increasing and conservation of this natural resource is important, and as the provincial government is setting reduction targets and encouraging conservation through education, rebate programs, and directed project funding. While the water conservation initiatives vary, as no one program suits every community, they are developed so as to reduce water demand as well as capital infrastructure upgrades and ongoing operation and maintenance costs.

11.8.1 Other Communities

Water conservation programs for three Vancouver Island and three BC mainland municipalities as well as for BC Hydro are briefly discussed below. The programs offered, and how they are delivered, vary with each municipality. Overall, the toilet exchange program is the most common; used in four of the six municipalities reviewed. All require proof of purchase and some, in addition, require proof of disposal at the local landfill. All have staged water restrictions.

Capital Regional District

The CRD has implemented a comprehensive water conservation program comprised of rebates for installing water efficient fixtures and appliances, irrigation controllers and rain sensors. The CRD also has drip irrigation installation training, institution/commercial/industrial programs, and public education. Public interest in these programs is reported to be strong.

The CRD has focused mainly on indoor water usage because once the fixtures and appliances are replaced and/or retrofitted, the water savings are in place. Each home is eligible for a maximum of two toilet replacement rebates.

The CRD offers a number of rebates for the implementation of indoor and outdoor water conservation appliances/fixtures/devices for residential and institutional, commercial, and industrial users.

Town of Ladysmith

In 2006, the Town of Ladysmith implemented a toilet replacement program with a $75 rebate. In the near future they plan to implement programs for distribution of low flow aerators, and provision of irrigation rain sensor and controller rebates.

District of Tofino

The District of Tofino implemented a toilet replacement program in 2005. The program allows for to replacement of up to three toilets with dual flush models. A rebate of $135 per toilet (equivalent to fifty percent of the local purchase cost) is provided.

Sunshine Coast Regional District

The Sunshine Coast Regional District (SCRD) provides two indoor water use conservation programs. A $100 or $200 rebate is provided for homeowners who replace minimum 13 litre/flush toilets, with a 6 litre or less than 4.8 litre per flush toilet; respectively. This program is open to homeowners, businesses, institutions and industrial users.

A bathroom fixture replacement program is offered where the District schedules a contractor to supply and install a toilet, a low flow showerhead and a faucet aerator, and dispose of the old toilet at no cost to the homeowner. The package program has a retail value of $500 per bathroom. The demand for this program has exceeded the budget funds each year. A maximum of two rebates per home is allowed.

City of Surrey

The City of Surrey has a free voluntary metering program. With each installation, the user is provided with an indoor conservation kit consisting of a low-flow showerhead and faucet aerators. To date, over 18,000 residential homes have been fitted with a water meter under the voluntary program. The meters are installed either inside the home or outside in a service box by a private utility contractor hired by the City.

Residents can purchase a rain barrel (45 ig) and rainwater diverter kit from the City at a cost of $44 and $15 each, plus taxes.

The City notes on their web site that water utilities rates are increasing to pay the rising cost of treating water, however, customers who volunteer to have meters installed will no longer be subsidizing the high volume users.

City of Kelowna

In 1996 the City of Kelowna implemented universal water metering accompanied by a two year water smart (efficiency) program in response to very high summertime demand. The water smart program continues to operate with a base funding level of $200,000 per year. Additional funding is secured for the operation of project specific programs. Three students are hired each summer to assist in the running of summer programs. One of their tasks includes monitoring properties for compliance with sprinkling regulations. Out of compliance notices are delivered to offenders, which can lead to fines for repeated offences.

The water smart program was specifically developed to reduce outdoor water use and has a dedicated web site. Through universal metering, the City identified that 80% of the summertime water demand was being used in specific neighbourhoods housing only 20% of the population. This permitted the development of site specific programs to identify the reason for the high use and solutions to bring about water use reduction.

Kelowna has a semi-arid climate and generally soil conditions which result in very high summer water demands. A review of the areas with excessively high use found the soils to be very sandy. In response the City offers a water and irrigation system assessment, hardier eco-lawn seed, compost tea fertilizer to replace traditional off-the-shelf fertilizers, and soil amendment programs. The soil amendment program was set up as a rewards program targeted towards high water users. The compost assisted in retaining moisture in the lawns and provides a reduction in water usage of around 25%. The program is no longer in operation as the target of reducing water use in high demand areas has been met.

The metering program has been very successful in reducing peak demands, which are the driving force on the sizing of the municipal water supply and distribution system, as well as in reducing overall consumption.

Kelowna is beginning the process of focusing on reducing indoor use. A pilot program for toilet replacement is to be launched this year with rebates provided for dual flush toilets. The effectiveness of a faucet aerator and a low-flow showerhead program is being reviewed but is not proposed at this time. The indoor water use reduction program is supported by the sanitary sewer system department because of the resulting reduced flows in the sanitary sewer system.

BC Hydro

BC Hydro offers a Power Smart Appliance rebate program for replacement of clothes washing machines, refrigerators and freezers. All appliances must be Energy Star rated to eligible. A $50 rebate is available for clothes washers. The benefits of this program include reduced energy bills and lower water consumption.

11.8.2 Implementation for the Alberni Valley Water System

Table 11 presents a list of indoor and outdoor conservation programs that could be implemented for the Alberni Valley water system along with the program cost estimate compared against the estimated reduction in water use per participating home.

Table 11. Alberni Valley Water System Conservation Program Costing
(see explanatory notes following table)

Item	Estimated Water Use Reduction as % of Total Annual	Program Cost Estimate			
		per home ($/home)			Cost per % of Reduction (Estimate)
		Rebate	Pub Ed./ Admin.	Total	
INDOOR					
Toilet (allow rebate for 2 per home)	8 %	$ 150	$ 19	$ 169	$ 21
Faucet Aerators (2 per home) and Showerhead (1 per home)	4.5 %	-	$ 39	$ 39	$ 9
Clothes washer	4 %	$ 100	$ 19	$ 119	$ 30
Total	17 %	$ 250	$ 77	$ 327	$ 60
OUTDOOR					
Rain barrel	< 1%	-	$ 19	$ 19	> $ 19
Irrigation System Moisture Sensors/Automatic Shut-off.	?	$ 25	$ 19	$ 44	?
365 day irrigation controller.	?	$ 50	$ 19	$ 69	?
Water Smart Landscaping Courses.	?	-	$ 19	$ 19	?
Increased Water Restrictions, e.g. implementation of at least Stage 2 from May through Sept.	?	-	$ 19	$ 19	?
Total	?	$ 75	$ 95	$ 170	?

Explanatory Notes:

Estimated Water Use % Reduction as % of Total Annual.

The estimated percent reduction of total annual demand (combined indoor and outdoor for the entire Alberni Valley water system) as shown in the indoor water use section is based on ½ of the estimated percent reduction listed in Table 9.

Rebate.

The proposed rebates are based on similar rebates by other municipalities. As such, they can be increased or decreased as determined to be necessary in order for the general public to participate. If 400 homes participated annually, in each program the rebate value would be $130,000; $100,000 for indoor and $30,000 for outdoor. The 400 homes represent a participation rate of approximately 4% per year based on an estimated 10,000 dwellings within the Alberni Valley water system.

Pub Ed./Admin.

The total annual cost for Public Education and Administration of a conservation program is proposed at $60,000 per year. The $19 per home is based on the program cost evenly split between each of the eight programs and an annual participation rate of 400 homes per year ($60,000 ÷ 8 programs ÷ 400 homes) equating to approximately 1 to 2 per day (Monday – Friday); excluding statutory holidays.

The $60,000 program cost would cover program development, advertising, web page development, staff time to process rebate claims, toilet recycling, monitoring and enforcement of water restrictions, displays at public events such as May Day, Canada Day, and for example Logger Sports Day or Fall Fair celebrations, and developing and hosting water smart workshops. It does not include the rebates provided to the program participants.

Faucet Aerator and Showerhead Program.

The $39 per home cost includes a $20 allowance for an indoor water conservation kit consisting of: faucet aerators, a kitchen faucet dual setting swivel aerator, low-flow showerhead, package of dye tablets to detect toilet leaks, a small roll of Teflon tape, and booklet on indoor and outdoor water saving tips.

Outdoor Program.

No empirical data could be found documenting the effectiveness of these programs, though the City of Kelowna and the Capital Regional District have programs targeted at reducing lawn and garden watering conservation; both have universal metering. The program effectiveness could be measured with the installation of a water meter which would permit comparison of demands before and after program implementation at each property.

Effective implementation of Stage 2 outdoor watering restrictions would require diligent monitoring and strict enforcement.

Indoor water conservation programs have proven to be effective in reducing water demand 365 days a year without requiring any behaviour modification by the users. Reducing outdoor (summertime) water demand is more difficult as it requires behaviour modification. Although the City has instituted universal metering, it is not yet accompanied by conservation pricing. Conservation pricing through increasing block water rates and public education have proven to be effective in reducing summer and winter demands.

The data clearly shows the significant demand increase during the summer months. The success of programs to reduce peak water use has significant cost saving implications, which can be measured by the delay in implementation of capacity upgrading.

Implementation of a water conservation strategy for the Alberni Valley water systems will require co-operation, involvement, and implementation by Council and staff from the City of Port Alberni, the Alberni-Clayoquot Regional District and the Beaver Creek and Cherry Creek Improvement Districts.

12.0 CONCLUSIONS AND RECOMMENDATIONS

12.1 Conclusions

The following conclusions may be drawn from the work presented in this report:

1. The existing water treatment systems for the City of Port Alberni, the Beaver Creek Improvement District and the Cherry Creek Improvement District will be in contravention of the B.C. Drinking Water Protection Act unless improvements are made to meet the new 2008 Vancouver Island Health Authority (VIHA) water treatment requirements.
2. The proposed Alberni Valley regional water system is designed to meet the new treatment requirements and would service the existing water systems of the City of Port Alberni, including Ahahswinis Reserve # 1 and Tsahaheh Reserve # 1, and the Beaver Creek and Cherry Creek Improvement Districts, as well as potential future service areas for the Sproat Lake, Bell/Stuart Road, McCoy Lake and Beaufort communities, and the Klehkoot Reserve # 2 and Alberni Reserve # 2.
3. The existing water systems in the Alberni Valley all have surface water supplies and have sufficient capacity for growth to the year 2050. They all have chlorination treatment, but none meet the new VIHA surface water treatment requirements. The BCID and CCID have been issued with an Operating Certificate amendment specifying compliance with the new VIHA treatment requirements by April 30, 2011 and September 1, 2013, respectively. The City of Port Alberni has been requested to present a plan for compliance following completion of the regional water study update.
4. The present Alberni Valley population is estimated at 25,000 people. The high growth rate projected in the 1995 study has been downgraded substantially from 2.4% to an average of 0.5 – 0.75% per annum. This results in a design population of between 30,000 and 35,000 people for the year 2050.
5. All three water systems have universal metering. Per capita water demands are similar, if not slightly lower, than most municipal systems on Vancouver Island, and are showing a gradual annual reduction during the past 5 years.
6. As a result of water conservation measures through universal metering and increasing public awareness, target water demands for future projections have been downgraded from a range of 1.25 – 1.45 m^3/day/cap used in the 1995 report to a range of 0.80 – 1.00 m^3/day/cap for the new 2050 projections. This is expected to result in a year 2050 maximum day demand of 30,000 m^3/day, down more than 50% from the 2020 design demand projected in the 1995 report.
7. The 1995 report considered three regional water supply sources, ie. China Creek/Bainbridge Lake, Great Central Lake and the Somass River. The present update report considers these three sources plus Sproat Lake, as Catalyst Paper has expressed an interest in transferring some of its excess water supply capacity to a regional water supply authority or the City, and a

new buried HDPE supply main has been installed from the Sproat Lake intake to the Mill, within close proximity to the City water distribution system.

8. Groundwater has not been considered as part of a regional water supply option, as information to-date has not indicated the presence of a large good quality aquifer in the valley and the cost of an extensive exploration program cannot be justified. Information obtained from a local well driller indicates the existence of drilled wells in the Beaver Creek area that accessed large quantities of water entirely unsuitable for drinking water.
9. Drinking water quality legislation is developed provincially under the provisions of the Drinking Water Protection Act and Regulation. On Vancouver Island, the regional authority administering this legislation is the Vancouver Island Health Authority (VIHA). In March 2008, VIHA adopted the 4-3-2-1 treatment rule for surface water, which aims to provide drinking water year-round with less than 1 NTU turbidity and a dual barrier treatment system, usually filtration followed by disinfection. Alternatively, when a source can provide raw water consistently below 1 NTU turbidity, two disinfection systems in series, capable of 4-log (99.99% removal of viruses) and 3-log (99.9%) removal of *Giardia* and *Cryptosporidium* may be approved to comply with the new rule.
10. Four regional water supply options have been compared, namely:

	Primary Supply	Secondary Supply
Option I	China Creek/Bainbridge Lake	None
Option II	China Creek/Bainbridge Lake	Sproat Lake
Option III	China Creek/Bainbridge Lake	Somass River
Option IV	China Creek/Bainbridge Lake	Great Central Lake

11. Local supply options (the above options, except Great Central Lake for the City, the Stamp River source with filtration for BCID, and the Cold Creek source with filtration for CCID) were compared against the cost of participating in the regional options.
12. Based on total capital costs, Regional Option II, China Creek/Bainbridge Lake with Sproat Lake as secondary source, is by far the most attractive option. This assumes that a filtration deferral can be obtained for both sources, and that filtration treatment would not be required until sometime after the year 2035.
13. The capital cost comparison of the individual options show that the cost for the City, BCID and CCID to proceed on their own is considerably higher for each than the cost of joining Regional Option II.
14. Government funding has not been considered in the cost estimates presented in the draft report. A regional or a local City supply and treatment system improvement qualifies for government funding, whereas the improvement districts do not qualify for such funding, unless they organize under a regional local service area function.
15. On the basis of Net Present Value (NPV) of the phased capital costs and the full cost of operation and maintenance of the supply and treatment systems

over 25 years, Regional Option II is also much lower than the other regional options.

16. When considering NPV estimates for the go-it-alone options for the two improvement districts, it becomes very clear that operation and maintenance costs of individual filtration treatment plants have a large additional cost implication. The NPV of capital and operation and maintenance costs over 25 years for the go-it-alone options for the improvement districts is almost double the proportional share of those costs in a regional system context.
17. In 2008 the Province of B.C. set out new provincial water priorities in the Living Water Smart Plan. The province has set a goal that by 2020 water use in the province will be 33% more efficient, with the implication that each municipality or regional district will need to meet this objective. Section 11.0 of this report deals with a discussion on how municipalities can conserve water, presents an overview of what communities in B.C. have achieved to-date, and which type of initiatives may work in the Alberni Valley.
18. A public Open House was held on July 28, 2010 at the Echo Centre to provide information on the second draft report and to solicit feedback from the public. A summary of the feedback received is included in Appendix B.

12.2 Recommendations

Based on the conclusions reached in this study, we recommend that:

1. The City of Port Alberni, the Beaver Creek Improvement District and the Cherry Creek Improvement District immediately start discussions on how to meet the new VIHA water treatment requirements, established under the provisions of the B.C. Drinking Water Protection Act.
2. In order to keep initial capital and operation and maintenance costs to a minimum, a regional water supply system is established in the Alberni Valley, adopting the following strategies:
    - Maximize the use of the China Creek/Bainbridge Lake gravity supply.
    - Establish a secondary source with year-round low turbidity, such as Sproat Lake or Great Central Lake, which automatically comes on line when China Creek and Bainbridge Lake turbidity threatens to equal or exceed 1 NTU, assuming VIHA will approve these sources for a filtration deferral.
    - Provide each source with double disinfection, UV radiation followed by chlorination, with sufficient property available to expand to add filtration treatment at a later date, when such is mandated.
3. Regional Option II – China Creek/ Bainbridge Lake with Sproat Lake as the secondary source be selected as the preferred regional water supply system, on the basis of obtaining a filtration deferral for both sources, so that the high capital and ongoing operation and maintenance expense of filtration treatment can be postponed to beyond the year 2035.

4. The water quality data collection in support of the application to VIHA for a filtration deferral, in particular raw water turbidity at China Creek/Bainbridge Lake and Sproat Lake, continue for at least one full year.
5. Additional raw water quality data be collected, starting at the earliest convenience, on both the China Creek/Bainbridge Lake and Sproat Lake sources, including UVT for the future sizing of UV reactors, E.Coli, total bacteria, organic carbon, and regular general drinking water quality parameter scans, in further support of the filtration deferral application, and that VIHA be consulted on which parameters to be included in the ongoing monitoring.
6. Discussions start as soon as possible between the ACRD, City, BCID and CCID about the feasibility of forming a regional water authority, and the selection of the preferred regional water supply option.
7. If a Sproat Lake secondary supply is to be considered for regional or City water supply development, discussions should take place as soon as possible with Catalyst Paper to explore the conditions and costs for transfer of a portion of the water licence and for the use of existing Catalyst infrastructure, such as the intake, pump station and water supply main, and to determine the conditions necessary to protect long term public water supply interests.
8. Source approval for Sproat Lake to be applied for to VIHA.
9. A schedule for implementation is established to be submitted to VIHA relative to the implementation dates currently specified in the individual Operational Certificates.
10. Government support and funding sources be explored for the preferred option, and using every available opportunity to apply for funding.
11. The regional district and/or City meet with the appropriate authorities to clarify the objectives of the B.C. Water Plan, and to determine the base line against which water conservation goals are to be measured.
12. A water conservation plan is prepared for the proposed regional water supply system, along the lines discussed in Section 11.0 of this report, and designed to comply with or surpass the provincial objectives.

13.0 REFERENCES

The following references have been consulted in the preparation of this report. Cross references are shown in the text with the number of the reference in brackets.

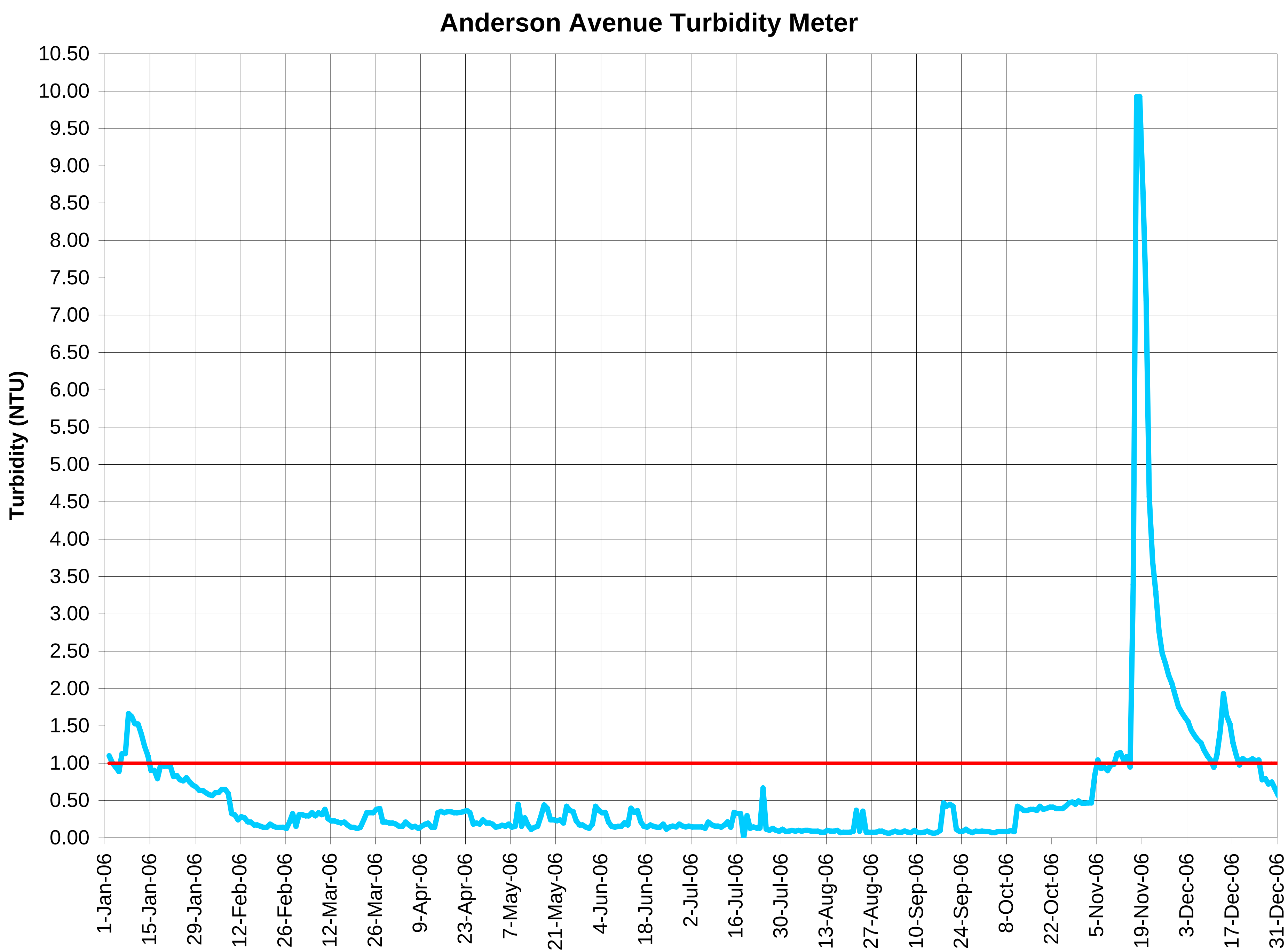
1. Alberni Valley Regional Water Study. Prepared for Alberni-Clayoquot Regional District and City of Port Alberni by Koers & Associates Engineering Ltd. March 1995.
2. Vancouver Island Health Authority. Policy # 3.3. Drinking Water Treatment for Surface Water Supplies. March 7, 2008.
3. Memorandum of Understanding between the City of Port Alberni and Hupacasath First Nation, dated March 24, 2004.
4. Watershed Assessment, China Creek Watershed (Draft). Prepared for Weyerhaeuser by Streamline Environmental Consulting Ltd. March 15, 2005.
5. Guidelines for Canadian Drinking Water Quality. Health Canada. May 2008.
6. Drinking Water Protection Act [SBC 2001]. Chapter 9. Ministry of Health. April 2001.
7. Drinking Water Protection Regulation. Ministry of Health. May 2003.
8. Water Source Options & Treatment Study. Prepared for the Beaver Creek Improvement District by Koers & Associates Engineering Ltd. April 2010.
9. Guidelines for the Approval of Water Supply Systems. Vancouver Island Health Authority. Last Revision April 25, 2006.
10. Living Water Smart. British Columbia's Water Plan. 2008 www.livingwatersmart.ca
11. Ontario Water Use Reduction Manual, June 2008, Ontario Water Works Assocation (page ii).

APPENDIX A

WATER SOURCE TURBIDITY RECORDS

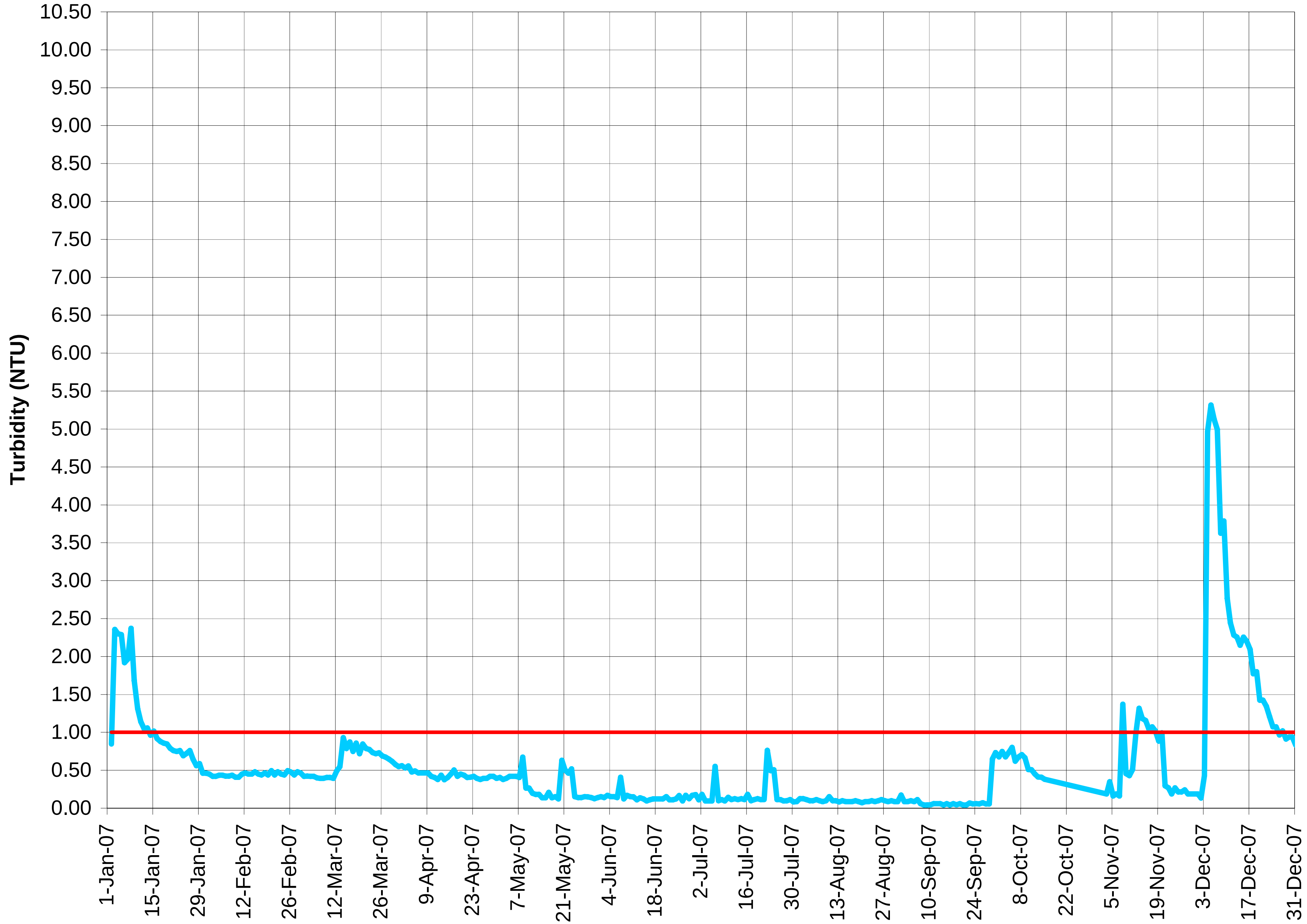
A-1

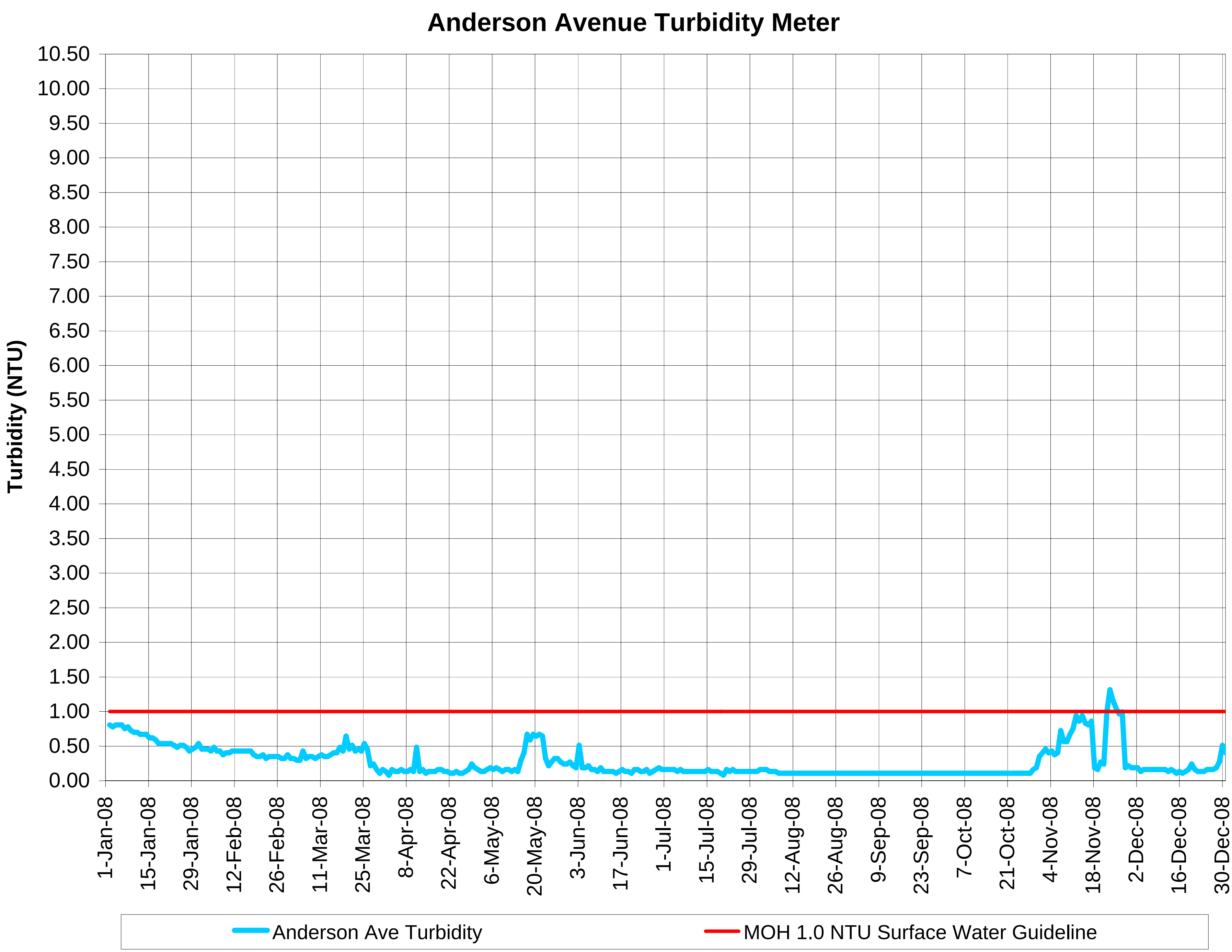
Turbidity Records for China Creek/Bainbridge Lake At Anderson Avenue



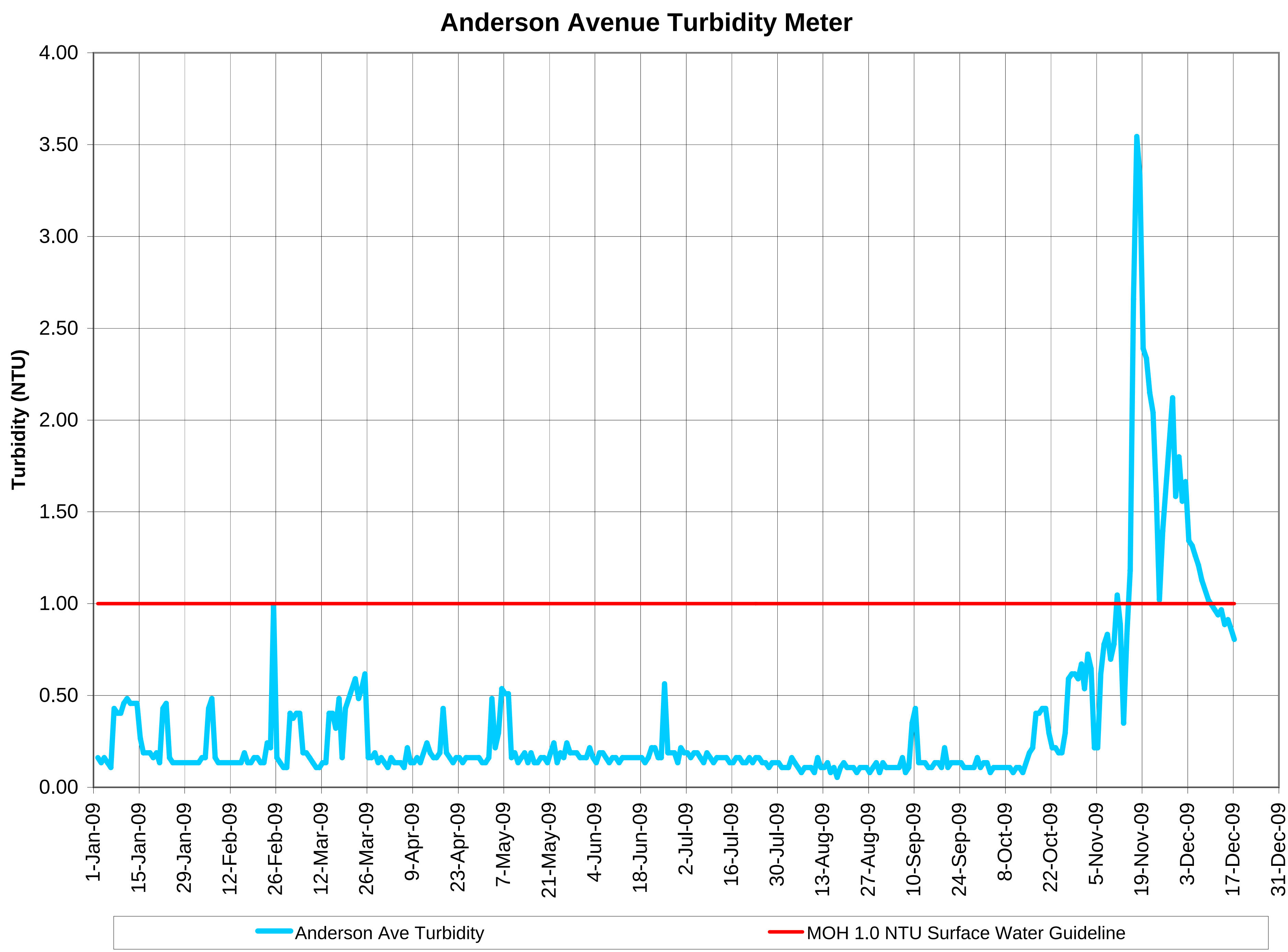
Anderson Avenue Turbidity Meter
Turbidity (NTU)
10.50
10.00
9.50
9.00
8.50
8.00
7.50
7.00
6.50
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1-Jan-06
15-Jan-06
29-Jan-06
12-Feb-06
26-Feb-06
12-Mar-06
26-Mar-06
9-Apr-06
23-Apr-06
7-May-06
21-May-06
4-Jun-06
18-Jun-06
2-Jul-06
16-Jul-06
30-Jul-06
13-Aug-06
27-Aug-06
10-Sep-06
24-Sep-06
8-Oct-06
22-Oct-06
5-Nov-06
19-Nov-06
3-Dec-06
17-Dec-06
31-Dec-06

Anderson Avenue Turbidity Meter



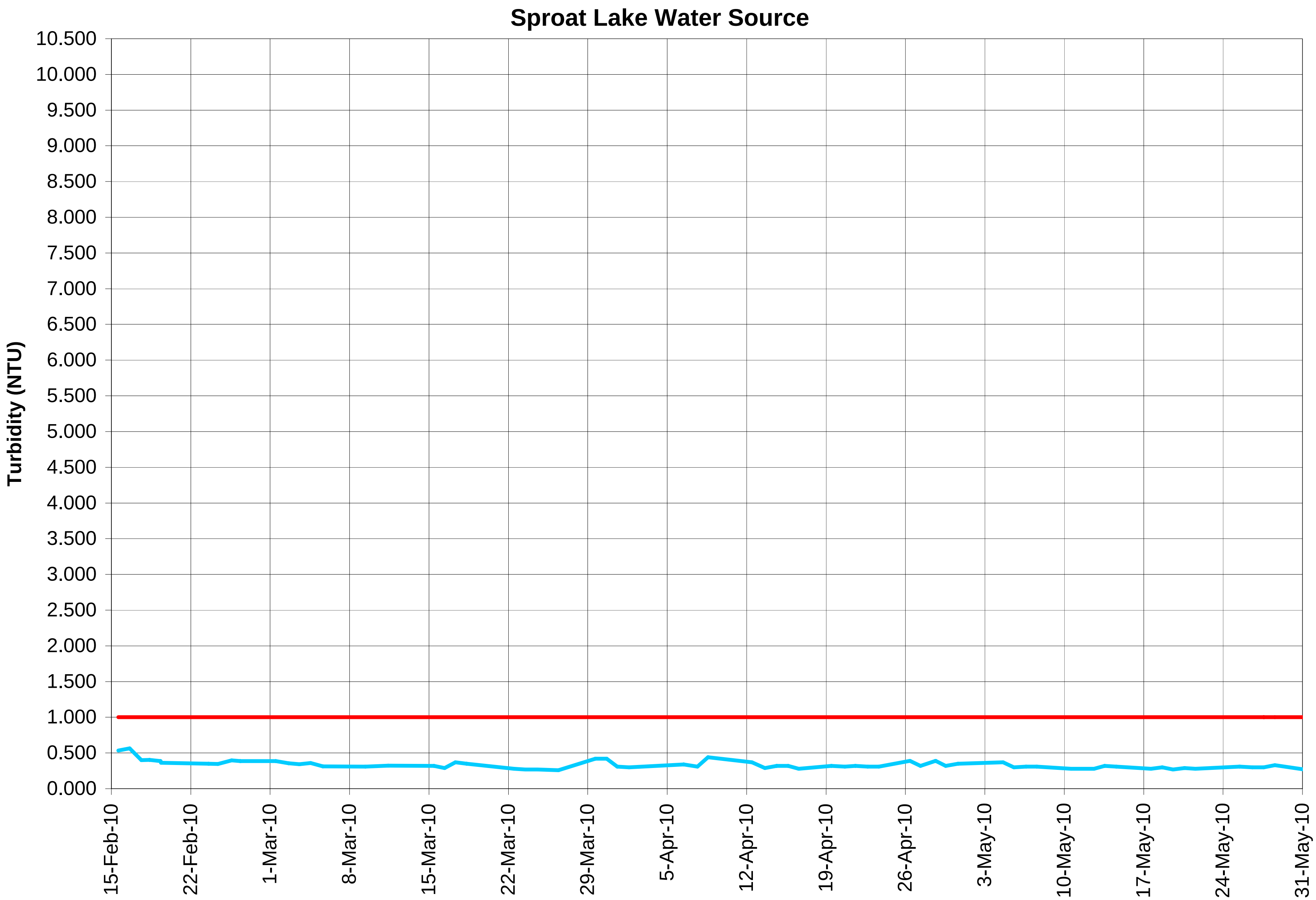


Anderson Avenue Turbidity Meter
Turbidity (NTU)
10.50
10.00
9.50
9.00
8.50
8.00
7.50
7.00
6.50
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1-Jan-08
15-Jan-08
29-Jan-08
12-Feb-08
26-Feb-08
11-Mar-08
25-Mar-08
8-Apr-08
22-Apr-08
6-May-08
20-May-08
3-Jun-08
17-Jun-08
1-Jul-08
15-Jul-08
29-Jul-08
12-Aug-08
26-Aug-08
9-Sep-08
23-Sep-08
7-Oct-08
21-Oct-08
4-Nov-08
18-Nov-08
2-Dec-08
16-Dec-08
30-Dec-08
Anderson Ave Turbidity
MOH 1.0 NTU Surface Water Guideline


Anderson Avenue Turbidity Meter
Turbidity (NTU)
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1-Jan-09
15-Jan-09
29-Jan-09
12-Feb-09
26-Feb-09
12-Mar-09
26-Mar-09
9-Apr-09
23-Apr-09
7-May-09
21-May-09
4-Jun-09
18-Jun-09
2-Jul-09
16-Jul-09
30-Jul-09
13-Aug-09
27-Aug-09
10-Sep-09
24-Sep-09
8-Oct-09
22-Oct-09
5-Nov-09
19-Nov-09
3-Dec-09
17-Dec-09
31-Dec-09
Anderson Ave Turbidity
MOH 1.0 NTU Surface Water Guideline

A-2

Turbidity Records for Sproat Lake
From Catalyst Supply Main at City Lagoons


Sproat Lake Water Source
Turbidity (NTU)
10.500
10.000
9.500
9.000
8.500
8.000
7.500
7.000
6.500
6.000
5.500
5.000
4.500
4.000
3.500
3.000
2.500
2.000
1.500
1.000
0.500
0.000
15-Feb-10
22-Feb-10
1-Mar-10
8-Mar-10
15-Mar-10
22-Mar-10
29-Mar-10
5-Apr-10
12-Apr-10
19-Apr-10
26-Apr-10
3-May-10
10-May-10
17-May-10
24-May-10
31-May-10

A-3

Turbidity Records for Stamp River
At Beaver Creek Improvement District Water Intake

KOERS & ASSOCIATES ENGINEERING LTD.
Consulting Engineers

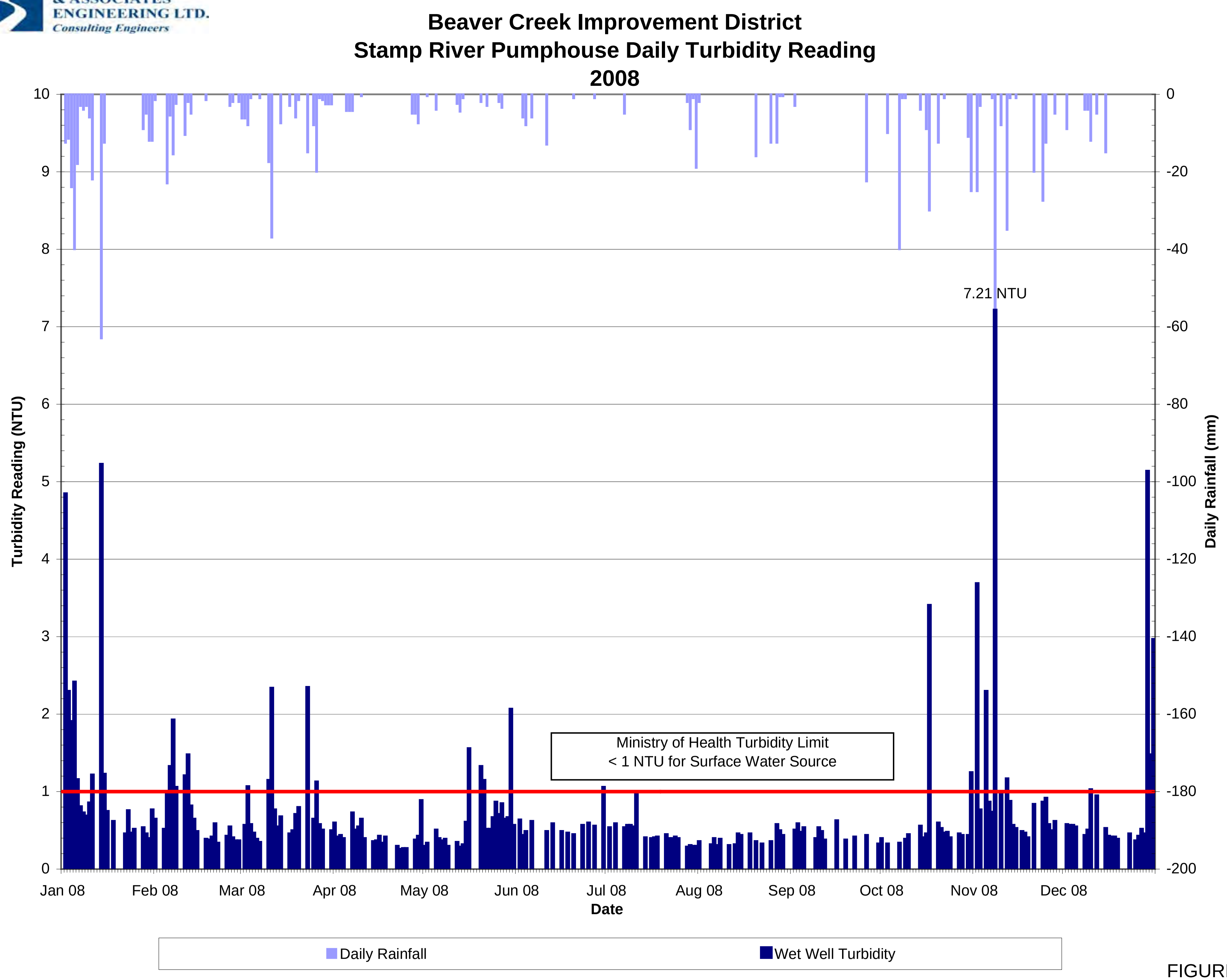


FIGURE 4

KOERS & ASSOCIATES ENGINEERING LTD.
Consulting Engineers

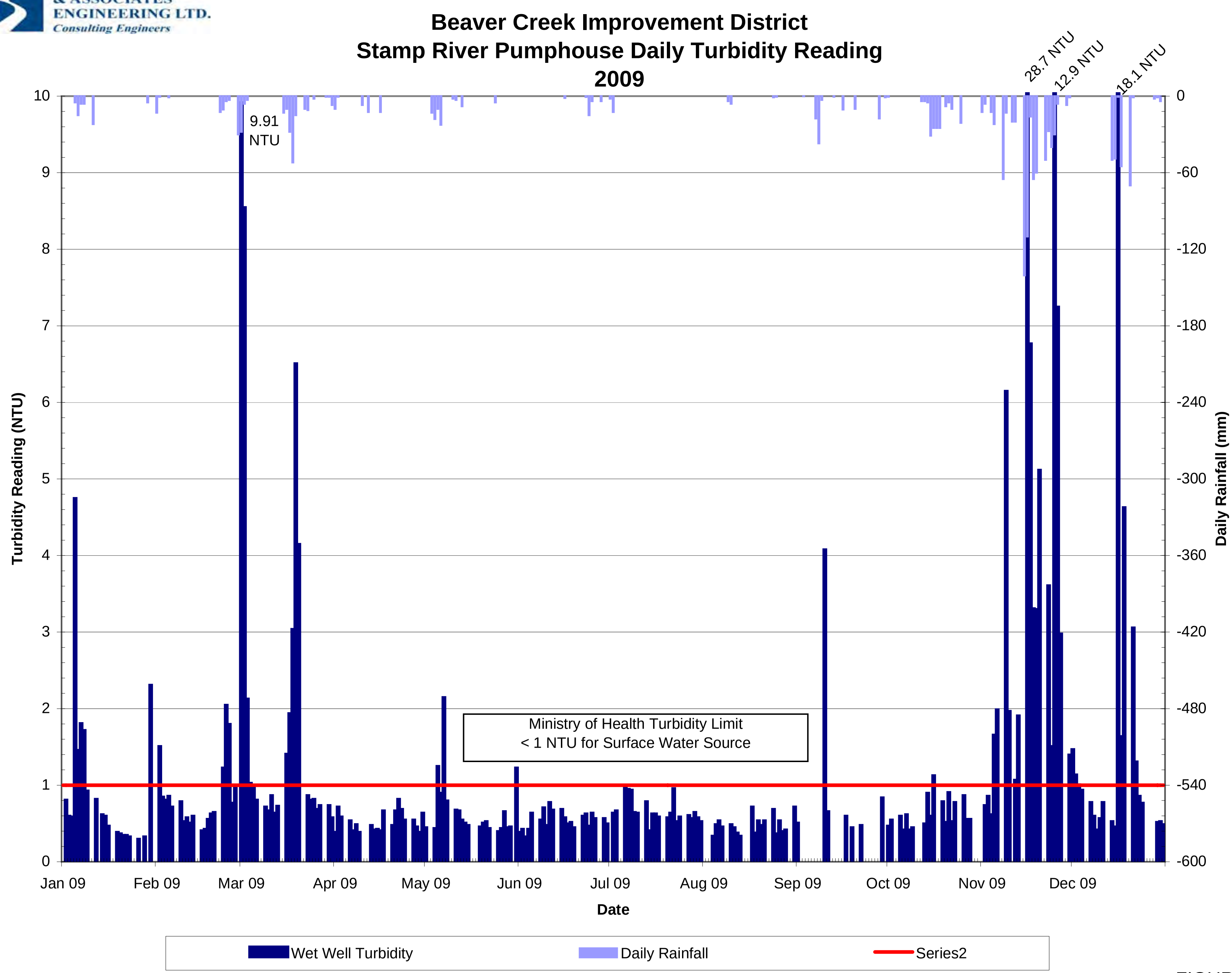
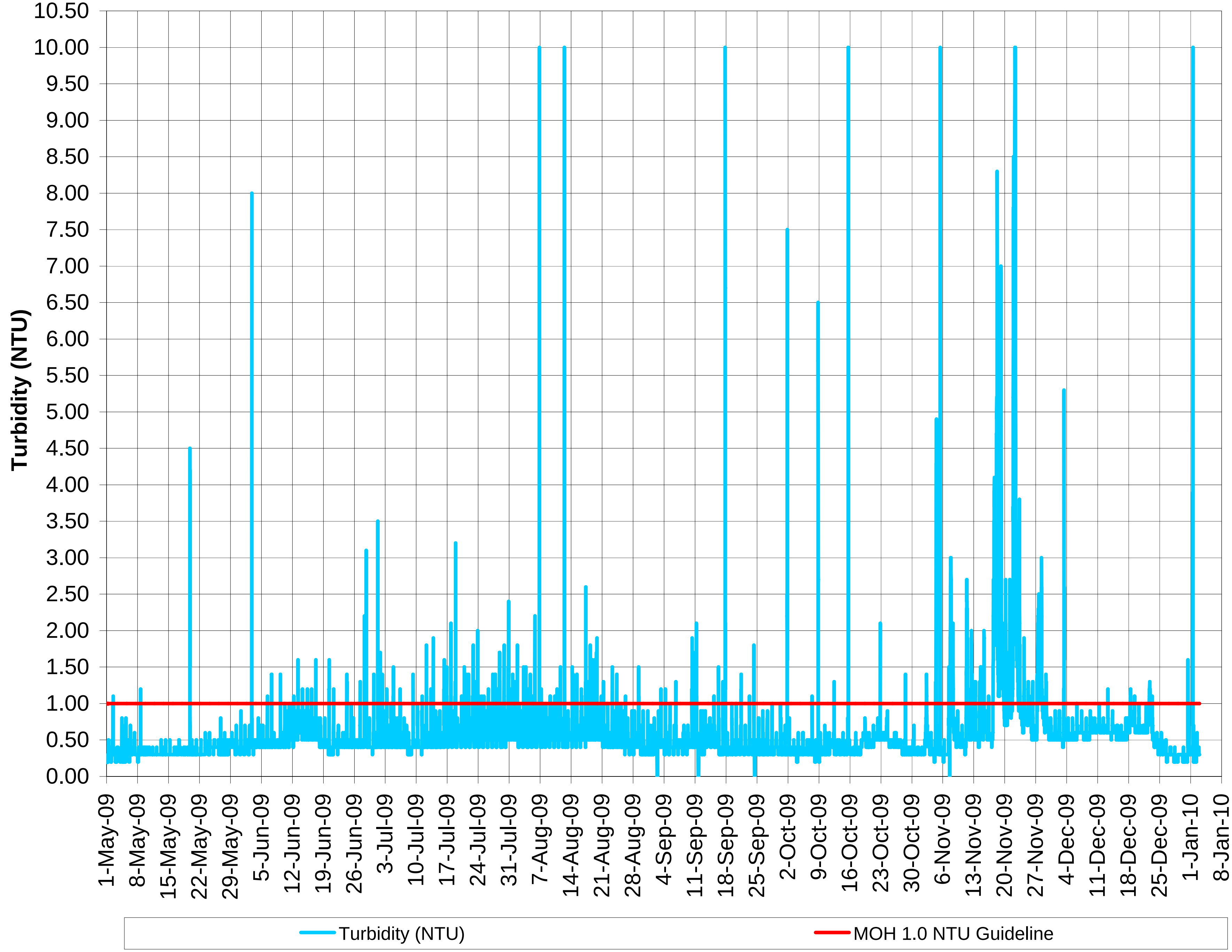


FIGURE 5

A-4

Turbidity Records for Cold Creek
At Cherry Creek Improvement District Water Intake

CCWD - Cold Creek Water Source



APPENDIX B

SUMMARY OF COMMENT SHEET FEEDBACK
OPEN HOUSE JULY 28, 2010

SUMMARY OF COMMENT SHEET RESPONSES
JULY 28, 2010 OPEN HOUSE

A public open house for the Alberni Valley Regional Water Study Update was held on July 28, 2010 from 5:00 pm to 8:00 pm at the Echo Centre. Approximately 35 – 45 people attended. Prior to the open house, Tony Koers made a presentation to the ACRD Board providing the same information as was presented at the Open House.

Comment sheets were provided at the Open House. A total of 12 were returned at the meeting. One completed form was delivered to the ACRD office after the open house.

Comments received to-date can be summarized as follows:

Number of comment sheets returned:	City residents	1
	BCID residents	10
	CCID residents	1
	Other	1
	Total	13

Number in favour of regional water system	10
(one of these was concerned if Sproat Lake option chosen)	
Number concerned with option I (China Creek alone)	1
Number concerned with option II (China Creek with Sproat Lake	5
Number in favour of independent systems	2
(one of these was only in favour of local systems if Sproat Lake option chosen)	
Number who did not know	3

The main comments can be summarized as follows:

- Need more information on cost to property owners, and compare against present cost for water.
- Three responses thought Great Central Lake is the best long-term source and provides the best opportunity for protection of the watershed from development. Some felt this option should be chosen now, even though it is more expensive.
- Concern over inability to control development in the Sproat Lake and Somass watersheds, and resulting deterioration of water quality.
- Concern about Catalyst owning water rights and supply main for regional option II.
- All of the Alberni Valley should have access to the best quality water.
- Access to infrastructure grants is important to reduce costs to residents in the improvement districts.
- The improvement districts should become a regional water service area.
- Look at power generation as part of the development of any regional water supply.
- What is the next step?

ALBERNI-CLAYOQUOT REGIONAL DISTRICT
ALBERNI VALLEY REGIONAL WATER STUDY UPDATE

PUBLIC INFORMATION MEETING
JULY 28, 2010 ECHO CENTRE 5:00 pm – 8:00 pm

COMMENT SHEET (leave in box or mail to ACRD)

I reside in: *(circle one)*

1. City of Port Alberni
2. Beaver Creek Improvement District
3. Cherry Creek Improvement District
4. Other, please specify: ______________________________

Are you in favour of : *(circle one)*

1. Regional Water Supply System
2. Local Water Supply System
3. Don't know

Why: ______________________________

____

____

____

____

The lowest cost option (Regional Option II) is a regional system with the China Creek/Bainbridge Lake supply as the primary source and Sproat Lake as the secondary source, with treatment for each source consisting of double barrier disinfection (ultraviolet radiation followed by chlorination), but without filtration.
An agreement with Catalyst would be required to implement this option.

The next lowest cost option (Regional Option I) is a regional system with China Creek/Bainbridge Lake as the only supply with treatment by filtration and chlorination. The existing Somass River, Stamp River and Cold Creek intakes would be emergency backup sources with chlorination only, to be operated under a boil water advisory.

Both options are expected to be in compliance with the new Vancouver Island Health Authority water treatment guidelines.

Do you have concerns with either option and why:

1. Regional Option II ______________________________

   ____

   ____

   ____

   ____

2. Regional Option I ______________________________

   ____

   ____

   ____

   ____

3. No Opinion ___________

Name: ___________________ Address: ______________________________

Please use back of sheet for additional comments.

ADDITIONAL COMMENTS