AECOM

Powell River Regional District

Southern Region Water Source Study

Prepared by:

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Project Number:

5516-008-00

Date:

November 25, 2009

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November 25, 2009

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Frances Ladret
Administrator
Powell River Regional District
5776 Marine Avenue
Powell River, BC
V8A 2M4

Dear Ms. Ladret:

Re: Southern Region Water Source Study – Final Report

Please find enclosed three bound hard copies, one unbound copy and one electronic pdf copy of the above final report.

The final report incorporates comments from reviews of October 12, 2009 and November 9, 2009.

Should you have any questions or comments, please let me know.

Sincerely,

AECOM Canada Ltd.

Richard Harper, P.Eng.
Richard.harper@aecom.com

RH:cla:kt
Encl.

Revision Log

Revision #	Revised By	Date	Issue / Revision Description
0	R. Harper	November 25, 2009	Final

Signature Page

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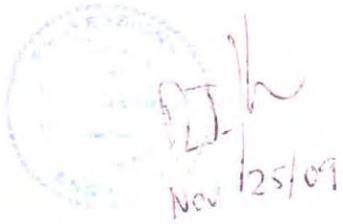


Richard Harper, P.Eng.

Report Reviewed By:

David Cass, P.Eng.

Executive Summary

This study, undertaken for the Powell River Regional District, reviewed the options for developing a regional water supply system for the Southern Region. The development of a regional water supply system was to be considered in the context of initially providing water supply service to the Myrtle Pond water system area.

Southern Region Overview

The Southern Region consists primarily of low density rural development interspersed with a few small subdivisions and small commercial areas. There is also a considerable amount of agricultural holdings, and much of the area is in tree farm licences. The Southern Region encompasses two Electoral Areas, Area B and Area C. The current estimated population is 1,500 for Area B and 2,100 for Area C for a total of 3,600 people. The rate of population growth since 1986 has been 0.6%. However, in recent years, population growth has levelled off and future projections show a decrease in population.

Since the completion of the 1989 Water Resource Study by Kerr Wood Leidel, the District has undertaken and established a Southern Region Official Community Plan (SROCP) which governs land use in the region.

Water supply in the Southern Region is provided by approximately 56 community water systems which are monitored by the local Health Authority. Eight of these water systems are the primary community water systems. The remainder of the water supply is by individual wells.

OCP Land Use and Future Population

Based on land use and density information provided in the OCP, population projections were developed for both an interim (2038) and ultimate case (or build out) for both Area B and Area C. The interim population for Area B is estimated at 2,345 people, the ultimate population is 9,960 people. The interim population for Area C is 3,282 people, the ultimate population is 23,755. Therefore, the total interim population for the Southern Region is 5,627 people; the ultimate population is 33,715 people.

Water Demands and Design Criteria

Water demands were estimated for interim and ultimate populations for Area B and Area C for both average day, peak day and peak hour. Although the historic population grown is only 0.6% per year, the development of a regional water supply system may increase the rate of growth and thus a population growth rate of 1.5% per year was used for this study. The water demands estimates used were based on the Master Municipal Construction Association's Municipal Infrastructure Design Guideline.

Typically, municipal or regional water supply systems are designed and sized on peak day demands with fire flows and peak hour demands being provided by storage. The estimated peak day interim demand for Area B is 2.8 ML/day (33 L/s), the estimated ultimate demand is 11.95 ML/day (139 L/s). The estimated interim peak day demand for Area C is 4.0 ML/day (46 L/s), the estimated ultimate peak day demand is 28.5 ML/day (330 L/s). The total estimated interim peak day demand for the entire Southern Region is 6.8 ML/day (78 L/s); the estimated ultimate peak day demand is 40.5 ML/day (468 L/s).

Fire flows provided in the Design Guidelines for Small Community Water Supply Systems are 30 L/s for one hour. Current guidelines from Fire Underwriters requires a minimum fire flow of 60 L/s for the duration of one hour for residential use. The 60 L/s value is consistent with design guidelines in the Master Municipal Design Guideline Manual.

Fire flows for commercial, institutional and industrial are higher, ranging from 90 L/s to 225 L/s for the duration of one to two hours.

Minimum pipe size recommended for distribution mains is 150 mm as recommended in current design standards.

Distribution system pressure requirements were established which met accepted standards. These were:

- Maximum allowable pressure: 850 kPa (125 psi)
- Minimum pressure at peak hour 300 kPa (40 psi)
- Minimum pressure at fire flow 138 kPa (20 psi)

It is important that any water system which is developed ensures demand side measures are incorporated into its development. For the Southern Region, it is recommended that provision for low water use fixtures and metering be included. Although there is no legislated or regulatory requirements, the District's long-term goal for demand side management should target the following estimated criteria:

- Average Day Demand: 500 L pcpd ±
- Peak Day Demand 1000 L pcpd ±
- Peak Hour Demand 1500 L pcpd ±

Reservoir sizing was established based on accepted standards which provides for fire flow based on 60 L/s for residential and an allowance for peak hour balancing and emergencies. Reservoir storage could be based on 30 L/s, subject to review by the District and their insurance provider, to determine the impact of the reduced fireflow.

Existing Water Systems

A field review of five of the community water systems was undertaken to establish a general sense of the capacity, quality, and condition of the systems. Detailed assessments were undertaken on two of the more significant water systems, Myrtle Pond and Stillwater. The condition of these systems was poor (Stillwater) to moderate (Myrtle Pond). To upgrade these water systems to current standards was estimated to cost $2.5 million. Both these water systems have little or no capacity for future expansion.

A review of the Brew Bay water system found that the system was generally capable of providing potable water to the area with a fire flow of approximately 30 L/s for 20 minutes, after which, withdrawals would exceed their licence on Lang Creek. It is not anticipated that the pump building can be expanded or possibly upgraded due to its proximity to Lang Creek. The facility is well within provincial and SROCP riparian setback limits for Lang Creek. The water quality of the Lang Creek source is poor and Brew Bay has been subjected to several boil water advisories. There is also no capacity on Lang Creek for further expansion of the Brew Bay water system. Upgrading and/or expansion of the Brew Bay water system is expected to be costly (possibly a complete replacement of the source and conveyance facilities except possibly the distribution system). The water distribution system could be re-used in a regional system subject to confirmation of pressure ratings.

The Lang Bay water system has recently been upgraded to include new chlorination facilities and a new 104,000 L steel reservoir. The limiting factor for Lang Bay is the water source quantity and quality. The Lang Bay water system obtains its water from a shallow infiltration gallery installed in an area of natural spring upwelling. This spring feeds Silver Creek. Because the infiltration gallery is shallow and the watershed area available is small and surrounded by private lands, water quality is a risk. To protect the watershed would involve restrictive covenants on private lands not controlled by Lang Bay Waterworks. It is also expected that additional flows for expansion may not be available due to environmental restrictions for maintaining flow in Silver Creek. Wells were attempted but were found to contain arsenic which exceeded guidelines. In summary, it is questionable whether the Lang Bay water system can be expanded much beyond its current capacity, without treatment of capacity upgrades. In terms of a regional system, the new chlorination facility and steel reservoir could be incorporated into a regional water supply system.

The remaining water systems did not meet current regulations and guidelines, and were of questionable quality and capacity. Water quality issues relevant to the small water systems in the Southern Region have been an issue with the local Health Authority for a long period and the Health Authority's preference is to see amalgamation/expansion of current water systems or the development of a regional water system.

In light of the information reviewed, it is estimated that an order of magnitude cost for upgrading the small community water systems in the Southern Region to current regulations, standards and guidelines would be in the order of $5.0 million to $10 million, which consists of both treatment and distribution upgrades.

Regional Source Capacity and Quality

This study considered three possible sources for supply to the Southern Region:

- Connect to the City of Powell River
- Develop Hammil Lake as a source
- Develop Lois Lake as a source

City of Powell River

The City of Powell River relies on Haslam Lake as a source with Powell Lake and Hammil Lake to be used as backups in case of emergency. Haslam Lake currently has the capacity to provide for a population of approximately 22,500 people. More, if demand side measures are pursued by the City. The current population is approximately 13,500 people. Service beyond a population of 22,500 is anticipated to require the City to apply for a modification to their water licence to withdraw further water from Haslam Lake. In any event, due to existing storage capacity and requirements to maintain flows downstream of the control weir for Lang Creek, the capacity of the Haslam source is estimated to be limited to a population of approximately 30,000 to 35,000 people, possibly more with demand side management. At this population level, additional storage needs to be created or accessed at the Haslam Lake supply or upgrades undertaken for the Powell Lake or Hammil Lake systems to provide additional capacity from a quantity perspective. Haslam Lake therefore does not have the capacity to supply the entire Southern Region for the ultimate case without significant upgrades to Haslam Lake and likely the City system. It does however have capacity to provide for the ultimate design flow for Area B, or the interim design flows for Area B and Area C.

The quality of water at Haslam meets current GCDWQ. The City is currently pursuing upgrading of the Haslam source by filtration or UV. Because of the length of the connection from Haslam to the Southern Region, it is expected that rechlorination will be required due to issues with free chlorine residuals.

The City's current upgrade program of their water supply system is estimated to cost $8.8 million ($2005) to service a population of 22,500. The potential Regional District share of this cost for a Southern Region connection is estimated $2.31 million for the interim Area B population and $5.5 million for the Area B and Area C populations.

The City's current Water Use Bylaw provides for a water base rate of $187/lot for 600 m^3/annum. The estimated unit cost of water is $0.312/$m^3$. The City recently negotiated water rates for a subdivision outside the City which required that connections outside the City pay twice the base rate plus $100 per connecting lot or $475/lot for 600 m^3/annum. In addition to this was a connection cost of $2000/lot. The estimated unit cost of water outside the City is $0.792/$m^3$. The City recently increased the Bylaw water rates by approximately 15% in April 2009. This would revise water rates to $0.359/$m^3$, $0.551/$m^3$, and $0.911/$m^3$, respectively. Under the current City Water Rates and Regulation Bylaw 2239, service outside the City requires negotiation with the City and possibly a change in their Water Use Bylaw.

Hammil Lake

Hammil Lake is governed by water licences held by the City of Powell River which allows for a withdrawal of 2.25 ML/day (26 L/s) and 309,000 m^3/year (309 ML/year). Hydraulic analysis undertaken by R.J. Cave in a 1964 study for the City of Powell River indicated a lake yield during draught conditions of 2.0 Mgpd (9.0 ML/day or 104 L/s). Hammil Lake therefore is estimated to have the capacity to provide the following:

- Hammil Lake has the capacity to provide interim Area B demands as well as City and downstream water licence demands [total = 5.06 ML/day (68 L/s)].
- Hammil Lake has the capacity to provide interim demands for Areas B and C [total = 9.1 ML/day (112 L/s)].
- The full build-out demand of 173 L/s of Area B would exceed the available flow of 104 L/s. This would require storage capacity to provide the additional 69 L/s of capacity.
- Hammil Lake does not have the capacity for full build-out demands for Areas B and C.

The additional storage required to provide the 69 L/s for the six month period during the summer from mid April to mid October to meet Area B ultimate population requirements is 1,074,000 m^3. Allowing for City storage of 309,000 m^3 and other water licence storage, the total storage required is 1,385,000 m^3, say 1,400,000 m^3. This is considered conservative as it assumes no inflow during this period. It would also be considered conservative if District demand side measures reduce the per capita peak day demand assumed in the demand analysis.

Storage of 1,400,000 m^3 represents a lake depth of 1.6 m. The storage can be developed by raising the lake to approximately 147.6 m, or accessing storage below 145.0 m to 143.5 m, or a combination of both. Based on the information provided in the Cave report, raising the lake to 147.75 m could be undertaken by berming the low area at the north outlet of the lake. A control structure is proposed to be constructed to better control water levels and lake outlet flows which would be required for environmental and downstream user requirements. The estimated cost is in the order of $220,000.

Water quality testing in the past has indicated issues with water quality. The watershed is open to commercial and public use and there is a BCTC/ Powell River Energy (PRE) transmission right-of-way through a portion of the watershed. The poor water quality was determined to be the likely result of the condition and location of the intake which is located in the shallow north end of the lake. Recent water quality testing found the lake water meeting GCDWQ. Further testing is required, particularly during the summer months, to confirm water quality parameters for source of treatment. The Hammil Lake source, provided a multi barrier approach is taken, is suitable as a potable water supply.

Lois Lake

Lois Lake is an extensive watershed which is operationally governed by water licences held by Powell River Energy (PRE). Key licence information is as follows:

- Maximum withdrawal of 1,297 ft^3/s (7,465 ML/day, 36,750 L/s)
- Maximum storage of 448,960 acre ft annum (555 mm^3/year)
- A smaller licence for West Coast Fish Culture of 2.25 ML/day (26 L/s)

PRE operates the lake levels between 143 m and 159 m.

For comparison purposes, the interim peak day demand of 6.75 ML/day (78 L/s) for Area B and Area C represents 0.2% of PRE's withdrawal. The ultimate peak day demand for Area C is 28.5 ML/day (330 L/s) represents 0.4% of PRE withdrawal. The ultimate peak day demand for Area B and Area C is 40.5 ML/day (469 L/s) represents 0.9% of PRE withdrawal. Lois Lake is expected to have capacity to provide for ultimate Southern Region peak day water supply demands. Further discussions with PRE and BC Water Management would be required.

There is little water quality data for Lois Lake. The watershed is exposed to forest resource activities as the land within the watershed is predominantly tree farm licences. In the vicinity of the dam, there is a commercial fishery operation, a log sort and recreational float cabins. The lake does experience significant flushing action due to the operation of PRE's hydro facility.

Water quality testing undertaken as part of this study found the water quality to meet GCDWQ. Further testing should be undertaken particularly during the summer months and during low lake levels.

It is expected that use of Lois Lake as a potable water source is possible, provided the following:

- Location of an intake upstream of the commercial operations in the vicinity of the dam, and location of the intake below PRE lake operating levels.
- Potential agreement with PRE and securing a water licence

Regional Source Development and Transmission

Given the constraints of the supply sources and required interim demands, consideration for development of a regional water system were based around a connection to the City or development of Hammil Lake for Area B. Supply to Area C for interim and ultimate demands would be from Lois Lake. An option of supplying Area B and Area C from Hammil Lake to meet the interim demands for 2037 was also considered.

Interconnecting Areas B and C would be trunk supply mains and a series of balancing reservoirs to supply peak day demand and fire flow supply.

Supply to Area B and Myrtle Pond

Five options were considered for supplying water to the Myrtle Pond water system and Area B. These were:

- Option 1: connect to City at Highway 101
- Option 2: connect to City at Duncan Street
- Option 3: connect to City at upper Nootka
- Option 4: develop Hammil Lake via Padgett Road
- Option 5: develop Hammil Lake via Padgett Road/BCTC/Stevenson Road

Costs were estimated based on expected connection costs to the City based on Water Use Bylaw rates, capital costs, water fees, and operation and maintenance costs. Present worth analysis, over a period of 30 years was completed to effectively compare alternatives. City costs utilized in the analysis were as follows:

- City upgrade or connection costs of $2.4 million
- City bulk water costs of $0.359/m^3, $0.551/m^3 and $0.912/m^3 which reflect the City's Water Rates and Regulation Bylaw rates, and rates recently negotiated for a development outside the City, adjusted for the City's recent 15% increase.

Based on water licence rates provided by BC Water Management, the cost of accessing water from Hammil Lake is estimated at $4,804/year.

Long term costs were estimated as follows:

		City Water $0.359/m^3	City Water $0.551/m^3	City Water $0.911/m^3
Option 1:	Connection to the City at Highway 101	$9,349,000	$11,349,000	$14,583,000
Option 2:	Connection to the City at Duncan Street	$10,845,000	$12,665,000	$16,079,000
Option 3:	Connection to the City at Nootka Street	$9,623,000	$11,443,000	$14,857,000
Option 4:	Develop Hammil Lake (Padgett Rd. Supply)	$6,339,000	$6,339,900	$6,339,000
Option 5:	Develop Hammil Lake (Padgett/BCTC/Stevenson	$6,689,000	$6,689,000	$6,689,000

(1) This does not include costs associated with dept servicing, District administration and insurance.

(2) Note Hammil Lake Options 4 and 5 include yearly cost of water licence rental.

In the absence of a negotiated agreement with the City, the most cost effective option over the longer term is Options 4 and 5, to develop Hammil Lake as a source of supply. The main drawbacks to connecting to the City water system are the potential initial connection cost and the ongoing cost of water. It is noted that even

if the City waived the connection cost and charged the water rate available to City residents, it would still be more cost effective in the long term to develop Hammil Lake.

In conveying flows from Hammil Lake to Padgett Road under Options 4 and 5, four alternatives were evaluated. The evaluation was based on capital costs and long term operations and maintenance cost. The alternatives were as follows, assuming the intersection at Gunther Road and Padgett Road as the common point:

Alternative A: Existing City watermain alignment north to Padgett then south to Gunther (gravity).

Alternative B: Due west from existing intake to Padgett (gravity).

Alternative C: BCTC Right-of-Way/Gunther Road (pumped).

Alternative D: BCTC Right-of-Way/Gunther Road (gravity/siphon).

The costs are summarized as follows:

Alternative	Capital Cost	PW of O/M over 30 years at 5%	Total
A	$550,000	$90,620	$640,620
B	$384,000	$60,415	$444,415
C	$897,000	$275,627	$1,172,627
D	$1,400,000	$227,480	$1,627,480

Based on the above, it is recommended Alternative 2 be advanced unless an agreement can be reached with the City for cost sharing in the order of $200,000.

Regional Supply

Development of the regional supply, which includes transmission supply mains reservoirs, pump station, and PRV stations, was evaluated on the basis that Lois Lake would be required for the ultimate demand of Area C. An alternative was also investigated where Hammil Lake could supply Area B and Area C in the interim via a transmission main along the BCTC right-of-way to either the Lang Bay lower zone or high zone, or alternatively, via BCTC right-of-way, Duck Lake Road and Highway 101. The costs are summarized as follows:

Option	Item	Capital Cost	PW O/M based on 5% for 30 years	Total Cost
Option 6	Interim supply Area C from Lois Lake	$20,675,000	$4,714,000	$25,389,000
Option 7	Interim supply Area C from Hammil Lake (low zone)	$22,780,000	$4,230,000	$27,010,000
Option 8	Interim supply Area C from Hammil Lake (high zone)	$23,720,000	$4,384,000	$28,104,000
Option 9	Interim supply Area C from Hammil Lake via Duck Lake Road	$21,830,000	$4,804,000	$26,634,000

The present worth (30 years at 5%) for the cost of the water would add an additional $249,850 to the total cost. Not included in these costs are costs associated with debt servicing, Regional District administration, and insurance.

Although the cost of deferring Lois Lake and servicing the Southern Region in the interim from Hammil Lake is approximately $1.3 million to $2.7 million more than developing Lois Lake, there are significant benefits with such an approach. These benefits include:

- The whole Southern Region can be serviced including the upper high zone in the Kelly Creek, Hammil Hill, and Nootka areas, not just the low zone Highway 101 corridor.
- Security, reliability and operational flexibility is optimized as the majority of the Southern Region, except Stillwater, will be looped.
- More efficient development of the water system in the future through internal looping in the area between the BCTC right-of-way and Highway 101.

It is recommended that, if the Regional Board and residents agree the additional benefits of servicing Area C in the interim from Hammil Lake justify the additional costs, and then proceed with Option 7, 8 or 9. Of these, we recommend Option 7. Should the additional costs not be justified, then proceed with Option 6.

Distribution Servicing Costs

Servicing costs for residential areas were estimated for three areas in Area B, and four areas in Area C. The costs are summarized as follows:

Area B

Area	# of Lots	Overall Cost	Cost/Lot
McClausland/Alta Vista	9	$95,000	$10,550
Gaudit/Myrtle Point/Barnes	30	$245,000	$8,170
Hwy 101-Masters Rd to Stevenson	20 (1)	$195,000	$9,750

(1) Four commercial lots included.

Area C

Area	# of Lots	Overall Cost	Cost/Lot
McLean Rd/Stittle Rd.	26	$220,000	$8,462
Wilcox Rd.	16	$225,000	$14,065
Donkersly Rd./Douglas Bay Rd.	32	$345,000	$10,780
Phillips/Kennedy/Manning/Dunlop	60	$880,000	$14,677

Per lot costs for the regional system would be in addition to the above local servicing costs.

Table of Contents

List of Figures

List of Tables

Appendices

Glossary

Lpcpd:	litres per capita per day
PVC:	Polyvinyl Chloride. Refers to water pipe material
HDPE:	High Density Polyethylene. Refers to water pipe material.
DI:	Ductile Iron. Refers to water pipe material.
Igal:	Imperial gallons
Igpm:	Imperial gallons per minute
HP:	Horsepower
psi:	pounds per square inch
kPa:	Kilopascals
L/s:	Litres per second
US gal:	US gallons (1 US gallon = 0.8327 Igal)
US gpm:	US gallons per minute
BCTC:	British Columbia Transmission Corporation
NTU:	Nephelometric Turbidity Unit (measure of water clarity)
O/M:	Operations and Maintenance
TWL:	Top Water Level
LWL:	Low Water Level
HGL:	Hydraulic Grade Line

Distribution Mains:	Refers to watermain which would service local areas and roads.
Supply Mains:	Refers to the bulk supply mains and infrastructure.

1. Introduction

The objective of this study for the Powell River Regional District is to review water supply options for the District's Southern Region. In particular, the report was to consider two sources Hammil (West) Lake and Lois Lake and connection to the City. In the near term water supply to the Myrtle Pond Water System requires investigation due to development pressures, water quality and quantity.

1.1 Background

The Southern Region of the Powell River Regional District consists of the area east of the City of Powell River from the municipal boundary to Jervis Inlet. The area is encompassed in District Electoral Areas B and C. The area is divided between a densely populated strip that follows Highway 101 along Malaspina Strait and Jervis Inlet. Inland, development consists of agricultural holdings and relatively sparse industrial/ commercial holdings. The area is approximately 288 square kilometres and includes 51 km of scenic coastline and a variety of geographic features. The area comprises of a mix of rural to suburban land use and provides an alternative to the higher development located in the City of Powell River.

In recognition of the potential for development, the Regional District undertook an Official Settlement Plan prior to 1993. In 1993, the Official Settlement Plan was formalized into an Official Community Plan for the Southern Region. This Southern Region Official Community Plan (SROCP) is currently being updated by the District.

Rural residential development is concentrated along Highway 101 and the coastal strip parallel to it. Coastal development is strung out in patches adjacent to the highway. It is expected that the demand for residential growth will continue to grow primarily along the coastal and Highway 101 strip, because of its attractiveness.

There are two agricultural "neighbourhoods" located within the Southern Region:

- Paradise Valley
- Kelly Creek

These areas support viable farms and hobby farms.

Small scale industrial enterprises are dispersed throughout the region. The settled areas are backed by large tracts of Crown Land, Agricultural Land Reserve and forest tenures including the Powell Provincial Forest. There is also a significant portion of land designated Airport Reserve and Agricultural Land Reserve. Surrounding the Airport Reserve is significant areas of City of Powell River owned land.

Existing Water Systems

Water supplies in the Southern Region have been developed by individuals and small groups. There are approximately 56 small water systems monitored by the Health Department in the Southern Region. Eight of these are "Local Improvement Districts" or utilities which have been formed to service larger numbers of users. These larger water systems are:

- Myrtle Pond Improvement District
- Stella Maris Water System
- Woodlyn Improvement District
- Pinetree Place Improvement District
- Brew Bay Improvement District
- Lang Bay Water Works (privately owned)
- Stillwater Waterworks Improvement District
- Saltery Bay Improvement District

The Myrtle Pond water system (MPWS) is currently operated by the Powell River Regional District. The remaining water systems are comprised of Improvement Districts or are privately owned and operated. The majority of the individual and small group water systems are groundwater based, either deep or shallow well. The Stella Maris, Myrtle Pond, Woodlyn, and Pinetree water systems are serviced by groundwater. The Brew Bay, Lang Bay, Stillwater, and Saltery Bay are serviced by surface water sources.

Recently there has been a desire by some residents in the Southern Region to become part of a regional water supply system.

Due to water quality concerns and an adjacent development, the District investigated upgrading the MPWS. The MPWS presently services 43 residential users on 51 parcels. The system is an amalgamation of two water systems; the Myrtle Pond system constructed in 1982 to service a subdivision and the old Munson water system which was constructed approximately 40-45 years ago.

Concerns were also raised regarding the quantity of water available from the wells. Static water testing was undertaken by the District in November 2004. The static level was found to be almost 46 m lower than the original static water level of the well. Subsequently the District conducted an investigation to confirm the following:

- Source of high colour in the well water
- Options for treating the water colour and estimated costs
- Requirements and costs for distribution system upgrades
- Address concerns regarding water supply capacity

These issues were reviewed in the Myrtle Pond Water Study (2005).

The cost and recommendations from the Myrtle Pond water study initiated the Southern Region Water Source Study by the District. The District has recently completed Phase I of this review which involved an extensive survey of the residents in the Southern Region on the status of their current water supply quality and quantity. The District also undertook a detailed assessment of the MPWS.

Over the years some of the community water systems have invested funds to upgrade their water supply and distribution infrastructures, other systems appear to lack the strong organization or financial resources required to maintain, improve, or upgrade the infrastructure.

Need for Source Review Study

Recognizing the need for potential upgrading of the MPWS, the District wished to consider other alternative sources. These sources include:

- Connection to the City of Powell River Water System
- Connection to Hammil (West) Lake
- Connection to Lois Lake

The intent was to consider these options for the supply of MPWS in the short term and in the context of a potential Southern Region Regional Water Supply System in the long term. More specifically the intent was to address:

- The quantity and quality of the water supply sources
- Provide a cursory review of the seven existing main water supply systems
- Initial and long term capital and operating costs
- Undisclosed costs and liabilities
- Prepare conceptual plan complete with costs to initially provide water to the MPWS. In the long term, consider options for accommodating growth in the overall Southern Region.

1.2 Study Area

The study area is shown in Figure 1-1. The Southern Region of Powell River can be characterized by forested terrain sloping broadly southwards from the Smith Mountain Range towards Malaspina Strait. The area is marked by three major drainage systems: Myrtle Creek, Lang Creek, and Lois River. There are also lesser watersheds such as Deighton Creek and Kelly Creek.

The eastern extremity of the region consists of a steeper forested mountain slopes which extend virtually to the edge of Jervis Inlet.

Presently, development is focused on a relatively narrow strip of land along the coast and in proximity to the main transportation route (Highway 101). The present population of the Southern Region is estimated to be 3600 people based on the 2006 Census. Between the 2001 and 2006 Census, the population of the Southern Region showed no growth.

1.3 Scope Assignment

The objective of this study is to provide direction with regard to quality, quantity and conveyance of water to supply initially the Myrtle Pond Water System and in the long term, the Southern Region. The scope of work is provided as follows:

1.3.1 City of Powell River Water and Hammil (West) Lake Source Investigation

Compare and evaluate each source for:

- Quality and quantity of water
- Initial and long term capital costs

- Initial and long term operating costs
- Life cycle and net present value
- Liabilities
- Undisclosed costs of water purveyance. For example:
  - contracts with City of Powell River
  - purchasing rights-of-way
  - water rights

Based on current construction costs for similar work, supply estimated costs per lineal metre to:

- Construct a transmission line to the MPWS area
- Construct service lines or arterials required to service the remote areas

Identify all feasible routes for transmitting water from each source to the MPWS and provide general specifications. Recommend alternatives that may reduce supply or transmission costs.

1.3.2 Lois Lake Source Investigation

Investigate the availability of Lois Lake as a potential community water source with respect to availability, quality and quantity of available water source

Compare and evaluate each source for:

- Quality and quantity of water
- Initial and long term capital costs
- Initial and long term operating costs
- Life cycle and net present value
- Liabilities
- Undisclosed costs of water purveyance. For example:
  - contracts with City of Powell River
  - purchasing rights-of-way
- Water rights, leases.

The study was approached in the following manner:

- Gather and review current information, review planning parameters, review sources
- Review the major Water Improvement Districts in the Southern Region
- Assess Quantity and Quality of the supply sources considered in this study
- Consider treatment and conveyance alternatives
- Estimate initial and long term costs
- Identification of liabilities and undisclosed costs

1.4 Reference Sources

Field investigations were carried out to obtain up-to-date information on the existing systems. This included visits to the Hammil Lake and Lois Lake Watersheds, potential transmission route alternatives.

Water quality sampling of the Lois Lake and Hammil Lake sources was also undertaken.

In addition, the following reports and data have provided historical background information relative to both the planning and operation of the waterworks systems.

- Powell River Regional District, Southern Region Water Resource Study, Kerr Wood Leidel, 1989
- Powell River Regional District, Southern Regional District, Official Community Plan, 1993
- Statistics Canada, Census Data 2006
- Ministry of Labour and Citizens Services, BC Statistics, P.E.O.P.L.E data 1985 - 2036
- City of Powell River, Long Term Water Supply Study, Dayton & Knight Ltd., May, 2005
- Powell River Regional District, Southern Region Water Supply Study - Phase I, Kerr Wood Leidel, March 2006
- Powell River Regional District, Myrtle Pond Water Study, Kerr Wood Leidel, July 2005
- Powell River Regional District, Stillwater Waterworks District, Water System Assessment Study; Draft Report; McElhanney Consulting Services, February, 2008
- City of Powell River; Hammil (West) Lake Water Supply; R.J. Cave Associates, 1957
- City of Powell River; Water Quality Survey of West Lake, BC Research, 1973
- MMCD – Municipal Infrastructure Design Guideline Manual
- Land and Water BC; Design Guidelines for Rural Residential Community Water Supply Systems; 2004
- Coast Garibaldi Community Health Services Society; An Investigation of High Arsenic Levels in Wells in the Sunshine Coast and Powell River Regions of BC; Institute for Research and Environmental; UBC; March 2000
- Communities of the Sunshine Coast and Powell River; Well Water Survey for Arsenic in the Powell River and Sunshine Coast Communities of British Columbia; Environmental Health Assessment and Safety Branch, Ministry of Health, April 1995
- Myrtle Creek Estates, Well Construction and Capacity Testing of Myrtle Creek Estates (DRAFT), Pacific Hydrology Consultants Ltd. 2007
- City of Powell River; Drinking Water Protection Act Implementation; Dayton & Knight Ltd./Whitehead Environmental; April 2006

These reports and studies provide the basis in terms of issues related to water quality and supply in the Southern Region. The intent of the review was to provide a context of water supply in the region prior to, and since the 1989 Southern Region Water Resource Study.

The findings are summarized as follows:

PRRD - Southern Region Water Resource Study

Key details of this 1989 study are:

- The study considered three sources: City of Powell River, Lang Creek, and Lois Lake.
- Water quality was identified as unacceptable for all of the existing local water systems relying on surface water sources. Only Stillwater system carried out disinfection. Water quality was less than satisfactory for many of the groundwater systems but appeared to be associated with contamination of the distribution system rather than the groundwater source.
- Peak day demand of 350 Igal/Cap/day was selected for the basis of planning.
- Estimated and projected peak day water demands were as follows:

Table 1-1. Estimated and Projected Peak Day Water Demands

Year	Rate (Igpm)	Estimate Population
1988	790	3250
2000 (design horizon)	1,000	4,100
2038 (ultimate case)	2,124	8,740

Fire flows varied from 400 Igpm to 1,000 Igpm depending on locality and extent of commercial and institutional development

- Surface waters should be provided with disinfection prior to domestic use. A water quality testing program was recommended.
- Three surface water sources considered for Southern Region system.
  - Purchase water from City of Powell River (supply to Western end, i.e., Myrtle Creek Valley)
  - Construction of Intake and pipeline on Lang Creek (supply for rest of Southern Region)
  - Purchase of water from Powell River Energy for Lois Lake. Backup for entire region
- The estimated capital cost (Class D) to construct the component facilities (i.e., intake, connection, transmission mains, reservoirs) was in the order $6.5 million.
- If a filtration treatment plant was required then the estimated capital (Class D) cost was $2.4 million.
- The proposed system would consist of the following components:
  - Low zone (sea level to 70 m), high zone (70 m to 127 m) pressure service zone
  - Connection to City system at Highway 101/City boundary and Paradise Valley Road/City boundary
  - Intake end disinfection facility on Lang Creek
  - Trunk transmission main along Highway 101 to Stillwater and along Paradise Valley Road
  - Reservoirs and Booster Pumping to provide peak hour and fire flows for the low and high zone systems
- Implementation of Southern Regional Plan was proposed as follows:
  1) Secure sources
  2) Develop Lang Creek to Service Brew Bay and Lang Bay

3) Connect to City of Powell River system to serve the Myrtle Creek Valley

4) Complete the feedermain links between development centres

City of Powell River Long Term Water Supply Plan

Key details of this 2005 study are:

- The City is currently supplied by two water sources:
  - The Powell Lake System which services the Wildwood Area
  - the Haslam Lake System which services the Townsite, Cranberry and Westview areas
- The current plan envisions a pumped interconnect between the Haslam system and the Powell Lake system. The Haslam system would then be the primary system for the whole city with Powell Lake acting as a backup for the Wildwood system.
- The Hammil Lake system is recommended to provide back up fire protection to the upper areas on zone 1 near the airport. The old wood stave watermain needs upgrading and the intake is to be relocated into the deeper water at the south end of the Lake to improve water quality and available storage. The Hammil Lake system can be used for redundancy in providing backup in the event of a Haslam Lake supply shutdown. Alternative to the Hammil Lake supply improvements could be the development of a groundwater supply near the airport.
- A multi-barrier treatment system is proposed for the Haslam source (UV, chlorination). Chlorination only is proposed for the Hammil Lake and Powell Lake back-up supplies.
- Several distribution system improvements are required to address fire flows and low pressures during peak hours.
- The 900mm diameter transmission main from Haslam Lake should be replaced due to age and to provide redundancy in the water system
- The estimated costs associated with the upgrades were $8.8 million ($2005). The majority of the works were scheduled between 2005 and 2010.

Southern Region Water Supply Study - Phase I

Key details of this March 2006 study are:

- The study was a survey of Southern Region area residents in regards to quality and quantity of water.
- Fifty five percent of residents who responded identified wells which have water that meets Health Standards. Seventy-seven percent (75%) have wells with sufficient water quantity. Although this implies that 45% do not have wells which meet Health Standards, we point out that it may be that they just don't know.
- From a public health perspective and regional perspective the number of residents that cannot confirm that their well water meets public health standards is a concern.
- Community water systems (greater than one connection) are required to meet legislated standards.
- The existence of numerous individual wells which do not meet health standards is typically an initiating point for consolidation of water systems and should be discussed with the local health officer.
- Potential solution to address problems:

  - expansion of existing systems
  - location of existing or new wells with sufficient capacity to supply new community supply systems
  - expansion of City of Powell River system
- Existing water systems which could potentially be candidates for operation and oversight by PRRD should be assessed to determine compliance with Drinking Water Protection Act (DWPA) and Drinking Water Regulation (DWR).

Myrtle Pond Water Study

Key details of this 2005 study are:

- The study concluded the following:
  - The colour in the groundwater is from organic carbon content
  - Additional testing with Granular Activated Carbon is required prior to confirming feasibility of water treatment
  - There are a few high risk potential cross-connections and security issues that should be resolved as soon as possible
  - The interior storage tank coating has failed and needs to be replaced and there is extensive corrosion inside the storage tank
  - The exterior storage tank coating requires repairs
  - The exterior of the well pump control building is in deteriorating condition
  - The maximum day, per capita water consumption is almost double the industry standard for similar communities
  - The 46 m drop in static water level in well W-93 indicates that the available yield of the aquifer has been exceeded for an extended period of time by the use of well W-93 or other unknown wells that draw from the same aquifer
- Suggested improvements were made for the system in terms of immediate, short term, and long term:

  Immediate Needs:
  - Eliminate potential cross connections
  - Address security/vandalism issues
  - Implement bi-weekly measurement of well W-93 static water level

  Short Term Needs (1 year):
  - Undertake a groundwater investigation for an additional water source
  - Initiate a raw water sampling program for implementing future treatment
  - Upgrade pump control building
  - Implement a water conservation and metering program
  - Construct a new bolted steel tank or re-coat existing storage tank
  - Make changes noted in Storage Tank Assessment (if re-coating existing tank)

  Long Term Needs (2 - 5 years):
  - Implement water treatment program
  - Complete upgrading of water distribution system

- Costs associated with the suggested improvements are as follows:

Table 1-2. Suggested Improvement Costs

No.	Item	Cost
1.	Immediate needs	$13,000
2.	Short term needs	$501,000
3.	Long term needs	$507,000
	Total	**$1,021,000**

Well Construction and Capacity Testing at Myrtle Creek Estates (MCE) - Draft

Key details of this 2007 study are:

- Based on available information and information obtained during a field testing program, the long term theoretical capacity of new well MCE 1-08 was estimated to be 12.5 usgpm (0.8 L/s) to 14.2 usgpm (0.9 L/s). The combined yield of MCE 1-05 and MCE 1-08 is estimated to be 23.7 usgpm (1.5 L/s) to 25.5 usgpm (1.6 L/s).
- The estimated maximum day demand for MCE is 1.42 L/s (22.5 usgpm) based on Provincial Rural Residential Community Water Systems Guidelines. A winter water demand of 0.6 L/s (10 usgpm) and a summer demand of 1.3 L/s (20 usgpm) was estimated for a combined MCE and Myrtle Pond water system.
- It was proposed that the water from the MCE wells be used to supply the Myrtle Pond water system.
- The water quality of the MCE wells met Canadian Drinking Water Guidelines except for iron and manganese.

Stillwater Water System Assessment Study

Key details of this 2008 study are:

- Water quality data identified total coliform contamination of the water supply system (28.2% of samples) and fecal coliform contamination (6.5% of samples prior to 2006; 9% of samples post 2006).
- The water supply source for the Stillwater Improvement District, Jefford Creek, is subject to contamination hazards from forestry operations, landslides and wind throw events, erosion of stream banks, wildlife, forest fires, beaver ponds and wetland areas.
- The current water supply system lacks adequate storage based on current demands.
- Recommended improvements are estimated at $1.5 million.
- Service levels and existing system components do not meet VCHA standards in several areas (treatment, monitoring and confirmation of chlorination storage).
- Resources available to SWWD with respect to system management, financial capacity and governance are very limited and becoming a burden to the community and staff.

Well Water Survey for Arsenic in the Powell River Sunshine Coast Communities of BC

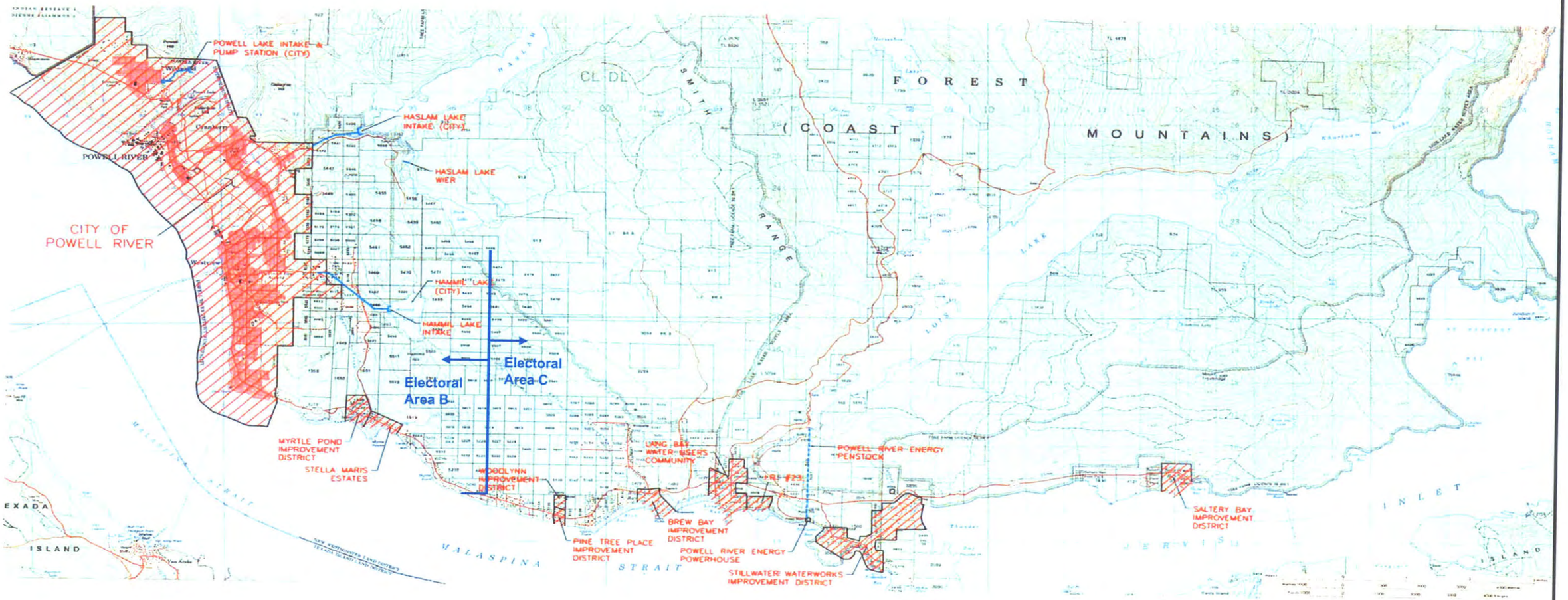
Key details of this 1995 study are:

- In the Powell River Southern Region, the percentage of wells exceeding the Guidelines for arsenic 0.025 ppm (0.025 mg/L) were 25% Lang Bay to Saltery Bay, 19% Black Point/Kelly Creek, and 2% Powell River South. For wells greater than 20 m, the percentages were as follows: 75% Lang Bay to Saltery Bay, 46% Black Point/Kelly Creek, 3% Powell River South.
- Recommendations included extending the community water supply systems or point of entry / use systems.
- It is noted that the current Canadian Drinking Water Guideline for arsenic is now 0.010 mg/L.

Investigation of High Arsenic Levels in Wells in the Sunshine Coast and Power River Regions of BC

Key details of this 2000 study are:

- 50% of the wells studied had levels of arsenic concentrations greater than the GCDWQ level of 0.025 ppm (0.025 mg/L). Approximately 20% of the samples had fluoride and boron levels which exceeded GCDWQ Guidelines.
- The source of high levels of arsenic was thought to be mineralization deposits in fissures present in the underlying bedrock. Water passing through the cracks dissolves and transports the arsenic from the precipitates into the wells.



AECOM

Powell River Regional District
Southern Region Water Supply
Study Area

Figure 1-1

2. Population Projections and Water Supply Demands

2.1 Planning Horizon

For the purpose of developing a long term plan for source development, it is important to consider a planning horizon. The planning horizon should ensure that sizing of initial infrastructure can provide water supply in the near term. This is typically 10 to 15 years. Assessment of water sources should be based on 30 to 50 year period to allow flexibility to expand water supply in the long term. If an Official Community Plan (OCP) exists, then long term water source development should be considered based on ultimate land use or "build out" as set out in the OCP.

For the purposes of this study, the initial study period is assumed to be a minimum of 15 years. The assessment of water sources would consider a 50 year horizon or to OCP build out.

2.2 Existing Population and Land Use

The population of the Southern Region based on 2001 and 2006 census data is as follows:

Table 2-1. 2001 and 2006 Census Population

	2001	2006	2008 (estimate)
Electoral Area B	1450	1489	1500
Electoral Area C	2135	2074	2100
Total	3585	3563	3600

Note: BC Statistics estimates are the same.

By comparison, the population of the Southern Region identified in the 1989 Southern Region Water Resource Study was 3,120 (1986 Statistics Canada Census). The increase over 20 years is approximately 450 people. This translates to a yearly growth rate of 0.6%. This is a relatively slow growth rate, but is considered consistent under the goals set out in the current OCP for land use and development in the Southern Region.

Since the development of the 1989 Southern Region Water Source Study, the District has completed an Official Community Plan for the Southern Region (SROCP). Land use in the Southern Region is governed by the Southern Regional District Official Community Plan Bylaw 178, 1993. Land use in the 1993 SROCP is described as follows:

a) The existing settlement pattern is generally described as "settlement-by-encroachment". Rural residential development is concentrated along the highway and the coastal strip parallel to it. Coastal development is strung out in patches adjacent to the highway. Development clusters also exist around the major community water systems in the Southern Region. It is expected that future residential development will occur in the existing community water systems and by infilling between these community water systems along the coast highway strip.

b) Two agricultural neighbourhoods have developed on the north south axis. Paradise Valley and Kelly Creek. These areas support a few viable farms.

c) Small scale industrial enterprises are dispersed throughout the Southern Region. Commercial establishments serving local residents are located primarily along the highway. There is some clustering of commercial enterprises but no "commercial centre" within the planning area.

d) Outside the settled and agricultural lands are large parcels of Crown Land, including Powell Provincial Forest. These areas fall within the jurisdiction of the Integrated Land Management Bureau (Crown Lands) and/or the Ministry of Forests and are primarily used for silviculture.

e) Outside of logging, industrial development is limited to a few small sawmills and some fish farms.

f) Almost all of the households and commercial/industrial enterprises located within the planning area are serviced by telephone and hydro. Cable television is available between the City and Stillwater. Sewage disposal is primarily by septic tanks and fields. Water is provided by numerous small to large community water systems or individual wells.

g) Community values in the Southern Region revolve around the following:

   i) A healthy, naturally environment;

   ii) Peaceful and natural beautiful surroundings;

   iii) A range of housing and lifestyle options;

   iv) Accessibility to a variety of recreational opportunities; and

   v) Freedom from restrictions and costs associated with government services.

Planning issues identified in the SROCP as they relate to water supply are as follows:

- In order to minimize the degradation of water quality for existing and potential domestic water supply areas, the protection of community watersheds has been identified as a major issue. The SROCP discourages commercial use in the watersheds and restricts development in watershed areas to low density rural land uses.
- Although commercial and industrial development is desirable for the employment opportunities it presents, the SROCP identifies home based businesses as a desirable alternative also consistent with the rural lifestyle of the SROCP planning area.
- The SROCP discourages development within environmentally sensitive areas which are classified as hazardous areas, ecologically important areas and unique features or scenic areas. The SROCP discourages development in hazardous areas (steep or unstable banks). The Ministry of Environment setback and elevation restrictions are also considered for land allocation.
- Residential small lot development is generally occurring in the sensitive Coastal Zone contained along Highway 101 south of the City. Development in this area is dependent on the ability of the aquifer to continue to supply the required quantity and quality of water.

The development strategy of the SROCP as it relates to water supply in the Southern Region is as follows:

- Maintain the rural character and lifestyle of the Southern Region by maintaining relatively large parcel sizes along the Coastal Zone and by encouraging rural – agricultural neighbourhoods in the Paradise Valley, Kelly Creek and Roberts Road area.
- Encouraged commercial developments in the following areas:

  - North of Highway 101 between the City boundary and Stevenson Road
  - In the vicinity of Black Point store
  - In the vicinity of the Lang Bay / Highway 101
  - In the vicinity of Saltery Bay
- Encourage home based businesses
- Focus residential development in the Brew Bay / Lang Bay area
- Protect community watersheds through the establishment of watershed management policies
- Limit the minimum lot size in the area adjacent to Highway 101 from the City boundary to Brew Bay to 0.4 ha until such time an engineering study can ascertain the area's capability to support smaller lot development without the implementation of community water or sewer systems.

Figure 2-1 provides an aerial overview of land use in the Southern Region.

The SROCP identifies several land use designations in the Southern Region. They are designated on Map Schedule B of the SROCP and are as follows:

a) **Agricultural** (agricultural, intensive agricultural, forest management, and silviculture and residential uses)
b) **Commercial** (service stations, car dealerships, mobile home sales or other uses, etc.)
c) **Commercial Recreation** (campgrounds, golf courses, driving ranges, marinas, etc.)
d) **Reserve** (forest management activities, including harvesting and silviculture, gravel extraction, or public recreation uses which do not limit options for future development)
e) **Industrial**
f) **Institutional**
g) **Parks and Recreation**
h) **Residential**:
   i) Rural (agricultural, one family residential, home occupation, home based business)
   ii) Low Density Residential
   iii) Suburban Residential

The land use designations provide for minimum lot sizes based on whether it is serviced by a community water system or not. The minimum lot sizes are as follows:

Table 2-2. SROCP Minimum Lot Sizes

Land Use Designation	Minimum Lot Size	
	Serviced by Community Water System	Unserviced by Community Water System
Agricultural (only when removed from ALR, approved by subdivision by ALC, exempted from Land Commission Act	2 ha (5 acres)	2 ha (5 acres)
Commercial	0.18 ha (0.444 acres)	0.6 ha (1.482 acres)
Commercial Recreation	0.15 ha (1.235 acres)	0.8 ha (1.976 acres)

Land Use Designation	Minimum Lot Size	
	Serviced by Community Water System	Unserviced by Community Water System
Reserve	N/A	N/A
Industrial	N/A	N/A
Institutional	0.25 ha (0.617 acres)	0.6 ha (1.5 acres)
Parks and Recreation	N/A	N/A
Residential		
Rural	Independently serviced Assumed Minimum 1.4 ha (3.5 acres) Average 2.0 ha (5.0 acres)	Minimum 1.4 ha (3.5 acres) Average 2.0 ha (5.0 acres)
Low Density Residential	Constrained by inadequate septic systems or lack of community water Assumed Minimum 0.35 ha (0.9 acres) Average 0.50 ha (1.2 acres)	Minimum 0.4 ha (1.0 acres) Average 0.6 ha (1.5 acres)
Suburban Residential	Minimum 0.25 ha (0.6 acres) Average 0.4 ha (1.0 acres)	Minimum 0.4 ha (1.0acres) Average 0.6 ha (1.5 acres)
Mobile Home Park	N/A	N/A
Resource Lands	N/A	N/A

It should be noted that at the time of writing, the Southern Regional District Official Community Plan was undergoing an update. Changes to the SROCP may result in changes to land use that could affect water supply issues.

2.3 Population Projections

2.3.1 1993 Southern Region Official Community Plan

Based on the above densities, and the land use areas provided on Map Schedule B of the SROCP, the following identifies the potential lot development in the Southern Region and potential "build out" population.

Table 2-3. SROCP Build out Population

Land Use	Total Southern Region Area (per SROCP Map Schedule B)		Lot Potential at Build Out (per SROCP) [1]				Estimated Equivalent Population [2]			
			Serviced by Community Water System		Unserviced by Community Water System		Serviced by Community Water System		Unserviced by Community Water System	
	Electoral Area B	Electoral Area C	Electoral Area B	Electoral Area C	Electoral Area B	Electoral Area C	Electoral Area B	Electoral Area C	Electoral Area B	Electoral Area C
Agricultural	635 ha	998 ha	317	499	317	499	542	1247	793	1247
Commercial	29 ha	7.5 ha	161	42	48	12	402 (1305) [3]	105 (338) [3]	120 (1305) [3]	30 (675) [3]
Commercial Recreation	14.5 ha	37.5 ha	29	75	18	47	72 (362) [6]	187 (937) [6]	45 (362) [6]	117 (937) [6]
Reserve	287.5 ha	80 ha	205 [8]	57 [8]	-	-	512 [8]	148 [8]	-	-
Industrial	40.5 ha	220 ha	-	-	-	-	(1822) [3]	(9900) [3]	1822 [3]	9900 [3]
Institutional	25 ha	52 ha	100	208	42	87	(625) [4]	(1300) [4]	(625) [4]	(1300) [4]
Parks and Recreation	16 ha	101 ha	-	-	-	-	-	-	-	-
Rural [1]	125 ha	908 ha	89 [1]	648	89	648	222	1620	222	1620
Low Density Residential [1]	226.5 ha	310 ha	647	885	453	620	1423	2212	1132	1550
Suburban Residential [1]	36.5 ha	201.5 ha	146	806	91	503	365	1773	227	1258
Mobile Home Park	12.5 ha	4.0 ha	-	-	-	-	712 [7]	228 [7]	712 [7]	228 [7]
Resource Lands	253.5 ha	275 ha	-	-	-	-	-	-	-	-
Airport Reserve [9]	46 ha	87 ha	-	-	-	-	(2070) [9]	(3915) [9]	-	-
IR [5]	-	20 ha	-	57	-	50	-	142	-	125

Notes:
1. uses minimum lot size
2. based on 2.5 people/lot except where noted
3. based on equivalent population of 45 people/ha which is 50% of the value provided for in the Master Municipal Infrastructure Design Guideline for estimating water demand, to reflect the goals for industrial and commercial development outlined in the SROCP.
4. based on equivalent population of 25 people/ha which is 50% of the value in the Master Municipal Infrastructure Design Guideline for estimating water demand, to reflect goals for institutional development outlined in the SROCP.
5. maximum lot size assumed as Low Density Residential
6. based on equivalent population of 25 people/ha derived from the City of Surrey Zoning Bylaw 12000 for estimating design populations
7. based on equivalent population of 57 people/ha which is 50% of the value derived from the City of Surrey Zoning Bylaw 12000 for estimating design population
8. assumes Rural Development under Regional Water Supply as water supply recharge not required, subject to SROCP amendment
9. assumes Industrial Development under Regional Water Supply as water supply recharge is not required and land may be available for development, subject to SROCP Amendment.

ha demotes hectares: 1 hectare = 2.471 acres

It should be noted that these estimates are considered conservative as they do not take into account non development areas such as roads, environmentally sensitive areas, crown land reserves, and potential park sites outlined on SROCP Map Schedules C and D.

The potential equivalent population for the Southern Region based on the availability of a regional water supply system and land use designations in the current SROCP is estimated as follows:

Table 2-4. SROCP Equivalent Population Projection

	Community (Regional) Water Supply System	Unserviced
Electoral Area B	9,960	7,200
Electoral Area C	23,755	18,840
Total	33,715	26,040

2.3.2 Historic Growth Projection

Past growth in the Southern Region over the long term (1986 to 2006) has averaged 0.6%. This is a relatively low growth rate but is considered consistent with a rural area where access to primary services, such as potable water and sewer, are limited. The development of a regional water supply system may increase the rate of growth. For the purposes of this study, a growth rate of 1.5% per year is considered. Future population projections are therefore estimated as follows:

Table 2-5. Future Population Projections

	2008	2028	2038	2053
Electoral Area B	1,500	1,875	2,345	2,931
Electoral Area C	2,100	2,625	3,282	4,104
Total	3,600	4,490	5,627	7,035

These projections compare with the SROCP build out equivalent population of 26,040 people for unserviced land and 33,715 when a community or regional water supply system is available.

Given that census population does not include an allowance for water supply due to land use other than residential, the following are considered for further discussion on water source issues:

Table 2-6. Southern Region Interim and Source Development Population Projections

	Interim	Source Development
Electoral Area B	2,345	9,960
Electoral Area C	3,282	23,755
Total	5,627	33,715

2.3.3 Future Land Use Issues

At the time of writing, the SROCP is undergoing review and public consultation. Land use may change as a result of the process which could impact population and hence water demands.

In addition, there are currently several past and impending developments which could impact the Southern Region. These include:

- A 12 lot subdivision is proposed for the end of Yaroshuck Road. Should the Regional District establish a water supply system, the developer would be required to join.
- Myrtle Point Golf Club has been developed which is not identified in the SROCP.
- There is an existing mobile home development in the vicinity of the golf course. Further mobile home development is being proposed. These mobile homes are not identified in the SROCP.
- An 11 unit apartment facility is under construction on Centennial Drive (Myrtle Pond). Not identified in the SROCP.
- A 30 lot subdivision is being constructed adjacent to the Myrtle Pond water system. Based on information reviewed in the well study for the subdivision, additional water supply may be required.
- Significant run-of-river hydroelectric development to the northeast which could impact population growth in the Southern Region.
- The potential development of airport reserve lands in the remote future (subject to amendment of the SROCP).
- Subdivision of Timberwest Lands in the Stillwater area.
- Potential development of land at Scotch Fir Point in Stillwater.
- Potential development of large reserve lands in the Grief Point area should a regional water system be developed.

The impact of some of these potential developments is unclear at this time.

2.4 Water Demands and Design Criteria

2.4.1 Consumption

Past records from community water supply records indicate the following consumption:

Table 2-7. Existing Consumption Records

System	Estimated Consumption		Estimate Basis
	Average Day	Peak Day	
City of Powell River	700 Lpcpd	2000 Lpcpd	2005 Long Term Water Supply Study
Myrtle Pond	1014 Lpcpd	2223 Lpcpd	Flow meter records
Stella Maris		630 Lpcpd	Based on well capacity
Pinetree		1170 Lpcpd	Based on well capacity
Lang Bay		1575 Lpcpd	Based on information provided by water operator
Stillwater		1035 Lpcpd	Flow meter records

Lpcpd = litres per capita per da.y

By comparison, design criteria provided in standard documents is as follows:

Table 2-8. Consumption Design Criteria

Source	Average Day	Peak Day	Peak Hour
Master Municipal Infrastructure Design Manual (MMIDM)	600 Lpcpd	1200 Lpcpd	1800 Lpcpd
Design Guidelines for Rural Residential Community Water Systems (DGRRCWS)	-	1170 Lpcpd [1] 1515 Lpcpd [2]	

Note:
1. *Based on 4.1 m^3/day and 3.5 people per dwelling. Single family detached house; temperate client; metering.*
2. *No metering.*

In general, the demands are discussed as follows:

- Peak Day demand for systems with limited water supplies is low.
- Where water supply is plentiful, sprinkling is more pronounced and peak day demands are in the order of 1200 Lpcpd to 1500 Lpcpd, which compares well to municipal design criteria.
- The high values for the City and Myrtle Pond were reported to be the result of leakage and/or sprinkling.

Given the reasonably good correlation of peak day demand between current water system flow records and standard design criteria, it is recommended the design criteria for average day, peak day, and peak hour, outlined in the Master Municipal Infrastructure Design Manual (MMIDM) be used for estimating water demand.

2.4.2 Water Demand

Based on MMIDM criteria the water demands are estimated, based on population projections provided in Table 2.9 as follows:

Table 2-9. Interim and Future Water Supply Demand

	Interim			Source Development		
	Average Day	Peak Day	Peak Hour	Average Day	Peak Day	Peak Hour
Electoral Area B	1.41 ML/day (16 L/s)	2.81 ML/day (33 L/s)	4.22 ML/day (49 L/s)	5.98 ML/day (69 L/s)	11.95 ML/day (138 L/s)	17.93 ML/day (207 L/s)
Electoral Area C	1.97 ML/day (23 L/s)	3.94 ML/day (46 L/s)	5.9 ML/day (68 L/s)	14.25 ML/day (165 L/s)	28.51 ML/day (330 L/s)	42.76 ML/day (495 L/s)
Total	3.38 ML/day (39 L/s)	6.75 ML/day (78 L/s)	10.12 ML/day (117 L/s)	20.23 ML/day (234 L/s)	40.46 ML/day (468 L/s)	60.69 ML/day (702 L/s)

Note: The above values do not include fire flow.

2.4.3 Fire Flow Requirements

Fire flows are in accordance with the criteria outlined in "Water Supply for Public Fire Protection", 1999, published by Fire Underwriters Survey, Insurance Bureau of Canada.

Minimum fire flows for the various zoning are co-incident with maximum day demand and are as follows:

Table 2-10. Minimum Fire Flows

Zoning	Required Fire Flow
Single and Two Family Residential	60 L/s [1]
Apartments, Townhouses	90 L/s [1]
Commercial	150 L/s [1]
Institutional	150 L/s [1]
Industrial	225 L/s [2]

Notes:

(1) one hour duration

(2) two hour duration

By comparison, the 2004 Design Guidelines for Rural Residential Community Water Systems references a fire flow of 32 L/s for a one hour duration based on the 1991 fire Underwriters Survey Guidelines.

For the purposes of this study, a fire flow of 60 L/s for a one hour duration has been assumed, which is the minimum current design standard. Actual fire flows should be confirmed in relation to land use and risk management as the water system is developed. To affect some cost savings in terms of reservoir sizing, the District could investigate with their insurance provider on the difference in providing 30 L/s versus 60 L/s for residential fireflows.

2.4.4 System Pressure Guidelines

Water pressure requirements outlined in the MMIDM provides the following desired pressure requirements:

Table 2-11. Distribution Pressure Requirements

	kPa	psi	m
Maximum Allowable Pressure [1]	850	125	88
Minimum Pressure at Peak Hour	300	40	28
Minimum Pressure in system during Design Fire Flow and Maximum Day Demand	150	20	14

Note:

1. *May be increased subject to approval of local authority*

The MMIDM also recommends service connections to be individually protected by pressure reducing valves where the maximum pressure exceeds 515 kPa (75 psi).

The above values are consistent with the guidelines outlined in the Design Guidelines for Rural Residential Community Water Systems which require a maximum pressure of 700 kPa (100 psi) and a minimum pressure of 150 kPa (20 psi).

The 1989 Southern Region Water Resource Study recommended a low zone ranging from sea level (140 psi) to 70 m elevation (114 psi) and an upper zone ranging from 70 m (114 psi) to 122 m (40 psi). The pressure range slightly exceeds current recommended design standards provided in the MMIDM. In our opinion, the proposed zones are workable given current water system technology at reasonable cost.

2.4.5 Reservoir Sizing

Storage in a water system is required for peak balancing and for providing a reserve for fire protection. The total storage volume recommended in the MMIDM is:

$$V = 0.25\,D + 3600\,Fd$$

Where:

V = Volume of reservoir in litres

D = Maximum Day Consumption (L/s)

F = Fire Flow (L/s)

d = duration of Fire Flow (hrs)

It is also prudent to consider providing some storage for emergency interruption of primary supply. This is typically 25% of maximum day demand. This can be reduced or eliminated based on consideration of the following:

- Dependability of water source
- Reliability of Supply System
- Presence of more than one supply source
- Whether the reservoir is part of a large system
- Presence of other reservoir(s) in the system
- Availability of standby power
- Need for adequate circulation of reservoir water to maintain quality

During further analysis, the fire storage requirements could be revised based on discussions with the District's insurance provider.

2.4.6 Supply and Distribution Mains

Sizing for supply mains would be based on the ability of providing maximum day demand plus fire flow.

Minimum distribution pipe sizing based on MMIDM criteria and DGRRCWS is 150 mm. Larger sizing may be required and would be subject to detailed engineering. For the purposes of this study, minimum distribution sizing is assumed as 150 mm.

Depth of cover is typically a minimum of 1.0 m within Ministry of Transportation and Infrastructure road right-of-ways. Shallow burial could be considered for residential roads subject to approval with local authorities. If such approval is possible, the depth of burial could be reduced to 0.8 m to 0.9 m. For the purposes of this study, minimum 0.9 m cover is assumed on residential roads and maximum 1.0 m along Highway 101 and Padgett Valley Road and Southern Region arterial roads such as Dixon Road and Zillinsky Road. For pipes installed along non travelled right-of-ways, a minimum depth of 0.8 m is assumed.

2.4.7 Demand Management

The District, in pursuing the development of a Southern Region water system, is required to ensure optimum use of the water system. The development and use of demand side management practices should therefore be considered and implemented where economically justifiable. The importance and options for demand side management are discussed further in the following sections.

Benefits

Water demand management can be defined as a strategy to influence water demand and usage of water. Water demand management provides the following benefits:

- Conservation of natural resources
- Savings from reduced costs for conveyance and treatment of bulk water supplies
- Savings in capital expenditure from deferred expenditure on bulk infrastructure and development of new water reservoirs
- Improved operational performance in systems that are reaching their design capacity.

A practice prediction of the impact of water conservation on future demands is difficult, but any measures should be directed towards reduced per capita demands. Reasonable estimates are in the order of 10 – 15% savings for moderate demand side measures.

Financial benefits of water conservation are:

- Reduced O/M costs
- Reduced cost in capital projects by deferred implementation of improvements and reduced capacity needed for improvements.

Water Conservation Strategy

The Regional District would have a number of tools at its disposal to develop a water conservation initiative.

Regulatory Tools

There are a wide variety of water use efficiency measures or tools. A range of tools should be included in any plan or program to compliment efforts and address specific needs. The principle tools that are used are

Legal Tools, Economic Tools and Operations and Management Tools. These three categories are mentioned as "Hard Conservation Measures" in the Water-Use Efficiency Catalogue of British Columbia.

One of the more effective regulatory tools for the Regional District would be the implementation of Bylaws to ensure the use of low water use fixtures for new homes. These can include water closets, shower heads, faucets, and efficient hot water heaters.

Legal Tools

Mandatory water use restrictions and implementation of Bylaws were the two most commonly identified legal tools. Both Federal and Provincial governments identified legislation as an effective means of increasing water use efficiency. Other legal tools include regulations, standards and licensing.

Mandatory Restrictions

Outdoor usage typically accounts for more than 40% of water consumed during summer months. It is imperative of communities to control the additional wastage of water. Restrictions on watering/sprinkling of lawns are an effective way to cut down excessive use of water. A lawn needs only one inch of water per week, which is about one hour of sprinkling. Various Districts and communities already have lawn-sprinkling restrictions. Fixing times and day for even and odd numbered houses is an established method. The City of Vancouver has lawn water restrictions from June 1 to September 30, and watering is allowed only during 4:00 am to 9:00 am and 7:00 pm to 10:00 pm. Odd numbered houses water on Sunday and Thursday, and even numbered houses on Saturday and Wednesday.

The City of Powell River currently employs sprinkling restrictions during the summer dry periods.

The development of a regional water supply should allow those with individual wells to re-use these wells for irrigation purposes. Although the water, in many cases, does not meet potable water standards, it is perfectly fine for irrigation purposes.

Economic Tools

Economic and financial tools include both incentives and disincentives. They may be used to convey the message that water is valuable and can assist in motivating people to reduce water use. Increased water service charges also tend to recover costs. As per the Ministry of Community Development, municipalities applying for infrastructure grants may be required to demonstrate that the proposed project uses water efficiently.

Metering Programs

An effective water pricing system relies heavily on a metered system. installing water meters and billing for a water service based on metered water use provides a strong initiative for customers to use less water than if they were billed on a flat rate basis. Water savings resulting from the installation of meters can vary anywhere from 13% to 45%. Several variables may contribute to the variation, including housing type, lot size, climate and season. A typical reduction of 20% in water use by metering can be expected. In areas

requiring water for landscape irrigation, savings in the spring and summer are usually much greater than in the fall and winter. Sprinkling and related uses affect the maximum day and peak hour use to a much greater extent than domestic use. However, water used for sprinkling has little effect on wastewater generation.

A reduction in water use after meters are installed is typically most substantial during the first year following installation. However, if post-metering water prices are kept low, there would be little incentive for decreasing water use. Therefore, metering is most effective in the long term if pricing reform establishes a rate structure, which provides the consumer with enough financial incentive to conserve water.

Issues in terms of implementing metering programs, such as meter location and installation type, vendor selection, meter reading technologies, and maintenance and costs, are discussed further as follows:

Meter Location and Installation Type

Meters can be generally classified as in-pit or in-building. Pit-mount meters placed at the property line provide less opportunity for illegal taps upstream of the meter, and often provide much easier access to the meter for maintenance. This is particularly true for residential installations. The cost of pit-mount meters, however, is generally higher than that of in-house mounts.

Nevertheless, the trend is for new meters to be pit-mounted, for the reasons given above (access and security). The meters need to be accessed for maintenance, which is difficult to do if they are in the basements of residents.

Meter installations typically include a shutoff valve, a meter idler, the meter itself, and encoded register, a data cable, and a data transmitter (touch-pad or radio). Many municipalities have a set of installation standards covering most typical situations.

Vendor Selection

There is no 'best practice' in vendor selection. Many utilities prefer not to be 'captive' to a single supplier, or for historical reasons are forced to continue accepting the products of several vendors. Other utilities, especially smaller systems, prefer to standardize on a single product to facilitate procurement and stocking and eliminate cross-vender compatibility problems.

The major meter manufacturers include Invensys Neptune, Badger, Hersey, Kent and ABB.

Meter Reading Technologies

The most prevalent (and economical) technology is the touch-pad system that is used by most municipalities. Data is read through a probe placed near the touch-pad, and recorded in a hand-held datalogger "reading gun". Other technologies generally classified as Automatic Meter Reading (AMR) require no meter readers but rather transmit data remotely.

Meter Maintenance

Meters need to be maintained, tested, calibrated and replaced over time, just as with any other asset. Failed and low-reading meters cause complaints and lost revenue. Efficient utilities, therefore, strive to have consistent meter maintenance and replacement programs. The American Water Works Association (AWWA) C700 standard has specific testing periods for the various types and sizes of meters.

Capital Cost Estimates

Capital costs typically include:

- Meter body, register and touch-pad
- Meter box, setter and accessories
- Installation labour and equipment rental
- Restoration

The estimated cost to install a water meter with meter box and touch-pad at the property line on an existing service is approximately $650, assuming minimal restoration is required. This cost should be increased by about 50% for services in paved driveways or heavily landscaped areas. These estimates are typical of the costs experienced in other areas.

The costs of new (future) installations could be significantly lower because the property owner/developer would bear the cost of installing the meter box and setter. The water utility would pay about $250 to supply a 19 mm meter and touch-pad for installation by the contractor during house construction. This cost is also reasonable.

Costs are approximately $20,000 for a meter reading gun and software.

Operating Costs

Operating costs typically include:

- Meter reading
- Billing
- Maintenance and testing

The estimated cost is $3.00 per read and $4.00 per bill, which again are typical costs. Reading and billing are done quarterly.

Some meters will require repair or replacement each year. In the long term, this percentage would have to reflect a meter life of about 20 years. The AWWA C700 standard recommends that 19 mm bronze meters be tested every 8 to 12 years.

Leak Detection Program

Every water system looses water through leaks and breaks – in fact some leakage can be considered one of the costs of doing business for most water utilities. Even newly constructed water lines are allowed a certain minimum leakage rate depending on system pressure, pipe size, number and kind of joints, and type of pipe. Most water systems experience breaks or leaks in watermains, service lines, hydrants, tanks, valves and appurtenances that occur due to a variety of causes. The problem of aging facilities and deteriorating system components are part of the growing infrastructure problem faced by most utilities and municipalities. Losses could be attributable to the following:

- Pipeline leaks (leaking joints, broken/cracked pipes)
- Reservoir leaks and overflows
- Meter error or inaccuracy (usually on low flush)
- Illegal or unrecorded users
- Municipal uses such as fire fighting, main flushing, new construction, street washing, sewer flushing, etc.
- Account error
- Service connection leaks (connections to pipeline, pipe, curb and corporation stops)
- Fitting leaks (fire hydrants, valves, etc.)
- Abandoned service connections.

The Southern Region will have a new water system built to current design standards. The importance in terms of leakage and demand management will be to ensure a long term program is developed and implemented to effectively monitor consumption so that any demand side measures, which are developed, can be compared against a baseline to ensure their effectiveness.

Demand Side Management Targets

The water demand analysis in this study was based on using standard per capita demand criteria as follows:

- Average Day Demand: 600 Lpcpd
- Peak Day Demand: 1200 Lpcpd
- Peak Hour Demand: 1800 Lpcpd

Although there are no legislated or regulatory requirements, the District's long term goal for demand side management should target the following estimated per capita criteria:

- Average Day Demand: 500 Lpcpd ±
- Peak Day Demand: 1000 Lpcpd ±
- Peak Hour Demand: 1500 Lpcpd ±

3. Existing Waterworks Systems

The Southern Region has 56 small community water systems monitored by the local Vancouver Coastal Health Agency. The eight main water systems are:

- Myrtle Pond Improvement District
- Stella Maris Water System
- Woodlyn Improvement District
- Pinetree Place Improvement District
- Brew Bay Improvement District
- Lang Bay Water Users Community
- Stillwater Waterworks Improvement District
- Saltery Bay Improvement District

The recent KWL Phase I Study surveys indicated there are approximately 375 individual wells (1 connection) in addition to the 56 small community water systems.

The main water systems are further discussed in the following sections.

3.1 Southern Region Water Supply Study – Phase I

In 2006, Kerr Wood Leidel (KWL) completed a Phase I study of the water systems in the Southern Region to better understand what and where problems existed. This provided a basis for resolving issues in a proactive and cost effective manner. The review consisted primarily of a survey of non community well water systems in the Southern Region with 578 survey responses submitted by area residents. The results are provided in Appendix A.

Of the 578 responses, the following was noted in terms of supply sources for individual users:

Table 3-1. Individual User Well Water Source

Source	#
Dug Wells	190
Drilled Deep Wells	159
Drilled Shallow Wells	26
Total:	375

The results for the two key questions for the Southern Region can be summarized as follows:

- 55% of all respondents with wells have water that meets health standards; and
- 77% of all respondents with wells have sufficient water quantity.

Based on the above, although there may be localized concerns with the quantity of well water from individual wells, there is generally a majority overall satisfaction with adequacy of supply. From a public health perspective and regional perspective, the number of opinions expressed by residents that cannot confirm that their well water meets health standards is a significant concern.

Although there is no regulatory requirement that governs individual wells, community water systems (greater than one connection) are required to meet legislated standards. The existence of many individual wells that do not meet health standards is typically the initiating point for consolidation of these systems and the creation of larger local water systems.

From a regional perspective, the survey indicated approximately 23% of the survey respondents have insufficient water supply to meet their needs. 45% of the respondents have water that does not meet, or they are unsure their water meets health standards.

A number of options were identified to address the issue:

- Expand existing community water systems
- Develop new wells and community water systems
- Expand the City of Powell River system

Initially, it was envisioned that several of the existing water systems could be reasonably expanded. They would be operated locally by the owner, or alternatively, transferred to the Regional District for oversight, management and operation. A significant impediment for expansion of private water systems is the inability of the private operators to access grants for planning and capital improvements. Prior to the District undertaking oversight and operation of existing water systems, it was recommended the District undertake water system assessments to determine compliance with the Drinking Water Protection Act and Drinking Water Regulations.

Subsequent to the Phase I Study, the Regional District completed an assessment of the Myrtle Pond water system and an assessment was undertaken for the Stillwater water system.

3.2 Myrtle Pond Water System

In July 2005, KWL completed an assessment and study of the Myrtle Pond Water System. The water system is operated by the PRRD and serves approximately 45 users from a well constructed in 1993, which pumps into an existing steel reservoir which then supplies the water distribution system.

Analysis of the water indicated the supply met Guidelines for Canadian Drinking Water Quality (GCDWQ) for health based parameters except Trihalomethanes. Some aesthetic parameters were not met which include pH, colour, and hydrogen sulphide. The hydrogen sulphide has been effectively treated since 1999. Because of the high colour content of the water, the secondary disinfection is not used over concern with production of disinfection by-products (THM's).

Another concern is the rapid decrease in the static water level of Well W-93 which is the supply for Myrtle Pond. The drop is almost 46 m, which indicates that the current demand of the water system is

exceeding the capacity of the aquifer. Therefore addition of further users to the system has not been approved by the PRRD. The per capita water consumption for maximum day demand is 1,977 lpcpd to 2,470 lpcpd. This indicates significant leaks in the distribution system and/or excessive waste by water users.

A number of immediate, short term, and long term needs were identified and a feasibility cost estimate was developed as follows:

Table 3-2. Myrtle Pond Feasibility Cost Estimate

Timeframe	Cost ($)
Immediate	13,000
Short Term	501,000
Long Term	507,000
TOTAL	**1,021,000**

Of these amounts, $471,000 is related to distribution system improvements and $550,000 is related to water quality, quantity, treatment, and storage improvements.

Given the cost to upgrade the Myrtle Pond Water System just to supply potable water to current users, the PRRD is currently looking at alternative sources, which will be discussed in a subsequent section.

3.3 Stillwater Water System

In February 2005, McElhanney Consultant Services Ltd. completed an assessment of the Stillwater Water System. The water system is operated by a private entity which provides water to a community of approximately 400 persons via 96 service connections (approximately four persons/connection). The source of water is Jefferd Creek, a small watercourse reportedly fed by springs. The watershed is impacted by potential impacts from wildlife, forestry related activities, and recreation.

Limited water quality testing of the source has been undertaken and the water supply meets GCDWQ with respect to physical and chemical properties. Monthly microbiological sampling has been undertaken on the water supply. The testing indicates positive tests for total coliform in 28.7% of the samples which exceeds GCDWQ. The presence of fecal coliform was detected in 6.5% of the samples until April 2006. At that time, sampling for E. Coli was undertaken with positive tests on 9% of the samples collected. Although the number of samples was limited, a positive test for E. Coli does not meet GCDWQ.

The vulnerability of the source is considered high. The latest Vancouver Coastal Health Authority's (VCHA) inspection report dated February 22, 2007 characterized critical measures which needed addressing as:

- Remove parasitic cysts of Giardia and Crytosporidium from the raw water
- Reduce the frequency of positive total coliform results in samples of water collected from the distribution system.

Current water treatment includes chlorination which is added upstream of the storage tanks at a dose of 2.5 mg/L to 4.5 mg/L, near the intake. The chlorine residual is monitored and found to be 0.2 mg/L to 0.9 mg/L just downstream of the storage tank at the start of the supply main. The residual at the outer limits of the distribution system is 0.01 mg/L. Other "high risk" issues related to the treatment and intake works were:

- Undetected critical issues are power outages and failure of chemical feed pump.
- Freezing and flood condition in Jefferd Creek at the intake site.
- Pipe damage and storage tank damage from fallen trees, wildlife, UV degradation, freezing, etc.

The study concluded that the existing treatment levels and facilities were considered too limited and too susceptible to physical damage. Improvements and upgrades were recommended.

The distribution system consists of supply mains which are undersized (50 mm and 100 mm diameter). A significant amount of the watermains would need upgrading. Consumption demands exceed supply and storage capacities. VCHA recommendations for emergency standby and pressure regulation can not be met. Fire flow capacity is grossly inadequate. Fire flow capacity of 119 m^3/min and storage of 114 m^3 exceed the system capacity of 0.84 m^3/min and 22.7 m^3.

In terms of financial capacity and governance, the SWWD is a private entity of very limited resources and typical of small improvement districts. The costs of maintaining, expanding, and managing water treatment and distribution are increasing dramatically. Currently, the SWWD faces the following challenges:

- No renewal plan and associated financing and rate structure are in place to reflect the true cost of water supply treatment, and conveyance.
- Access to grant funding for capital and planning purposes is severely limited. The provincial government does not, at this time, provide funding to local Water Improvement Districts for capital improvements.
- Managers of the water system have limited depth and experience.

A capital plan was developed to bring the water system into compliance with current treatment and conveyance, requirements identified by VCHA. The estimated order of magnitude cost was $1,500,000, not including engineering and contingency. Of the $1.5 million, approximately $680,000 is related to distribution system improvements and $820,000 is related to water quality, treatment, and storage improvements.

In summary, of the two community water systems in the Southern Region which have recently undergone detailed assessments, significant deficiencies have been identified in terms of meeting current design standards and regulatory requirements for water quality, supply, conveyance, and governance.

These deficiencies are estimated to cost in the order of $2.5 million to bring the Myrtle Pond and Stillwater water systems into compliance with current regulations and guidelines. Of the $2.5 million, $1,151,000 is related to distribution system improvements, and $1,349,000 is related to water quality, treatment, and storage improvements.

3.4 Vancouver Coastal Health Authority

The Vancouver Coastal Health Authority was canvassed to gauge the general status of water systems in the Southern Region. The Health Authority oversees 56 community water systems as well as the 375 or so private wells. Appendix B provides information on the water systems. In summary, the following is noted:

1. There are approximately 13 Class II water systems and 43 Class III water systems.
2. The estimated population served is 2,570 not including five water systems.
3. Community water source in the Southern Region is provided in Table 3.3.

Table 3-3. Community Water Sources

Type	Number
Shallow well	18
Deep well	32
Water course intake	3
Infiltration gallery	1

4. Fourteen water systems have both primary and secondary treatment. Ten water systems have primary treatment. Thirty water systems have no primary or secondary treatment.
5. Seven water systems have boil water advisories. Of these, three have been resolved and four are outstanding (Anchor Way, Lang Bay Store, Nelson, and PR Trailriders). Within the last year, eleven water systems have been on a boil water advisory. Five have been resolved.
6. Thirty-one water systems have completed Emergency Response Plans. Two need updating.
7. Twenty two water systems do not meet VCHA monitoring criteria.
8. In terms of maintenance, ten water systems were identified to have excellent maintenance; thirty-two moderate maintenance; and twelve poor maintenance.
9. Thirty-three water systems have no operators who are trained or certified. Fourteen water systems have trained operators. Seven water systems have certified operators.
10. Thirty-one water systems had positive bacteriological results in the past six months.

Between January 1, 2007 and November 14, 2007, VCHA undertook a sampling program on several of the water systems in the Southern Region. They were:

- Stillwater Improvement District
- Stella Maris Estates
- Brew Bay Improvement District

- Woodlyn Improvement District
- Pinetree Place Improvement District

The sampling was taken for total coliform and E. Coli and at various residents and locations on the water system. The results are provided in Appendix C and are summarized in Table 3.4.

Table 3-4. VCHA 2007 Southern Region Water Sampling Program Summarized Results

Water System	# of Samples	# Containing Total Coliform	# Containing E. Coli	# Containing Fecal Coliform	# of Consecutive Samples which Contain Total Coliform	# of Samples which Contains Total Coliform in the last 30 Days	Comments
Stillwater Improvement District	48	16	6	0	6	1/4	Maximum Fecal Coliform 160
Stella Maris Estates	53	7	0	0	5	0/5	Maximum Fecal Coliform 36
Brew Bay Improvement District	127	9	0	0	0	0/13	Maximum Fecal Coliform 8 Boil water advisory in place
Woodlyn Improvement District	55	2	0	0	0	0/3	Maximum Fecal Coliform 38
Pinetree Place Improvement District	72	0	0	0	0	0/6	

In summary, the majority of the water systems do not meet current standards required by VCHA or provincial regulations. The large number of small water systems and individual well water supplies is onerous for VCHA in terms of monitoring and ensuring compliance with drinking water regulations and guidelines. There is a preference from VCHA to consolidate water systems where possible. Preferably the VCHA sees beneficial synergies in the development of a regional water supply system.

3.5 Field Review of Existing Water Systems

A field review was undertaken for the following water systems:

- Pinetree
- Woodlyn
- Brew Bay
- Lang Bay
- Stillwater

The intent was to get a general sense of the condition of the water systems in comparison with other water systems (Myrtle Pond and Stillwater) which had been reviewed in more detail.

3.5.1 Woodlyn Community Water System

Woodlyn Water Improvement District supplies approximately 14 users and consists of a well pump (1 HP, 17 Igpm capacity) which pumps into a storage tank (900 Igal capacity). The storage tank and distribution system are pressurized with a 300 Igal compressed air, pneumatic tank. The well has been capped. These facilities are located within a small wooden building in the lane between Evergreen Road and Woodlyn Road.

Water is pumped from the well to the storage tank. From the storage tank, the water is pressurized (50 psi – 70 psi by compressed air) and sent to the distribution system on Woodlyn via a 100 m PVC pipe (pressure rating unknown). The distribution system on Woodlyn is 75 mm PVC. The pipe sizing would not meet current standards. The water system has no fire flow capacity.

The system has had issues with fecal/coliform contamination; however residents have elected not to install chlorination. Therefore, no primary or secondary treatment exists for the water system.

The operators noted that multiple use of the water system does cause supply issues with the pump (i.e., it can not keep up). During high demand, there are backflow issues for the upper lots on Woodlyn. Residential PRV's have been installed on the lower side of the road to regulate upper and lower pressures evenly. The above comments indicate the present system is not adequate to meet water system demands. Expansion of the Woodlyn water system would require significant upgrade.

Other issues associated with the water system are:

- It is not known if easements or right-of-ways exist for the well pump building and the feedermain from the pumphouse to Woodlyn.
- The pump building is susceptible to fire.
- The well is adjacent to a travelled lane and is surrounded by residential lots. Therefore, a hydrocarbon spill or other contaminants, such as nearby septic systems, have the potential to affect the well water quality.

Photos of the Woodlyn water system are provided in Appendix D.

3.5.2 Pinetree Community Water System

The Pinetree Water Improvement District is supplied by a 36.5 m deep well. The well has a capacity of 25 to 28 Igpm (2.1 L/s). Water is pumped from the well through the chlorination building to a storage tank. From the storage tank, water is conveyed by gravity to the distribution system. The storage tank has a capacity of 12,500 Igal (56,250 litres). The storage tank provides approximately 15.5 L/s of fire flow storage for a 1 hour duration. A dedicated fire hydrant on the old well at the storage tank provides further fire flow capacity for tanker trucks.

The distribution system consists of 100 mm, 75 mm, 50 mm and 25 mm PVC watermains. A 100 mm line runs down Twin Eagles Road to Highway 101. South of Highway 101, the waterline is 50 mm. The waterlines along Alley Road and Random Road are 25 mm. A 75 mm line runs along Evergreen Road and Pinetree Place. A 25 mm line connects Pinetree Place and Evergreen Road on Pinetree Road. The watermains do not meet current standards. The water system has four 50 mm standpipes for fire protection and flushing. Given the size of the distribution mains, water supply is limited.

The water system is disinfected with dilute liquid chlorine prior to entering the storage tank. Chlorine use is approximately 1 to 2 litres/day. Current consumption is approximately 74,000 Igal/week or 10,000 Igd/day (45,000 L/day, 0.5 L/s). Demand is recorded weekly.

The foundation of the chlorine building has failed. The existing storage tank is in reasonable shape except for the underlying support struts and outlet connection. Remedial corrosion protection needs to be undertaken.

An issue noted by the operator is the lack of a qualified well technician.

Significant issues related to the Pinetree water system are undersized watermains and low fire storage. Adequate fire supply is uncertain due to small size of the distribution main, particularly south of Highway 101.

Photos of the Pinetree Water System are provided in Appendix D.

3.5.3 Brew Bay Community Water System

Brew Bay is supplied via an intake on Lang Creek just upstream of the fish hatchery. The intake is a 200 mm perforated pipe. Flows are conveyed from the intake via a 200 mm watermain by gravity, to two steel storage tanks located at the pumphouse. The pumphouse is located adjacent to the west bank of Lang Creek, within riparian set back limits, south of the Highway 101 Bridge. From the storage tank, water is conveyed via 150 mm piping to the pumphouse where it is chlorinated and booster pumped into the distribution system. The storage tanks have an approximate capacity of 20,000 Igal (50,000 litres).

The pump system consists of 2 – 225 USgpm Berkley Pumps (one operating, one on standby) for domestic demand which provides 60 psi – 80 psi pressure. There is also a 500 USgpm fire flow pump. When both domestic pumps are operating and pressure drops below 55 psi, the fire pump starts up. The estimated pump capacity with all three pumps operating is reported to approximately 650 USgpm (40 L/s). At this rate, flows are reported to start dropping after about 3 hours. This is likely the result of the supply main and pumphouse storage not being able to provide this capacity.

The distribution system consists of 150 mm PVC watermain with some 50 mm watermain on short dead end sections. Water supply at this time is only to the area south of Highway 101. There are approximately 46 houses connected to the water system via 19 mm service connections (50 mm for larger lots). The water system operators estimate that 60 to 70 houses could be supplied by the system. There are 6 hydrants in the water system.

Other issues identified by the water system operators are:

- The water system bond expires next year. Continuation of the bond will require water system upgrades (possibly filtration).
- There is logging and other commercial and recreational uses in the watershed and along the creek which could impact water quality.
- There is a proposed gravel operation in the watershed which could impact water quality.

In light of the above information, the Brew Bay water system is in reasonably good shape. Increased capacity may be possible; however, it will be at the expense of potential fire supply unless the water system is upgraded. The current fire supply is approximately 30 L/s to 35 L/s which just meet requirements for rural community water systems. It is not clear though, whether 20 psi residual pressure is available in the water systems as required in the guidelines. The watershed is also at risk from industrial, commercial and recreational activities which could impact water quality. Filtration is currently being considered. The location of the current pumphouse would not meet current environmental requirements for water course riparian setback limits.

The current supply source is Lang Creek. Lang Creek is controlled by an outlet weir on Haslam Lake which is operated by the City of Powell River. Haslam Lake is the water supply for the City and governed by a water licence that requires the release of 0.43 m^3/s (430 L/s) from December to September and 0.71 m^3/s (710 L/s) from October to November. In addition to the minimum release at Haslam Lake, there are 23 water licences on Lang Creek which are summarized as follows:

Table 3-5. Water Licenses on Lang Creek

Licenses	Holder	Quantity
C024665, C033938, C033939, C033944, C033947, C033949, C053506, C067912	Brew Bay Improvement District	14,417,500 Igal/year 39,500 Igal/day (2.0 L/s)
C048989, C055988, C058577, C059751, C061723, C061724, C062365, C070078, C108360, C111319, C111320, C120934, C122062	Various individual users	6,700 Igal/day (0.35 L/s) 7 acre ft./annum (8,653 m^3/year)
C065324	Fisheries and Oceans Canada	16 ft^3/s (450 L/s)
C072782	Powell River Salmon Society	2ft^3/s (56 L/s)

Based on a capacity of 2.0 L/s and a peak day demand of 1,200 lpcpd (0.013 litres per second/capita/day), the Brew Bay water licenses have a capacity of approximately 150 people or 50 to 60 lots. Based on their reported fire flow of 40 L/s, the storage tanks have approximately 20 minutes of fire storage. After 20 minutes, fire flow is drawn in from their intake. When this occurs, they exceed their water license. 108,000 L of storage is required for fire supply.

Water Survey of Canada stream flow records for Lang Creek were reviewed, and from the 1960 to 1990, the average minimum daily discharge was 0 m^3/s (216 L/s). The current water licenses exceed the average minimum daily discharge. Over the same period, the mean monthly flow for August was 0.528 m^3/s (528 L/s) and September 0.896 m^3/s (896 L/s). There is no capacity in Lang Creek to allow for the expansion of the Brew Bay water system. The source is identified by BC Water Management as being fully allocated.

3.5.4 Lang Bay Community Water System

The Lang Bay water system is supplied from an infiltration gallery installed in a natural spring area which supplies Silver Creek. The infiltration gallery is a set of 4 – 150 mm perforated pipes set approximately 0.9 m below ground which collects water to a common header. The water is then conveyed by gravity via a 150 mm PVC water pipe to the Chlorination Building. The infiltration gallery was installed as the original supply was from a nearby pond which resulted from the spring water. The pond had poor water quality. A well was drilled and investigated, but it was found to have arsenic which exceeded GCDWQ. This resulted in the installation of the infiltration gallery. It is not clear what the potential capacity of the infiltration gallery is, but stream flows discharging from the pond were found to be small.

The new operator has recently completed an upgraded chlorination facility with new piping and chlorination monitoring and feed systems. From the chlorination facility, water is conveyed to a new 30,000 USgal (114,000 litres) bolted steel reservoir. The reservoir has adequate fire protection of 30 L/s for one hour as required in the DGRRWS. The reservoir is covered with a plastic canvas cover secured with rope.

From the reservoir, water is supplied by a 150 mm trunk watermain down Dixon Road. Smaller 50 mm diameter waterlines are used for distribution lines on the various streets. There are two pressure reducing valves, above Highway 101 on Dixon Road and just upstream of the fish hatchery.

Photos of the Lang Bay water system are provided in Appendix D.

In light of the above information, the Lang Bay water system is in relatively good shape. Some distribution mains would have to be upsized/replaced. The key issues are security, quality and quantity of the supply source for the following reasons:

1. The source is a shallow groundwater spring which can be impacted by private lands upstream which are out of the control of the Lang Bay water system owner. It has a very limited surface watershed which would likely have to be significantly expanded onto private lands. Restrictive covenants in terms of development would have to be placed on these upland private lands to protect the watershed.

2. The infiltration gallery is shallow and is exposed to contamination ranging from Giardia and E Coli, from wildlife activities directly above and in the vicinity of the infiltration gallery.

3. It is not clear what capacity the groundwater spring can provide. What little flow does surface creates the headwaters for Silver Creek which is a relatively small creek. Withdrawing further water would reduce flows into Silver Creek. Additional environmental studies and discussions with the Department of Fisheries and Oceans and the Ministry of Environment would be required to access further water. If additional water supply is not possible, then an alternative source needs to be found.

3.5.5 Stillwater Water System

Review of the Stillwater water supply is not expanded on as it has been more thoroughly investigated in the 2008 McElhanney Water System Assessment Study and Section 3.3. Additional photos of the Stillwater water system are provided for in Appendix D.

3.6 Summary of the Field Review

The water systems reviewed in the Southern Region have been developed and kept in operation in a reasonable manner given the limited resources and funds available to the private community water systems. Over the years, increased regulations to improve water supply from source to tap make it increasingly difficult for these water systems to operate.

The Woodlyn and Pinetree water systems ideally should be joined together. Their distribution systems do not meet current design standards and should be upgraded. The source for the Woodlyn water system is exposed to potential contamination and currently is barely able to supply domestic demands to the water consumer. The Pinetree water system appears to have adequate capacity for domestic supply but has limited fire flow capacity.

The two main community water systems in the Southern Region (Brew Bay and Lang Bay) are currently in reasonably good shape. Brew Bay's distribution system is adequate, while Lang Bay would need some upgrading of the distribution system to meet current standards. Brew Bay would require upgrading to service lots on the north side of Highway 101. The biggest drawback for future development or expansion of these water systems is the availability of supply and quality. Brew Bay currently exceeds its water licence during fire flow conditions due to the lack of storage. There is no capacity to access future flows from Lang Creek given commitments in existing water licences and that Water Management has identified Lang Creek as fully allocated. Primary treatment of the water supply by filtration, UV or other means could also be anticipated. Lang Bay is anticipated to have limited ability to access future water supplies from Silver Creek, in addition to water quality impacts associated with the water source. The alternative for Lang Bay would be to consider another source, such as wells, but arsenic has already been encountered in past wells. An alternative which could provide sufficient water for expansion of the Lang Bay water system is Lois Lake.

4. Regional Source Capacity and Quality

This study was to consider three potential sources in terms of supply to the Southern Region:

- Connection to the City of Powell River
- Use Hammil Lake as a source
- Use Lois Lake as a source

These sources are described in terms of their ability to provide the required quantity and quality of water for the Southern Region.

4.1 Connection to the City of Powell River

4.1.1 Water Quantity

Haslam Lake is currently being proposed as the main water supply source for the City with Powell Lake and Hammil Lake being proposed as back up. The top water of Haslam Lake is approximately 172.4. Water is conveyed from Haslam Lake to the City via a concrete pipe with a capacity of 700 L/s (60.5 ml/day) to Haslam Lake Road where it is conveyed to the distribution system.

Haslam Lake water supply is regulated by Conditional Water Licence No. 24036 issued by the Provincial Water Rights Branch (see Appendix E). The licence provides the following:

- Fisheries minimum release rate to Lang Creek of 0.43 m^3/s (430 L/s) December to September. Minimum release rate to Lang Creek of 0.71 m^3/s (710 L/s) October to November
- Maximum release for City consumption of 0.71 m^3/s or 710 L/s (25 cfs)
- Storage of 14,400 acre ft. (17,800,000 m^3)

Because the City's supply and distribution system has no storage, the distribution system must be capable of providing peak hour demand. The long term (2021) peak hour demand is 59.6 ml/day or 700 L/s for a population of 22,441. This is the current limit of the water licence. Current peak hour demand in the City is approximately 30 ml/day (347 L/s) for a population of approximately 13,500 people. The City is currently considering the construction of a reservoir at Haslam Lake in the long term plan. This would reduce the requirement to provide peak hour demands thus allowing the Haslam source to supply a somewhat larger population.

A Southern Region connection to the City water system, in the absence of water conservation measures on the City's part, will advance the City's requirement to access further withdrawal, and/or storage from Haslam Lake. This would require the City to apply for an increase in their water licence and result in large capital costs. Because of current licensed operating levels, and requirements to ensure minimum flows in Lang Creek, the Haslam Lake supply currently has an estimated ballpark capacity of 32,000 people.

At that level of population, without demand side management, the City is anticipated to require further storage. This could be achieved by accessing existing storage in Haslam Lake or creating additional storage.

The demands required for the Southern Region are provided in Table 2.9. In the interim term, the City could provide the capacity of Areas B and C. Estimated interim and build out peak day water demands for Electoral Area B are 2.81 ml/day (32.6 L/s) and 11.95 ml/day (138 L/s). The City currently has the capacity to supply Electoral Area B of the Southern Region, however, there will be costs associated with providing these flows to the Southern Region.

The City's current long term water supply plan identified a number of improvements to bring the water system to a level where it could supply a 2021 population of 22,441. The cost of the improvements was estimated at $8.8 million ($2005). A key point of the long term plan is the difficulty of supplying required flows to the southern end of the City due to the distance from the Haslam Lake source. The City also has difficulty supplying required flows and pressures to areas surrounding the airport and the top end of Nootka Street, due to the elevation of this area and the elevation of the Haslam supply. The District's current water system can only provide about 30 L/s to the airport without upgrades. This compares to a recommended fire flow of 150 L/s.

In the interim, the City could provide the capacity for both Electoral Area B and C. To provide the required flow to the Upper Nootka Airport area, the City requires a booster pump zone, ideally with reservoir storage, or the City needs to reconnect and upgrade the Hammil Lake source. A 4.54 ML reservoir at an elevation of about 143 m (149 m top water level) in the vicinity of upper Nootka could be fed from Haslam. 800 m of 400 mm watermain would be required, as well as 1400 m of 300 mm watermain to downstream pressure zones to improve circulation. The estimated value of this work was $2.6 million. This compared to the cost of upgrading the Hammil Lake source of $900,000 (intake relocation and new 250 mm watermain to Duncan) which does not include treatment. Alternatively, the City could choose to investigate a groundwater sourced booster pump zone. The City's long term water supply plan currently considers reconnection of Hammil but only as an emergency backup with chlorination (i.e., no primary treatment).

It is noted that the proposed reservoir, with a TWL of 143 m, would not be able to supply the majority of land in the upper Nootka Street area of the Regional District. This area is located between elevation 136 m and 144 m. If a reservoir was to be situated to service these lands, it needs a TWL of approximately 172 m. A TWL of 172 m can not be supplied from Haslam Lake or Hammil Lake and would have to be supplied via a booster pump from either the City or a Regional District supply in the vicinity of Hammil Lake.

A Southern Region connection at Highway 101 would likely require further improvements and additional costs than what has been considered already in the City's long term plan. At the time of writing, the City has been contacted but it is not known what these additional improvements would be or their associated costs as further hydraulic study of the City's water supply is required to assess the impact of the Regional District's supply demands. In addition to a share of the capital costs, the Regional District is also anticipated to cover a yearly cost to the City for operation and maintenance. A one time connection fee could also be anticipated.

In accordance with the City's Waterworks Rates and Regulation Bylaw 2239, costs for servicing outside of City boundaries are on a negotiated basis.

Connection cost information was obtained from a recent agreement between the City and a developer for service of lands in the Regional District in the vicinity of Nootka Street and are based on their Water Regulation Bylaw. The City's costs were as follows:

- One time connection cost of $2,000/lot. This cost was based on the capital investment paid or is to be paid by the City in bringing water from Haslam to Nootka. The developer is responsible for all costs of connecting to the City water system.
- Base user rate of 2 x City base rate per water works regulations and rates bylaw for service outside the City boundary (2 x $187.40 = $374.80 per strata lot 2008). This is the cost of basic allocation of 600 m^3/residence.
- An overuse charge of $0.50/$m^3$, assessed annually and paid by the Strata for use in excess of 600 m^3
- Annual strata fee is $100/lot
- For a 30 lot Strata, the costs were estimated as follows:
    - Connection: 30 lots x $2,000/lot = $60,000
    - Annual Strata Fee: 30 x 374.80 = $11,244
    - Strata Annual Base Fee: 30 x $100 = $3,000
    - Total Annual Fee: $14,244 or $475/lot (not including overuse charge)

All costs of conveying water from the City boundary is also the responsibility of the developer.

It is noted that if the base City residential user rate of $187.40/lot is used, the cost of water is approximately $187.40/lot ÷ 600$m^3$/lot = $0.312/$m^3$. If the base City residential user rate of $187.40 plus the $100 strata cost is used ($287.40 total), the cost of water is $287.40/lot ÷ 600$m^3$/lot = $0.479/$m^3$. If the negotiated rate is used for service outside the city, the cost of water is approximately $475/lot ÷ 600 m^3/lot = 0.792/m^3. The City recently increased their Bylaw rates by 15%. This would revise the Bylaw and negotiated rates as follows:

- Base user rate: $0.312/$m^3$ x 1.15 = $0.359
- Base user plus Strata Fee: $0.479/$m^3$ x 1.15 = $0.551
- Negotiated Rate (outside city connection): $0.792/$m^3$ x 1.15 = $0.911

It is expected that a Regional District connection would be negotiated differently. For instance, a Southern Regional connection would likely be subject to Section 14 of the Community Charter. This would require a bylaw approval from the City and likely the Regional District, the contents of which would need negotiation. A possible consideration for negotiation with the City would be a proportionate share of the long term water supply upgrade costs. This would be a minimum of say [2,345/(22,441-13,500)] x $8.8 million = $2.31 million ($2005) for interim service for Area B and $5.5 million for interim service for Area B and Area C. Based on the current population of 3,500 people for Area B and Area C, the cost is estimated at $3.42 million.

As mentioned previously, the addition of a Southern Region demand is anticipated to require further upgrades and costs to the City. The City may also request compensation for accelerating the upgrade of the Haslam Water Licence for storage and demand above their current licence amounts. Alternatively, the proposed upgrading to a reservoir by the City, which would provide a sufficient HGL and storage for a Southern Region connection at Highway 101, is estimated at $2.6 million. Therefore an order of magnitude cost of $2.4 million is used as an initial cost for a connection to the City in the cost analysis. The actual amount would depend on further hydraulic analysis of the City system with the Southern Region demand and negotiations with the City. It is noted that the order of magnitude cost of $2.4 million is equivalent to 1,200 lots based on the $2,000/unit connection cost negotiated with the developer for Upper Nootka water service. This is equivalent to a population of 3,000 to 3,600 based on a lot density of 2.5 to 3.0 people respectively.

4.1.2 Water Quality

The Haslam Lake supply is a potable water supply. The City currently undertakes chlorination for treatment and disinfection of the water system. The City's long term water supply recommended a multi barrier approach to treatment of the Haslam Lake water supply by either filtration with chlorine disinfection or UV plus chlorine disinfection.

4.1.3 Summary

The City has the capacity to provide water to the Southern Region of the Regional District for the interim and SROCP build out population for Electoral Area B. The use of this source would be subject to costs being negotiated with the City for required upgrades to their water system. An initial assessment of upgrade costs could potentially be in the order of $2.4 million not including yearly water costs, however, this would need to be confirmed with the City. It is not anticipated that the City could supply the long term demands associated with the build out population of the SROCP without significant improvement or costs associated with the Haslam water supply.

Current planned upgrades to City treatment would provide a potable water supply which meets current guidelines and regulations. Current chlorine residuals for a connection at Highway 101 are insufficient and a rechlorination station could be anticipated.

4.2 Hammil Lake

4.2.1 Water Quantity

The operation of Hammil Lake is governed by the Provincial Water Conditional Water Licence No. C14455 and C14456. These are held in the name of Westview Light, Power and Waterworks District (assumed to be the City of Powell River). The licences are provided in Appendix E.

The water licences provide for the following:

- Maximum water which may be diverted is 500,000 Igal/day (26 L/s or 2.25 ML/day); and
- Storage of 250 acre ft./yr (309,000 m^3/yr or 309 ML/year).

Land tenure around Hammil Lake is as provided in Table 4.1.

Table 4-1. Legal Description of Land Tenure – Hammil Lake

Legal Description	Land Owner
District Lot 5460, New Westminster, Group 1 Land District	No ownership
District Lot 5461, New Westminster, Group 1 Land District	Island Timberlands
District Lots 5462, 5463 New Westminster, Group 1 Land District	Crown land
District Lot 5469 New Westminster, Group 1 Land District	Crown land
District Lots 5470, 5471 New Westminster, Group 1 Land District	Crown land
District Lots 5486, 5485, 5492, 5493, 5494, 5510, New Westminster, Group 1 Land District	Crown Lands (City of Powell River Lease#232880)
District Lots 5511 New Westminster, Group 1 Land District	Tideline Services Ltd.
District Lots 6228	Powell River Energy Ltd.
District Lot 6250, New Westminster, Group 1 Land District	Powell River Energy Ltd.
District Lot 5488, New Westminster, Group 1 Land District(Block A, B, PID 015- 892- 310)	City of Powell River (Crown Grant)
DL 5488, New Westminster, Group 1 Land District (Block D Plan 6335)	Westview Power and Waterworks District
District Lot 5646, New Westminster, Group 1 Land District (Ref. Plan 4906)	BC Hydro
District Lot 5646, New Westminster, Group 1 Land District (Ref. Plan 2376)	Powell River Energy Inc.
District Lot 5489, Lot A, New Westminster, Group 1 Land District	Private owner

Land identified in crown lease #232880 was approved March 21, 1987 for a period of 30 years. It expires on March 21, 2017. The value of the lease is one dollar ($1.00).

The treatment plant is anticipated to be located on DL 5488, Lot B, which is a crown grant in favour of the City of Powell River.

The supply main to Padgett Road is anticipated to cross the BCTC and Powell River Energy rights-of-way (DL 5646-Plan 4906 and DL 5646-Plan 2377, respectively). There would be a small easement required on Pt A of DL 5493, which is private.

Hammil Lake has historically been used as a water source for the City of Powell River. Recently, due to issues primarily with the poor condition of the supply watermain and water quality, the City has abandoned the use of Hammil Lake. The long term water supply plan does allow for the upgrade of the Hammil Lake source as a backup supply by replacing the 250 mm watermain and lowering the intake deeper into the lake to access potentially better quality water. With the watermain out of service, fire flow to the airport area does not meet Fire Underwriters requirements.

Hammil Lake is located in Electoral Area B at the upper end of Paradise Valley in the vicinity of Hammil Mountain. The lake level is approximately 147 m. Hammil Lake discharges via a small creek through the low lying area at the north end of the lake. A field review found the outlet structure no longer exists and the old berm is, for the most part, washed away. Other than wood and log debris which accumulates at the outlet, water is free flowing. Water flows from Hammil Lake a short distance down Hammil Creek and connects to Myrtle Creek. Hammil Creek and Myrtle Creek have 13 water licences registered against them. They are provided in Table 4.2.

Table 4-2. Water Licenses – Hammil and Myrtle Creeks

License No.	Quantity	Purpose	Licensee
Hammil Creek			
F052931	2000 Igal/day	Domestic	N/A
Myrtle Creek			
C022446	2000 Igal/day	Domestic	N/A
C045085	5 acre ft.	Domestic	Charles Barta
C049189	1000 Igal/day	Domestic	Norma Smith
C049190	500 Igal/day	Domestic	Darren Brown
C053802	500 Igal/day	Domestic	Gunter Moran
C065234	1000 Igal/day	Domestic	Thomas Parsons
C065274	500 Igal/day	Domestic	471375 BC Ltd.
C069906	0.1 ft^3/s	Ponds	Richard Machin
C108854	5 acre ft./annum	Irrigation	Brian Baldwin
F013752	1000 Igal/day	Domestic & Irrigation	Roger Hodgins
F017175	2000 Igal/day	Domestic	Barry Cuther
F020251	500 Igal/day	Domestic	David James

The total commitment of these licences is as follows:

- Diversion: 63,800 Igal/day (3.36 L/s or 0.29 ML/day)
- Storage: 10 acre ft/year (12,320 m^3/year or 12.3 ML/year)

It is noted that Hammil Creek is a minor tributary to Myrtle Creek. Some of the licences (Barta) are located upstream of the confluence of Hammil Creek. Allowing for the total water licence commitment in the capacity analysis is therefore considered conservative.

The Hammil Lake watershed is relatively small – 4.15 km^2 (1.75 square miles). The watershed consists of second growth forest to the north. The south and west portions of the watershed have been recently cleared. BCTC and Catalyst Paper own transmission facilities and rights-of-way through the watershed. Commercial vehicle access through the watershed is required for right-of-way maintenance. The watershed and lake area

are exposed to public access and people do swim in the lake. Motor bikes, horse trail riders and ATV's commonly use the transmission right-of-way. The current Southern Region SROCP designates the watershed as a community watershed subject to Community Watershed Management Policies.

The Hammil Lake watershed was assessed in the 1954 R.J. Cave Report in terms of watershed yield. The report identified the safe draught year yield at 104 L/s (2.0 Imgd).

Based on required Southern Region water demands, potential options for use of Hammil Lake as a water source are as follows:

- Supply Area B in the interim: Peak Day Demand of 2.81 ML/day (or 33 L/s)
- Supply Area B at full OCP build-out: Peak Day Demand of 11.95 ML/day (or 138 L/s)
- Supply Areas B and C in the Interim: Peak Day Demand of 6.75 ML/day (or 78 L/s)

There is insufficient water available at Hammil Lake to serve Areas B and C at full OCP build-out. An alternative source, such as Lois Lake, would have to be considered in the distant future.

Based on the above options and the available drought year flow of 9.68 ML/day (104 L/s), taking into consideration the City's water demands (26 L/s), downstream water licences (3.4 L/s), and an environmental allowance of 5 L/s (total 34.4 L/s), the following is estimated:

- Hammil Lake has the capacity to provide interim Area B demands as well as City and downstream water licence demands [total = 5.06 ML/day (68 L/s)]
- Hammil Lake has the capacity to provide interim demands for Areas B and C as well as City and downstream water licence demand [total = 9.1 ML/day (112 L/s)]
- The full build-out demand of 173 L/s of Area B (138 L/s District supply plus 34.4 L/s City and other users) would exceed the available flow of 104 L/s. This would require storage capacity to provide the additional 69 L/s of capacity.

The additional storage required to provide the 69 L/s for the six month period during the summer from mid April to mid October to meet Area B ultimate population requirements is 1,074,000 m^3. Allowing for City storage of 309,000 m^3 and other water licence storage, the total storage required is 1,385,000 m^3, say 1,400,000 m^3. This is considered conservative as it assumes no inflow during this period. It would also be considered conservative if District demand side measures reduce the per capita peak day demand assumed in the demand analysis.

Storage of 1,400,000 m^3 represents a lake depth of 1.6 m. The storage can be developed by raising the lake to approximately 147.6 m, or accessing storage below 145.0 m to 143.5 m, or a combination of both. Based on the information provided in the Cave report, raising the lake to 147.75 m could be undertaken by berming the low area at the north outlet of the lake. A control structure is proposed to be constructed to better control water levels and lake outlet flows which would be required for environmental and downstream user requirements. The estimated cost is in the order of $220,000.

The potential for additional storage was investigated in the City's long term water supply study. The potential lake drawdown ranges from 0 m (elevation 147 m) to 25 m (elevation 123 m). The south end of the lake is

the deeper section. Based on bathymetric data, the lake has the following storage potential. The limitation on lake drawdown is dependent on the ability of the lake to recharge itself over the winter months. Based on information in the Cave report, the lake can recharge a depth of 1.6 m – 2 m over the winter months.

Table 4-3. Hammil Lake Storage Potential

Volume Between Contours		Cumulative Volume
Elevation	Volume (m^3)	Volume (m^3)
147	1,617,000	1,617,000
145	3,614,000	5,231,000
140	2,996,000	8,227,000
135	2,321,000	10,548,000
130	1,511,000	12,059,000
125		

Source: City of Powell River – Long Term Water Supply Study (D&K 2005)

Bathymetric and storage data for Hammil Lake is provided in Appendix F. The storage available between elevation 146 m and 147 m is approximately 808,500 m^3. The City water licence storage requirements represent 38% of this depth. Based on mass storage data in the Cave report, accessing storage below 140 m may not allow the lake to recharge over the winter. Further analysis would be required.

4.2.2 Water Quality

In the past, water quality has been an issue with the Hammil Lake water supply. Public and recreational users have access to the lake. The BCTC and Catalyst Paper own the transmission right-of-way which runs through the watershed and is in close proximity to the lake. This requires vehicle access for maintenance and clearing. Currently, the City has abandoned the water supply except for fire protection. It is proposed to be a backup supply in the City's long term plan.

BC Research Study

A report on the water quality of Hammil Lake was prepared by BC Research just over 30 years ago (Water Quality Survey of Hammil Lake, Powell River, BC, 1973). The report was commissioned in response to taste and odour complaints by consumers. Based on the water quality data in this report, the following is offered:

pH

The pH of the raw water was found to be between 5.9 and 6.4, which is outside of the aesthetic objective range set out by the GCDWQ (pH 6.5 to 8.5). This suggests that the raw water is corrosive. Many factors can influence pH, but the addition of a treatment chemical to water with low alkalinity, such as gaseous chlorine can have the effect of lowering pH. This can improve disinfection but low pH can also lead to pipe corrosion

unless non corrosive pipe materials are used such as PVC or HDPE. It is therefore recommended that pH measurements be taken downstream of chemical treatment.

Total Organic Carbon

Total organic carbon (TOC) ranged from 2 to 6 mg/L and did not improve with depth of the sampling point. TOC concentrations with depth were associated with high algal counts in the bottom sediments. Although there is no current guideline in the GCDWQ for TOC, raw water TOC should be below 4 mg/L and treated water TCO should be generally less than 2 mg/L if chlorine disinfection is applied to avoid disinfection by-product issues.

Turbidity

Turbidity measured was generally less than 1 NTU. Samples taken from near the bottom were believed to contain interference from bottom sediments, which resulted in elevated turbidities (exceeding 5 NTU). The lake bottom in the vicinity of current intake is shallow and wave action could cause suspension of bottom sediments. The shallow waters of the intake location would also be more susceptible to algae growth due to the potential for warmer waters.

Water Treatment

The authors of the 1973 water quality report suggested relocation of the intake and construction of an underwater chimney in order to improve influent water quality. There would be some benefit to investigating a new location for the intake to a zone less influenced by turbidity caused by bottom sediments and TOC. Although this would provide some improvement, there may still be a need for TOC reduction, which could be achieved through treatment.

It was recommended in the City's long term water supply plan that options for intake relocation be assessed, and that portability analysis be conducted at the proposed intake location.

Water treatment options should be considered which achieves the requirements set out in the Drinking Water Protection Act. If the water supply was reactivated for a Southern Region supply, the short term goal should be for primary and/or secondary disinfection depending on further water quality data analysis.

2007 Water Quality Data

In November 2007, a water sampling program was undertaken on Hammil Lake to provide further information on water quality. Samples were obtained every 10 ft. from a depth of 3 m (10 ft) to 21 m (70 ft) at 3 m (10 ft) intervals. The data is provided in Appendix C.

In summary, the following is noted:

1. All measurements were within GCDWQ recommended limits

2. Turbidity was measured less than 1.0 NTU in all samples. The highest value was 0.8 NTU. The remaining levels were below detectible limits (<0.5 NTU).

3. One parameter not tested for was algae. This should be included in future sampling

4. Total organic carbon (TOC) ranged from 1.9 mg/L to 4.8 mg/L. The higher readings were recorded at depth and are considered associated with algae counts in bottom sediments. The values were within recommended guidelines for raw water quality and with further water sampling may be appropriate for only chlorine disinfection subject to discussions with the local Health Officer, but unlikely.

4.2.3 Summary

Hammil Lake, based on the information reviewed, has the capacity to provide for both the City's water licence allotment and Southern Region Area B demand in the interim and the future. Future build out demands for Area B will require the provision of storage.

Based on previous sampling and investigation, as well as the November 2007 sampling, the water quality of Hammil Lake is found to be acceptable as a source for drinking water quality. It is recommended that further sampling be undertaken in June and August to get a better sense of water quality in the summer months where issues with algae and turbidity would be greatest. The results would then need to be reviewed with the local Health Authority to confirm recommended treatment requirements.

4.3 Lois Lake

4.3.1 Water Quantity

The operation and management of Lois Lake is governed by Provincial Water Licences No.113351 and No.113353 which are held by Powell River Energy (PRE). In addition, there is Licence No.114763 held by West Coast Fish Culture. They have a fish hatchery facility located significantly upstream near Camp "B" which is near Lois/Khartown channel. In summary, the water licences provide for the following:

- PRE: maximum withdrawal of 1,297 ft^3/s (36.75 m^3/s; 1,158.85 Mm^3/year; 36,750 L/s; 7,464.96 ML/day
- PRE: maximum storage of 448,960 acre ft per year (554.96 Mm^3/year)
- West Coast Fish Culture: maximum withdrawal of water of 500,000 Igal/day (2.25 ML/day or 26 L/s)

At the time of this report, Lois Lake has not been identified as being fully allocated by BC Water Management.

The Lois Lake watershed is an extensive watershed of over 456 km^2. The predominant land use in the watershed is tree farm licences with associated logging activities. Water levels in Lois Lake are governed by the operation of the PRE hydroelectric generating station based on the licensed storage of 448,960 acre ft. The lake is reported by PRE to operate between elevation 143 m and 159 m (472 ft to 521 ft). An intake should not interfere with operation of the PRE generating facility provided it is located below elevation 143 m. Ideally an intake elevation of 130 m +/- would be required.

Just upstream of the PRE generating facility dam are a number of commercial operations, as follows:

- West Coast Fish Culture fish farm operation
- A log removal facility
- There is an underwater logging operation on the lake
- There are four or five floating homes.

To minimize issues with water quality, any proposed intake should be located upstream of these facilities. Because the proposed intake would need to be below the existing operating lake level, and the topography of the surrounding area, District demand would need to be pumped to a storage tank or treatment plant. Flow could then be conveyed to the Southern Region by gravity. Two alternatives could be considered:

1. Pump to the high point on Dixon Road, then convey flows by gravity

2. Pump to balancing tank and/or treatment plant at a lower elevation and convey water along the Stillwater forest resource road to just before the bridge. From there, cross Silver Creek to the Lang Bay water system.

Pumping from the intake to the high point on Dixon Road would require pumping from Lois Lake to an elevation of 178 m. From there, flows could be conveyed by gravity and service not only the lower and high pressure zones in Lang Bay, but also an upper high pressure zone. There are only three parcels in the upper high pressure zone identified in the SROCP. It is not cost effective to pump all flows to the high point of Dixon Road to provide gravity service to only a few lots.

Pumping to an elevation of approximately 165 m near the vicinity of Dixon Road and Stillwater access road, in the vicinity of the dam, would allow flows to be conveyed to the lower and high pressure zones by gravity via the Stillwater access road. From the balancing tank / treatment plant, the watermain would follow Stillwater access road until just before the bridge over Lois River. From there the watermain would traverse west across Silver Creek and connect to the Lang Bay system in the vicinity at the existing chlorination building and reservoir. Depending on the elevation of the existing reservoir, it may be possible to reuse the reservoir and chlorination as part of a regional water system subject to negotiation with Lang Bay waterworks.

Under this scenario, booster pumping would be required to reach an upper high pressure zone. However, because there are only three lots, it is more cost effective to booster pump under this option in comparison to the Dixon Road option, as Dixon Road would require pumping all Southern Region flows rather than just the upper high zone. In addition, any supply to an upper high zone would not likely be required until well into the future. For this reason, the option to pump from the intake to the 165 m elevation is advanced further in the options discussed further in Sections 4 and 5.

In comparison to the PRE withdrawal demands, the interim peak flow required for Area C of the Southern Region is 3.94 ML/day (45.6 L/s) which represents 0.1% of PRE's withdrawal allocation. The interim peak day flow for Areas B and C is 6.75 ML/day (78.2 L/s) which represents 0.2% of PRE's withdrawal allocation. The ultimate peak day demand for Area C is 28.51 ML/day (329.9 L/s) which represents 0.9% of PRE's withdrawal allocation. The ultimate peak day demand for Area B and C is 40.46 ML/day (468.2 L/s) which represents 1.3% of PRE's withdrawal allocation. It is important to note that the District demands would be in

addition to the PRE water licence requirement. The percentages are only shown to clarify the water demands required by the District in relation to PRE water licence demands. Provided the intake is located below the PRE operating levels of Lois Lake, the Lois Lake system should have ample capacity to be considered as a source for the Southern Region (both Area B and Area C). Further analysis may be required to confirm this. There may be cost issues associated with loss of generating revenue; however, this would be minimized with an intake location below the generation facility operating levels. Costs would need to be further explored with PRE and Provincial Water Management.

4.3.2 Water Quality

There is no past water quality data available for the Lois Lake watershed. It is noted that the watershed is subject to forest resource activities, and some minor commercial and public activities on the lake. Lois Lake does have significant flow through or flushing action due to power generation activities.

In November 2007, a water sampling program was undertaken on Lois Lake just upstream of the dam to provide preliminary information on water quality. Samples were obtained at 10ft (3m) intervals from a depth of 10 ft (3 m) to 30 ft (9 m). The data is provided in Appendix C. In summary, the following is noted:

1. All measurements were within GCDWQ recommended limits
2. Turbidity was measured less than 0.5 NTU
3. Total organic carbon (TOC) ranged from 2 mg/L to 2.6 mg/L. This compares to the recommended level of 3.0 mg/L identified by Environment Canada as "clean".

4.3.3 Summary

Lois Lake has adequate capacity to supply both Area B and Area C if required and is not identified as being fully allocated by BC Water Management. The Southern Region water demand represents 0.9% to 1.3% of current licensed capacity. Provided the intake is located below PRE operating lake levels, compensation for loss of power reduction may not be required. The treatment plant is recommended to be located at an elevation of approximately 165 m and conveyed to the Lang Bay water supply area via the Stillwater access road.

Preliminary water quality meets current GCDWQ. Should the source be considered further, then additional water quality sampling should be undertaken, particularly during the low flow summer period. The results should then be reviewed with the Coastal Health Authority to confirm treatment requirements.

5. Regional Source Development and Transmission

5.1 Introduction

The proposed regional water supply system components such as trunk mains, reservoirs, treatment plants and booster pump stations are shown on Figure 5-1. The regional system is, for the most part, as proposed in the 1989 Southern Region Water Resource Study with some minor adjustments. The system consists of three pressure zones (low zone, high zone and upper high zone) as provided in Figure 5-2.

5.2 Water Sources

The goal of the study was to consider the supply of Myrtle Pond in the context of a regional supply. Three sources were to be considered:

- Connection to City of Powell River (Highway 101 and Duncan)
- Hammil Lake
- Lois Lake

We also believe there is merit in considering a connection to the City system at Nootka. This is discussed further in this Section.

In terms of developing a water supply source, it is important to consider an ultimate service population or an equivalent population based on the SROCP. The equivalent population and associated average day, peak day, and peak hour demands are provided in Table 2.8 and Table 2.9. Based on this information, we comment as follows:

- The City does not have the capacity to supply the ultimate Southern Region peak day demand without a substantial upgrade to the Haslam Lake supply. The City does have the capacity to supply Area B in both the interim and ultimate cases, and Area B and C in the interim. The ultimate demand for Area B or the interim demand for Area B and Area C is anticipated to accelerate the upgrade of the Haslam Lake source.
- Hammil Lake does not have the capacity to provide ultimate peak day Southern Region water demands for Areas B and C. Hammil Lake can provide for Area B water demands in both the interim and ultimate cases. Ultimate peak day demands for Area B will require additional storage. Hammil Lake can also provide interim demands for Area B and Area C.
- Lois Lake is anticipated to have adequate capacity to provide Southern Region peak day demand in both the interim and ultimate cases. Access to Lois Lake water needs to be investigated further with Water Management and PRE to confirm if a licence can be obtained without detrimentally affecting PRE and at what cost.

In terms of other sources, Lang Creek has insufficient capacity given existing water licences and average minimum yearly flows and the source is already fully allocated by BC Water Management. Development of wells has been investigated and found not able to provide required flows for a Southern Region water supply.

Deep wells in the Southern Region have been found to be susceptible to arsenic contamination, and shallow wells are subject to yield and water quality issues.

In terms of possible expansion in the short term, Brew Bay water system and Lang Bay water system are the only ones of sufficient size and quality; however, their sources offer no capacity to provide for Southern Region demands even for the interim. Even much expansion beyond their current capacity is severely limited or not possible. The quality of the source water is also poorer than the City, Lois Lake and Hammil Lake.

5.3 Water Quality and Treatment

5.3.1 Background

The quality of British Columbia's drinking water is currently protected by the Drinking Water Protection Act and Regulations. The regulatory authority for drinking water quality in British Columbia rests with the Ministry of Health Services. Each municipality is regulated through Drinking Water Officers stationed within their own region.

New measures to govern drinking water from source-to-tap were set into place in May 2003, with the amended Drinking Water Protection Act and Regulations that came into force. The new regulations replace the BC Safe Drinking Water Regulation (April 2001) under the Health Act.

The Act provides a comprehensive and co-ordinated framework for protecting BC's drinking water from source-to-tap. Under the new legislation the province has increased the basic expectations around assessing water systems, certifying operators and suppliers, and monitoring and reporting on water quality. The new standards help ensure safe, reliable and accessible drinking water for all British Columbians. Appointed Drinking Water Officers employed by the Regional Health Authorities in dedicated positions under the Act ensure the water is safe to drink. The Drinking Water Officers ensure that the water quality is maintained through operating permits developed specifically for each water system. The new regulations also require that all water system and operators be certified under the Environmental Operators Certification Program (EOCP).

Water treatment goals adopted as a minimum should meet the BC's Drinking Water Protection Regulation and should also, where applicable, meet the Guidelines for Canadian Drinking Water Quality (GCDWQ). The trend in BC appears to be to provide "multi-barrier" strategies, whereby drinking water quality is not protected by a single process particularly for unprotected surface water sources.

5.3.2 Drinking Water Quality

Surface water sources are viewed to be more vulnerable to man-made and/or natural contamination and transient water quality events than groundwater. Raw water quality monitoring is key to identifying the short and long term impacts of events occurring in the watershed. Based on water characteristics and potential impacts, a long term supply strategy should address watershed protection, water quality monitoring and water treatment goals.

Some of the common parameters relevant to characterizing the Lois Lake and Hammil Lake drinking water supplies are described below.

Turbidity

Turbidity is an expression of the optical property that causes light to be scattered and absorbed rather than transmitted in straight lines through a liquid sample. Turbidity in water is caused by any suspended mater, which interferes with the clarity of the water. This may include clay or silt, algae, and other organic or inorganic compounds.

Excessive turbidity in drinking water is not only unsightly, but also may be a health hazard since the turbidity causing particles can interfere with disinfection, allowing disease causing pathogenic organisms (bacteria, viruses, cysts) to enter the distribution system. In effect, the particles of turbidity provide "shelter" for microbes by reducing their exposure to the action of chlorine.

Turbidity also reacts with chlorine disinfectants directly, causing depletion of disinfecting power, and possibly allowing disease causing pathogens to survive and be passed into the distribution system. Turbidity causing particles can also provide food for microbes, promoting their regrowth in the distribution system. The GCDWQ recommends a maximum turbidity level of one (1) NTU for water entering a distribution system.

Colour

The GCDWQ recommends a maximum level for colour of 15 true colour units (TCU). While the standard is set for aesthetic considerations, the presence of colour is viewed as an indicator of levels of complex natural organic matter (humic substance) resistant to microbial degradation. Organic content is a problem for a number of reasons:

- Certain organics contribute to taste and odour problems
- The presence of organic matter may lead to problems with biological quality changes in the distribution system.
- Disinfection By-products (DBP's) can be formed on addition of chlorine. The by-products, trihalomethanes (THMs) pose a long term health risk.
- Organic matter can shield waterborne pathogens from disinfection treatment and can lead to water quality problems in the distribution system.
- Visually unappealing to the consumer.

pH

The pH value is a measure of the hydrogen ion concentration in the water and it indicates the balance between acids and bases. The GCDWQ recommends a pH for drinking water of between 6.5 and 8.5. pH plays an important role in water treatment chemistry. For instance, a pH greater than 8.5 interferes with chlorine disinfection while a pH less than 6.5 can lead to corrosive effects in pipes.

Alkalinity and Hardness

Alkalinity is a measure of the water's capacity to neutralize an acid while hardness is a measure of the divalent cations, especially magnesium and calcium.

Alkalinity standards have been set as a guide to chemical balance in water for treatment processes involving chemical addition, to avoid corrosion and encrusting properties and to minimize gastro-intestinal problems. Hardness can have a positive effect on human health but may have a detrimental effect on piping due to scaling. According to the Health and Welfare Canada guidelines, the acceptable alkalinity range is 30 to 500 mg/L as $CaCO_3$ while the hardness should be less than or equal to 120 mg/L as $CaCO_3$.

Potential for Waterborne Bacteria and Viruses, Giardiasis, and Cryptosporidiosis

Giardiasis is an intestinal disease caused by the *Giardia lamblia* cyst. The District has not had problems but like any surface water source in British Columbia, the potential exists. *Cryptosporidium* is a protozoan parasite that can live in the intestines of humans and animals.

Giardia is found in surface water sources in British Columbia. Waterborne outbreaks have been documented at 100 Mile House, Creston, Kitimat, Kimberly, Kelowna, Penticton, Trail, Revelstoke and Barriere. Cases of *Cryptosporidium* are more rare, although outbreaks were reported in Cranbrook, Kelowna and Chilliwack. Chlorine is not considered to be an effective disinfectant against *Giardia* cysts and *Cryptosporidium* oocysts.

People with compromised immune systems are very susceptible to cryptosporidiosis. These include AIDS patients, cancer patients undergoing chemotherapy (which suppresses the immune system) and those suffering from certain viral illnesses such as chickenpox or measles.

Generally the requirements for treating the water are to meet the following:

- 4-log (99.99%) inactivation of bacteria and viruses
- 3-log (99.9%) inactivation or removal of *Giardia* cysts
- 2-log (99%) inactivation or removal of *Cryptosporidium* oocysts

In order to ensure effective disinfection that provides 4-log inactivation of bacteria and viruses (primary disinfection), the turbidity at the point of disinfection must be less than 1.0 NTU. The preference is to include multiple treatment barriers such as disinfection with UV and chlorine, or filtration and chlorine, so that there is some redundant protection. The standards for potable water from the Drinking Water Protection Regulation (DWPR) are shown in Table 5.1 as follows.

Table 5-1. Standards for Potable Water

Parameter	Standard
Fecal coliform bacteria	No detectable fecal coliform bacteria per 100 ml
Escherichia coli	No detectable Escherichia coli per 100 ml
Total coliform bacteria	
(a) 1 sample in a 30 day period	No detectable total coliform bacteria per 100 ml
(b) more than 1 sample in a 30 day period	At least 90% of samples have no detectable total coliform bacteria per 100 ml and no sample has more than 10 total coliform bacteria per 100 ml

In addition to the above, the Regional Health Authority usually requires that the drinking water meet all health-based parameters of the Health Canada GCDWQ. The presence of a chlorine residual in the distribution system (secondary disinfection) is recommended to minimize the potential effects of bacterial regrowth.

Total Organic Carbon

Total organic carbon (TOC) is a direct expression of the TOC in the water, a portion of which, the humic substances, will react with chlorine to produce THM's. There are no standards for the TOC levels in drinking water but according to the Water Quality Sourcebook (of Environment Canada) a level of "less than 3.0 mg/L has been observed to be relatively clean". Focus is normally spent on precursor reduction as opposed to THM removal post-chlorination.

Trihalomethanes

THM's are formed by the reaction of chlorine with naturally recurring precursor such as humic or fulvic acids (by-products of the decay of organic matter). THM's are considered carcinogenic and therefore limits have been established in the GCDWQ at 0.100 mg/L. In the US, the current maximum THM contamination level is 0.08 mg/L.

The formation of THM's is related to the water treatment process and thus the raw water quality in terms of precursor availability and concentration is important. If the precursor availability and concentration varies seasonally, then the THM formation will also likely vary.

5.3.3 Source Water Quality

Hammil Lake

Consumers have reported taste and odour issues with the Hammil Lake source in the past. The poor quality is likely attributed to the location of the intake and the condition of the Woodstave supply main. The intake was located in shallow water where sediments were easily disturbed. The shallow water at the intake also was more susceptible to algae growth due to warming of the shallow water, particularly in the summer months.

Recent water quality testing found the water to meet GCDWQ. However, the watershed is exposed to commercial and public use activities. Development of this source should consider a multi barrier approach. Either UV or filtration followed by disinfection. Further water quality analysis, particularly during the summer months should be undertaken to confirm treatment requirements.

Additional considerations for development of the water source should include:

- Relocate the intake to deeper water and include a chimney intake.
- The berm and outlet structure should be rebuilt to better provide storage and control outflows for environmental and downstream purposes.
- An Integrated Watershed Management Plan should be undertaken to better protect the watershed. In the long term, public access along the transmission right-of-way should be moved around the west side of Hammil Hill outside of the watershed boundary.

Lois Lake

Water quality of Lois Lake is relatively unknown. Historic water quality sampling was not found. The watershed is exposed to forest resource and commercial activities. There are a small number of floating homes on the lake. Because of power generation activities, flushing action on the lake is substantial.

Recent water quality testing indicated that the water source meets GCDWQ. Even so, with the potential for watershed activities, a multi barrier approach should be considered similar to Hammil Lake. Further water quality testing should be undertaken, particularly during the summer months and during low lake levels to confirm treatment requirements.

Additional considerations for development of the water source should include:

- Locate the intake below PRE lake operation levels
- Locate the intake upstream of the commercial activities located upstream of the dam
- An Integrated Watershed Management Plan should be undertaken to better protect the watershed

City of Powell River

Current plans for the City include a multi barrier approach to treatment of the Haslam source. Water quality issues for a City connection are related to water quality in the distribution system. The minimum recommended chlorine residual within municipal water distribution systems in BC is approximately 0.2 mg/L free chlorine. The optimum residual is 0.5 mg/L. Samples taken in support of the City's Long Term Water Supply Study found five chlorine samples in the range of 0.02 mg/L to 0.1 mg/L. Given that a Southern Region connection would be at the far end of the City's system, it is likely that rechlorination will be required. Further discussions with the City will be required to confirm:

- present free chlorine residuals at the connection points
- further measures needed to ensure a desired residual of 0.2 mg/L to 0.5 mg/L.

5.4 Regional Supply

5.4.1 Pressure Zones

The 1989 Southern Region Water Resource Study identified a proposed plan for water supply to the Southern Region. The system consisted of two pressure zones (high and low). The zones were developed to economically provide acceptable water pressure to water users over the entire regional system. The pressure zones have been modified somewhat to better match potential treatment plant locations. A potential third pressure zone (upper high) has also been identified which would be needed to provide supply to the Nootka Street / airport area, Hammil Hill, and upper Kelly Creek areas. These zones are outlined on Figure 5-1 and 5-2.

Low Zone

The low zone would supply water to the area between sea level and the 65 m elevation. The designated zone elevation (reservoir elevation) would be 93 m, which is similar to the City's Zone 4. Pressure would vary in the zone from 910 kPa (132 psi) at sea level to 276 kPa (40 psi) at elevation 65 m. The low zone covers most of the existing development in the Southern Region including Stillwater. The low zone pressure would be controlled by a series of four balancing reservoirs located with a top water level of 93 m. The location of the proposed Stillwater low zone reservoir is proposed on the hill in the vicinity of Lamb Road. Construction of a reservoir in the Jefferd Creek area would be more difficult due to the topography.

High Zone

The high zone would supply water to the area between elevation 65 m and 114 m. The proposed zone designation would be 142 m. Pressures in this zone would vary from 758 kPa (110 psi) at elevation 65 m and 275 kPa (40 psi) at elevation 114 m. The high zone would be developed in isolated pockets in existing developed areas around upper Myrtle Creek Valley (Padgett Road), Kelly Creek (Zillinsky Road), Lang Bay above the highway, upper Stillwater, or as allowed, in the SROCP.

The zone can be provided by gravity by assuming a feed from Hammil Lake of 142 m and from Lois Lake with an elevation of 142 m. A feed from Hammil Lake at 142 m will allow for provision of a treatment plant at the current Hammil Lake intake. The upper Myrtle Valley could also be provided from the City's 172 m zone. The high zone at Lang Bay can be served by gravity by siting the proposed treatment plant at elevation 165 m. A raw water intake pump station would be required to feed the proposed treatment plant (required in any case). The high zone reservoir in the vicinity of Zillinsky Road would be served by booster pumping.

Upper High Zone

The current SROCP would allow development in a higher zone in the vicinity of Zillinsky Road and in the vicinity of Nootka Street. To service these areas would require an additional pressure zone (upper high zone). The upper high zone would supply water between elevation 114 m and 149 m. The proposed zone designation would be 175 m. Pressures in this zone would vary from 620 kPa (90 psi) at elevation 114 m and 275 kPa (40 psi) at elevation 175 m.

It is not possible to service these zones by gravity and they must be serviced by booster pumping.

It is noted that the zone in the vicinity of Nootka and the airport can not be supplied from the City's 172 m zone without significant upgrades. Even with the upgrades, the reservoir is limited to a TWL of 149 m which would not allow servicing of the Upper Nootka Regional District lands. To service the upper Nootka area requires a reservoir with a TWL of 172 m +/-. The area could be serviced by booster pumping to a standpipe type reservoir located on the hill in the southern part of the zone within the Regional District. The reservoir could be serviced by booster pumping from the City or the Regional District's high zone via booster pumping. Alternatively, a booster pumped zone could be considered. The feed from the District high zone would best be accomplished by way of the existing BCTC hydro right-of-way. Currently, there is a development in the Regional District on Nootka which is proposed to be serviced from the City. It is understood that the City requires, on top of connection costs, that the developer pay for the costs of booster pumping or a portion thereof to service this development.

It is noted that by developing the upper high zone in the upper Nootka area by booster pumping and transmission to the proposed reservoir along the BCTC right-of-way, the transmission could easily be extended further along the right-of-way and connected to the City's system at the south end of town. This would significantly benefit the City system by hydraulically anchoring or looping the City system in the south. This may mitigate much of the cost of upgrading the City's system to the south and would allow further development in their 172 m zone in the southern part of the City, as well as provide full fire supply to the airport.

The upper high zone in the vicinity of Kelly Creek needs to be serviced from the 175 m elevation. This could be accomplished by a booster pumped pressure zone or booster pumping to a reservoir situated at elevation 175 m. There are only two locations in the vicinity where this can occur – on the northeast slope of Hammil Hill or the northwest slope at the hill to the east of Hammil Lake. For the purposes of this study, we have assumed the former. By booster pumping from the Hammil Lake treatment plant to a reservoir located at elevation 172 m, it would be possible to service the upper high zone in the Myrtle Valley and the upper high zone in the upper Kelly Creek area by gravity.

5.4.2 Reservoirs

The proposed Southern Region Water Source Plan includes the provision of storage reservoirs at seven locations. Reservoirs should typically be sized to provide balancing storage for peak flows as well as fire protection for its service area. Fire storage is assumed at 60 L/s for a one hour duration or 324,000 litres except for the airport. Fire flow for the airport is assumed at 150 L/s for a two hour duration or 1,080,000 litres as provided in the City's Long term Water Supply Plan. Potential reservoir locations are identified on Figure 5-1.

Myrtle Valley Low Zone

Located near the intersection of Padgett Road and the BCTC transmission right-of-way system at the 94 m contour. It is estimated that interim balancing storage is 260,000 litres. With fire flow of 324,000 litres, the total reservoir volume is 584,000 litres (584 m^3).

The existing Myrtle Pond Reservoir (MPR) is located at a base elevation of approximately 66 m and is approximately 18.0 m high. The TWL is approximately 83 m. The LWL would be 67 m.

The volume of the reservoir is 273,000 litres (60,000 Igal) and the diameter is 4.5 m. We note the following in regards to the use of the reservoir within a regional system.

- The MPR operating levels do not meet the proposed Southern Region Myrtle lower zone reservoir TWL elevation of 94 m.
- Maintaining 138 kPA (20 psi) residual pressure at the top of Byron Road is estimated to limit the available storage to a TWL of 80 m. The resulting available storage is estimated at 47,000 L (10,400 Igal).
- A City supply with an HGL of 94 m (without the existing MPR) is not sufficient to provide required fireflow with a minimum residual pressure of 138 kPA (20 psi) at the top end of Byron Road, unless a 300 mm to 350 mm pipe is installed along Hwy 101.
- A City supply with an HGL of 94, in conjunction with the existing Myrtle Pond Reservoir, could provide required fireflow to the Highway 101 corridor south of town to Myrtle Road. There may still however be 139 kPa (20 psi) residual pressure deficiencies at the top end of Byron Road under fire flow conditions. More detailed hydraulic analysis is required.
- Without a City connection, supply of the Highway 101 corridor between the City and Myrtle Pond is not possible from the existing MPR. The elevation of the reservoir is not sufficient to provide fireflow to the area between the City boundary and Stevenson Road, and the top end of Southhill Estates.

The KWL report identified a number of issues with the existing MPR and recommended constructing a new reservoir or recoating the existing reservoir at a cost of $250,000. It is noted that the review did not include a structural assessment. Should cost be an issue then reuse of the existing MPR reservoir could be considered in the interim for a City connection along Hwy 101, however it is recommended a new reservoir be provided at the required zone elevation.

An alternate location for a low zone reservoir would be at the 94m contour north of Stevenson Road. The location of the reservoir would be dependent on the conveyance option considered and further hydraulic analysis.

Myrtle Valley High Zone

Myrtle Valley high zone is located at the proposed treatment plant located at Hammil Lake with a TWL of 142 m. The clearwell is estimated to have interim balancing storage of 240,000 litres. With fire flow of 324,000 litres, the storage volume is 544,000 litres (544 m^3).

Myrtle Valley Upper High Zone

Myrtle Valley upper high zone is located at the high point (elevation 148 m) south of Nootka Street. To meet the supply zone elevation of 175 m would require the reservoir TWL to be approximately 27 m above ground to ensure a minimum 40 psi is maintained in the upper Nootka area. The majority of the surrounding ground is at elevation 134 m to 144 m. A standpipe or elevated reservoir would be required.

The estimated volume for interim balancing demands is estimated at 60,000 litres. With a fire flow of 324,000 litres, the total reservoir volume is 404,000 litres. If the reservoir was to be considered for City purposes, the size of the reservoir would be:

PRRD Balancing Storage	60,000 L
Fire Flow (150 L/s for 2 hours)	1,080,000 L
City Balancing	1,000,000 L
Total	**2,140,000 L**

It is noted that the provision of this reservoir provides significant benefits to the City as it improves fire flows and water supply to the supply deficient area in the vicinity of the airport and the area above Manson Avenue. This area is currently the only developable area left in the south end of the City. By extending a trunk main from the proposed reservoir, along the BCTC right-of-way, to the southern end of the City system near Toba Street would essentially anchor or loop the City water system with two 175 m sources. This could potentially mitigate many upgrades the City is currently planning and potentially extend the service period of the Haslam source prior to requiring an upgrade of their water licence. The location would benefit the District by anchoring the west side of the Southern Region and provide service to Upper Nootka area.

It is noted that the City and a local developer currently are planning on servicing the upper high zone area by booster pumping from the City system at the top end of Nootka.

Hammil Hill Upper High Zone

Should servicing of the upper high Myrtle Valley or Hammil Hill area be required and/or the upper high zone in the Kelly Creek area, this could be accomplished by locating a reservoir at the 172 m elevation on the northwest side of Hammil Hill at the southern boundary of DL5492.

The estimated interim storage volume is 100,000 litres with a fire flow of 324,000 litres; the storage volume is 424,000 litres.

Lower Zone Black Point

Located north along Pinetree Road the reservoir would be located at approximately elevation 93 m. Estimated interim demand storage is 180,000 litres. With a fire flow 324,000 litres, the estimated volume is 504,000 litres.

High Zone Kelly Creek

Located north of Maywood Road, the reservoir would be situated at an elevation of approximately 142 m. Estimated interim demand storage is 180,000 litres. With a fire flow of 324,000 litres, the estimated storage volume is 504,000 litres.

Lower Zone Lang Bay

Located in the vicinity of Tiller Road and Tuck Road, the reservoir would be situated at an elevation of approximately 93 m. Estimated interim demand storage is 180,000 litres. With a fire flow of 324,000 litres, the estimated storage volume is 504,000 litres.

High Zone Lang Bay

The Lang Bay high zone is located at the proposed treatment plant site at Lois Lake with a TWL of approximately 165 m due to operating levels in Lois Lake (143 m to 159 m). The clearwell is estimated to have interim demand storage of 180,000 litres. With a fire flow of 324,000 litres, the estimated storage volume is 504,000 litres.

Lower Zone Stillwater

Located in the vicinity of Hwy 101/Loubert Rd at an elevation of approximately 93 m. Estimated interim demand is 100,000 litres. With a fire flow of 324,000 litres, the estimated storage volume is 424,000 litres. An alternate location would be on the hill in DL 3873 which would be preferred to assist reservoir circulation if Scotch Fir Point Estates connects.

In addition to sizing requirement reservoir siting should include sufficient land for expansion as the population grows to SROCP build out. An allowance of 1.5 hectares should be provided.

Final reservoir sizing, location and operating levels would be considered as the system is developed further.

5.4.3 Booster Pumping Stations

Myrtle Point Upper Zone

Should a reservoir be considered in the upper high zone of Myrtle Creek, then booster pumping would be required. A proposed location would be near the intersection of Padgett Road and the BCTC right-of-way.

This location could also be used to provide booster pumping to the reservoir on Hammil Hill if required to supply the upper high zone of Myrtle Valley and upper high Kelly Creek zone. As an alternate to this location, a booster pump station could be located in the City on Nootka Avenue, just west of the City/District boundary (150 m west assumed).

Upper High Zone from Kelly Creek

Alternative to booster pumping to a reservoir at Hammil Hill to service the upper high zone at Kelly Creek, the upper high zone around Kelly Creek could be booster pumped from the high zone reservoir.

The Kelly Creek high zone reservoir would be serviced from a booster pump on Zillinsky Road or the lower Black Point reservoir.

5.4.4 Treatment Plants

Two treatment plants could be considered for a regional system at Hammil Lake and/or Lois Lake.

Hammil Lake

The location of the treatment plant at Hammil Lake would be located downstream of the current intake location at an elevation of 144 m plus or minus. This will allow a TWL of approximately 142 m for the upper zone reservoir which is required in conjunction with the treatment plant.

The treatment plant would be located on 4 hectares of land in DL5488. This should allow sufficient space for expansion of the facility. Three hundred (300) metres of 250 mm diameter watermain with associated easement west along the southern boundary of the DL to Padgett Road will be required.

Depending on results of further water quality testing and discussions with the Health Authority, a single multi barrier treatment plant is proposed. The interim peak day design flow would be 2.8 ML/day respectively for service to Area B, and 6.75 ML/day if Areas B and C are to be serviced.

A siting study would need to be undertaken to confirm treatment plant layout, access, hydraulic and land criteria.

Lois Lake

The location of the Lois Lake treatment plant would be near the intersection of Dixon Road and Stillwater access road. The elevation is approximately 165 m which would provide for TWL of approximately 162 m for the upper Lang Bay zone reservoir which is required in conjunction with the treatment plant.

The treatment plant would be located on 2 hectares of land in DL1571. This should allow sufficient space for expansion of the facility. The Southern Region supply main would follow the Stillwater access road through DL3905 and DL1571, and DL4829 to the Lang Bay water system. Depending on the results of further water quality testing, a multi barrier treatment plant is proposed. The potential interim design flows are 4.0 ML/day for Area C and 6.75 ML/day for Areas B and C.

A siting study would need to be undertaken to confirm treatment plant layout, access, hydraulic and land criteria.

5.4.5 Distribution of Supply Mains

The proposed regional system requires a network of feedermains to convey water from the supply sources to the storage facilities. These feedermains will also provide the backbone of the distribution network.

Feeder mains are sized to convey the peak day flow to the various storage reservoirs. Peak instantaneous flows and fire flows are then provided by the distribution system.

Based on interim flows, pipe sizing for a Southern Region supply with sources at the west end (City or Hammil Lake) and east (Lois Lake) is as follows:

- 250 mm City to Myrtle Pond (Highway 101 and Padgett Road)
  - 2500 m Highway 101
  - 5000 m Padgett Road
- 6800 m of 300 mm Myrtle Point to Lower Black Point reservoir
- 2000 m of 400 mm Lois Lake to Lang Bay
- 2700 m of 300 mm Lang Bay to Brew Bay
- 2200 m of 250 mm Brew Bay to Black Point
- 5000 m of 250 mm Lang Bay to Stillwater
- 4000 m of 250 mm along Zillinsky Road, Nassichuck Road and Maywood

In addition to the above feedermains, there are additional 150 diameter distribution mains which would be required to service individual streets. This is discussed further in Sections 5.5.6.

5.5 Supply Alternatives and Costing

A number of alternatives are available for serving the Myrtle Pond and Southern Region. The intent was to investigate alternatives and provide estimated costs, both capital and operating. These costs would then be used to estimate long term costs for comparison of alternatives on a conceptual basis (Class D).

5.5.1 Basis of Costs

Costs are estimated based on the following and are considered Class D:

1. Watermains (includes valves, fittings, hydrants) $1.05/m/mm dia ($8/ft/in dia)
2. Reservoirs $0.60/L ($2.75/Igal)
3. Land costs for easements
   - Developed areas $135,900 / ha ($55,000/acre)
   - Suburban $35,900 / ha ($14,530/acre)
   - Rural $17,000 / ha ($6,880/acre)
4. Where long term costs are estimated the interim period of 2036 (30 years) is used with a discounted rate of 5%.
5. 40% is added for contingency and engineering
6. Watermain cost assumes installation would be outside the paved road structure.
7. Operating and maintenance costs are assumed as follows:
   - Watermains, reservoirs, and other non mechanical/electrical components 1.5% of capital costs
   - Booster pump stations, PRV's, and treatment plants 4% of capital costs

   These do not include debt financing, District administration, and insurance costs.
8. The cost of water from the City is based on the current Water Regulation Bylaw Rate adjusted for the 2009 rate increase of 15%. To provide sensitivity, the options were analyzed using the following City water rates:

Base City User Rate:	$0.359/m^3
Base User Rate + Strata:	$0.551/m^3
Negotiated Rate (Outside City Connection):	$0.911/m^3

The above cost does not take into account the following:

- The overuse charge of $0.50/m^3 above $600m^3/yr
- The strata unit charge of $2,000/unit

9. The annual cost for use of Hammil Lake and Lois Lake water, based on rates provided by Water Management, is:

Withdrawal:	$1.10/1,000m^3 or 0.0011/m^3
Storage:	$0.01/1,000m^3 or 0.00001/m^3

10. In addition to the yearly cost of the City water, an estimated amount of $2.4 million is assessed to the City supply options, as the proportionate share of upgrade costs currently required by the City in their long-term water supply plan. The actual cost would need to be confirmed through hydraulic analysis and negotiated with the City.

5.5.2 Supply Myrtle Pond

Alternatives evaluated for supplying the Myrtle Pond water system include the following:

- Option 1: City connection along Highway 101
- Option 2: City connection at Duncan along Padgett Road
- Option 3: City connection from Nootka
- Option 4: Development of Hammil Lake - Padgett Road Connection
- Option 5: Development of Hammil Lake - Padgett Road / BCTC / Stevenson Road Connection

Option 1: City Connection along Highway 101

A connection along Highway 101 requires the City to provide the required interim flow of 2.8 ML/day at an elevation of approximately 97 m to provide comparison with the other options; a Myrtle Valley Low Zone reservoir is included north of Stevenson Road. Components and costing are estimated in Table 5.2 as follows:

Table 5-2. Estimated Cost – Option 1 – City Connection (Highway 101)

Item	Unit	Cost
2500 m of 250 mm watermain to Padgett/Centennial	$262/m	$656,250
Flow meter and rechlorination chamber[1]		$150,000
Myrtle Low Zone Reservoir (584,000 L)	$0.60/L	$350,400
1,500 m of 250 mm Reservoir piping – Stevenson Road	$262/m	$393,000
PRRD share of City upgrades		$2,400,000
Subtotal		$3,949,650
40% Contingency and Engineering		$1,579,860
Total		**$5,529,510**
Say		**$5,530,000**

Notes:

1. Includes City SCADA connection

The yearly O/M for Option 1 is estimated at $26,995/year.

The option is outlined in Figure 5-3.

Option 2: City connection at Duncan along Padgett Road

A connection at Duncan and Padgett Road requires the City to provide the required interim flow of 2.8 ML/day at an elevation of 142 m. The section of watermain along Highway 101 from the City to Centennial is included for comparison purposes. Components and costs are estimated in Table 5.3 as follows:

Table 5-3. Estimated Cost – Option 2 – City Connection (Padgett Road)

Item	Unit	Cost
5000 m of 250mm watermain	$262/m	$1,310,000
Flow meter and rechlorination chamber [1]		$150,000
PRRD share of City upgrades		$2,400,000
Myrtle low zone reservoir (584,000 L)	$0.60/L	$350,400
2,500 m of 250 mm dia watermain to Highway 101 City to Padgett	$262/m	$656,250
Subtotal		$4,866,650
40% Contingency and Engineering		$1,946,660
Total		**$6,813,310**
Say		**$6,815,000**

Notes:

1. Includes City SCADA connection

The yearly O/M for Option 2 is estimated at $40,750/year.

Option 2 is outlined in Figure 5.4.

Option 3: City Connection at Nootka

A connection to the City at the top end of Nootka Street is to provide interim flow of 2.8 ML/day at an elevation of 142m. The water would be booster pumped to a high zone reservoir located at the high point south of Nootka Dunes Golf Course. From there this will provide gravity supply to the Myrtle Pond service area.

The City's proportionate share of upgrade costs of $2.4 million is not included as the option assumes city infrastructure would participate in this option due to the benefits.

The estimated cost is provided in Table 5.4 as follows:

Table 5-4. Estimated Cost – Option 3 – City Connection (Nootka Street)

Item	Unit	Cost
Booster pump station		$350,000
1,100 m of 400 mm	$420/m	$462,000
Reservoirs		
Upper high zone (2,140,000 L)	$0.60/L	$1,284,000
Myrtle Valley lower zone (584,000 L)	$0.60/L	$350,400
3,400 m of 250 mm Nootka Reservoir to Centennial	$262/m	$890,800
1,400 m of 250 mm Stevenson Road to City	$262/m	$366,800
Land – 0.72 ha suburban	$35,900/ha	$25,848
Subtotal		$3,729,848
40% Contingency and Engineering		$1,491,939
Total		**$5,221,787**
Say		**$5,225,000**

The yearly O/M for Option 3 is estimated at $64,685/year.

This option is shown on Figure 5-5.

This option has the benefit of the City cost sharing certain items as estimated in Table 5-5 as follows.

Table 5-5. Potential Cost Sharing with City – Option 3

Item	Description	Cost
Booster pump station	The proposed upper zone benefits City cost share 50/50 (0.5 x $350,000)	$175,000
400 dia. reservoir supply	The 400 dia. required to convey 150 L/s fire flow. Regional supply would only require 250 dia. Savings (400 mm x $1.05/mm/ø – 250 mm x 1.05/mm/ø) x 1,100 m	$173,250
Reservoir sizing	Reservoir size large due to fire flow and balancing storage. City volume (2,080,000 L) less PRRD volume 384,000 L = 1,776,000 x $0.60/L	$1,065,000
Subtotal		$1,413,250
40% Contingency and Engineering		565,280
	Total	**$1,978,480**
	Say	**$1,980,000**

The yearly O/M savings is estimated at $25,574/year.

In summary, if the City did not participate then the cost of Option 3 for District infrastructure is estimated to be $5,275,000 less $1,980,000 which is $3,245,000 with yearly O/M estimated at $39,111. However, you would then have to apply the City connection cost of $2,400,000 as provided in Options 1 and 2, which would raise the cost to $5,645,000.

Option 4: Development of Hammil Lake – Padgett Road Connection

Development of Hammil Lake as a water source for the Southern Region is considered to involve a multi barrier treatment plan located at an elevation of approximately 142 m. A land requirement of four hectares is assumed for the treatment plant (ultimate). The intake would be extended deeper into the lake. The outlet structure would be rebuilt and berming completed to improve storage. There would be 300 m of easement, 3 m wide required from the treatment plant to Padgett Road. Costs are estimated in Table 5-6 as follows:

Table 5-6. Estimated Cost – Option 4 – Develop Hammil Lake (Padgett Road)

Item	Unit	Cost
Treatment Plant		$1,200,000
Intake extension		$120,000
Control structure and berming		$220,000
3600mm of 250mm dia. watermain	$262/m	$943,200
2500m of 250mm dia. watermain – City to Centennial	$262/m	$656,250
Reservoirs		
Myrtle lower zone (584,000 L)	$0.60/L	$350,400
Land		
Treatment plant (4 ha)	$35,000/ha	$68,000
Easement (0.09 ha)	$135,900/ha	$12,231
Subtotal		$3,570,081
40% Contingency and Engineering		$1,428,032
Total		**$4,998,113**
Say		**$5,000,000**

The estimated yearly O/M for Option 4 is $82,348/yr.

This option would require the Regional District to obtain a water licence from BC Water Management.

This option is provided on Figure 5-6.

Option 5 – Develop Hammil Lake – Padgett / BCTC / Stevenson Connection

This option is similar to Option 4 except the watermain will transverse via Padgett Road, the BCTC right-of-way west from Padgett and then south to Stevenson Road and east to Myrtle Pond. The costs are estimated in Table 5-7.

Table 5-7. Estimate Cost – Option 5 – Develop Hammil Lake (Padgett/BCTC/Stevenson)

Item	Unit	Cost
Treatment Plant		$1,200,000
Intake extension		$120,000
Control structure and berming		$220,000
4,100 mm of 250mm dia. watermain – Hammil Lake to Stevenson/Highway 101	$262/m	$1,074,200
2,500 m of 250mm dia. watermain – Highway 101 – City to Centennial	$262/m	$655,000
Reservoirs		
Myrtle lower zone (584,000 L)	$0.60/L	$350,400
Land		
Treatment plant (4 ha)	$35,000/ha	$140,000
Easement to Padgett (0.09 ha)	$135,900/ha	$12,231
Easement to BCTC (0.32 ha)	$35,000/ha	$11,200
Easement to BCTC/Stevenson (0.39 ha)	$35,000/ha	$13,650
Subtotal		$3,796,681
40% Contingency and Engineering		$1,518,672
Total		**$5,315,355**
Say		**$5,320,000**

The estimated yearly O/M for Option 5 is $84,294/yr.

This option is shown in Figure 5-6.

Summary

In summary, long-term costs associated with the supply of water to Myrtle Pond in terms of a regional supply are summarized in Tables 5-9, 5-10 and 5-11. The yearly cost of water for the City and Hammil Lake options is based on the following:

> For the City Connection: 50% of interim average day demand of Area B of 3.38 ML/day (1,233,760 m^3/yr) which is 616,880 m^3
>
> For Hammil Lake Connection: Withdrawal of interim peak day demand of 11.9 ML/day (4,313,500 m^3/yr). Storage of 1,074,000 m^3 as the full cost of the licence will need to be covered.

Costs are therefore estimated and summarized in Table 5-8 as follows:

Table 5-8. Summary of Estimated Yearly Cost of Water – City and Hammil Lake

Source	Cost
City [(1) (2)]	
Base Residential User Rate (616,850 m^3 x \$0.359/m^3)	\$221,449/yr
Base Residential User + Strata (616,850 m^3 x \$0.551/m^3)	\$339,844/yr
Bylaw Negotiated Rate (Outside City Connection) (616,850 m^3 x \$0.911/m^3)	\$561,950/yr
Hammil Lake	
Withdrawal (4,343,500 m^3 x \$0.0011/m^3)	\$4,779/yr
Storage (1,074,000 m^3 x \$0.00001/m^3)	\$25/yr
Total	**\$4,804/yr**

Notes:

(1) Does not take into consideration the overuse charge of \$0.50/m^3 above 600 m^3/yr.

(2) Does not take into consideration the upfront strata cost of \$2,000/unit.

Table 5-9. Summary of Costs (City water \$0.359/m^3)

Option	Capital Cost	Annual O/M Cost	PW of O/M (30 years at 5%)	Total	Annual Cost of Water	PW Cost of Water (30 years at 5%)	Total Long Term Supply Cost
1 – City Connection Hwy 101	\$5,530,000	\$26,995	\$415,000	\$5,945,000	\$221,449	\$3,404,000	\$9,349,000
2 – City Connection Padgett Rd	\$6,815,000	\$40,750	\$626,000	\$7,441,000	\$221,449	\$3,404,000	\$10,845,000
3 - City Connection Nootka	\$5,225,000	\$64,685	\$994,000	\$6,219,000	\$221,449	\$3,404,000	\$9,623,000
4 – Hammil Lake Padgett Rd	\$5,000,000	\$82,348	\$1,266,000	\$6,266,000	\$4,804	\$73,900	\$6,339,900
5 – Hammil Lake BCTC/Stevenson	\$5,320,000	\$84,294	\$1,296,000	\$6,616,000	\$4,804	\$73,900	\$6,689,000

Table 5-10. Summary of Costs (City water $0.551/m^3)

Option	Capital Cost	Annual O/M Cost	PW of O/M (30 years at 5%)	Total	Annual Cost of Water	PW Cost of Water (30 years at 5%)	Total Long Term Supply Cost
1 – City Connection Hwy 101	$5,530,000	$26,995	$415,000	$5,945,000	$339,844	$5,224,000	$11,169,000
2 – City Connection Pagdett Rd	$6,815,000	$40,750	$626,000	$7,441,000	$339,844	$5,224,000	$12,665,000
3 - City Connection Nootka	$5,225,000	$64,685	$994,000	$6,219,000	$339,844	$5,224,000	$11,443,000
4 - Hammil Lake Padgett Rd	$5,000,000	$82,348	$1,266,000	$6,266,000	$4,804	$73,900	$6,339,900
5 - Hummel Lake BCTC/Stevenson	$5,320,000	$84,294	$1,296,000	$6,616,000	$4,804	$73,900	$6,689,000

Table 5-11. Summary of Costs (City water $0.911/m^3)

Option	Capital Cost	Annual O/M Cost	PW of O/M (30 years at 5%)	Total	Annual Cost of Water	PW Cost of Water (30 years at 5%)	Total Long Term Supply Cost
1 – City Connection Hwy 101	$5,530,000	$26,995	$415,000	$5,945,000	$561,950	$8,638,500	$14,583,500
2 – City Connection Padgett Rd	$6,815,000	$40,750	$626,000	$7,441,000	$561,950	$8,638,500	$16,079,500
3 - City Connection Nootka	$5,225,000	$64,685	$994,000	$6,219,000	$561,950	$8,638,500	$14,857,500
4 - Hammil Lake Padgett Rd	$5,000,000	$82,348	$1,266,000	$6,266,000	$4,804	$73,900	$6,339,900
5 - Hammil Lake BCTC/Stevenson	$5,320,000	$84,294	$1,296,000	$6,616,000	$4,804	$73,900	$6,689,000

In terms of initial capital and operations and maintenance costs, Options 1, 3, 4 and 5 are the lowest cost options. Taking into consideration the cost of water, Options 4 and 5 are the least cost by a considerable margin ($3 to 4.5 million) even if the City was to agree to a cost of water equivalent to their base City user rate. If the outside city negotiated rate is used, Options 1, 2 and 3 (City Supply) are over double the cost of Options 4 and 5 (Hammil Lake supply).

For Options 1 and 3, if the City was to waive the estimated $2.4 million connection cost, and allow the base City water user rate to be used, Options 1 and 3 would still be more expensive, compared to Options 4 and 5, in the long term (approximately $7.0 million and $7.2 million versus $6.6 million and $6.3 million). Accordingly, to make a City connection viable, a considerable departure from the City's current Water Rates and Regulation Bylaw would be required.

Based on the long term analysis, the preferred Options are 4 and 5 at $6.34 million and $6.69 million respectively. Option 4 has slightly less initial capital cost ($5.0 million versus $5.32 million) and slightly less in operation and maintenance costs. The difference in cost is attributed to the additional pipe costs along the BCTC right-of-way. An important advantage to Option 5 however is that it will allow for a more cost effective expansion to the Upper Nootka area in the future. This Option also has benefits to the City due to the potential for cost effectively addressing pressure issues in the south of the City. This can be accomplished by the following:

- Extend watermain southwest along BCTC right-of-way to City boundary (approximately 1,500 m)
- Construct reservoir at high point along BCTC right-of-way with booster pump
- Upsize watermain from Hammil Lake to north end of Stevenson Road / BCTC right-of-way from 250 mm to 300 mm

If beneficial cost sharing can be negotiated with the City, it is suggested the preferred approach be Option 5. Otherwise, it is recommended Option 4 be advanced further.

Options 4 and 5 have the following issues to be confirmed:

- Securing a PRRD water license for Hammil Lake.
- Securing access to land and permission to upgrade existing City facilities at Hammil Lake.
- Cost sharing with City on Option 4 components (relocated intake, supply main to treatment plan, control structure) as well as negotiation of land for treatment plant site and other rights-of way on City land. For Option 5, same as Option 4 plus main upsizing, reservoir, and booster pump.
- Benefits, with associated costs, to the City for having a backup treated water supply.

Subject to further confirmation of connection and yearly costs with the City, it appears more cost advantageous to develop the Hammil Lake source. It is noted that the City, in their long term plan, recommended upgrading the intake and may be willing to provide funding for the intake portion of new watermain to the treatment plant and the benefit of having treated water as a backup source provided the City upgrades their existing deteriorated 250 mm supply main to Duncan.

5.5.3 Conveyance from Hammil Lake to Padgett Road

For Options 4 and 5, alternatives were considered for conveyance of flows from Hammil Lake to Padgett Road. They are:

- Option A – Existing City water alignment to Padgett Road then south (Gravity Supply)
- Option B – Alignment west to Padgett Road (Gravity Supply)

- Option C – BCTC Right-of-Way / Gunther Road (Pumped Supply)
- Option D – BCTC Right-of-Way / Gunther Road (Gravity/Siphon Supply)

The four options are compared as follows in Tables 5-12, 5-13, 5-14, and 5-15 using the intersection of Gunther Road and Padgett Road as a common point:

Option A

Table 5-12. Hammil Lake Conveyance – Option A (Existing City Water Alignment to Padgett Road - Gravity Supply)

Item	Unit	Cost
1,500 m of 250 mm dia. watermain	$262/m	$393,000
Subtotal		$393,000
+ 40% Engineering and Contingency		$157,200
Total		**$550,200**
Say		**$550,000**

The estimated yearly O/M costs for Option A are $5,895.

Cost sharing on Option 1 with the City on the portion from the Hammil Lake to Padgett Rd could be negotiated which would lower the costs.

Option B

Table 5-13. Hammil Lake Conveyance - Option B (Current Proposed Alignment - Gravity Supply)

Item	Unit	Cost
1,000 m of 250 mm dia. watermain	$262/m	$262,000
Easement (0.08 ha)	$135,000/ha	$12,150
Subtotal		$274,150
+ 40% Engineering and Contingency		$109,656
Total		**$383,806**
Say		**$389,000**

The estimated yearly O/M costs for Option B are $3,930.

Option C

Table 5-14. Hammil Lake Conveyance - Option C (BCTC/Gunther Road - Pumped Supply)

Item	Unit	Cost
1,000 m of 250 mm dia. watermain	$262/m	$262,000
Booster Pump Station		$350,000
Land – 700 m of 3 m easements (0.21 ha)	$135,900/ha	$28,539
Subtotal		$640,539
+ 40% Engineering and Contingency		$256,215
Total		**$896,744**
Say		**$897,000**

The estimated yearly O/M costs for Option C are $17,930.

Option D

This option considers the feasibility of using a siphon to convey flows from Hammil Lake over the high point along the BCTC right-of-way to Gunther Road. Hydraulic analysis has estimated that the maximum elevation change between Hammil Lake level and the high point in the siphon be no more than 8 m. Assuming a minimum lake level of 143 m, the maximum height of the siphon would be elevation 151 m. This would require cuts of up to 9 m through the high point. The cost is estimated as follows:

Table 5-15. Hammil Lake Conveyance - Option D (BCTC / Gunther Road - Gravity/Siphon Supply)

Item	Unit	Cost
250 mm dia. Pipe Installation		
80 m of 0-2 m depth	$262/m	$20,960
150 m of 2-4 m depth	$437/m	$65,550
220 m of 4-6 m depth	$612/m	$134,640
290 m of 6-8 m depth	$787/m	$228,230
340 m of 8-10 m depth	$962/m	$327,080
700 m of 250 mm dia. pipe (1 m cover)	$262/m	$183,400
Siphon equipment (Prime Pump, MH, Foot Valve)		$10,000
Land – 700 m of 3 m easement (0.21 ha)	$135,900/m	$28,539
Subtotal		$998,399
+ 40% Engineering and Contingency		$399,360
Total		**$1,397,759**
Say		**$1,400,000**

The estimated yearly (O/M) costs for Option D are $14,798/yr.

The long term costs associated with the four options are estimated in Table 5-16 as follows:

Table 5-16. Hammil Lake Conveyance Options - Summary

Option	Capital Cost	PW of O/M over 30 years at 5%		Total
A – Existing City W/M	$550,000	$5,895	$90,620	$640,620
B – West to Padgett	$384,000	$3,930	$60,415	$444,415
C – BCTC (Pumping)	$897,000	$117,930	$275,627	$1,172,627
D – BCTC (Gravity Siphon)	$1,400,000	$14,798	$227,480	$1,627,480

The much higher cost of pumping, or the higher cost of the deep excavation associated with a siphon, for conveying water along the BCTC Right-of-Way to Gunther make these options much less desirable. The preferred option is Option 2, unless the City is willing to cost share in the order of $200,000 on the Option 1 alternative.

The costs for Option B were used in the cost estimates for Options 4 to 5.

5.5.4 Regional Supply

The basis of an upgraded regional supply system is provided in Figure 5-8. Based on information provided in the SROCP, Hammil Lake does not have the capacity to provide build out capacity to the Southern Region. Hammil Lake could provide interim water supply to Area B and C. Lois Lake is the only option which has the capacity to provide ultimate build out capacity to the Southern Region or Area C.

Regional Supply Cost

Costs for the development of the Southern Region water supply assuming a Hammil Lake source on the west side and Lois Lake on the east side for the next 30 years are estimated as provided in Tables 5-17 and 5-18 for Areas B and C, respectively.

Table 5-17. Regional Water System Cost Estimate – Area B

Item	Unit	Cost
Treatment Plant		$1,200,000
Reservoirs		
Myrtle lower zone (584,000 L)	$0.60/L	$350,400
Myrtle high zone (544,000 L)	$0.60/L	$326,400
Myrtle upper zone (1,140,000 L)		$684,000
Hammil Lake Intake Extension		$150,000
Control Structure and Berm		$220,000

Item	Unit	Cost
Watermains		
• Highway 101 – City to Padgett Road (2500m of 250 dia.)	$262/m	$655,000
• Padgett Road – City to Highway 101 (5000m of 250 dia.)	$262/m	$1,310,000
• Highway 101 / Padgett to Area B boundary	$262/m	$1,048,000
Land		
Treatment Plant (4 ha)	$35,000/ha	$140,000
Easement – Treatment Plant to Padgett Road (0.09 ha)	$135,900/ha	$12,300
Myrtle Valley Reservoir (2 ha)	$35,000/ha	$70,000
Subtotal Area B		$4,966,100
40% Contingency and Engineering		$1,986,400
Total		$6,952,500
Say		**$6,955,000**

The yearly operation and maintenance cost is estimated at $119,157/year.

Table 5-18. Regional Water System Cost Estimate – Area C

Item	Unit	Cost
Treatment Plant		$1,700,000
Reservoirs		
Kelly Creek high zone (504,000 L)		$302,400
Black Point low zone (504,000 L)		$302,400
Lang Bay low zone (504,000 L)		$302,400
Lang Bay high zone (504,000 L)		$302,400
Stillwater low zone (424,000 L)		$254,400
Lois Lake intake and booster pump to treatment plant		$450,000
Watermains		
• Lois treatment plant to Dixon Road Highway 101 (3,000 m of 400 dia.)	$420/m	$1,260,000
• Dixon Road / Highway 101 to Brew Bay (2,700m of 300 dia.)	$315/m	$850,500
• Brew Bay to Black Point low zone (3100m of 250 dia.)	$262/m	$812,200
• Black Point Reservoir to Area B/C boundary (1,800 m of 250 dia.)	$262/m	$471,600
• Highway 101/Dixon to Stillwater low zone (5,000 m of 250 dia.)	$262/m	$1,310,000
• Zillinsky Road / Nassichuck Road / Maywood	$262/m	$1,048,000

Item	Unit	Cost
(4,000 m of 250 dia.)		
Crossing of Lois River		$150,000
Crossing of Lang Creek		$100,000
Kelly Creek high zone booster pump		$350,000
Land		
Treatment Plant (4 ha)	$17,000/ha	$68,000
Reservoirs (5 @ 2 ha = 10 ha)	$17,000/ha	$170,000
Easement (Pinetree) (600 m x 3 m = 0.18 ha)	$17,000/ha	$3100
Treatment Plant (Lang Bay) (2,000 m x 3 m = 0.6 ha)	$17,000/ha	$10,200
Stillwater reservoir (300m x 10 m = 0.3 ha)	$17,000/ha	$5,100
Subtotal Area C		$10,222,700
40% Contingency and Engineering		$4,089,080
Total		$14,301,780
Say		**$14,305,000**

The yearly operation and maintenance costs are estimated at $187,500/year.

5.5.4.2 Area C Service – Lang Bay and Brew Bay from Lois Lake

As an interim measure, Area C water supply could be developed to provide service only to the two main community water systems of Lang Bay and Brew Bay. This would require development of smaller supply mains and treatment plant initially with the expectation that upgrading takes place in the future, as the system expands. The anticipated components are as follows:

- Treatment Plant (Reduced Plant Capacity);
- Lois Lake Intake and Booster Pump (Reduced Capacity);
- Lois Treatment Plant to Dixon Road (3,000 m of 300 mm ø);
- Dixon Road/Highway 101 to Brew Bay (2,700 m of 250 mmm ø);
- Lang Bay Low Zone; and
- Crossing Lang Creek.

Not included are potential costs for upgrading watermains within Lang Bay Water System. Brew Bay watermains are assumed re-used. Estimated costs are provided in Table 5-19 as follows:

Table 5-19. Area C Service – Lois Lake to Lang Bay and Brew Bay

Item	Unit	Cost
Treatment Plant		$1,200,000
Lois Lake Intake and Booster Pump Station		$350,000
Watermains:		
– Lois Treatment Plant to Dixon Road/Highway 101 (3,000 m of 300 ø)	$315/m	$945,000
– Dixon Road/Highway 101 to Brew Bay (2,700m of 250 ø)	$262/m	$707,400
Lang Bay Low Zone Reservoir		$302,400
Crossing of Lang Creek		$100,000
Land		
– Treatment Plant (4 ha)		$68,000
– Reservoir (115 ha)		$25,000
– Treatment Plant/Dixon Road (0.6 ha)		$10,200
Subtotal:		$3,708,500
40% Engineering and Contingency		$1,483,400
Total		$5,191,900
Say		**$5,195,000**

Estimated yearly O/M costs are $93,752/yr.

5.5.4.3 Stillwater Connection

It is estimated that the capital cost to connect Stillwater is $2,527,000 from the intersection of Dixon Rd/Hwy 101 including 40% engineering and contingency. This compares to the estimated upgrade cost in the McElhanney Study of $2.1 million, which allows for 40% engineering and contingency but excludes land costs and accommodates a fire flow 30 L/s versus 60 L/s in the proposed regional system. It is also noted that the water source, Jefferd Creek, is limited and unable to supply the entire Stillwater service zone whereas a regional supply would.

5.5.4.4 Summary Regional Supply – Option 6

The total estimated cost for development of a Southern Region water supply is provided in Table 5-20. The yearly cost of water for water license purposes is estimated as follows:

- Area B – $4,804/yr
- Area C – 28.51 ML/day (10,406,150m^3/year) x $0.0011/$m^3$ = $11,450/yr

Table 5-20. Option 6 - Total Estimated Cost for Development of a Southern Region Water Supply

	Capital Cost	Annual O/M Cost	O/M based on 5% for 30 years	Total	Yearly Cost of Water	PW Cost of Water 30 yrs @ 5%	Total
Area B	$6,995,000	$119,157	$1,832,000	$8,477,000	$4,804	73,850	8,350,850
Area C	$14,395,000	$187,500	$2,882,000	$16,912,000	$11,450	176,000	17,088,000
Total	**$21,030,000**	**$306,657**	**$4,714,000**	**$25,744,000**	**$16,259**	**249,850**	**25,993,850**

This is further referred to as Option 6.

5.5.5 Service Area B and Area C in the Interim from Hammil Lake

For this option, the interim supply of Area C from Lois Lake would be deferred and supply would be provided via booster pumping and reservoir at Hammil Hill, to the Lang Bay lower zone reservoir (Option 7), or Lang Bay high zone (Option 8) via the BCTC transmission right-of-way.

5.5.5.1 Deferred Cost – Interim Service Area B

The deferred costs at Lois Lake would be the treatment plant, intake, and the 400 mm trunk main to the lower Lang Bay reservoir. The capital and O/M cost of this work is provided in Table 5-21 as follows:

Table 5-21. Deferred Lois Lake Cost – Hammil Supply

Item	Unit	Cost
Intake and booster pump		$450,000
Treatment plant		$1,700,000
1,050 m of 400 dia. supply main	$420/m	$441,000
Subtotal		$2,591,000
40% Contingency and Engineering		$1,036,000
Total		**$3,627,400**
Say		**$3,630,000**

The O/M costs are estimated at $93,615/year. The total long term deferred cost is $5,054,000, including the present worth of O/M over 30 years. Costs associated with accessing water from Lois Lake are not included.

5.5.5.2 Interim Service Area C – BCTC Right-of-Way

The available hydraulic head from Hammil Hill reservoir (TWL – 175 m) to Lang Bay lower zone reservoir (TWL = 93 m) is 82 m. The available hydraulic head from Hammil Hill to Lang Bay high zone reservoir is 33 m. The interim peak day design flow for Area C is 3.94 ML/day (46 L/s). Based on these criteria, a 250 mm main is required to supply the Lang Bay low zone reservoir (Option 7) and 300 mm main to supply the high zone reservoir. (Option 8)

Costs for Options 7 and 8 are provided in Table 5-22 as follows.

Table 5-22. Costs for Service Area B and Area C in the Interim from Hammil Lake

Item	Unit	Cost	
		Option 7 Low Zone	Option 8 High Zone
Booster pump station (Hammil Hill)		$450,000	$450,000
1,300 m of 200 dia.	$210/m	$273,000	$273,000
Upper high zone reservoir (1,112,000 L)	$0.60/L	$691,200	$691,200
Transmission main:			
Low zone (10,300 m of 250 dia.)	$262/m	$2,698,600	
High zone (10,700 m of 300 dia.)	$315/m		$3,370,500
Kelly Creek high zone reservoir connection (1,000 m of 200 mm)	$210/m	$210,000	$210,000
Creek crossing (Kelly Creek / Lang Creek)		$120,000	$120,000
Land costs			
Hammil Hill reservoir (2 ha)	$35,000/ha	$70,000	$70,000
Right-of-way (11,300 m x 3 m = 3.4 ha)	$17,000/ha	$57,800	$57,800
Credit for deletion of Kelly Creek high zone P. Star		($350,000)	($350,000)
Subtotal		$4,219,990	$4,892,490
40% Contingency and Engineering		$1,687,996	$1,956,996
Total		**$5,908,000**	**$6,849,486**
Say		**$5,910,000**	**$6,850,000**

The O/M costs associated with Option 7, the Lang Bay low zone supply, are estimated to be $62,092. The total long term cost associated with interim supply from Hammil Lake to Lang Bay lower zone reservoir is $6,864,500 which includes the present worth of O/M over 30 years. Costs of accessing water from Lois Lake are not included.

The O/M costs associated with Option 8, the Lang Bay high zone supply, are $72,170. The total long term cost associated with supply from Hammil Lake to Lang Bay high zone reservoir is $7,960,500 which includes the present worth of O/M over 30 years. Costs of accessing water from Lois Lake are not included.

It is noted that under this scenario, it may be more beneficial to relocate Lower Black Point reservoir to a location near the intersection of the BCTC right-of-way and Serendipity Road or extend the supply from the Kelly Creek high zone reservoir to the Black Point low zone reservoir.

The long term costs of supply to the Lang Bay low zone (Option 7) or high zone (Option 8) regions exceeds the interim long term deferred cost of $5,054,000 for developing Lois Lake. However, it is noted that Options 7 and 8 do allow for the supply of the upper high zone in Myrtle Valley around Hammil Hill and potentially Nootka, and the upper high zone in Kelly Creek. The upper high zone in the vicinity of Nootka Street could be serviced via the BCTC right-of-way or by extending the Hammil supply west from Padgett Road, then south to the proposed reservoir at upper Nootka. Another benefit is that there is a looped water supply system which provides for increased reliability, security, and operational flexibility.

5.5.6 Interim Service Area C – Duck Lake Road/Highway 101

A possible alternative to conveyance of interim flows along the BCTC right-of-way to Area C is to convey flows along the BCTC right-of-way, Duck Lake Road, and then along Highway 101 and Dixon Road to the Lang Bay low zone reservoir. This is further noted as Option 9. The length of this route is approximately 16,750 m. Given the available head of 82 m to Lang Bay low zone reservoir, the required watermain size to convey the interim peak day flow of 3.94 ML/day is 300 mm diameter. Running the high zone watermain along Highway 101 would require:

1) Additional pressure reducing stations for connection of local areas.

2) A pressure reduced parallel low zone main parallel to the 200 m high zone along Highway 101.

Initially, pressure reducing stations would be utilized for individual local areas. As development grows, infill between these service zones with a parallel low zone water supply main can be advanced. For the purposes of evaluation, it is assumed that pressure reducing stations would be provided at the following locations:

- Duck Lake Road/Highway 101
- Whalen Road/Highway 101
- Woodlyn/Pinetree & Highway 101
- Brew Bay
- Black Point Road/Highway 101

It is expected that the existing PRV Station for the low zone of Lang Bay Water System would be re-used for a connection point. It is also assumed that PRV's would be installed in existing road rights-of-way (i.e., no land cost).

This option allows for a "combination" of a high and low pressure zone along Highway 101. A potential disadvantage of this option would be circulation and maintenance of a chlorine residual at the southern end of Area C and the ability to effectively use the Lang Bay reservoirs hydraulically. It is expected a rechlorination station would be needed and is allowed for in the estimate. The location of the rechlorination station and hydraulics would need to be confirmed through further hydraulic analysis. Estimated costs are provided in Table 5-23.

Table 5-23. Option 9 Interim Service Area C – Duck Lake Road

Item	Unit	Cost
Booster Pump Station (Hammil Hill)		$450,000
1,300 m of 200 ø Forcemain	$210/m	$273,000
Reservoirs:		
– Hammil Hill Upper High Zone Reservoir (1,112,00 L)	$0.60/L	$691,200
– Kelly Creek High Zone (504,000 L)	$0.60/L	$302,400
– Black Point Low Zone (504,000 L)	$0.60/L	$302,400
– Lang Bay Low Zone (504,000 L)	$0.60/L	$302,400
– Lang Bay High Zone (504,000 L)	$0.60/L	$302,400
– Stillwater Low Zone (424,000 L)	$0.60/L	$254,400
Transmission Mains		
– Upper High Zone/BCTC/Duck Lake Road to Highway 101 (5,850 m of 300 ø)	$315/m	$1,842,750
– Highway 101/Duck Lake Road to Area B/C Boundary (2,100 m of 300 ø)	$315/m	$661,500
– Area B/C Boundary to Brew Bay (3,100 m of 300 ø)	$315/m	$976,500
– Brew Bay to Dixon Road (2,700 m of 300 ø)	$315/m	$850,500
– Dixon Road to Lang Bay Low Zone (1,200 m of 300 ø)	$315/m	$378,000
– Duck Lake Road to Padgett Road (1,700 m of 250 ø)	$262/m	$445,400
– Zillinsky Road/ Nassichuk Road/Maywood (4,000 m of 250 ø)	$262/m	$1,048,000
– Highway 101-Dixon to Stillwater (5,000 m of 250 ø)	$262/m	$1,310,000
– Credit for redundant mains in Area B (Duck Lake Road to Area B Boundary (2100 m of 250 ø)	$262/m	($550,200)
Pressure Reducing Stations (5)	$150,000	$750,000
Creek Crossing (Lang Creek)		$100,000
Creek Crossing (Lois River)		$150,000
Credit for deletion Kelly Creek High Zone Booster Pump		($350,000)
– Hammil Hill Reservoir (2 ha)	$37,000/ha	$74,000
– Right-of-Way (8,050 m x 3 m – 2.42 ha)	$17,000/ha	$41,140
– Reservoirs (5 @ 2 ha) = 10 ha	$17,000/ha	$170,000
Rechlorination Station		$150,000
Subtotal		$10,623,390
40% Contingency and Engineering		$4,249,356
Total		**$14,872,746**
Say		**$14,875,000**

The estimated O/M of Option 9 is $193,360.

An added benefit of Option 9 is that it allows for the looping of Area B to improve security, reliability and operational flexibility.

The total capital cost of Option 9, including Area B to allow comparison with Options 6, 7, and 8 is $21,830,000, with estimated O/M costs of $312,517/year.

Given the four options for interim supply, the estimated capital costs including O/M are compared in Table 5-24 as follows (40% contingency and engineering included).

Table 5-24. . Interim Supply Options Capital Costs (Areas B and C)

Option	Item	Capital Cost	Annual O/M Cost	PW O/M based on 5% for 30 years	Total Cost
Option 6	Interim supply Area C from Lois Lake	$21,030,000	$306,657	$4,744,000	$25,711,000
Option 7	Interim supply Area C from Hammil Lake (low zone)	$22,780,000	$275,170	$4,230,000	$27,010,000
Option 8	Interim supply Area C from Hammil Lake (high zone)	$23,720,000	$285,185	$4,384,000	$28,104,000
Option 9	Interim supply Area C from Hammil Lake via Duck Lake Road	$21,830,000	$312,517	$4,804,000	$26,634,000

The present worth of the yearly cost of water of $16,254 (30 years at 5%) would add approximately $249,850 to the above total costs.

5.5.7 Summary

Option 6 provides water service to densely populated strip along Highway 101 only from the City boundary to Stillwater and requires the security of water licences on both Hammil Lake and Lois Lake.

Options 7, 8 and 9 provide water supply service coverage to the entire Southern Region from the City boundary to Stillwater and between the BCTC right of way and Highway 101. The only limitation is the capacity of Hammil Lake. Once capacity is reached at Hammil Lake, then Lois Lake will need to be developed. When this occurs, the trunk main along the BCTC corridor in Options 7 and 8 will provide additional supply security, reliability and operational flexibility to the region between Lang Bay and Myrtle Valley assuming the Highway 101 trunk is completed.

Option 9 could achieve this, but in a less effective manner than Options 7 and 8, as long as inter connection between the high zone feed and the parallel low zone feed is maintained. However, as growth develops in the Southern region, a supply main along the BCTC right-of-way is, in our opinion, preferred. A failure of the main along Highway 101 would still allow service to the southern region via the supply main along the BCTC right-of-way or vice versa.

To summarize, the additional long term cost of approximately $923,000 to $2,393,000 to defer development of Lois Lake and service Area C in the interim from Hammil Lake has to be weighed against the benefits this option provides versus the financial capacity and community goals of the Southern Region. The benefits include:

- Service for the whole Southern Region including the upper high zone in the upper Myrtle Valley area of Nootka Street and Hammil Hill as well as upper Kelly Creek. The exception would be a small area at the top of Lang Bay (Dixon Road)

- Security, reliability and operational flexibility of a looped water system (both present and future)
- More efficient economic development of future expansion of the water system through increased capacity to loop the infill development area between Highway 101 and the BCTC right-of-way.

5.5.8 Other Costs

The previous costs do not include costs associated with providing distribution mains to individual roads and residents (local service areas). These would primarily be 150 mm diameter mains, fire hydrants and service connections (both on public and private lands). These are discussed further in the following sections.

5.5.8.1 Service Connection Costs

Table 5-25 outlines estimated service connection costs for residential and commercial lots within public rights-of-way (i.e., from the supply main up to the property line).

Table 5-25. Estimated Service Connection Costs

Item	Cost
Residential	
• 19 mm s/c 10 m @ $100/m (assumes 0.9m burial)	$1,000
• Curb stop and meter (with service box @ property line)	$1,100
• Residential PRV	$500
Total	**$2,700**
Commercial	
• 50 mm s/c 10 m @ $110/m	$1,100
• Curb stop and meter (with service box at property line	$1,500
• Commercial PRV	$500
Total	**$3,100**

5.5.8.2 Local Servicing Costs

To provide some estimate as to costs for servicing individual roads, examples are provided each for Areas B and C. A key assumption is that watermains would be installed in the non paved portion of road rights-of-way. Contingency and Engineering is estimated at 40%.

5.5.8.2.1 – Area B

Three typical service areas are considered as follows. The areas are outlined on Figure 5.8.

- McClausland/Alta Vista
- Gaudet Road/Myrtle Point Drive/Barnes
- Highway 101 – Masters Road to Stevenson Road

Costs are estimated as follows in Tables 5-26 through 5-29.

McKelausland/Alta Vista – The number of lots serviced is 9. Costs are estimated as follows:

Table 5-26. Local Servicing – McClausland/Alta Vista

Item	Unit	Cost
Watermain (250 m of 150 ø)	$150/m	$37,500
Hydrants (2)	$3,000/each	$6,000
Service Connections – Public (9)	$2,700/each	$24,300
Subtotal		$67,800
40% Contingency and Engineering		$27,120
Total		**$94,920**
Say		**$95,000**
Cost/Lot		**$10,555**

Gaudet Road/Myrtle Point Drive/Barnes Road – The number of lots served is 30. Costs are estimated as follows:

Table 5-27. Local Servicing – Gaudet Road/Myrtle Point Drive/Barnes Road

Item	Unit	Cost
Watermain (550 m of 150 ø)	$150/m	$82,500
Hydrants (3)	$3,000/each	$9,000
Service Connection – Public (30)	$2,700/each	$81,000
Subtotal		$172,500
40% Contingency and Engineering		$69,000
Total		**$241,500**
Say		**$245,000**
Cost/Lot		**$8,170**

Highway 101 – Masters Road to Stevenson Road- The number of lots served is 20 (16 residential, 4 commercial). The estimated cost is:

Table 5-28. Local Servicing – Highway 101/Masters Road to Stevenson Road

Item	Unit	Cost
Watermain (500 m of 150 ø)	$150/m	$75,000
Hydrants (3)	$3,000	$9,000
Service Connections – Public – Residential – 16 – Commercial - 4	 $2,700 $3,100	 $43,200 $12,400
Subtotal		$139,600
40% Contingency and Engineering		$55,840
Total		**$195,440**
Say		**$195,000**
Cost/Lot		**$9,750**

The estimated costs for servicing local areas in Area B are summarized in Table 5-29.

Table 5-29. Local Servicing Costs – Area B - Summary

Area	# of Lots	Overall Cost	Cost/Lot
McClausland/Alta Vista	9	$95,000	$10,550
Gaudit/Myrtle Point/Barnes	30	$245,000	$8,170
Hwy 101-Masters Rd to Stevenson	20 (1)	$195,000	$9,750

(1) Four commercial lots included.

5.5.8.2.2 Area C

Four typical service areas within Area C are considered as follows. The areas are outlined on Figure 5.8.

- McLean Rd/Stittle Rd
- Wilcox Road
- Donkersly Road/Douglas Bay Road
- Phillips Road/Kennedy Road/Manning Road/Dunlop Road

Costs are estimated as follows in Table 5-30 through 5-34.

McLean Road/Stittle Road – The number of lots serviced is 26. Costs are estimated as follows:

Table 5-30. Local Servicing – McLean Road/Stittle Road

Item	Unit	Cost
Watermain (520 m of 150 ø)	$150/m	$78,000
Hydrants (3)	$3,000/each	$9,000
Service Connections – Public (26)	$2,700/each	$70,200
Subtotal		$157,200
40% Contingency and Engineering		$62,880
Total		**$220,080**
Say		**$220,000**
Cost/Lot		**$8,462**

Wilcox Road – The number of lots serviced is 16. Costs are estimated as follows:

Table 5-31. Local Servicing – Wilcox Road

Item	Unit	Cost
Waterman (730 m of 150 ø)	$150/m	$108,000
Hydrants (3)	$3,000/each	$9,000
Service Connections – Public (16)	$2,700/each	$43,200
Subtotal		$160,200
40% Contingency and Engineering		$64,080
Total		**$224,280**
Say		**$225,000**
Cost/Lot		**$14,065**

Donkersly Road/Douglas Bay Road – The number of lots served is 32. The costs are estimated as follows:

Table 5-32. Local Servicing – Donkersly Road / Douglas Bay Road

Item	Unit	Cost
Watermain (970 m of 150 ø)	$150/m	$145,500
Fire Hydrants (4)	$3,000/each	$12,000
Service Connection - Public (32)	$2,700/each	$86,400
Subtotal		$243,900
40% Contingency and Engineering		$97,560
Total		**$341,460**
Say		**$345,000**
Cost/Lot		**$10,800**

Phillips Road/Kennedy Road/Manning Road/Dunlop Road – The number of lots served is 60. The estimated cost is:

Table 5-33. Local Servicing – Phillips/Kennedy/Manning/Dunlop

Item	Unit	Cost
Watermain (2920 m of 150 ø)	$750/m	$438,000
Fire Hydrant (9)	$3,000/each	$27,000
Service Connections – Public (60)	$2,700/each	$162,000
Subtotal		$627,000
40% Contingency and Engineering		$250,800
Total		**$877,800**
Say		**$880,000**
Cost/Lot		**$14,677**

The estimated costs for servicing local areas in Area C are summarized in Table 5-34.

Table 5-34. Local Servicing Costs – Area C - Summary

Area	# of Lots	Overall Cost	Cost/Lot
McLean Rd/Stittle Rd.	26	$220,000	$8,462
Wilcox Rd.	16	$225,000	$14,065
Donkersly Rd./Douglas Bay Rd.	32	$345,000	$10,780
Phillips/Kennedy/Manning/Dunlop	60	$880,000	$14,677

5.5.9 Summary

Western Area (Area B)

In summary, costs were reviewed and evaluated for supply to the western and eastern ends of the Southern Region. Costs included both interim capital costs (2038), long term operation and maintenance cost, and long term cost of water.

On the western side, five options were reviewed and are summarized in Table 5-35.

Table 5-35. Summary of Area B – Supply Options

		City Water $0.359/m^3	City Water $0.551/m^3	City Water $0.911/m^3
Option 1:	Connection to the City at Highway 101	$9,349,000	$11,349,000	$14,583,000
Option 2:	Connection to the City at Duncan Street	$10,845,000	$12,665,000	$16,079,000
Option 3:	Connection to the City at Nootka Street	$9,623,000	$11,443,000	$14,857,000
Option 4:	Develop Hammil Lake (Padgett Rd. Supply)	$6,339,000	$6,339,900	$6,339,000
Option 5:	Develop Hammil Lake (Padgett/BCTC/Stevenson	$6,689,000	$6,689,000	$6,689,000

Including operation and maintenance costs and the cost of water, the least cost option was Option 4; develop Hammil Lake with conveyance along Padgett Road. It is considerably less desirable to connect to the City primarily due to the cost of water and potential share of City upgrade costs to accommodate a District supply. If the City's base water user rate is used and the connection cost is waived, or addressed in some other manner, the development of Hammil Lake is still less cost in the long term by approximately $1.0 million. It is expected a considerable departure from the City's Water Rates Regulation Bylaw would be required.

Option 3 could be developed jointly with the City which would result in the City picking up a share of the cost. It was estimated that potential cost sharing (or contribution) from the City could be in the order of $2,060,000. This would make this option slightly higher than Option 4 ($6,601,000 versus $5,518,000). It is however noted that Option 4, development of Hammil Lake, could also provide cost sharing with the City on the intake relocation and control structure. There may also be a benefit to the City for having a backup treated water supply.

It is our recommendation that in the absence of a negotiated agreement with the City for water supply to the southern region the development and initial servicing of Myrtle Pond and Area B be by developing Hammil Lake as a source, subject to financing and Regional Board and public approval.

Regional System

Hammil Lake does not have the capacity for ultimate supply of the Southern Region (Areas B and C) by itself. Hammil Lake could supply Area B and C of the Southern Region in the interim. As such, development of the Lois Lake source will be required eventually. Two options were considered for development of the Southern Region for the interim:

- Develop Lois Lake in conjunction with Hammil Lake
- Defer development of Lois Lake and service Area C from Hammil Lake (low zone or high zone connections)

The estimated capital cost, with 40% contingency and engineering and O/M included, for the four options are summarized in Table 5-36 as follows.

Table 5-36. Summary of Southern Region Supply Options

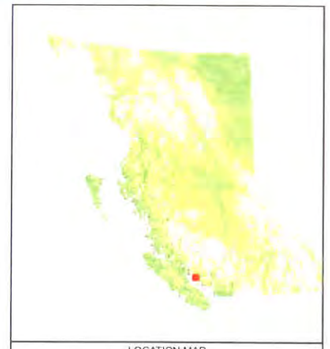
Option	Description	Cost
Option 6:	Interim supply Lois Lake and Hammil Lake	$25,744,000
Option 7:	Interim supply Hammil Lake – BCTC Row (low zone)	$27,010,000
Option 8:	Interim supply Hammil Lake – BCTC Row (high zone)	$28,104,000
Option 9:	Interim supply Hammil Lake (BCTC/Duck Lake Rd/Hwy 101)	$26,634,000

The additional present worth (30 years at 5%) cost of water would be $249,858 and applied to all four options.

Although the costs of deferring Lois Lake and servicing the Southern Region in the interim (as provided in Options 7 and 8) is slightly more cost, there is significant benefits in terms of supply in the Southern Region. These benefits include:

- The whole Southern Region can be serviced including the upper high zone in the Kelly Creek, Hammil Hill, and possibly Nootka areas. This could potentially lower the cost per lot as the long term cost is spread over more serviceable parcels.
- Security, reliability and operational flexibility is provided as the whole Southern Region water system would be looped, more so for Options 7 and 8, and less so for Option 9.
- More economic development of the water system in the future through internal looping of the area between the BCTC right-of-way and Highway 101 (Options 7 and 8).

It is recommended that if the District Board and residents decide the benefits of servicing Area C in the interim from Hammil Lake justify the additional expenditure of $1.89 million to $2.36 million, then it is recommended that Options 7, 8 or 9 be considered further. Of these three, it is our opinion the benefits of Option 7 and 8 outweigh the benefits of Option 9. Should the additional costs associated with Options 7, 8 and 9 not be acceptable to the Regional Board and the residents, then proceed with the low cost Option 6. The option for supplying Area C in the interim is provided by Hammil Lake subject to financing, Regional Board public approval.



LOCATION MAP

0 250,000 500,000 1,000,000 1,500,000 2,000,000 Meters

Notes: Not a plan of survey

AECOM

SOUTHERN REGION WATER SUPPLY

5516-008	FIGURE 2-1	2

E

PARADISE VALLEY MHP
POWELL RIVER REFORMED CHURCH W.S.
AIRPORT GOODBURN W.S.
NASSICHUK MHP C.W.S.
OPEN AIR MARKET C.W.S.
POTENTIAL TREATMENT PLANT LOCATION TWL= 142m
Existing City 250 dia Watermain
Hammil Lake TWL = 147m
BARTA C.W.S.
NOOTKA BOOSTER PUMP STATION
RETIREMENT MHP C.W.S.
POWELL HEIGHTS MHP C.W.S.
EASEMENT REQUIRED
LOWER ZONE MYRTLE VALLEY
GUNTHER ROAD W.S.
NOOTKA DUNES GOLF COURSE C.W.S.
NOOTKA STREET C.W.S.
UPPER HIGH ZONE NOOTKA
UPPER HIGH ZONE HAMMIL HILL
MYRTLE VALLEY HIGH ZONE RESERVOIR
VALLEY FIELD C.W.S.
MYRTLE VALLEY LOWER ZONE RESERVOIR
UPPER DEVELOPMENT LIMIT SERVICABLE FROM LOWER ZONE
VALLEY MARINE
EXISTING MYRTLE ROAD WATER SYSTEM STORAGE TANK
DEVITO C.W.S.
MYRTLE POND W.S.
STELLA MARIS W.S.
MYRTLE POINT GOLF COURSE C.W.S.
DUCK LAKE RD OPTION 9
KELLY CREEK HIGH ZONE
MOUNTAIN ASH FARMS W.S.
CAMP NASSICHUK W.S.
LANG BAY HIGH ZONE RESERVOIR
PROPOSED INTAKE
PROPOSED TREATMENT PLANT TWL = 142m AND ZONE 2 FEED
NELSON CREEK W.S.
LANG BAY LOWER ZONE RESERVOIR
HWY 101 "ER RD TO NSON RD CE AREA
CONNECT TO MYRTLE POND WATER SYSTEM (CITY SUPPLY)
McCAUSLAND/ALTA VISTA SERVICE AREA
GAUDET RD/MYRTLE POINT DR/ BARNES RD SERVICE AREA
ELECTORAL AREA B
ELECTORAL AREA C
CAMP GRENDA W.S.
STOLZ DAYCARE W.S.
BLACK POINT LOWER ZONE RESERVOIR
KELLY CREEK ELEMENTARY SCHOOL C.W.S.
LANG BAY STORE W.S.
STILLWATER LOWER ZONE RESERVOIR
UPPER DEVELOPMENT LIMIT SERVICABLE FROM LOWER ZONE
SUNSHINE COAST HEALTH CENTRE W.S.
SKEETER JACKS OUTBACK W.S.
WOODLYN W.S.
BLADE W.S.
BARRY HAY W.S.
LANG BAY WATER USERS W.S.
THUNDER BAY SUBDIVISION W.S.
WEST COAST FISH CULTURE
NIHM FARM W.S.
BEW BAY IMPROVEMENT DISTRICT
PALMER ROAD RENTALS W.S.
SUNSHINE COAST MHP W.S.
LORD WATER SYSTEM
PINNITREE PLACE IMPROVEMENT DISTRICT
BLACK POINT STORE
MALASPINA FIREHALL #1
UPPER DEVELOPMENT LIMIT SERVICABLE FROM UPPER ZONE
STILLWATER W.S.
STILLWATER LOWER ZONE RESERVOIR (ALTERNATIVE)
BCTC R/W
Kelly Creek
Lang Creek
Hammil Creek
Powell River
Malaspina Strait
Brew Bay
Lang Bay
Stillwater Bay
Frolander Bay

LOCATION MAP

Legend
- Proposed Water Gravity Feed
- Proposed Water Pump Feed
- Proposed Waterman
- Future Area B Waterman
- Future Service Area System
- Future Service Area
- Hammil Lake Watershed
- Existing Water System
- Community Water System
- Lower Limit Pressure Zone
- Upper Limit Pressure Zone
- Electoral Area Boundary

0 375 750 1,500 2,250 3,000 Meters

Notes: Not a plan of survey

AECOM

SOUTHERN REGION WATER SUPPLY LAYOUT

PROJECT NUMBER	FIGURE NUMBER	REVISION
5516-008	FIGURE 5-1	2

ISS/REV: A
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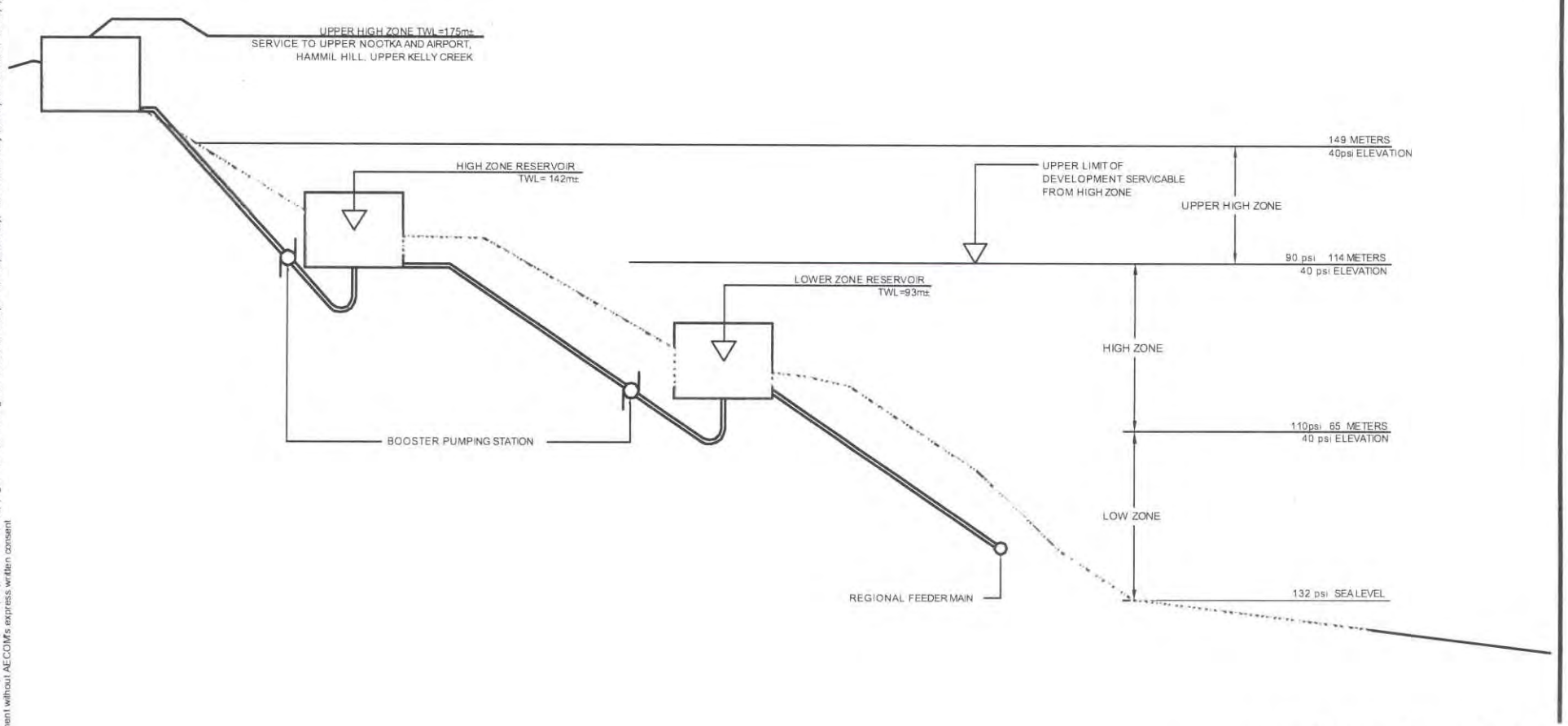
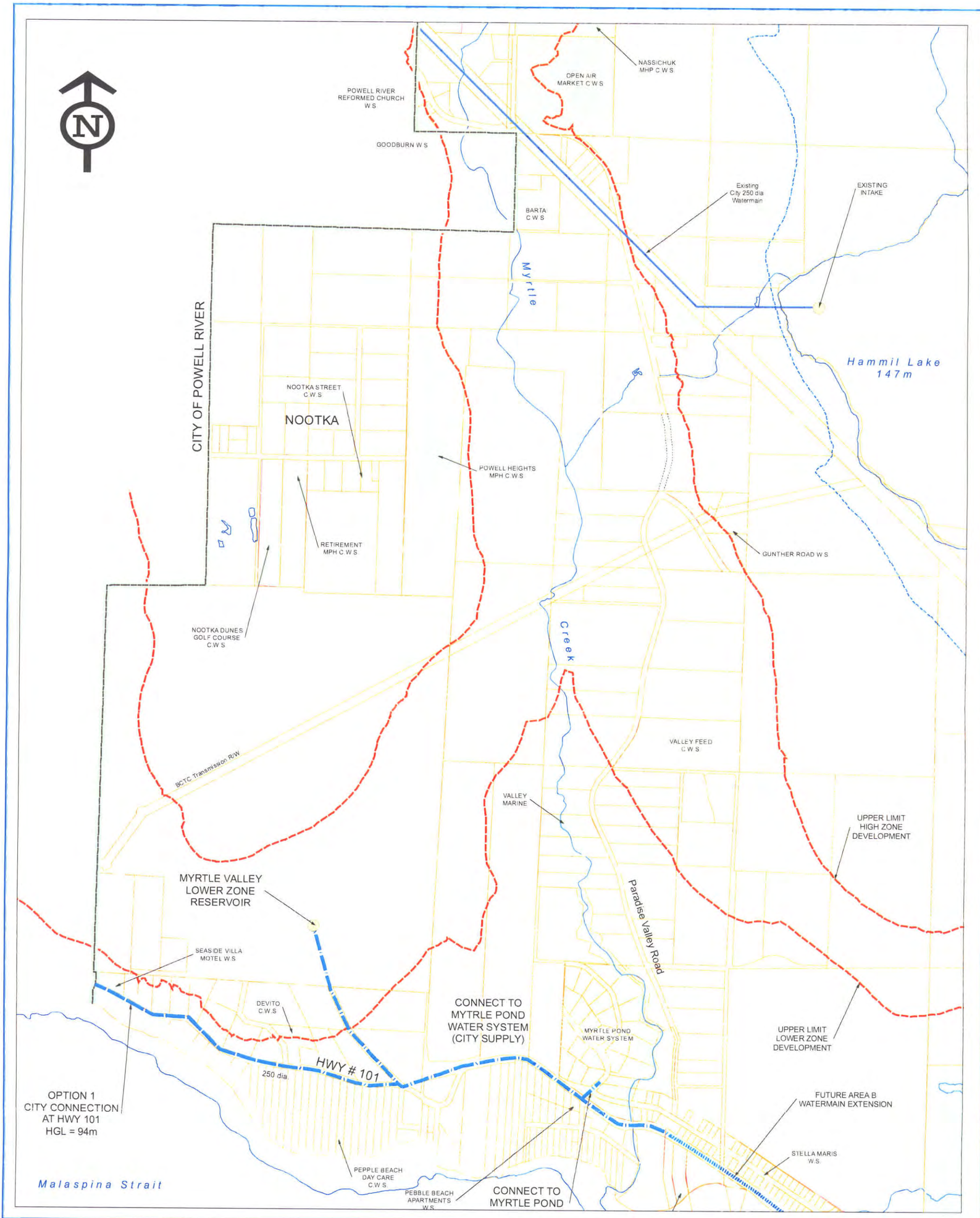
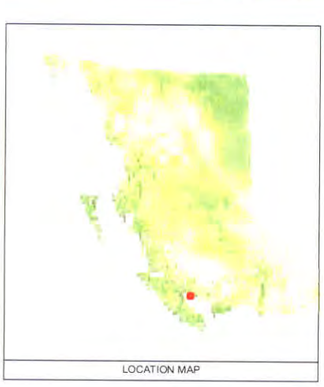


Powell River Regional District
Southern Region Water Source Study
Water Supply Pressure Zones

AECOM

Figure - 5.2





Legend

- Proposed Water Gravity Feed
- Proposed Water Pump Feed
- Proposed Watermain
- Future Area B Watermain
- Hammil Lake Watershed
- Existing Water_System
- Community Water System
- Lower Limit Pressure Zone
- Upper Limit Pressure Zone
- Contours 2m Interval

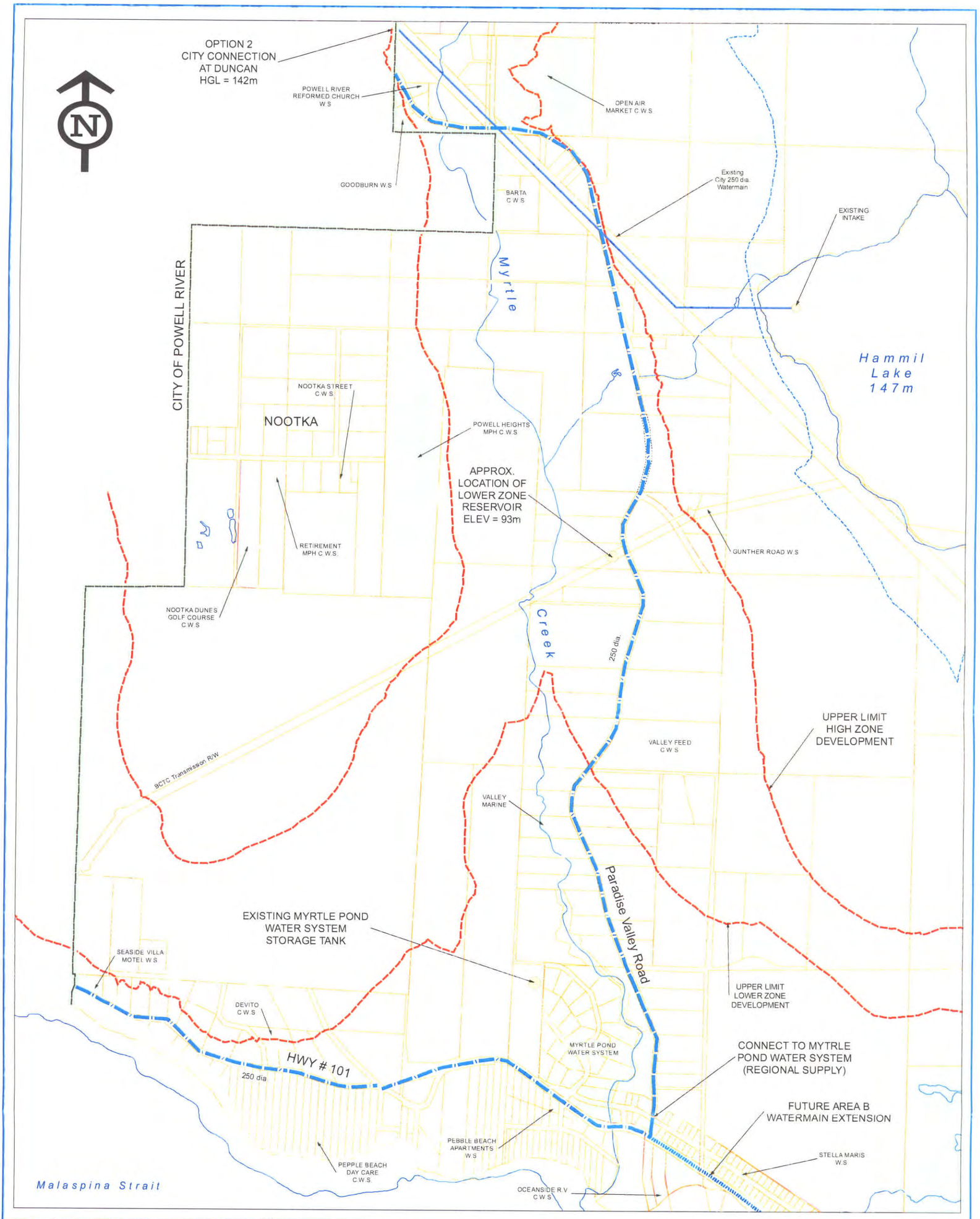
0 100 200 400 600 800 Meters

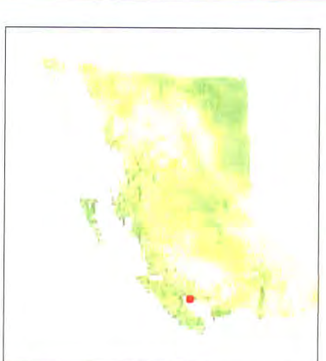
Notes: Not a plan of survey

AECOM

OPTION 1
AREA B MYRTLE VALLEY SUPPLY OPTIONS
WATER SYSTEM CONVEYANCE
CITY CONNECTION ALONG HWY 101

5516-008	FIGURE 5-3	2





Legend

- Proposed Water Gravity Feed
- Proposed Water Pump Feed
- Proposed Watermain
- Future Area B Watermain
- Hammil Lake Watershed
- Community Water System
- Existing Water System
- Lower Limit Pressure Zone
- Upper Limit Pressure Zone
- Contours 2m Interval
- Electoral Area Boundary

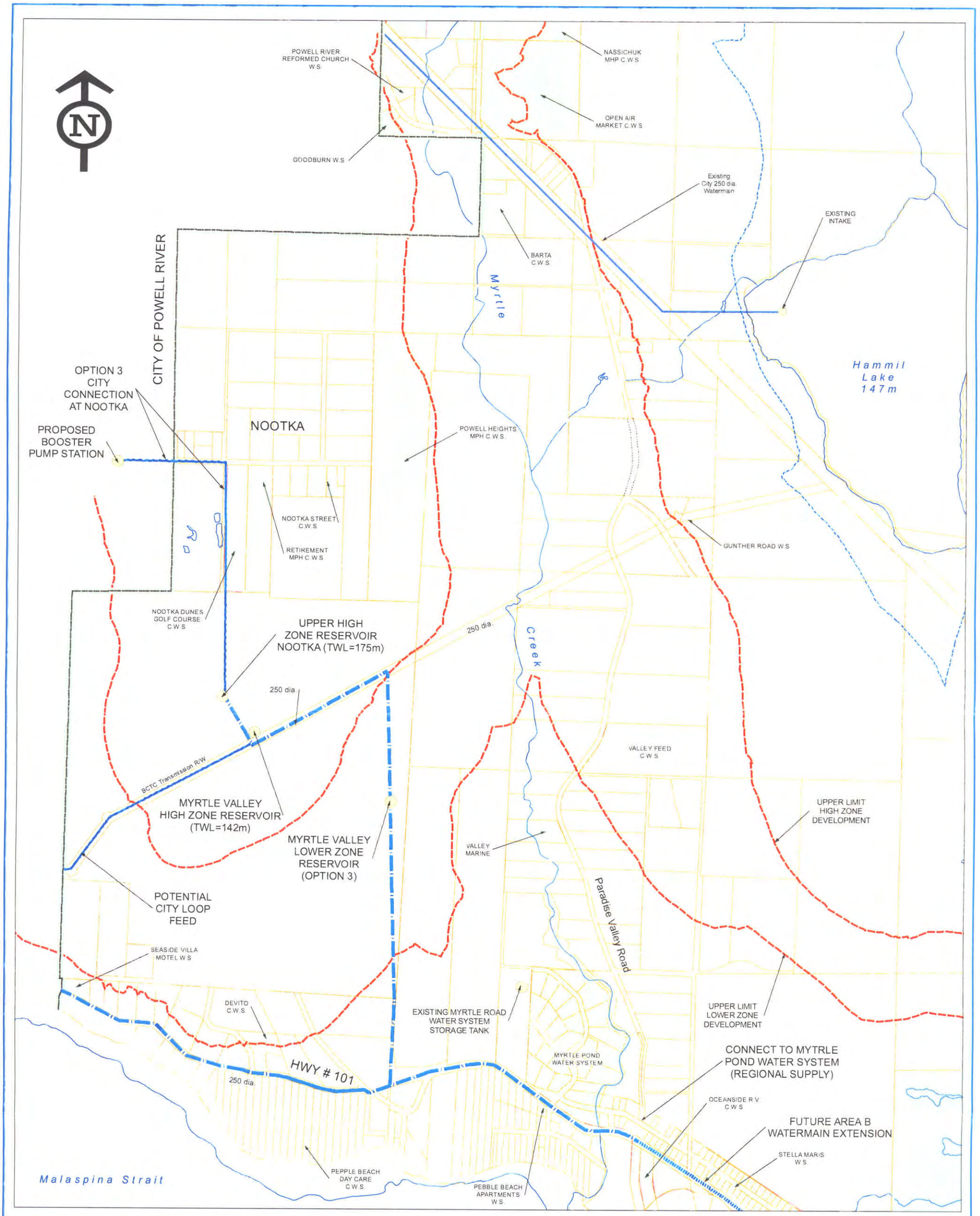
0 100 200 400 600 800 Meters

Notes: Not a plan of survey

AECOM

OPTION 2
AREA B MYRTLE VALLEY SUPPLY OPTIONS
WATER SYSTEM CONVEYANCE
CITY CONNECTION AT DUNCAN ALONG PADGETT RD.

PROJECT NUMBER	FIGURE NUMBER	SHEET NO.
5516-008	FIGURE 5-4	2



LOCATION MAP

Legend

- Proposed Water Gravity Feed
- Proposed Water Pump Feed
- Proposed Watermain
- Future Area B Watermain
- Hammil Lake Watershed
- Existing Water System
- Lower Limit Pressure Zone
- Upper Limit Pressure Zone
- Contours_2m Interval
- Community Water System
- Electoral Area Boundary

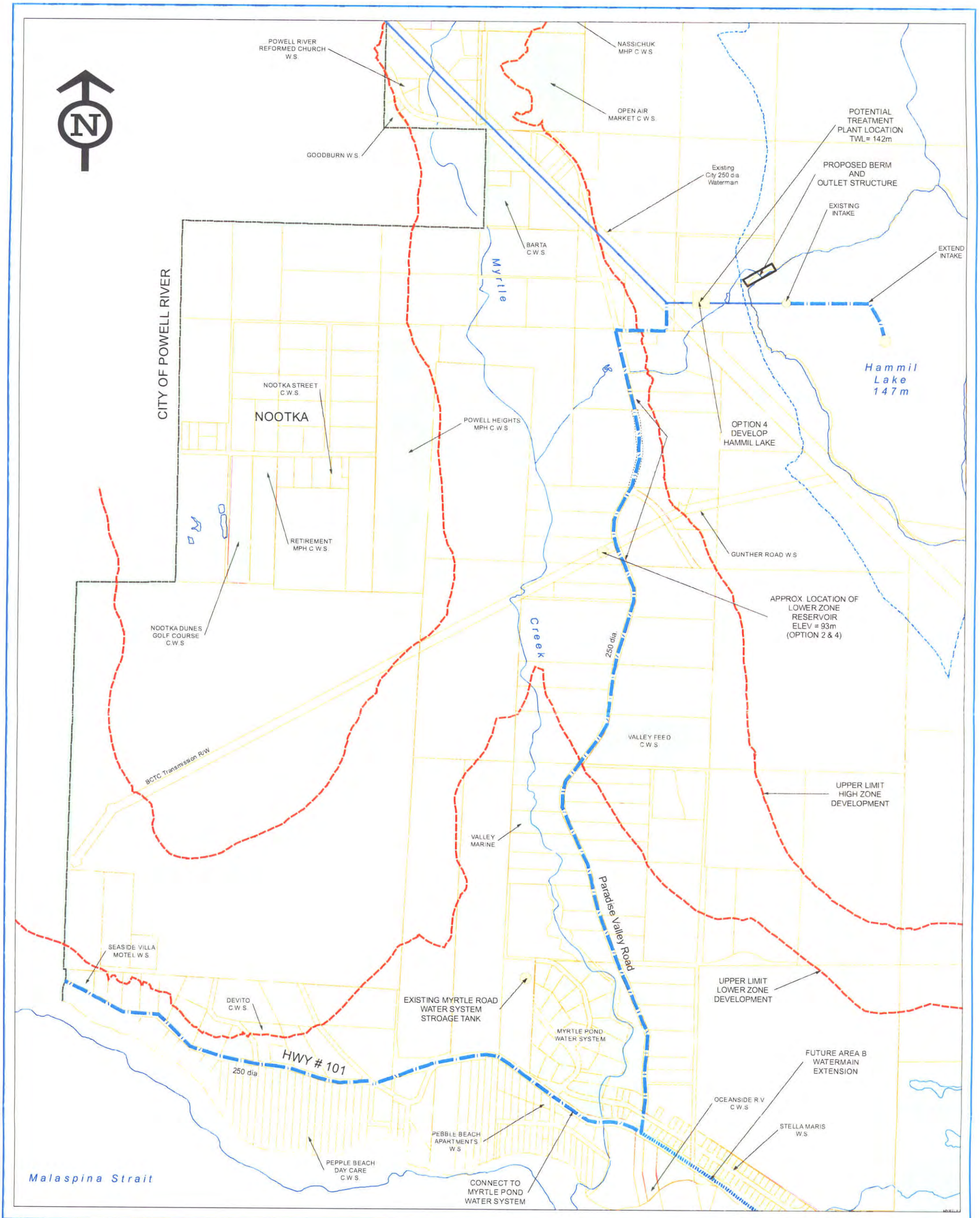
0 100 200 400 600 800 Meters

Notes: Not a plan of survey

AECOM

OPTION 3
AREA B MYRTLE VALLEY SUPPLY OPTIONS
WATER SYSTEM CONVEYANCE
CITY CONNECTION FROM NOOTKA

Project No. (AECOM)	Title No. (AECOM)	Sheet No. (AECOM)
5516-008	FIGURE 5-5	2



LOCATION MAP

Legend

- Proposed Water Gravity Feed
- Proposed Water Pump Feed
- Proposed Watermain
- Future Area B Watermain
- Hammil Lake Watershed
- Existing Water_System
- Community Water System
- Lower Limit Pressure Zone
- Upper Limit Pressure Zone 2
- Contours 2m Interval
- Electoral Area Boundary

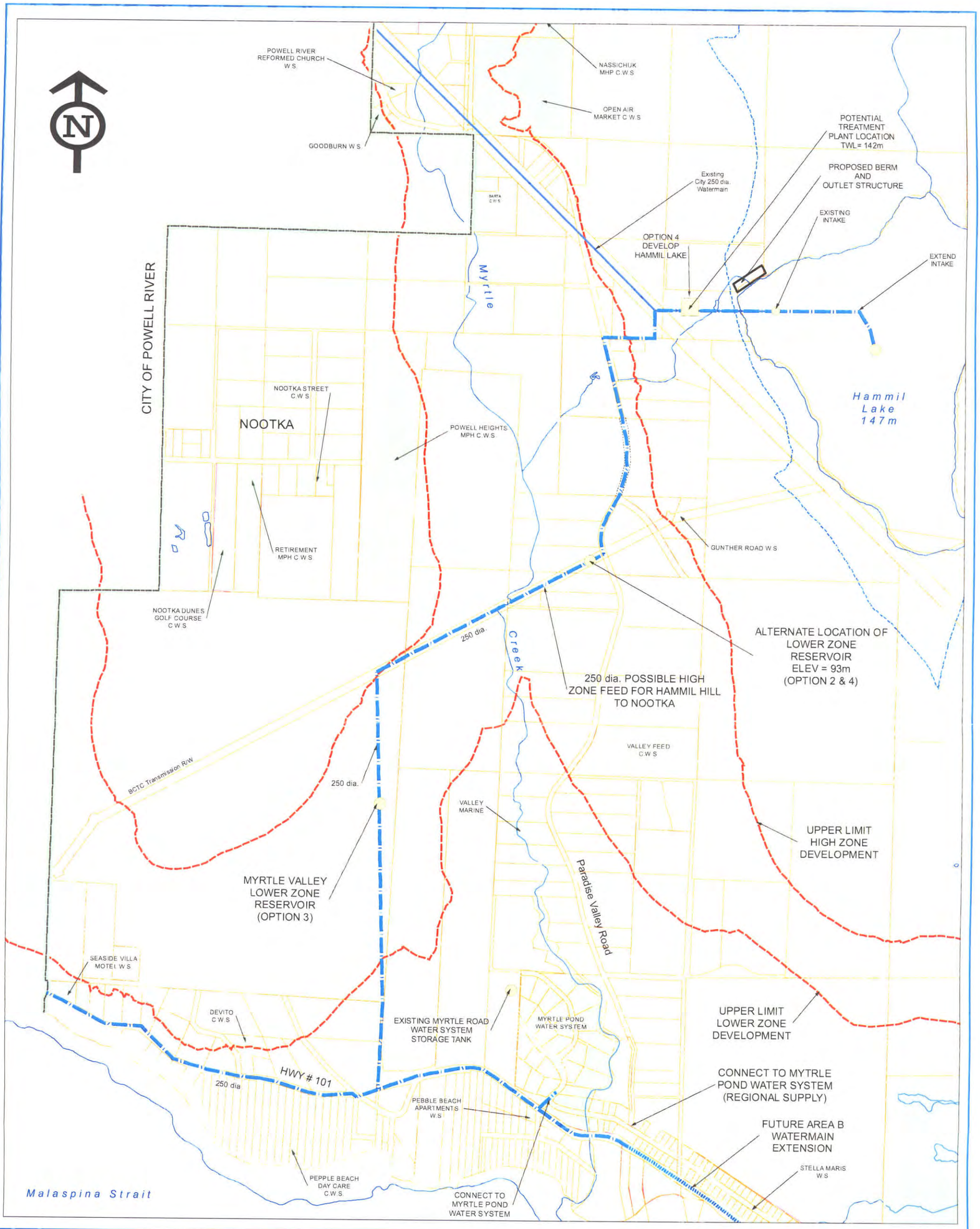
0 100 200 400 600 800 Meters

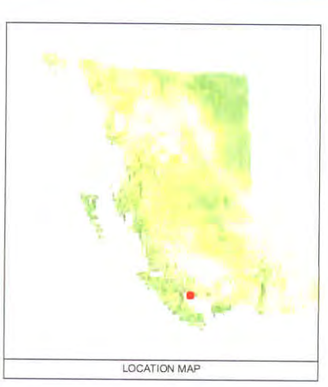
Notes: Not a plan of survey

AECOM

OPTION 4
AREA B MYRTLE VALLEY SUPPLY OPTIONS
WATER SYSTEM CONVEYANCE
DEVELOP HAMMIL LAKE PADGETT RD. CONNECTION

Project No.	Figure No.	Sheet No.
5516-008	FIGURE 5-6	2





LOCATION MAP

Legend
- Proposed Water Gravity Feed
- Proposed Water Pump Feed
- Proposed Watermain
- Future Area B Watermain
- Hammil Lake Watershed
- Existing Water System
- Community Water System
- Lower Limit Pressure Zone
- Upper Limit Pressure Zone
- Electoral Area Boundary

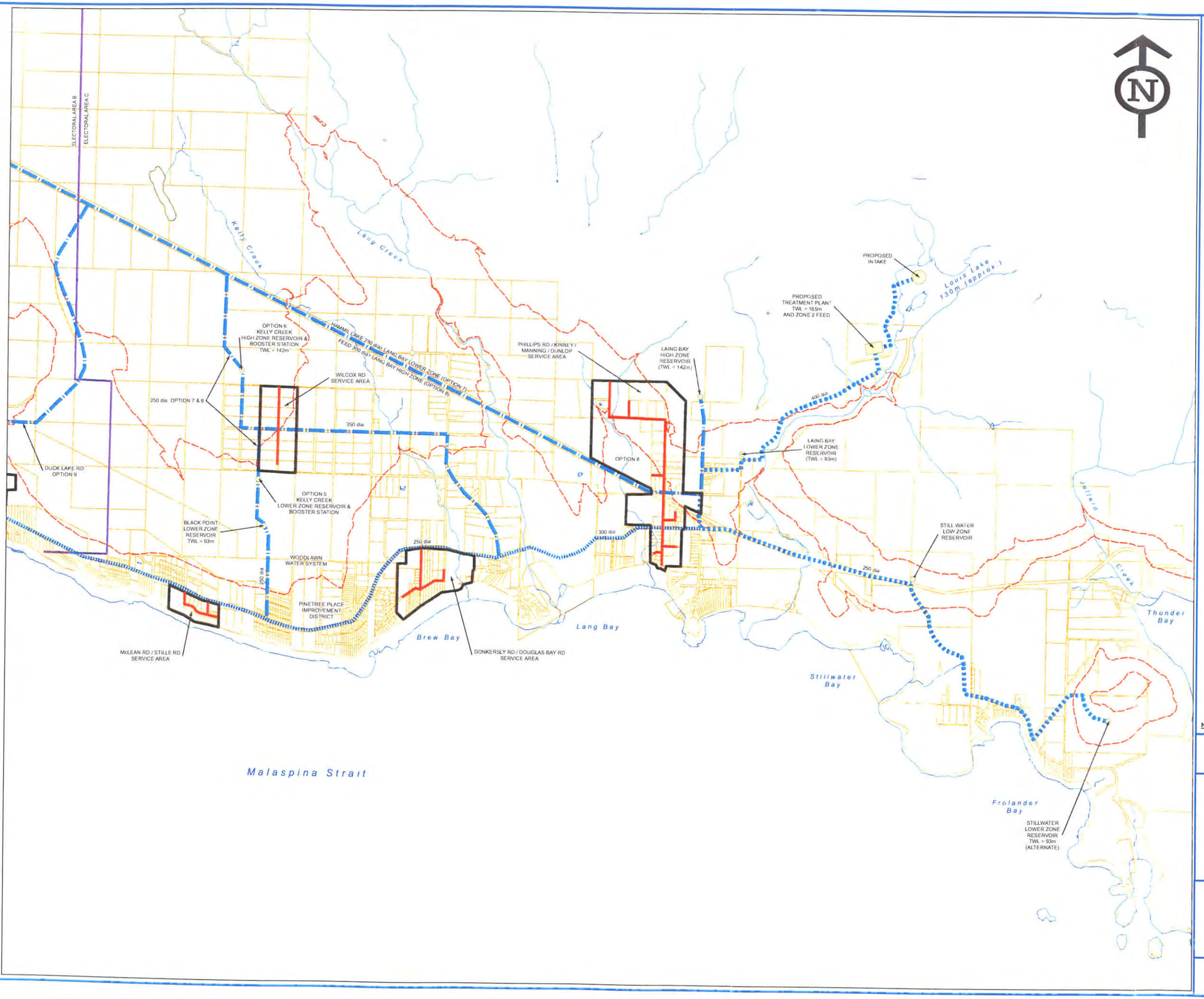
0 100 200 400 600 800 Meters

Notes: Not a plan of survey

AECOM

OPTION 5
AREA B MYRTLE VALLEY SUPPLY OPTIONS
WATER SYSTEM CONVEYANCE
DEVELOP HAMMIL LAKE PADGETT RD./BCTC/ STEVENSON CONNECTION

PROJECT NO.	DRAWING NO.	REV.
5516-008	FIGURE 5-7	2



LOCATION MAP

Legend

- Proposed Water Gravity Feed
- Proposed Water Pump Feed
- Proposed Watermain
- Future Area B Watermain
- Future Service Area System
- Future Service Area
- Hammil Lake Watershed
- Upper Limit Pressure Zone
- Upper Limit Pressure Zone
- Contours 2m Interval

0 375 750 1,500 2,250 3,000 Meters

Notes: Not a plan of survey

AECOM

AREA C WATER SYSTEM CONVEYANCE OPTIONS

5516-008	FIGURE 5-8	2

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6. Implementation of the Regional Plan

6.1 General

The Regional Plan proposed for advancement and implementation is the development of Hammil Lake in the interim for the supply of both Area B and Area C. This advancement is subject to review and approval of the Board and the residents of the Southern Region. The ultimate long term goal would be the additional development of Lois Lake.

Implementation of the proposed regional water supply system will require ten types of action on the part of the Regional District.

- Estimate rate costs to allow for financing of the works.
- Review with and obtain approval from Southern Region residents.
- Secure regional water supply sources. A water licence application needs to be submitted to BC Water Management Front Counter BC.
- Secure government funding.
- Investigate options for power recovery from the new water system.
- Specify standards for construction of new water systems so that they can be incorporated into a regional system.
- Undertake further water quality testing on Hammil and Lois Lakes during the summer period (August/September).
- Establish standards to which existing systems must be upgraded prior to acceptance into a regional water works system.
- Constructing key elements of the regional waterworks infrastructure
- The findings of the report should be reviewed with Southern Region residents, the City, Vancouver Coastal Health Authority, and First Nations.

6.1.1 Obtain Southern Region Residents Approval

The proposed Southern Region water supply program is an extensive and costly program. Upon review with the Board, public meetings should be held with residents to explain the advantages, disadvantages, and costs of the proposed Southern Region water supply system. The meetings should discuss:

- Past and current state of water quality and availability in the Southern Region.
- Water supply options.
- Options and costing to residents.

6.2 Securing of Water Supply Sources

As discussed previously, the Regional District should take immediate steps to:

- Secure a water licence on Lois Lake for a withdrawal of 40.5 ML/day (468 L/s) and Hammil Lake for a withdrawal of 6.8 ML/day (79 L/s) and storage of 1,100,000 m^3. If Area C is to be serviced from Hammil Lake, in the interim, the District should investigate with BC Water Management, the placement of a reserve on Lois Lake.
- Initiate discussions with the City on potential cost sharing opportunities and joint development of Hammil Lake and the upper high zone reservoir located south of Nootka.
- Conduct an investigation of Hammil Lake as a watershed in terms of water quality, base flows and development.

6.3 Grant Funding

The Regional District should apply for infrastructure grant funding to lessen the costs to rate payers in the Southern Region. There are numerous funding programs available both federally and provincially. Federally, there is Canadian Infrastructure Funding (Build Canada Fund). There are several potential programs within available which provide funding in the following areas:

The potential area and specific programs are:

- Gas Tax Fund
- GST Rebate Fund
- Public Private Partnership Fund
- Canada/BC Municipal Rural Infrastructure Fund
- BC Community Water Improvement Program
- Infrastructure Planning Grant Program
- Towns for Tomorrow
- Canada / BC Infrastructure Fund
- Eco Energy

Funding opportunities should be applied for as soon as possible.

6.4 Standards for New Development

All new development within the Southern Region must be designed with water systems suitable for incorporation in the regional water system. This would include:

- Capability of being served from the proposed regional pressure zones without pumping
- Water distribution system engineered to conform to current standards for providing peak day domestic demands and fire flows

- As constructed drawings and information necessary to operate and maintain the system
- Each residence or building to be equipped with a pressure regulating valve and meter

In general, new water systems should be designed to the requirements of the Master Municipal Infrastructure Design Guidelines. Among other items, these standards require:

- Design for domestic, domestic irrigation, and fire demand
- Minimum of 150 mm diameter watermains

Smaller developments cannot be expected to include trunk watermains or major storage facilities which would benefit the remainder of the system. The key is that the smaller developments be compatible with the regional system when installed.

Major developments which will require significant water distribution and storage facilities must be required to design these so that they become a part of the regional water supply system.

6.5 Water Sources for New Development

As discussed in previous sections, the existing water systems have barely sufficient capacity to serve their existing users and do not have sufficient water to meet demands from significant further development.

Therefore, new developments must provide their own temporary water source until such time as they can be provided from the regional system. In most cases, groundwater wells will continue to be the appropriate water source for small developments due to:

- Ease of development (no intakes or long pipelines)
- No usual need for disinfection

6.6 Incorporation of Existing Systems

Several of the existing water systems (Stella Maris, the new section of the Myrtle Pond system, the Brew Bay system and the Stillwater system) have generally been designed to provide peak domestic and fire flows and have incorporated suitable waterworks materials in their construction. The key elements required prior to incorporation of these systems in a regional system include:

- Confirm which actual systems can be retained in the regional system
- Provide municipal type fire hydrants
- Provide up to date drawings and operating manuals
- Provide pressure regulating valves and meters at each residence and building

The remaining systems, while they serve in many ways, do not approach a standard which is acceptable for incorporation into a regional system.

6.7 Major Works to be Constructed by the Regional District

The following items must be constructed by the Regional District since the larger items of the infrastructure cannot be adequately financed or coordinated at a lower level. A key initial decision is whether to develop Lois Lake to service Area C or service Area C in the interim from Hammil Lake.

- Development of Hammil Lake (Lois Lake as well, if supply of Area C in the interim from Hammil Lake is not approved)
- Feedermains along Highway 101, Padgett Road, Dixon Road and the BCTC right-of-way (if Hammil Lake source is approved for interim supply)
- Regional storage reservoirs

6.8 Strategy for Implementation and Impact on Regional Planning

The following suggests a program for construction and implementation of a regional water system by the Regional District. The program shows key phases in the sequence of implementation and at the same time, shows the impact of each phase on development planning in the Southern Region.

6.8.1 Phase 1 – Preliminary

The preliminary phase includes:

- Securing provincial water licences for the water sources (Lois Lake, Hammil Lake)
- Further water quality analysis of Lois Lake and Hammil Lake particularly during the summer period
- Hydraulic analysis to confirm final regional system component sizing, reservoir locations and TWL's
- Preliminary surveys, location of intake at Hammil Lake and possibly Lois Lake, treatment facility, major watermains, water storage reservoirs
- Securing easements, rights-of-ways and land as required for the various water supply facilities
- Initiate discussions with the City on cost sharing of improvements at Hammil Lake and upper Nootka
- Explore energy recovery options within the regional systems (reservoirs – potential candidates)

During this phase, all new development in any area of the Southern Region will have to be self-sufficient in terms of water supply.

6.8.2 Phase 2 – Major Infrastructure Elements

Phase 2 would include detailed design and construction of:

- The Hammil Lake intake and treatment plant. Construction of a filtration facility would be allowed for in the design; however, actual construction could be deferred pending further water quality testing and discussion with the Ministry of Health.
- The feedermain from the treatment plant, along Padgett Road to Highway 101 and Duncan, and then along Highway 101 west to the City and east to Black Point.

- Construction of low zone reservoirs at Myrtle Valley and at Lang Bay. Possible construction of the upper high zone reservoir at Nootka subject to negotiations with the City.
- Connection of Myrtle Pond and Stella Maris estates.

The treatment facility would be designed for a flow 3.0 ML/day if Hammil is to be developed for supply to Area B. If Hammil is to be developed for Area B and C, then the design flow should be 6.8 ML/day

This work would release development restrictions due to inadequate water supply for the upper and lower Myrtle Valley and the section of Highway 101 between the City and Myrtle Point.

The existing Woodlyn, Pinetree, Brew Bay and the Lang Bay water systems could be incorporated into the regional system once suitable reconstruction and/or upgrading has been completed as the regional system is expanded.

6.8.3 Phase 3 – Construct Trunk Main from Hammil Lake to Lang Bay

Implementation of Phase 3 is contingent upon the Regional District and residents approving this option. The required work by the Regional District includes:

- Construction of booster pumping station at Hammil Lake
- Construction of feedermain to the upper high zone reservoir, at Hammil Hill
- Construction of 250 dia. or 300 dia. trunk watermain from Hammil Hill to Lang Bay lower or upper high zone reservoirs

The phase will allow development in the lower Lang Bay and upper Kelly Creek areas to proceed unrestrained by the limitations of the groundwater resource in the area.

6.8.4 Phase 4 – Linking and Infilling

The remaining work to be completed by the Regional District in order to implement a comprehensive regional water supply is:

- Extension of the trunk watermain along Highway 101 from Myrtle Point to Black Point, from Lang Bay to Black Point, and from Lang Bay to Stillwater
- Construction of low zone reservoirs at Lang Bay and Kelly Creek, and Stillwater

The existing Stillwater system would be incorporated into the regional system and the existing trunk watermain upgraded to ensure supply of the new low zone reservoir at Frolander Bay.

At the completion of Phase 4, the regional water system would be available to support development along the coast and near any of the existing centres of development.

6.9 Impact on Planning

Based on the strategy for implementation outlined above, the following guidelines will apply to future development in the Southern Region.

Myrtle Creek / Myrtle Point

Development is to be limited by the availability of groundwater until the Regional water supply becomes available.

Coast from Myrtle Point to Black Point

Development must be restricted to what can be supported from groundwater wells until the final phase of the regional water system implementation. Significant development proposals may warrant accelerated extension of the regional water system, either by the Regional District or by the developer.

Black Point / Brew Bay / Lang Bay / Zillinsky Road

Increased development in these areas can be supported by the first stages of the proposed regional water system.

Stillwater

Development in this area will be restricted to the capacity of the existing system until the final phase of implementation of the regional water system.

7. Conclusions and Recommendations

7.1 Conclusions

Based on the information and data presented in the foregoing sections, it is concluded that:

Existing Waterworks Systems and New Land Development

1. Existing community water supply systems are typically small and the sources of supply are currently, generally fully utilized. Expansion and upgrading to meet current regulations and guidelines in the interim is expected to be costly.

2. Additional land use and development identified in the SROCP is contingent on development of major new sources of supply.

3. New major sources of supply can be most effectively provided as part of a regional system.

4. There are currently an estimated 56 small water systems monitored by the local Health Authority in the Southern Region and approximately 375 individual wells. A significant number of the community water systems do not meet current guidelines and regulations.

   For the two water systems which were assessed in detail, the value of upgrading required to bring the water systems into compliance was approximately $2.5 million. Of the $2.5 million, $1,151,000 is related to distribution system improvements and $1,349,000 is related to quantity, quality, treatment, and storage improvements. Given this, it is expected that upgrading the remaining water systems to meet current guidelines and regulations will result in costs which may exceed the cost estimated for the regional system, depending on the level of grant funding.

Capacity Limitations of Groundwater

5. The groundwater resource in the Southern Region is insufficient for development as a regional source of supply. Wells have suffered from contamination or from fecal contaminants. Deep wells are prone to arsenic contamination.

6. The service potential for the largest capacity production wells is limited to small subdivisions (i.e., typically up to 12 dwelling units), primarily in the Myrtle Point area.

Surface Water Potential and Development

7. Lang Creek is currently over-subscribed in terms of water licences or withdrawal when minimum long term stream flows are taken into consideration.

8. Hammil Lake could provide supply to Area B at full OCP buildout, or Area B and C for interim supply demands. Hammil Lake has insufficient capacity for Area B and C OCP buildout supply demands.

9. A connection to Lois Lake above the existing dam could provide a supply for the entire Southern Region in the long term.

10. A regional plan for water supply should therefore be based on integrated use of Hammil Lake and Lois Lake surface water sources. Hammil Lake could supply the Southern Region in the interim.

11. These sources should be linked by means of a feedermain installed along Highway 101. A feedermain along the BCTC right-of-way from Hammil Hill to Lang Bay is also beneficial and could be implemented.

Water Supply System Planning

12. Two pressure zones are required in order to ensure adequate water pressure for all users, as well as to facilitate the eventual integration of isolated water systems. A third pressure zone is required to supply the upper Hammil Hill, upper Nootka and upper Kelly Creek areas.

13. The proposed pressure zoning would limit development to Elevation 65 m in the low zone and to Elevation 114 m in the high zone. The upper high zone would be approximately 149 m.

14. Balancing and fire flow storage for each zone must be provided in a series of reservoirs located strategically from west to east across the Southern Region.

15. On a long term basis, water from the Hammil Lake and Lois Lake sources are considered to require a multi barrier approach. Ultraviolet (UV) or filtration could be used for primary disinfection with chlorination, as secondary. Other treatment options could be investigated.

Implementation of Regional Plan and Impact on Land Development

16. The plan for a regional system as presented on Figure 5-2 lends itself to phased implementation in order to promote orderly land development.

17. Reconstruction of the Hammil Lake intake complete with treatment plant and feedermain links to both Myrtle Pond and Black Point would facilitate land development in the western portion of the Southern Region.

18. Construction of the feedermain along the BCTC right-of-way to Lang Bay would facilitate development in the Lang Bay area and west to Brew Bay and Black Point.

19. Construction of feedermain between Lang Bay and Stillwater would facilitate development along the entire coast.

Estimated Costs

The estimated long-term costs for supplying the Myrtle Pond Water System area is as follows:

		City Water $0.359/m^3	City Water $0.551/m^3	City Water $0.911/m^3
Option 1:	Connection to the City at Highway 101	$9,349,000	$11,349,000	$14,583,000
Option 2:	Connection to the City at Duncan Street	$10,845,000	$12,665,000	$16,079,000
Option 3:	Connection to the City at Nootka Street	$9,623,000	$11,443,000	$14,857,000
Option 4:	Develop Hammil Lake (Padgett Rd. Supply)	$6,339,000	$6,339,900	$6,339,000
Option 5:	Develop Hammil Lake (Padgett/BCTC/Stevenson	$6,689,000	$6,689,000	$6,689,000

(1) This does not include costs associated with dept servicing, District administration and insurance.

(2) Note Hammil Lake Options 4 and 5 include yearly cost of water licence rental.

The estimated long-term costs for servicing the Southern Region are provided as follows:

Option	Item	Capital Cost	PW O/M based on 5% for 30 years	Total Cost
Option 6	Interim supply Area C from Lois Lake	$20,675,000	$4,714,000	$25,389,000
Option 7	Interim supply Area C from Hammil Lake (low zone)	$22,780,000	$4,230,000	$27,010,000
Option 8	Interim supply Area C from Hammil Lake (high zone)	$23,720,000	$4,384,000	$28,104,000
Option 9	Interim supply Area C from Hammil Lake via Duck Lake Road	$21,830,000	$4,804,000	$26,634,000

7.2 Recommendations

Based on the foregoing information, the key recommendations from this study are that:

1. A regional water system as summarized in the report should be developed for supply to Area B in the absence of a negotiated agreement with the City.

2. The development of Hammil Lake be adopted for interim supply of Area B subject to Regional Board and public approval for phased implementation in conjunction with future land development.

3. Should the Regional Board and residents agree the benefits of servicing Area C in the interim period to 2038 from Hammil Lake justify the additional cost, then the development of Hammil Lake should be expanded to provide interim service for Area C.

4. If the Regional Board and residents do not find the benefits of servicing Area C in the interim period to 2038 from Hammil Lake justify the additional costs, then consideration should be given to the development of Lois Lake for supply to Area C using the least cost option identified in the report.

5. Regional water supply to be added to the functions of the Powell River Regional District.

6. A Southern Region Water Supply District be established to implement the approved plan and to manage the regional system.

7. A Water Licence to be obtained for utilization of Hammil as a regional supply source. A licence or reserve should also be secured for Lois Lake.

8. A water quality study of Hammil Lake and Lois Lake be undertaken in order to quantify design criteria for a proposed water treatment facility.

On the matter of new subdivision developments, and until such time as Phase 2 (Major Infrastructure Elements) of the Master Plan is implemented, it is further recommended that:

9. A community waterworks system (complete with local supply source) be provided as part of new developments.

10. Waterworks systems to be designed in accordance with the Ministry of Environment's Design Guidelines for Rural Residential Community Water Systems.

11. System design provides for possible future integration into the regional system.

Appendix A
KWL – Southern Region Water Supply Study – Phase I
Survey Results
Raw Data

PRRD Well Information Survey **19-Oct-05**

Table 1: Summary of Wells located in Southern Region

Source	Total Number of Wells	Individual Wells (1 connection)	Community Wells (2+ connections)	Number of Duplicate Wells	Mapped Wells
1995 Arsenic Study [1,6]	178	172	6	-	-
Undated PRRD Map	189	189	0	145	44
1970/71 Provincial Map [4]	257	257			257
2000 Arsenic Study [2,6]	12	-	-	-	-
2001 BC Water Resource Atlas [5]	333	89	2	0	91
Coast Garibaldi Health Authority [3]	42	0	42 [4]	0	6
Survey [8]	272	272			272
					670

O:\0300-0399\355-004\400-Work\Wells\[Mapped_Wells-2005_10_19.xls]Summary of Wells

Notes:

1. Carmichael, Vicki, Len Clarkson, and Lee Ringham, 1995. Well water survey for arsenic in the Powell River and Sunshine Coast communities of BC. Gibsons, BC: Coast Garibaldi Community Health Services Society.

2. Mattu, Gevan and Hans Schreier, 2000. An investigation of high arsenic levels in wells in the Sunshine Coast and Powell River regions of BC. Vancouver, BC: Institute for Resources and Environment UBC.

3. Dan Glover, EHO - Powell River (604) 485-8860.

4. Province of BC, Department of Lands, Forests, and Water Resources,1970/1970. Water Well Location Map New Westminster District 38. Victoria, BC.

5. BC Water Resource Atlas, 2001. Province of British Columbia, http://srmapps.gov.bc.ca/apps/wrbc. Accessed August, 2005.

6. Well locations were given by district lot and are not precise enough for KWL mapping.

7. 23 of the 42 community wells have fewer than 5 connections.

8. Total survey responses = 578, of which 132 did not provide location info and approx 174 were community water systems

Powell River Regional District
Table 2: Summary of Well Survey Results

September 26, 2005
KWL File 355.004

#	Question	Responses	Result	Percent of Total in Area
-	Total number of survey responses	-	578	-
1	Did you complete the Water Quality & Supply Survey in the June 9, 2005 issue of the Powell River Peak?	Yes	70	12%
		No	414	72%
		No response	94	16%
2	From what source do you obtain your domestic water (drinking and household use)?	Dug wells	190	33%
		Drilled deep wells	159	28%
		Drilled shallow wells	26	4%
		Community system	174	30%
		No response	29	5%
3	If you have a drilled well, do you have a well log?	Yes	22	4%
		No	199	34%
		No response	357	62%
	Willing to share records?	Yes	24	4%
		No	3	1%
		No response	551	95%
4	If you know, what is your wells pumping rate (USgpm)?	0 to 5	38	7%
		5 to 10	24	4%
		10 to 20	15	3%
		20 +	10	2%
		No response	491	85%
5	Do you know the approximate age of your well?	0 to 10	59	10%
		10 to 20	81	14%
		20 to 50	117	20%
		50+	3	1%
		No response	318	55%
6	Does any other household(s) use your water source?	Yes	152	26%
		No	152	26%
		No response	274	47%
7	Has your domestic water ever been tested for water quality?	Yes	415	72%
		No	73	13%
		No response	90	16%
	Willing to share records?	Yes	3	1%
		No	3	1%
		No response	572	99%
8	Does your water meet Health standards?	Yes	296	51%
		No	71	12%
		Don't know	147	25%
		No response	64	11%
9	Are there other water quality concerns?	Yes	188	33%
		No	293	51%
		Don't know	23	4%
		No response	74	13%
10	Is your water treated?	Yes	138	24%
		No	338	58%
		No response	102	18%
10	Type of treatment	Bacteria	79	48%
		Iron	39	23%
		Manganese	15	9%
		Arsenic	9	5%
		Odour	24	14%
		Other	0	0%
11	Do you regularly purchase bottled water?	Yes	190	33%
		No	318	55%
		No response	70	12%
12	Does your water source and system provide you with enough water to meet all your needs?	Yes	435	75%
		No	95	16%
		No response	48	8%
13	How many people live in your household?	1	68	12%
		2	273	47%
		3	66	11%
		4	47	8%
		5	31	5%
		6	9	2%
		7+	5	1%
		No response	79	14%

Table 4: PRRD Southern Region Well Water Quality

Sample Location: (Note 3)		W1 (2)	W2 (2)	W3 (1)	W4 (3)	W5 (3)	W6 (4)	W7 (4)	W8 (6)	W9 (6)	W10 (6)	W11 (1)	W12 (3)	W13 (1)	W14 (4)	W15 (7)	GCDWQ
Road Name:		Traff	Traff	Padgett	Armour	Hwy 101	Whalen	Stittle	Victory	View	Douglas	Padgett	Alta Vista	Regal	Gela	Berger	
Well Type		Drilled	Drilled	Drilled	Dug Well	Drilled	Drilled	Dug Well	Drilled	Drilled	Dug Well	Drilled	Drilled	Drilled	Drilled	Drilled	
Sample Date:		30-Aug-05	30-Aug-05	30-Aug-05	30-Aug-05	30-Aug-05	30-Aug-05	30-Aug-05	30-Aug-05	30-Aug-05	30-Aug-05	30-Aug-05	30-Aug-05	31-Aug-05	31-Aug-05	31-Aug-05	
Physical Tests																	
Colour (CU)		<5.0	12.2	9.1	<5.0	<5.0	7.6	<5.0	5.0	<5.0	<5.0	<5.0	16.7	<5.0	<5.0	<5.0	15
Conductivity (µ ohms/cm)		173	193	113	186	129	154	191	129	153	168	146	356	143	169	163	-
Total Dissolved Solids (mg/L)		108	120	74	109	89	87	101	65	77	93	78	231	85	97	99	500
Hardness	$CaCO_3$	59.2	53.6	40.0	58.2	43.1	53.9	62.2	43.6	49.6	27.5	55.0	36.2	44.7	62.3	62.2	-
pH		8.21	8.11	7.95	7.31	7.58	7.97	7.49	8.01	8.03	7.15	8.00	8.27	7.85	7.77	7.67	6.5 - 8.5
Turbidity (NTU)		0.17	0.68	0.73	0.13	0.20	0.53	0.11	0.16	0.18	0.34	2.75	0.25	0.59	8.89	0.17	1
UV Absorbance		0.0190	0.0620	0.0410	0.0410	0.0070	0.0320	0.0360	0.0320	0.0110	0.0180	0.0220	0.0870	0.0150	0.0050	0.0060	-
UV Transmittance	%	96	87	91	91	98	93	92	93	97	96	95	82	97	99	99	-
Dissolved Anions (mg/L)																	
Alkalinity - Total	as $CaCO_3$	84.4	95.0	58.1	73.7	49.9	75.6	68.5	63.1	68.9	14.0	76.1	122	72.3	70.9	74.3	-
Chloride	Cl	6.99	7.13	2.96	12.3	8.92	6.68	16.4	5.16	8.09	34.6	4.80	43.5	3.54	9.08	11.1	250
Fluoride	F	0.041	0.087	<0.020	<0.020	<0.020	0.053	<0.020	0.082	0.022	<0.020	0.039	0.152	0.098	<0.020	<0.020	1.5
Sulphate	SO_4	0.72	<0.50	<0.50	3.60	2.24	2.33	3.88	<0.50	2.33	8.08	0.95	<0.50	<0.50	3.18	1.61	500
Nutrients (mg/L)																	
Nitrate Nitrogen	N	<0.10	<0.10	<0.10	1.17	0.75	<0.10	1.15	<0.10	<0.10	0.52	<0.10	<0.10	<0.10	0.36	0.37	10
Nitrite Nitrogen	N	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	1
Total Metals (mg/L)																	
Aluminum	Al	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.019	<0.010	<0.010	0.013	<0.010	<0.010	-
Antimony	Sb	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-
Arsenic (see Note 2)	As	<0.00010	0.00011	0.00395	0.00018	0.00016	0.00012	0.00044	0.00019	0.00141	<0.00010	<0.00010	0.00012	0.00076	0.00054	0.00024	0.005
Barium	Ba	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	1
Boron	B	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	5.0
Cadmium	Cd	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.005
Calcium	Ca	15.3	13.3	11.3	14.7	11.4	13.0	16.7	11.7	13.6	7.11	14.5	8.27	11.5	17.0	18.1	-
Chromium	Cr	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.1
Copper	Cu	<0.0010	0.0013	<0.0010	0.628	0.0490	<0.0010	0.585	<0.0010	<0.0010	0.0362	<0.0010	0.0015	0.0034	0.0032	0.122	1.0
Iron	Fe	0.050	0.534	0.462	<0.030	<0.030	0.412	<0.030	0.129	0.069	0.071	0.443	<0.030	<0.030	2.61	<0.030	0.3
Lead	Pb	<0.0010	<0.0010	<0.0010	0.0035	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.01
Magnesium	Mg	5.10	4.97	2.85	5.24	3.57	5.23	4.98	3.49	3.78	2.38	4.58	3.77	3.89	4.85	4.14	-
Manganese	Mn	0.0399	0.0898	0.217	<0.0020	0.0044	0.0806	<0.0020	0.148	0.0171	0.0043	0.0753	0.129	0.835	0.0243	<0.0020	0.05
Mercury	Hg	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.001
Potassium	K	2.15	2.27	1.50	1.32	0.76	1.50	1.27	1.61	2.07	1.39	1.65	6.36	1.57	1.47	2.03	-
Selenium	Se	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.01
Sodium	Na	11.2	19.8	5.7	13.3	9.1	10.3	13.2	9.4	12.3	20.1	8.4	59.1	12.9	10.8	7.3	200
Uranium	U	<0.00010	<0.00010	<0.00010	0.00012	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.02
Zinc	Zn	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-
Organic Parameters																	
Total Organic Carbon	C	0.81	1.24	0.99	0.66	0.51	0.66	1.00	1.08	0.87	1.39	0.71	2.51	0.75	0.74	<0.50	-

Notes: 1) Miscellaneous: Parameters above the Guidelines for Canadian Drinking Water Quality (GCDWQ) are shown bold and highlighted.
2) Current Proposed Health Canada Drinking Water Guideline for Arsenic is 0.005 mg/L (Actual Interim Guideline level is 0.025 mg/L)
3) Number in brackets refers to the Local Area as designated for this study (ie. 2 = Area 2)
4) UV transmittance is calculated from UV absorbance

Raw Data

Well Information Survey

Southern Region Water Resource Study - Phase 1

Revision Date. September 26, 2005

#	House No.	Street Name	Name: Last	Name: First	Phone	Did you complete the Water Quality & Supply Survey in the June 9, 2005 issue of the Powell River Peak?	From what source do you obtain your domestic water (drinking and household use)?	Name of Community system	If you have a drilled well, do you have a well log?	Willing to share records?	If you know, what is your wells pumping rate?	Do you know the approximate age of your well?	Does any other household(s) use your water source?	Has your domestic water ever been tested for water quality?	Willing to share records?	Does your water meet Health standaRoads?	Are there other water quality concerns?	Is your water treated?	Bacteria (total or fecal coliform or E.Coli)	Iron	Manganese	Arsenic	Odour	Other	Do you regularly purchase bottled water?	Does your water source and system provide you with enough water to meet all your needs?	How many people live in your household?	Well Log Given	Water Quality Results Given	Photograph Number	GPS Waypoint	Map Area	Electoral Area	Comments
						1	2		3		4 GPM	5	6	7		8	9	10							11	12	13	Other						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
1		Douglas Bay Road				No	Dug well		No			12	Yes	Yes		Yes	No	No	No	No	No	No	No		No	Yes	1					5	C	
2		Victory Road				Yes	Drilled deep well		Yes	Yes	25	4	No	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No	No		No	Yes	2					6	C	
3		Traffa Road				No	Drilled deep well		Yes	Yes	20	26	No	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	No		No	Yes	2					2	B	
4		Albion Road				No	Dug well					5	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2					6	C	
5		Armour Road				No	Dug well						Yes	Yes		Yes	No	Yes	Yes	No	No	No	No		No	No	5					3	B	
6		Traffe Road				No	Drilled deep well		No			30	No	Yes	Yes	Yes	Yes	No	No	No	No	No	No		No	Yes	3					2	B	
7		View Road				No	Drilled deep well		No				Yes	Yes		No	No	Yes	Yes	No	No	No	No		No	Yes	2					6	C	
8		Regal Place				Yes	Drilled deep well		Yes	Yes	10	11	No	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	H2S	No	Yes	6					1	B	
9		Varkirk Road				No	Drilled deep well		Yes	Yes	5	26	No	Yes	Yes	Yes	No	No	No	No	No	No	No		No	Yes	1					1	B	
10		Padgett Road				No	Dug well		No			15	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2					1	B	
11		Gela Road					Drilled deep well		Yes	Yes	12	12	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	No		No	Yes	4					4	C	
12		Traffe Road				No	Drilled deep well		No				No	Yes		Don't Know	No	No	No	No	No	No	No		No	Yes	2					2	B	
13		Hwy 101				No	Dug well		No			30	No	Yes		No	Yes	No	No	No	No	No	No		No	Yes	3					3	B	
14		McAulay Road				No	Drilled deep well		No			10	No	Yes		No	Yes	Yes	No	No	No	Yes	No		No	Yes	5					1	B	
15		Traffe Road					Drilled deep well		Yes	Yes		22	No	Yes	Yes	Don't Know	No	No	No	No	No	No	No		No	Yes	2					2	B	
16		Stittle Road				No	Dug well					40	No	Yes		Don't Know	Yes	No	No	No	No	No	No		No	No	3					4	C	
17		Random Road				No	Drilled deep well		Yes			30	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	1					4	C	
18		Hwy 101				Yes	Dug well		No			35	No	Yes		Yes	Yes	Yes	No	Yes	Yes	No	No		No	Yes	2					2	B	
19		Traffe Road				No	Drilled deep well		Yes		30	12	No	Yes		Yes	Yes	Yes	No	No	No	No	Yes		No	Yes	1					2	B	
20		Twin Eagles Road				No	Community system	Pine Tree Place			20 - 21	11				Yes	No	Yes	Yes	No	No	No	No		No	Yes	2					6	C	
21		McGuiness Road				No	Dug well					8	No	Yes		Yes	No	No	No	No	No	No	No		Yes	Yes	2					3	B	
22		Hwy 101				No	Drilled deep well		No			9	No	Yes		Yes	No	No	No	No	No	No	No		Yes	Yes	na					1	B	Seaside Villa Motel
23		Armour Road				Yes	Dug well				10	25	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	5					3	B	
24		Cedar Crest Road				No	Drilled deep well		No				Yes	Yes		Yes	Yes	No	No	No	No	No	No		Yes	No	11					1	B	
25		Bracken Place				No	Drilled deep well		No		3.5	12	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2					1	B	
26		Black Point Road				No	Drilled deep well		No			8	No	No		Don't Know	Yes	No	No	No	No	No	No		Yes	No	4					6	C	
27		Kelly Creek Road				No	Dug well		No			12	No	Yes		Yes	No	No	No	No	No	No	No		Yes	Yes	2					5	C	
28		Patrick Road				No	Community system	Brew Bay						Yes		Yes	No	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	2					Brew Bay	C	
29		Zilinsky Road				No	Dug well					4.5	No	Yes		Yes	No	Yes	Yes	No	No	No	No		No	Yes	2					5	C	
30		Stillwater School Road				No	Community system	Stillwater					No	No		Yes	Yes	Yes	Yes	No	No	No	No		No	Yes	3					Stillwater	C	
31		Hwy 101				Yes	Community system	Lang Bay	No				Yes	Yes		Don't Know	Don't Know	No	No	No	No	No	No		Yes	Yes	2					Lang Bay	C	
32		Scotch Fir Point Road				Yes	Community system	Stillwater						Yes		Yes	Yes	Yes	Yes	No	No	No	No		Yes	Yes	2					Stillwater	C	
33		Mahood Road				No	Community system	Brew Bay					No	Yes		Yes	Yes	Yes	Yes	No	No	No	No		No	Yes	2					Brew Bay	C	
34		Hwy 101				No	Dug well		No			11	No	Yes		Don't Know	Yes	No	No	No	No	No	No		Yes	Yes	2					3	B	
35		Maywood Road				No	Drilled deep well		No					Yes		Yes	No	No	No	No	No	No	No		No	Yes	5					5	C	
36		Regal Place				No	Drilled deep well		No		1.5	10	No	Yes		Yes	Yes	No	No	No	No	No	No		No	No	2					1	B	
37		Phillips Road				No	Community system	Lang Bay						Yes		No	No	No	No	No	No	No	No		Yes	Yes	2					Lang Bay	C	
38		Scotch Fir Point Road				No	Community system	Stillwater					No	Yes		Yes	No	Yes							No	Yes	2					Stillwater	C	
39		Serendipity Road				No	Dug well					20	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	4					5	C	
40		Donkersley Road				Yes	Drilled deep well					3	No	No		Don't Know	No	No	No	No	No	No	No		No	Yes	1					6	C	
41		Lang Bay Road				No	Community system		No				Yes			Don't Know	No								No	Yes	2					Lang Bay	C	
42		Brew Bay Road				No	Community system	Brew Bay	No				Yes	Yes		Yes	Don't Know	Yes	Yes	No	No	No	No		No	Yes	2					Brew Bay	C	
43						No						25	No	No		Don't Know	No	No	No	No	No	No	No		Yes	No	2							
44						No	Community system	Brew Bay						Yes		Yes	Yes	Yes	Yes	No	No	No	No		Yes	Yes	2							
45		Stittle Road				Yes	Dug well					50+	No	No		Don't Know	No	No	No	No	No	No	No		No	No	2					4	C	
46		Stager Road				No	Dug well					45	No	Yes		Don't Know	No	No	No	No	No	No	No		No	No	3					4	C	
47		Albion Road				No	Drilled deep well		Yes	Yes	10	20	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2					6	C	
48		Banks Road				No	Drilled deep well		No			< 1	No	Yes		Yes	Yes	Yes	No	Yes	No	No	Yes		Yes	Yes	2					4	C	
49		Evergreen Road				No	Community system	Pine Tree	No			40	No	Yes		Don't Know	Yes	No	No	No	No	No	No		Yes	No	2					Pine Tree	C	
50		Fleury Road				No	Dug well					68	No	No		Don't Know	Yes	No	No	No	No	No	No		No	Yes	2					4	C	
51		Pine Tree Road				No	Drilled deep well		No			15	No	Yes		Yes	Yes								No	Yes	2					4	C	
52		Random Road				No	Drilled deep well		No			35	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2					4	C	
53		Stark Road				Yes	Drilled deep well		No	No	8	2	Yes	No	No	Yes	Yes	No	No	No	No	No	No		Yes	Yes						3	B	
54		Stittle Road				Yes	Dug well				40	8	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	4					4	C	
55						No	Community system	Myrtle Pond	No				Yes	Yes		Don't Know	Yes	Yes	No	No	No	No	Yes		Yes	Yes	3							
56		Traffe Road				No	Drilled deep well		No		2		No	Yes		Yes	No	No	No	No	No	No	No		No	No	3					2	B	
57		Broom Road				No	Drilled deep well		No		2.5	20	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	4					6	C	
58		Douglas Bay Road				No	Dug well		No				No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2					6	C	
59		Hwy 101 #12				No	Drilled deep well		No				Yes	Yes		Yes	No	No	No	No	No	No	No		No	Yes	1					3	B	
60		Padgett Road				No	Drilled deep well		No		30	17	Yes	Yes		Yes	No	No	No	No	No	No	No		No	Yes	4					1	B	
61		Springbrook Road				No	Community system	Sherwood Park						Yes		Yes	Don't Know								Yes	Yes	3					3	B	C-15
62						Yes			No			4	Yes	Yes			Yes	No	No	No	No	No	No		Yes	Yes	2							Use a creek
63		Maywood Road				No	Dug well					12	No	Yes		Yes	Yes	Yes	No	Yes	No	No	Yes		No	Yes	2					5	C	
64		Hwy 101				Yes	Drilled shallow well		No			35	No	Yes		Yes	Yes	Yes	No	Yes	Yes	No	Yes		Yes	Yes	2					6	C	
65		Broom Road				Yes	Dug well					30	Yes	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2					6	C	
66		Byron Road				Yes	Community system	Myrtle Creek					No	Yes		Yes	Yes	Yes					Yes		No	Yes	2					1	B	
67		Myrtle Avenue				No	Dug well						Yes	No		Yes	No	No	No	No	No	No	No		No	Yes	4					1	B	
68		Zilinsky Road				No	Drilled deep well		No		2	10	No	Yes		No	No	Yes	Yes	Yes	Yes	Yes	Yes		No	Yes	2					5	C	
69		Stark Road				Yes	Drilled deep well		No		5	33	No	Yes		Yes	Yes	No	No	No	No	No	No		No	Yes	1					3	B	
70		Patrick Road				No	Community system	Brew Bay								Don't Know	Yes	Yes							Yes	Yes	2					Brew Bay	C	
71		Centennial Drive				No	Community system	Myrtle Pond					No			Don't Know	Yes								Yes	Yes	2					Myrtle Pond	B	
72		Stager Road				No	Drilled shallow well					40	No	Yes		Don't Know		No	No	No	No	No	No		Yes	Yes	4					4	B	
73		Padgett Road				No	Drilled deep well		No		30	17	Yes	Yes		Yes	No	No	No	No	No	No	No		No	No	1					1	B	
74		Phillips Road				No	Dug well					10	No	Yes		No	No	Yes	Yes	No	No	No	No		No	Yes	2					7	C	
75		View Road				Yes	Dug well		No			18	No	Yes		No	Yes	Yes	Yes	No	No	No	No		Yes	No	2					6	C	
76		Hwy 101				Yes	Dug well					40	No	Yes		Yes	No	No	No	No	No	No	No		No	No	2					6	C	
77						No	Dug well					43	No	No		Don't Know	No	No	No	No	No	No	No		No	Yes	2							

Well Information Survey

Southern Region Water Resource Study - Phase 1

Revision Date: September 26, 2005

#	House No.	Street Name	Name: Last	Name: First	Phone	1. Did you complete the Water Quality & Supply Survey in the June 9, 2005 issue of the Powell River Peak?	2. From what source do you obtain your domestic water (drinking and household use)?	Name of Community system	3. If you have a drilled well, do you have a well log?	Willing to share records?	4. (GPM) If you know, what is your wells pumping rate?	5. Do you know the approximate age of your well?	6. Does any other household(s) use your water source?	7. Has your domestic water ever been tested for water quality?	Willing to share records?	8. Does your water meet Health standards?	9. Are there other water quality concerns?	10. Is your water treated?	Bacteria (total or fecal coliform or E.Coli)	Iron	Manganese	Arsenic	Odour	Other	11. Do you regularly purchase bottled water?	12. Does your water source and system provide you with enough water to meet all your needs?	13. How many people live in your household?	Well Log Given	Water Quality Results Given	Photograph Number	GPS Waypoint	Map Area	Electoral Area	Comments
78		Padgett Road				No	Dug well					31	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2					1	B	
79		Runnells Road				No	Community system	Stillwater Waterworks						Yes		Yes	No	Yes							No	Yes	2					Stillwater	C	
80		Dixon Road				No	Community system	Lang Bay	No				Yes	Yes		No	Yes	No	No	No	No	No	No		Yes	No	35					Lang Bay	C	
81		Nassichuk Road				Yes	Dug well		No		0.4	35	Yes	Yes		No	No	Yes	Yes	No	No	No	No		No	Yes	3					5	C	Water supply for irrigation i
82		Tuck Road				No	Community system	Deer Creek					No	Yes		Don't Know	No	No	No	No	No	No	No		No	Yes	2					Lang Bay	C	
83		Croft Road				No	Community system	Brew Bay					Yes					Yes							Yes	Yes	2					Brew Bay	C	
84							Community system	Brew Bay						Yes		Yes		Yes								Yes	2							
85		Croft Road				No	Community system	Brew Bay						Yes		Yes	Yes	Yes	Yes	No	No	No	No		No	Yes	2					Brew Bay	C	
86		Patrick Road				No	Community system	Brew Bay					Yes	Yes		Yes	Yes	Yes	Yes	No	No	No	No		Yes	Yes	2					Brew Bay	C	
87		Twin Eagles Road				No	Drilled shallow well		No			10	Yes	Yes		Yes	No	Yes	Yes	No	No	No	No		No	Yes	1					6	C	
88		Haddle Road				No	Drilled shallow well		No			18	No	Yes		Yes	Yes	No	No	No	No	No	No		No	No	2					5	C	
89		Barnett Lane				No	Community system	Lang Bay					No	Yes		No	No	No	No	No	No	No	No		Yes	Yes	2							
90		Hwy 101				No	Drilled deep well		No				No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2					3	B	
91		Padgett Road				No	Dug well						Yes	Yes		Don't Know	Yes	No	No	No	No	No	No		Yes	Yes	3					1	B	
92		Padgett Road				Yes	Dug well		No			40	No	No		Don't Know	Yes	No	No	No	No	No	No		No	Yes	2					1	B	
93		Bradford Road				No	Community system	Myrtle Pond					No	Yes		Yes	Yes								Yes	No	2					1	B	
94		Lang Bay Road				Yes	Community system	Lang Bay					No	Yes		No	Yes	Yes	Yes	No	No	No	No		No	Yes	2					Lang Bay	C	
95		Hwy 101				No	Dug well					27+	No	No		Don't Know	No	No	No	No	No	No	No		Yes	No	3					2	B	
96		Hwy 101				No	Dug well					50+	No	Yes		Don't Know	No	Yes	Yes	Yes	No	No	No		No	Yes	2+					2	B	
97		Trafle Road				No	Drilled deep well						No	No		Don't Know	No								Yes	Yes	2					2	B	
98		Woodlynn Road				No	Community system	Woodlynn					Yes	Yes		Yes	No	Yes	Yes	No	No	No	No		Yes	Yes	2					Woodlynn	C	
99		Trafle Road				No	Dug well		No			30	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2					2	B	
100		Scotch Fir Point Road				No	Community system	Stillwater						Yes		Yes	No	Yes	Yes	No	No	No	No		No	Yes	5					Stillwater	C	
101		Stittle Road				No	Drilled shallow well		No			45	Yes	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2					4	C	
102		Williams Road				No	Drilled deep well						Yes			Don't Know	Don't Know								No	No	1					4	C	
103		Hwy 101				No	Dug well	Kent's Beach	No		2.5	10	Yes	Yes		Yes	No	Yes	Yes	No	No	No	No		No	Yes	100-200					6	C	
104		Hwy 101				Yes	Drilled shallow well		No			20+	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	1					6	C	
105		Random Road				No	Community system	Pine Tree Place																	Yes	Yes	2					Pine Tree	C	
106		Lang Bay Road				No	Community system	Lang Bay					No	Yes		Yes	No								Yes	Yes	2					Lang Bay	C	
107		Centennial Drive				Yes	Community system	Myrtle Pond						Yes		Yes	Yes	No	No	No	No	No	No		No	Yes	2					Myrtle Pond	B	
108		Hwy 101				No	Dug well					16	No	Yes		Don't Know	Yes	Yes	No	No	No	No	Yes		Yes	No	4					3	B	
109		Springbrook Road				No	Drilled deep well		No			10	Yes	Yes		Yes	Yes	Yes	Yes	No	No	No	No		Yes	Yes	2					3	B	
110		Springbrook Road				No	Drilled deep well						Yes			Don't Know	Yes								No	Yes	1					3	B	Sherwood Park MHP
111		Random Road				No	Drilled deep well						Yes	Yes		Yes	No	Yes	Yes	No	No	No	No		No	No	2					Pine Tree	C	
112		Hwy 101				No	Drilled deep well	Garnet Rock Park					Yes	Yes		Yes	No	Yes	Yes	No	No	No	No		No	Yes	1					3	B	
113		Hwy 101				No	Drilled deep well		No		8	10	No	No		Don't Know	No	No	No	No	No	No	No		No	Yes	2					3	B	
114		Bradford Road				No	Community system	Myrtle Creek									Yes								No	Yes	2					1	B	
115		Broom Road				No	Dug well					70+	No	No		Don't Know	No	No	No	No	No	No	No		No	Yes	1					6	C	
116		Hwy 101				No	Drilled shallow well		No			35	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2					2	B	
117						No	Drilled deep well		No			30	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2							
118		Elias Road				No	Drilled deep well		No				No	Yes		Yes	Yes	No	No	No	No	No	No		Yes	Yes	2					6	C	
119		Patrick Road				Yes	Community system	Brew Bay					No	Yes		Yes	No	Yes	Yes	No	No	No	No		Yes	Yes	2					Brew Bay	C	
120						Yes	Community system	Pine Tree Imp. Dist	No					Yes		Yes	No	Yes	Yes	No	No	No	No		No	Yes	2							
121						No	Drilled deep well				55	20	Yes	Yes		Yes	No	No	No	No	No	No	No		No	Yes	5							
122						No	Community system	Stillwater					Yes	Yes		Yes	Yes	Yes							No	Yes	2							
123						No	Dug well					30+	No	Yes		Don't Know	No	No	No	No	No	No	No		Yes	Yes	2							
124		Stager Road				No	Dug well					15	No	Yes		Yes	No								No	Yes	2					4	B	
125		View Road				No	Drilled deep well		No			25+	No	Yes		Yes	Yes	No	No	No	No	No	No		Yes	Yes	2					6	C	
126		Springbrook Road				No	Dug well						No			Don't Know	No	No	No	No	No	No	No		Yes	Yes	3					3	B	
127		Tiller Road				No	Community system	Lang Bay					Yes	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2					Lang Bay	C	
128		Centennial Drive				Yes	Community system	Myrtle Pond	No				Yes	Yes		Yes	Yes								Yes	Yes	1					Myrtle Pond	B	
129		Hwy 101				Yes	Dug well				5	20	No	Yes		Yes	Yes	Yes	No	Yes	No	No	No		Yes	Yes	5					6	C	
130		Phillips Road				No	Community system	Lang Bay	No					Yes		Yes	No								No	Yes	2					Lang Bay	C	
131		Hwy 101				No	Dug well					50	Yes	Yes		No	Yes	Yes	Yes	Yes	No	No	No		Yes	No	2					3	B	
132		Myrtle Point Drive				No	Dug well						No	Yes		Yes		No	No	No	No	No	No		Yes	Yes	1					3	B	
133		Kristensen Road				No	Dug well				7	26	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2					4	C	
134						No	Community system	Lang Bay	No				Yes	Yes		No	Yes	No	No	No	No	No	No		No	Yes	2							
135		Myrtle Point Drive				No	Drilled shallow well		No				No	No		Don't Know	Yes	No	No	No	No	No	No		Yes	Yes	1					3	B	
136		Shuhum Road				No	Community system	Sechelt Band	No			17	Yes	No		Don't Know	No	No	No	No	No	No	No		Yes	Yes	1					Lang Bay	C	
137		Palm Beach Road				No	Community system							Yes		No	Yes	No	No	No	No	No	No		Yes	Yes	2					Lang Bay	C	
138		Bradford Road				No	Drilled deep well		No		10	13	No	Yes		Don't Know	Yes	No	No	No	No	No	No		No	No	2					1	B	
139		Random Road				No	Dug well						No	Yes		Don't Know	Don't Know	No	No	No	No	No	No		No	Yes	2					4	C	
140		Tiller Road				No	Dug well		No			30	No	No		Don't Know	Don't Know	No	No	No	No	No	No		No	Yes	2					Lang Bay	C	
141		Morton Road				Yes	Community system	Lang Bay					No				Yes	No	No	No	No	No	No		Yes	Yes	2					Lang Bay	C	
142		Edlund Road				No	Dug well					1	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	4					5	C	
143		Nassichuk Road				No	Dug well					30	Yes	Yes		Yes	No	No	No	No	No	No	No		Yes	Yes	3					5	C	
144						No	Community system	Brew Bay					Yes	Yes		Yes	No	Yes	Yes	No	No	No	No		No	Yes	2							
145		Scotch Fir Point Road				No	Community system	Stillwater					Yes	Yes		Yes	Yes	Yes							No	Yes	2					Stillwater	C	
146		Hwy 101				No	Dug well					28	No	Yes		Yes	No	Yes	Yes	No	No	No	No		No	Yes	2					2	B	
147		Ansle Road				No	Community system	Brew Bay					Yes	Yes		Yes	No	Yes	Yes	No	No	No	No		No	Yes	4							
148		Hwy 101				Yes	Dug well				0.66	59	Yes	Yes		Don't Know	No	No	No	No	No	No	No		Yes	No	2					2	B	
149		Daisy Road				No	Drilled deep well		No			25	No	Yes		Yes	Yes	No	No	Yes	No	No	No		Yes	Yes	4					1	B	
150		Daisy Road				No	Dug well					25	Yes	No		Don't Know	Yes	No	No	No	No	No	No		No	Yes	3					1	B	
151		Hwy 101				No	Community system	Lang Bay								No	Yes	No	No	No	No	No	No		Yes	Yes	2					Lang Bay	C	
152		Whalen Road				No	Drilled deep well		No	Yes	25	12	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes			Yes	Yes	2					4	B	
153		Wilcox Road				No							Yes	Yes		Don't Know	No	No	No	No	No	No	No		No	Yes	4					5	C	
154						No	Drilled deep well		No			30	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2							
155						No	Dug well						No	Yes		No	Yes	Yes	Yes	No	No	No	No		No	Yes	1							

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Well Information Survey

Southern Region Water Resource Study - Phase 1

Revision Date: September 26, 2005

#	House No.	Street Name	Name Last	Name First	Phone	1	2		3		4 GPM	5	6	7		8	9	10						11	12	13	Other				Map Area	Electoral Area	Comments
						Did you complete the Water Quality & Supply Survey in the June 9, 2005 issue of the Powell River Peak?	From what source do you obtain your domestic water (drinking and household use)?	Name of Community system:	If you have a drilled well, do you have a well log?	Willing to share records?	If you know, what is your wells pumping rate?	Do you know the approximate age of your well?	Does any other household(s) use your water source?	How your domestic water ever been tested for water quality?	Willing to share records?	Does your water meet Health standards?	Are there other water quality concerns?	Is your water treated?	Bacteria (Ex:ator fecal coliform or E.Coli)	Iron	Manganese	Arsenic	Odour	Other	Do you regularly purchase bottled water?	Does your water source and system provide you with enough water to meet all your needs?	How many people live in your household?	Well Log Given	Water Quality Results Given	Photograph Number	GPS Waypoint			
234		Springbrook Road				No	Community system	Sherwood Park			2.5		Yes	Yes		Don't Know	Yes							Yes	Yes	2					3	B	
235		Steger Road				No	Drilled deep well		No			8	No	Yes		Yes	No	No	No	No	No	No	No	No	Yes	2					4	B	
236						Yes	Drilled deep well		No		5	10	No	Yes		Don't Know	Yes	No	No	No	No	No	No	No	Yes	2							
237						No	Community system		No				Yes	Yes		Yes	No	Yes	Yes	No	No	No	No	No	Yes	1							
238		View Road				No	Drilled deep well		No		18		Yes	Yes		Yes	Yes	Yes	No	No	No	No	Yes	No	No	3					6	C	
239		Hwy 101				Yes	Drilled deep well		No			30	No	Yes		Yes	No	Yes	Yes	No	No	No	No	No	No	1					6	C	
240		Hwy 101				No	Dug well		No			30	No	Yes		Yes	No	No	No	No	No	No	No	No	Yes	1					2	B	
241		Kelly Creek Road				No	Dug well		No			15	No	No		Don't Know	No	No	No	No	No	No	No	No	Yes	3					5	C	
242		Gunther Road				No	Drilled deep well		No			12	Yes	Yes		Don't Know	Yes	No	No	No	No	No	No	No	Yes	4					1	B	
243		Arbour Drive				No	Community system	Stillwater					Yes	Yes		Yes	No	Yes						No	Yes	2					Stillwater	C	
244		Hwy 101				No	Drilled shallow well		No			50	No	Yes			No	No	No	No	No	No	No	No	No	1					2	B	
245						No	Dug well					24	No	Yes		Don't Know	No	No	No	No	No	No	No	No	No	6							
246		Waldwood Road				No	Dug well		No			22	No	No		Yes	No	No	No	No	No	No	No	No	Yes	2						C	
247		Southill Road				No	Dug well		No			1	No	Yes		Yes	No	No	No	No	No	No	No	No	Yes	2					1	B	A
248		Palm Beach Road				No	Community system	Palm Beach	No					Yes		No	Yes	No	No	No	No	No	No	No	Yes	No	2					Lang Bay	C	
249		Lee Road				No	Community system	Stillwater					Yes	Yes		Don't Know	No								Yes	Yes	2					Stillwater	C	
250		Traffe Road				No	Dug well					25	No	Yes		Don't Know	Yes								Yes	No	3					2	B	
251		Gails Road				No	Dug well		No				No	Yes		Don't Know	Yes	Yes							No	Yes	3					4	C	
252		Stittle Road				No	Dug well		No				No	Yes		No	Yes	Yes	Yes	No	No	No	No	Veg. Coliform	No	Yes	1					4	C	
253		Nasaichuk Road				No	Drilled deep well		Yes			30	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2					5	C	
254						No	Dug well					50	No	Yes		Yes	Yes	No	No	No	No	No	No			Yes	3							
255		Palm Beach Road				No	Community system	Lang Bay						Yes		No	Yes	No	No	No	No	No	No		Yes	No	2					Lang Bay	C	
256		Gaudet Road				No	Dug well					35	No	No		Don't Know	Don't Know	No	No	No	No	No	No		Yes	Yes	2					3	B	
257		McAulay Road				No	Drilled deep well		No			6	No	Yes		Don't Know	Yes								No	Yes	2					1	B	
258		Shushs Road				No	Community system	R23 Rand					Yes	Yes		Don't Know	Yes	No	No	No	No	No	No		Yes	No	3					Lang Bay	C	
259		Alta Vista Drive				Yes	Drilled deep well		No		40 to 60	23	Yes	Yes		Yes	Yes	No	No	No	No	No	No		No	Yes	1					3	B	
260		Centennial Drive				No	Community system	Centennial				30	Yes	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2					Stella Maris	B	
261						No	Community system						Yes	Yes		Yes	No								Yes	Yes	4							
262		Roberts Road				No	Dug well					15	No	Yes		Don't Know	No	No	No	No	No	No	No		No	Yes	1					8	C	
263		McKenzie Road				No	Dug well						No	Yes		No	Yes	No	No	No	No	No	No		Yes	No	1					6	C	
264		Dixon Road				No							Yes			Don't Know	Yes	No	No	No	No	No	No		No	Yes	1					Lang Bay	C	private water source- Dear
265						No	Community system	Lang Bay						Yes		No	Yes	No	No	No	No	No	No		Yes	Yes	2							
266						No	Drilled deep well		Yes			10	Yes	Yes		Yes	No	Yes							No	No	2							
267		Brew Bay Road					Community system	Brew Bay								Yes	No	Yes							No	Yes	2					Brew Bay	C	
268		Pine Tree Place					Community system	Pine Tree District								Don't Know	Don't Know								No	Yes	2					Pine Tree	C	
269						Yes	Community system	Pine Tree	No				No	No		Don't Know	No	No	No	No	No	No	No		No	Yes	2							
270		Ramsay Road				Yes	Dug well					26	No	Yes		No	Yes	No	No	No	No	No	No		Yes	Yes	2					6	C	
271		Centennial Drive				No	Community system	Myrtle Pond					Yes	No		Don't Know	Yes								No	Yes	4					Myrtle Pond	B	
272		Scotch Fir Point Road				No	Community system						Yes			Don't Know	Yes	Yes							No	Yes	2					Stillwater	C	
273		Stevarson Road												Yes		Yes	No	No	No	No	No	No	No		No	Yes	3					1	B	
274		Hwy 101				No	Dug well					30	Yes	Yes		Yes	No	No	No	No	No	No	No		No	Yes	4					2	B	
275		Hwy 101				No	Dug well					10	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2					3	B	
276		Myrtle Point Drive				No	Drilled deep well		No			30	Yes	Yes		Yes	No	No	No	No	No	No	No		Yes	Yes	3					3	B	
277		Dolmage Road				No	Dug well		No			40	No	Yes		No	No	No	No	No	No	No	No		Yes	Yes	1					Lang Bay	C	
278		Centennial Drive				No	Community system	Myrtle Pond					No	Yes		Don't Know	Yes								Yes	Yes	2					Myrtle Pond	B	
279		Centennial Drive				No	Community system	Centennial Drive					Yes			Yes	No								No	Yes	5					Stella Maris	B	
280		Myrtle Point Drive				Yes	Dug well					10	No	Yes		Yes	Yes	Yes	Yes	Yes	No	No	No		No	Yes	2					3	B	
281		View Road				Yes	Dug well						No	Yes		No	Yes	Yes	No	No	No	No	No		Yes	No	2					6	C	
282						No	Dug well					20+	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2							
283		Blank Point Road				No	Dug well					12+	No	Yes		Don't Know	No	No	No	No	No	No	No		No	No	3					6	C	
284		Arbour Drive				No	Community system	Stillwater						Yes		Yes	Yes	Yes	Yes	No	No	No	No		No	Yes	2					Stillwater	C	
285		Swarte Bell Road				No	Dug well					30	No	Yes		Don't Know	No	No	No	No	No	No	No		No	No	2					5	C	
286		Tiller Road				Yes	Community system	Lang Bay					No	Yes		No	No	No	No	No	No	No	No		Yes	Yes	3					Lang Bay	C	
287		Oxford Road				No	Dug well					11	No	Yes		Yes	Yes	Yes	Yes	No	No	No	No		Yes	No	2					5	C	
288		Phillips Road				No	Community system	Lang Bay	No					No		Don't Know		No	No	No	No	No	No		Yes	Yes	2					Lang Bay	C	
289		Phillips Road				No	Dug well					18	Yes	No		Don't Know	No	No	No	Yes	No	No	No		No	Yes	6					7	C	
290		Hwy 101				No	Drilled deep well		Yes		10	25	No	No		Don't Know	No	No	No	No	No	No	No		No	Yes	2					4	C	
291		Springbrook Road				No	Drilled deep well		No				Yes	Yes			Yes	Yes	Yes	No	No	No	No		No	Yes	2					3	B	
292		Hwy 101 #1				No	Community system	Myrtle Pond					Yes	Yes		Don't Know	Yes	Yes	Yes	No	No	No	No		No	Yes	1					2	B	
293		View Road				No	Drilled deep well		No			40	No	No		Don't Know	No	No	No	No	No	No	No		Yes	Yes	1					9	C	
294		Centennial Drive				No	Community system	Centennial Drive	Yes				Yes	Yes		Yes	No	No	No	No	No	No	No		No	Yes	4					Stella Maris	B	
295		Morton Road				Yes	Community system	Lang Bay					Yes			Don't Know	Yes	No	No	No	No	No	No		Yes	Yes	2					Lang Bay	C	
296		Patrick Road				No	Community system	Brew Bay					Yes			Don't Know	No								No	Yes	3					Brew Bay	C	
297		Ramsay Road				Yes	Drilled deep well							Yes		Don't Know	Don't Know	No	No	No	No	No	No		Yes	No	1					5	C	
298		Fern Road				No	Drilled deep well		No			2	7	Yes		Yes	No	No	No	No	No	No	No		No	Yes	7					3	B	
299		Scotch Fir Point Road				Yes	Community system	Stillwater				28	No	No		Yes	No	No	No	No	No	No	No		No	Yes	2					Stillwater	C	
300		Douglas Bay Road				No	Drilled deep well						No	Yes		Yes	No	Yes	Yes	No	No	No	No		No	Yes	2					8	C	
301						No	Community system					45	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2							
302							Dug well							Yes		Don't Know	Yes								Yes	Yes	4							
303		Hwy 101				No	Community system	Myrtle Pond	No			5	No	Yes		Yes	No								Yes	No	1							See 2779 Tanglewood Rd
304						No	Drilled deep well		No					Yes		No	Yes								Yes	Yes	1					Myrtle Pond	B	
305		Roberts Road				No	Community system	Stillwater			20	21	No	Yes		Don't Know	Yes								No	Yes	1					8	C	
306		Douglas Bay Road				No	Dug well						No	Yes		Yes	No	Yes	Yes	Yes	No	No	No		No	Yes	2					8	C	
307		Stillwater School Road				No	Community system	Stillwater			15	14	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2					Stillwater	C	
308		Lee Road				No	Community system	Stillwater					No	Yes		Don't Know	Yes	Yes	Yes	No	No	No	No		Yes	Yes	5					Stillwater	C	
309						No	Community system	Lang Bay					Yes	No		No	Yes	No	No	No	No	No	No		Yes	No	2							
310		Waldwood Road				No	Dug well					35	No	No		Don't Know	No	No	No	No	No	No	No		No	Yes	4					6	C	
311		Hwy 101				No	Drilled shallow well		No				No	Yes		Yes	Yes	No	No	No	No	No	No		Yes	Yes	2							

Well Information Survey

Southern Region Water Resource Study - Phase 1

Revision Date: September 26, 2005

#	House No.	Street Name	Name: Last	Name: First	Phone	1. Did you complete the Water Quality & Supply Survey in the June 9, 2005 issue of the Powell River Peak?	2. From what source do you obtain your domestic water (drinking and household use)?	Name of Community system	3. If you have a drilled well, do you have a well log?	Willing to share records?	4. If you know, what is your wells pumping rate? (GPM)	5. Do you know the approximate age of your well?	6. Does any other household(s) use your water source?	7. Has your domestic water ever been tested for water quality?	Willing to share records?	8. Does your water meet Health standaRoads?	9. Are there other water quality concerns?	10. Is your water treated?	10. Bacteria (total or fecal coliform or E.Coli)	10. Iron	10. Manganese	10. Arsenic	10. Odour	10. Other	11. Do you regularly purchase bottled water?	12. Does your water source and system provide you with enough water to meet all your needs?	13. How many people live in your household?	Other: Well Log Given	Other: Water Quality Results Given	Other: Photograph Number	Other: GPS Waypoint	Map Area	Electoral Area	Comments
312		Black Point Road				No	Drilled deep well		No		5	3	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2					6	C	
313						Yes	Drilled deep well		No	No	10	20	No	Yes	No	Yes	No	No	No	No	No	No	No		No	Yes								
314		Kelly Creek Road				No	Dug well		No			25	Yes	Yes		Yes	Yes	No	No	No	No	No	No		Yes	No	2					5	C	
315		Whalen Road				No	Drilled deep well		No			12	No	No		Yes	No	No	No	No	No	No	No		No	Yes	2					4	C	
316		Evergreen Road				No	Community system	Pine Tree					No	Yes		No	Yes	Yes	Yes	No	No	No	No		No	No	1					Pine Tree	C	
317						No	Community system	Kant Creek					Yes	Yes		Don't Know	No	Yes	Yes	No	No	No	No		No	Yes	2							
318		Jenkinson Road				No	Community system	Saltry Bay	No				No	Yes		Don't Know	Yes	No	No	No	No	No	No		No	Yes	2					8	C	
319						No	Drilled deep well		No		10	18	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2							
320		Phillips Road				No	Community system	Lang Bay	Yes		1	12	No	Yes		No	No	No	No	No	No	No	No		Yes	No	4					Lang Bay	C	
321						No	Drilled deep well			Yes	11	5	No	Yes		Don't Know	Yes	No	No	No	No	No	No		Yes	Yes	3							
322		Hwy 101				Yes	Community system	Lang Bay						Yes		No	Don't Know	No	No	No	No	No	No		Yes	Yes	2					Lang Bay	C	
323						No	Dug well						No	Yes		Yes	No	No	No	No	No	No	No		Yes	Yes	2							
324		Pine Tree Place				No	Community system	Pine Tree						Yes		Don't Know	Yes								No	No	4					Pine Tree	C	
325		Tanglewood Road				No	Drilled deep well		Yes	Yes		25	No	Yes	Yes	Don't Know	Yes	No	No	No	No	No	No		Yes	Yes	2					3	B	
326		Douglas Bay Road				No	Drilled deep well		No		8	18	No	Yes		No	Yes	No	No	No	No	No	No		Yes	No	2					6	C	
327		Wilcox Road				No	Drilled deep well		No			20+	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	4					5	C	
328		Zilinsky Road				No	Dug well				5	50	Yes	Yes		Yes	No	No	No	No	No	No	No		No	No	5					5	C	
329		Kelly Creek Road				No	Dug well				5	50	Yes	Yes		Yes	No	No	No	No	No	No	No		No	No	5					5	C	
330		Padgett Road				No	Dug well		No				No	Yes		Don't Know	No	Yes							No	Yes	1					1	B	
331		Pine Tree Place				No	Community system	Woodlynn Imp. Dist						Yes		Yes	No	No	No	No	No	No	No		No	Yes	2					Woodlynn	C	
332		Streek Road				No	Dug well					12	No	Yes		Yes	Yes	No	No	No	No	No	No		No	No	2							
333						No	Community system	Stillwater						Yes		Yes	No	Yes	Yes	No	No	No	No		Yes	Yes	3							
334		Runnells Road				No	Community system	Stillwater					No	Yes		Yes	No	Yes	Yes	No	No	No	No		No	Yes	3					Stillwater	C	
335		Hwy 101				Yes	Community system	Lang Bay					Yes	Yes		No	Yes	No	No	No	No	No	No		Yes	No	1					Lang Bay	C	
336		Hwy 101				No	Community system	Lang Bay						Yes		Yes	Don't Know									Yes	2					Lang Bay	C	
337		Oxford Road				Yes	Dug well					1	No												Yes	Yes	2					5	C	
338						No	Community system	Myrtle Creek					Yes	Yes		Yes	Yes								Yes	Yes	2							
339		Stittle Road				No	Drilled deep well				16	11	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	Yes	Lead	No	Yes	2					4	C	
340		Spencer Road				No	Drilled shallow well		No			24	No	No		Don't Know	Don't Know	No	No	No	No	No	No		No	No	2						C	
341		View Road				No	Drilled deep well		Yes	Yes	3	5	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes		Yes	Yes	3					6	C	
342		Patricia Road				No	Dug well					15	No	Yes		Don't Know	No	No	No	No	No	No	No		No	Yes	2					3	B	
343						No	Drilled deep well		No		10	10	No	Yes		No	No								No	Yes	2							
344		Lang Bay Road				No	Community system		No				Yes	No		No	Yes	No	No	No	No	No	No		Yes	Yes	5					Lang Bay	C	
345		View Road				No	Dug well		No			28	No	Yes		Yes	No	Yes	No	Yes	No	No	No		No	Yes	2					8	C	
346						No	Dug well					30	No	Yes		Yes	No	No	No	No	No	No	No		Yes	Yes	2							
347						No	Dug well					20	No	No		Don't Know	No	No	No	No	No	No	No		No	Yes	2							
348		Valley Road				No	Dug well					40	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2					1	B	
349		Black Point Road				Yes	Drilled deep well		No			30	No	Yes		Yes	Yes	No	No	No	No	No	No		No	Yes	6					6	C	
350		Hwy 101				No	Drilled deep well		No		1	35	No	Yes		Yes	Yes	No	No	No	No	No	No		No	Yes	2					4	C	Lot 2, Plan 9242, DL5238
351		Black Point Road				Yes	Drilled deep well		Yes	Yes	6	20	No	Yes		No	Yes	No	No	No	No	No	No		Yes	No	2					6	C	
352		View Road				No	Drilled deep well		No		4	50	No	Yes				No	No	No	No	No	No		No	Yes	5					6	C	
353		Powers Road				No	Drilled deep well		No			5	No	Yes		Yes	No	Yes							No	Yes	2					4	C	
354						No	Drilled deep well		No			18	No	Yes		Yes	No	No	No	No	No	No	No		Yes	Yes	3							
355		Berger Road				No	Drilled deep well						No	Yes		Yes	No	No	No	No	No	No	No		Yes	Yes	2					7	C	
356		Gela Road				No	Dug well						No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2					4	C	
357		Black Point Road				No	Drilled deep well		No			20	No	Yes		Yes	No	Yes	Yes	No	No	No	No		No	Yes	4					6	C	
358		Random Road				No	Community system	Pine Tree																		No	2					Pine Tree	C	
359		Williams Road				No	Drilled shallow well		No				No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	3					4	C	
360		Trapp Road				No	Dug well					30	Yes	Yes		Yes	No	Yes	Yes	Yes	Yes	Yes	Yes		No	Yes	2							
361		Zilinsky Road				No	Drilled deep well		No			20	No	Yes		No	No	No	No	No	No	No	No		No	Yes	3					5	C	Also has dug well that mee
362		Myrtle Point Drive				No	Drilled deep well		No					Yes			Yes	No	No	No	No	No	No		No	Yes	1					3	B	
363		Regal Place				No	Dug well		No			10	No	Yes		Yes	Yes	Yes	No	No	No	No	Yes		Yes	Yes	2					1	B	
364		View Road				No	Drilled deep well		No		3	8	No	Yes		Yes	Yes	No	No	No	No	No	No		No	Yes	3					6	C	
365		View Road				No	Drilled deep well		No				No	Yes		Yes	Yes	Yes	No	Yes	No	No	Yes		Yes	Yes	2					6	C	
366		Douglas Bay Road				No	Dug well		No			15	No	Yes		No	No	No	No	No	No	No	No		Yes	No	2					6	C	
367		Kelly Creek Road				No	Dug well				8	10	No	Yes		Yes	No	Yes	Yes	Yes	No	No	No		No	Yes	6					5	C	
368		Zilinsky Road				Yes	Drilled deep well		No			35	No	No		Don't Know		No	No	No	No	No	No		Yes	No	2					5	C	
369		Kelly Creek Road				No	Drilled shallow well		No			25	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2					5	C	
370		Gela Road				No	Drilled deep well		No				No	Yes		Don't Know	Yes	No	No	No	No	No	No		Yes	Yes	2					4	C	
371		Roberts Road				No	Community system	Stillwater					Yes	Yes		Yes	Yes	Yes							No	Yes	2					8	C	
372		View Road				No	Drilled deep well		No			25	No	Yes		Yes	Yes	No	No	No	No	No	No		No	Yes	4					6	C	
373		Hwy 101				No	Drilled deep well		No			25	Yes	Yes		Yes	No	No	No	No	No	No	No		Yes	Yes	5					3	B	
374		Zilinsky Road				No	Dug well						No	Yes		Yes	No	No	No	No	No	No	No		Yes	Yes	2					5	C	
375		Gela Road				No	Dug well		No			20	No	Yes		Don't Know	Yes	Yes	No	Yes	Yes	No	No		Yes	Yes	3					4	C	
376		Alta Vista Drive				No	Drilled deep well		No			20	Yes	Yes		Yes	Yes	No	No	No	No	No	No		No	Yes	5					3	B	
377		Dickson Road				No	Dug well		No			25	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2							
378		Stager Road				No	Dug well		No			48	No	No		Don't Know	No	No	No	No	No	No	No		No	Yes	1					4	B	
379		Centennial Drive				No	Community system	Centennial Drive						Yes		Yes	No	No	No	No	No	No	No		Yes	Yes	2					Stella Maris	B	
380		Donkersley Road				Yes	Dug well					35	No	Yes		Don't Know	No	No	No	No	No	No	No		Yes	No	2					6	C	
381						Yes	Dug well		Yes	Yes		30+	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2							See #387
382		Hwy 101 #4					Drilled deep well		No				Yes	Yes				Yes							Yes	Yes	2					4	C	
383		Dixon Road				No	Community system		No					Yes		Yes	No								Yes	Yes	4					Lang Bay	C	
384		Palmer Road				No	Dug well				5	30	No	No		Yes	No	No	No	No	No	No	No		No	Yes	2					4	C	
385		Palmer Road				No	Drilled deep well		No		2.5	40	No	Yes		Yes	Don't Know	No							No	Yes						4	C	
386						No	Community system	Brew Bay					Yes	Yes		Yes	No	Yes	Yes	No	No	No	No		No	Yes	3							
387		Padgett Road				Yes	Dug well		Yes	Yes		30+	No	Yes	Yes	Yes	No	No	No	No	No	No	No		No	Yes	2					1	B	
388		Dixon Road				No	Community system		No					Yes		Yes	No								Yes	Yes	4					Lang Bay	C	
389		Hwy 101				No	Dug well					30	No	No			No	No	No	No	No	No	No		No	Yes	1					6	C	

Well Information Survey

Southern Region Water Resource Study - Phase 1

Revision Date: September 26 2005

#	House No.	Street Name	Name Last	Name First	Phone	1	2		3		4	5	6	7	8	9	10							11	12	13	Other				Map Area	Electoral Area	Comments
						Did you complete the Water Quality & Quantity Survey in the June or 2005 issue of the Powell River Peak?	From what source do you obtain your domestic water (drinking and household use)?	Name of Community system	If you have a drilled well, do you have a well log?	Willing to share records?	If you know what is your wells pumping rate? GPM	Do you know the approximate age of your well?	Does any other household use your water source?	Has your domestic water ever been tested for water quality?	Willing to share records?	Does your water meet Health standards/Goals?	Are there other water quality concerns?	Is your water treated?	Bacteria (total or fecal coliform or E.Coli)	Iron	Manganese	Arsenic	Odour	Other	Do you regularly purchase bottled water?	Does your water source and system provide you with enough water to meet all your needs?	How many people live in your household?	Well Log Given	Water Quality Results Given	Photograph Number	GPS Waypoint			
390		Sallery Road				No	Community system	Sallery Bay					Yes	Yes	No	No	No	No	No	No	No	No		Yes	Yes	2					8	C	
391						No	Dug well				20		No	Yes	Yes	No	No	No	No	No	No	No		No	Yes	4						C	
392		Padgett Road				No	Drilled deep well		Yes	Yes	4	25	No	Yes	Yes	Don't Know	Yes	No	No	No	No	No	No	No	No	2					1	B	
393		Black Point Road				No	Drilled deep well		No				No	Yes		Yes	No	No	No	No	No	No	No	No	Yes	3					6	C	
394		Phillips Road				No	Drilled shallow well	"	No				No	Yes		Yes	No	No	No	No	No	No	No	Yes	Yes	2					7	C	
395		Padgett Road					Drilled deep well									Yes															1	B	
396		Padgett Road					Dug well																		Yes						1	B	
397		Nootka Street					Dug well				20	13	No	Yes		Yes	No	No	No	No	No	No	No	No	Yes	3					1	B	
398		Padgett Road					Drilled deep well					10	No	No		Yes	Yes	Yes	No	Yes	No	No	No	No	Yes	3					1	B	
399		Padgett Road					Drilled deep well		No		3	30	No	Yes		Yes	Yes	No	No	No	No	No	No	No	No	7					1	B	
400		Padgett Road					Drilled deep well		No		10	13	No	Yes		Yes	No	No	No	No	No	No	No	No	Yes	4					1	B	
401		Padgett Road				No	Dug well					13	No	Yes		No	Yes	No	No	No	No	No	No	Yes	No	5					1	B	
402		Padgett Road					Drilled deep well					15	No	Yes		Yes	No	No	No	No	No	No	No	No	Yes	2					1	B	
403		Padgett Road					Drilled deep well		No			30+	No			Yes	No							No	Yes	2					1	B	
404		Hwy 101					Community system	Oceanside RV						Yes		Yes	No								No						2	B	
405		Pebble Beach Road				No	Drilled deep well		No		0.5	40	No	Yes		Yes	No	No	No	No	No	No	No	No	Yes	2					2	B	
406		Pebble Beach Road				No	Drilled deep well		No			25	No	Yes		Don't Know	No	No	No	No	No	No	No	No	Yes	2					2	B	
407		Traffe Road					Dug well																								2	B	
408		Pebble Beach Road					Dug well					35	No	Yes		Yes	No	No	No	No	No	No	No	No	Yes	2					2	B	
409		Traffe Road					Dug well					40	Yes	No		Don't Know	Don't Know	No	No	No	No	No	No	No	No						2	B	
410		Traffe Road				No	Drilled deep well				2	7+	Yes	Yes		Yes	No	Yes	No	No	Yes	No	No	No	Yes	3					2	B	also 7883 Traffe Road(doc
411		Traffe Road				No	Drilled shallow well		No			15	No	No		Yes	Yes	Yes	No	Yes	No	No	No	Yes	Yes	2					2	B	
412		Traffe Road																													2	B	
413		Hwy 101					Dug well						No	No		Yes	No	No	No	No	No	No	No	Yes	Yes	5					2	B	7496, 7507, 7533
414		Hwy 101				No	Dug well					10	No	Yes		Yes	No	No	No	No	No	Ng	No	Yes	Yes	4					2	B	
415		Traffe Road																													2	B	
416		Traffe Road																													2	B	
417		Traffe Road					Dug well									Don't Know	No	No	No	No	No	No	No	No	Yes						2	B	
418		Traffe Road					Drilled deep well																								2	B	
419		Patricia Road				No	Dug well		No			15+	No	Yes		Yes	No	No	No	No	No	No	No	Yes	Yes	3					3	B	
420		Myrtle Point Drive					Drilled deep well																								3	B	
421		Myrtle Point Drive					Drilled deep well																								3	B	
422		Myrtle Point Drive					Drilled deep well																								3	B	
423		Myrtle Point Drive					Dug well																								3	B	
424		Myrtle Point Drive					Drilled deep well						No			Don't Know	No	No	No	No	No	No	No		Yes	4					3	B	
425		Myrtle Point Drive					Drilled deep well																								3	B	
426		Myrtle Point Drive					Drilled deep well																								3	B	
427		McCausland Road					Community system	Padgett CWS																							3	B	
428		Hwy 101					Community system	Garnet Rock MHP																							3	B	Well shared with 2812 Mc
429		McCausland Road					Community system	Myrtle Golf Course																							3	B	
430		Hwy 101					Community system	Sherwood Park MHP																							3	B	Dug well:Info provides by C
431		Hwy 101					Community system	Anchor Way Strata					Yes	Yes		No		No							Yes					3	B	
432		Armour Road																													3	B	
433		Armour Road					Dug well									Yes	No								Yes						3	B	
434		Patricia Road																													3	B	
435		Hwy 101					Drilled shallow well																								6	C	
436		Black Point Road					Dug well																								6	C	
437		Douglas Bay Road																													6	C	
438		Elias Road				No	Drilled deep well				6	7	No	No		Don't Know	Yes	No	No	No	No	No	No	No	Yes	2					6	C	
439		Elias Road																													6	C	
440		View Road					Drilled deep well							Yes																	6	C	
441		Ramsay Road					Drilled deep well						No	Yes		Yes	No	Yes							No	Yes	5					6	C	
442		View Road																													6	C	
443		View Road				No	Dug well					22	No	Yes		Don't Know	No	No	No	No	No	No	No	No	Yes	Yes	2					6	C	
444		View Road																													6	C	
445		View Road																													6	C	
446		Hwy 101					Drilled deep well	Nadin CWS					Yes	Yes		Yes		No								Yes					6	C	Drilled well shared with 995
447		Black Point Road																													6	C	
448		Stark Road					Dug well					47	No	Yes		Yes	No	No	No	No	No	No	No	No	Yes	Yes	2+					4	B	
449		Stark Road					Dug well									Yes	No	No	No	No	No	No	No		Yes						4	B	
450		Stager Road																													4	B	
451		Whalen Road					Dug well									Yes	No								Yes						4	B	
452		Whalen Road					Drilled deep well							No		Don't Know	No								Yes						4	C	
453		Stager Road					Drilled deep well									Yes	No								Yes						4	C	
454		Stager Road					Dug well									Yes	No								No	2					4	C	
455		Stager Road				No	Dug well									Yes	No	No	No	No	No	No	No		No	2					4	C	Well shared with 9089 Sta
456		Fleury Road					Community system	Ishine Coast Health Centre					Yes	Yes		Yes		Yes						various	Yes						4	C	Drill well: info from CGH
457		Williams Road					Community system	Sunshine Coast MHP																							4	C	
458		Hwy 101						Skeeter Jacks																							4	C	Well shared with 0493 Hwy
459		Hwy 101					Community system	Lord CWS			12		Yes	Yes		Yes		Yes	Yes							Yes					4	C	Dug well: UV: info from CG
460		Palmer Road						Maryk Rentals WS					Yes	Yes		Yes		Yes	Yes							No					4	C	Dug well: UV: info from CG
461		Yahoshuk Road				No	Drilled deep well		No			10	No	No		Don't Know	Yes	No	No	No	No	No	No		No	Yes	2					1	B	
462		Padgett Road					Community system	Valley Marina																							1	B	
463		Padgett Road					Community system	Valley Feed CWS																							1	B	
464		Padgett Road					Community system	Paradise Valley MHP					Yes	Yes		Yes		No								Yes					1	B	Deep well: info from CGH
465								Open Air Market																									D.L. 5115
466		McLeod Road					Community system	Nassichuk MHP					Yes	Yes		Yes		No								Yes					1	B	Drilled well: info from CGH
467		Padgett Road					Community system	Reformed Church WS																							1	B	

Well Information Survey

Southern Region Water Resource Study - Phase 1

Revision Date: September 26, 2005

#	House No.	Street Name	Name Last	Name First	Phone	1	2		3		4 GPM	5	6	7		8	9	10							11	12	13	Other			Map Area	Electoral Area	Comments
456		Padgett Road						Barta CWS					Yes	Yes		Yes		No								Yes				1	C	Dug well also serves 4298
469		D.L. 3695					Community system	Powell Heights MHP																								
470		Nootka Street					Community system	Retirement MHP																						1	B	
471		Nootka Street					Community system	Nootka Dunes Golf Course			40		Yes	Yes		Yes		No								Yes	rse + 4 homes			1	B	drilled well; info from CGH
472		Masters Road					Community system	DeVito CWS					Yes	Yes		No		No								Yes	me, 4 bigs			1	B	Info provided by CGH
473		Hwy 101					Community system	Pebble Beach Apts WS					Yes	Yes		Yes		Yes								Yes	s + 1 house			2	B	Dug well; UV; info from CG
474		Hwy 101					Community system	Pebble Beach Daycare																						2	B	Shared w 7611 Hwy 101
475		Zillinsky Road						Kelly Creek Elem Schl					Yes	Yes		No		No								Yes	na			5	C	High arsenic; School
476		Alta Vista Drive				No	Drilled deep well		No			17	Yes	Yes		Yes	No	No	No	No	No	No			No	Yes	2			3	B	
477		Armour Road				No	Dug well					20	No	No		Don't Know	Yes	No	No	No	No	No			Yes	Yes	5			3	B	
478		Douglas Bay Road				Yes	Dug well						No				No	No	No	No	No	No			No	Yes	3			6	C	
479		Dolmage Road					Community system	Lang Bay					Yes			No	Yes	Yes	Yes	No	No	No			Yes	Yes	5			Lang Bay	C	
480		Scotch Fir Point Road				No	Community system	Stillwater					Yes	Yes		Yes	Yes								Yes	Yes	3			Stillwater	C	
481						No	Drilled shallow well						No	Yes		Yes	No	No	No	No	No	No			No	No	2					
482		View Road				No	Dug well		No			35	No	Yes		Yes	No	No	No	No	No	No			No	Yes	2			6	C	
483		Morton Road				No	Community system	Lang Bay					Yes			Yes	No	No	No	No	No	No			No	Yes	2			Lang Bay	C	
484		Hwy 101				No	Dug well						Yes	No		No	Yes	No	No	No	No	No			Yes	Yes	1			3	B	
485		View Road				Yes	Drilled deep well		No	Yes			No	Yes	Yes	Yes	Yes	No	No	No	No	No			No	Yes	1			6	C	
486		Padgett Road				No	Dug well					17	No	No		Don't Know	No	No	No	No	No	No			No	Yes	2			1	B	
487		Hellingsworth Road				No	Community system	Stillwater					No	No		Don't Know	No	Yes							Yes	Yes	2			Stillwater	C	
488						No	Dug well		No			19	Yes	Yes		Yes	No	No	No	No	No	No			Yes	No	4					
489							Community system	Saltery Bay	No				No	Yes		No	Don't Know	No	No	No	No	No			Yes	Yes	4					
490		Tanglewood Road				No	Dug well					15	No	Yes		Yes	No	No	No	No	No	No			Yes	Yes	3			3	B	
491						No	Dug well					20	No	Yes		Yes	No	No	No	No	No	No			No	Yes	4					
492		Claridge Road				No	Drilled deep well		Yes	No	35	10	Yes	Yes	No	Yes	No	No	No	No	No	No			No	Yes	4			1	B	
493		Claridge Road #68				No							Yes												No		1			1	B	
494		Claridge Road #30				No							Yes				No								No	Yes	1			1	B	
495		Traff Road				No	Drilled deep well					20	No	Yes		Yes	No	No	No	No	No	No			No	Yes	3			2	B	
496		Wilcox Road				No	Dug well					25	No	Yes		Yes	No	No	No	No	No	No			No	Yes	2			5	C	
497		Roberts Road				No	Community system	Stillwater					No	Yes		Yes	No	Yes	Yes	No	No	No			No	Yes	3			8	C	
498		Claridge Road #28				No	Dug well									Don't Know									No	Yes	1			1	B	
499		Morton Road				No	Community system	Lang Bay	Yes	Yes	7	6	No	Yes		No	Yes	No	No	No	No	Yes	No		Yes	Yes	2			Lang Bay	C	
500		Black Point Road				No	Drilled shallow well		No			27	No	Yes		Don't Know	Don't Know	No	No	No	No	No			Yes	Yes	2			6	C	
501		Hwy 101				No	Drilled deep well		No		1.25	8	No	No		Don't Know	No	No	No	No	No	No			No	No	5			3	B	
502		Zillinsky Road				Yes	Community system	Brew Bay					Yes	Yes		Yes	No	Yes							No	Yes	1			5	C	
503		Cove Road				No	Community system	Brew Bay						Yes		Yes	Yes								Yes	Yes	5			Brew Bay	C	
504		Phillips Road				No	Community system	Lang Bay						Yes			Yes	No	No	No	No	No	No		No	Yes	4			Lang Bay	C	
505		Butler Road				No	Community system	Myrtle Pond					Yes	Yes		Yes	Yes								Yes	Yes	3			Myrtle Pond	B	
506		Zillinsky Road				No	Drilled deep well						No	Yes		No	No	Yes	Yes	No	No	Yes	No		Yes	No	4			5	C	
507		Tuck Rd				No	Dug well		No	Yes			No	Yes	Yes	Don't Know	No	No	No	No	No	No	No		No	Yes	1			Lang Bay	C	
508		Zillinsky Road					Drilled deep well																							5	C	
509		Zillinsky Road (B)				No	Dug well						No	No		Don't Know	No	No	No	No	No	No	No		No	Yes	1			5	C	
510		Zillinsky Road (A)				No	Dug well									Don't Know	Don't Know								Yes	Yes	3			5	C	
511		Phillips Road				No	Dug well						No	Yes		No	No	Yes	Yes	Yes	No	No	No		No	Yes	1			7	C	
512		Zillinsky Road					Dug well						Yes																	5		Uses well from 2497 Zillins
513		Kelly Creek Rd				No	Dug well					50+		Yes		Yes	No	No	No	No,	No	No	No		No	Yes				5	C	
514		Kelly Creek Rd.				No	Dug well					50+	No	No		Don't Know	No	No	No	No	No	No	No		No	Yes	2			5	C	
515		Kelly Creek Rd.				No	Dug well					15		No		Don't Know	No	No	No	No	No	No	No		No	Yes				5	C	
516		Phillips Road					Community system	Lang Bay						Yes		Don't Know	Yes								Yes					Lang Bay	C	
517		Serendipity Road					Dug well					33		Yes		Yes	No	No	No	No	No	No	No			Yes	2+			5	C	
518		Hwy 101					Dug well						No	Yes		Yes	Yes	Yes	Yes	No	No	No	No		No	Yes	1			2	B	
519		Hwy 101					Dug well					50+	No	Yes		No	No								Yes		2			3	B	
520		Hwy 101					Drilled deep well				2.5		No	Yes		No	Yes	No	No	No	No	No	No		Yes	Yes	2			3	B	
521		Hwy 101																												3	B	
522		Hwy 101																												3	B	
523		Hwy 101				Yes	Community system	Pebble Beach					Yes	Yes		Don't Know		No	No	Yes	No	No	No		No	No	2			2	B	
524		Woodlynn Road				No	Community system	Woodlynn	No		17	18	Yes	Yes		Yes	No								No	Yes	2			Woodlynn	C	
525		Douglas Bay Road				No	Dug well				5	8	No	Yes		Yes	Yes	Yes	Yes	Yes	Yes	No	Yes		No	Yes	3			6	C	
526		Williams Road				No	Drilled deep well		No				No	Yes		No	Yes	Yes	No	Yes	No	No			Yes	Yes	5			4	C	
527		Claridge Road #36				No	Community system	Paradise Valley MHP					Yes	Yes		Yes	No	No	No	No	No	No	No		Yes	Yes	3			1	B	
528		Myrtle Point Drive				No		Municipal	Yes	Yes		20	No	Yes	Yes	No	Yes	No	No	No	No	No	No		Yes		6			3	B	
529		Serendipity Road				No	Dug well					20	No	Yes		No	Yes	No	No	No	No	No	No		No	Yes	2			5	C	
530						No	Drilled deep well		No			6	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	5					
531		Claridge Road #22				No	Community system	Top Duncan St. Area					No	No		Yes	No	No	No	No	No	No	No		No	Yes	1			1	B	
532		Centennial Drive				No	Drilled deep well		No				Yes	Yes		Yes	No	No	No	No	No	No	No		Yes	Yes	2			3	B	
533		Gela Road				No	Drilled deep well		Yes		7	14	No	Yes		Yes	Yes	No	No	Yes	No	Yes	Yes		No	Yes	2			4	C	
534		Claridge Road #48				No	Drilled deep well		No			12	Yes	Yes		Don't Know	Yes	No	No	No	No	No	No		Yes	No	4			1	B	
535		Hwy 101				Yes	Drilled deep well		No		15	30	Yes	Yes		Yes	Yes	Yes	No	Yes	No	No	No		No	Yes	2			2	B	
536		Williams Road				No	Dug well				1	20	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2			4	C	
537						No	Dug well		No	Yes			No		Yes		No	No	No	No	No	No	No		No	Yes	1 to 4					
538		Pine Tree Road				No	Dug well		No				No	No		Don't Know	No	No	No	No	No	No	No		No	No	2			4	C	
539		Palmer Road				No	Dug well		No				Yes	Yes		Yes	No	Yes							Yes	Yes	2			4	C	
540		View Road				No	Dug well					25	No	No		Don't Know	Yes	No	No	Yes	No	No	Yes		Yes	Yes	2			6	C	
541		Scotch Fir Point Road				No	Community system	Stillwater								Yes		Yes							Yes	Yes	1			Stillwater	C	
542		Donkersley Road				No	Drilled shallow well		No				No	No		Don't Know	No	No	No	No	No	No	No		No	No	2			6	C	
543		Lasside Road				No	Drilled deep well	Stillwater					Yes	Yes		Yes	Yes	Yes	Yes	No	No	No	No		No	Yes	2			8	C	
544		Edlund Road				No	Dug well		No			12	No	Yes		Yes	No	No	No	No	No	No	No		No		2			5	C	
545						No	Dug well						No	Yes		Don't Know	No	No	No	No	No	No	No		Yes	Yes	2					

Well Information Survey

Southern Region Water Resource Study - Phase 1

Revision Date: September 26, 2005

#	House No.	Street Name	Name Last	Name First	Phone	1	2		3		4 GPM	5	6	7		8	9	10							11	12	13	Other				Map Area	Electoral Area	Comments
						Did you complete the Water Quality & Supply Survey in the June 9 2005 issue of the Powell River Peak?	From what source do you obtain your domestic water (drinking and household use)?	Name of Community system	If you have a drilled well, do you have a well log?	Willing to share records?	If you know, what is your wells pumping rate /	Do you know the approximate age of your well?	Does any other household(s) use your water source?	Has your domestic water ever been tested for water quality?	Willing to share records?	Does your water meet Health standards?	Are there other water quality concerns?	Is your water (water)?	Bacteria (total or fecal coliform or E.Coli)	Iron	Manganese	Arsenic	Odour	Other	Do you regularly purchase bottled water?	Does your water source and system provide you with enough water to meet all your needs?	How many people live in your household?	Well Log Given	Water Quality Results Given	Phosphorish Number	GPS Waypoint			
546						No	Drilled deep well		No			20	No	Yes		Yes	Yes	No	No	No	No	No	No		No	Yes	1							
547		Ramsay Road				No	Dug well					35	Yes	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2				6	C	
548		Hwy 101				No	Dug well					36	No	No		No	Yes	No	No	No	No	No	No		Yes	No	1				3	B	
549		Morton Road				Yes	Community system	Lang Bay																	Yes	Yes	2				Lang Bay	C	
550		Random Road				No	Community system	Pine Tree					Yes	Yes		Yes	No	Yes	Yes	No	No	No	No		No	Yes	2				4	C	
551		Dolmage Road				No	Dug well		No	Yes	8		No	Yes	Yes	Yes	No	No	No	No	No	No	No		No	Yes	2				Lang Bay	C	
552						No	Dug well						No	Yes		Don't Know	No	No	No	No	No	No	No		No	Yes	2 to 3						
553		Stark Road				No	Drilled shallow well		No			25	No	Yes		Yes	No	Yes							No	Yes	5 to 8				4	B	
554		Padgett Road				No	Dug well					20	No	No		Don't Know	No	No	No	No	No	No	No		No	Yes	2				1	B	
555						No						22	No	Yes		Yes	No	No	No	No	No	No	No		No	No	4						
556		Black Point Road				No	Drilled shallow well		No		4		Yes	No		Don't Know	Yes	No	No	No	No	No	Yes		Yes	No	4				6	C	
557		Douglas Bay Road				Yes	Dug well						No				No	No	No	No	No	No	No		No	Yes	3				6	C	
558		Dolmage Road					Community system						Yes			No	Yes	Yes	Yes	No	No	No	No		Yes	Yes	5				Lang Bay	C	
559		Scotch Fir Point Road				No	Community system	Stillwater					Yes	Yes		Yes	Yes								Yes	Yes	3				Stillwater	C	
560						No	Drilled shallow well						No	Yes		Yes	No	No	No	No	No	No	No		No	No	2						
561		View Road				No	Dug well		No			35	No	Yes		Yes	No	No	No	No	No	No	No		No	Yes	2				6	C	
562		Morton Road				No	Community system	Lang Bay					Yes			Yes	No	No	No	No	No	No	No		No	Yes	2				Lang Bay	C	
563		Hwy 101				No	Dug well						Yes	No		No	Yes	No	No	No	No	No	No		Yes	Yes	1				5	B	
564		View Road				Yes	Drilled deep well		No				No	Yes		Yes	Yes	No	No	No	No	No	No		No	Yes	1				6	C	
565		Padgett Road				No	Dug well					17	No	No		Don't Know	No	No	No	No	No	No	No		No	Yes	2				1	B	
566		Hwy 101				Yes	Community system	Pebble Beach					Yes	Yes		Don't Know		No	No	No	No				No	No	2				2	B	
567		Woodlynn Road				No	Community system	Woodlynn	No		17	31	Yes	Yes		Yes	No								No	Yes	2				Woodlynn	C	
568		Douglas Bay Road				No	Dug well				5	8	No	Yes		Yes	Yes	Yes	No	Yes	No	No	Yes		No	Yes	3				6	C	
569		Williams Road				No	Drilled deep well		No			20-25	No	Yes		No	Yes	Yes	No	Yes	Yes	No	No		Yes	Yes	5				4	C	
570		Claridge Road #35				No	Community system	Paradise Valley MHP					Yes	Yes		No	Yes	No	No	No	No	No	No		Yes	Yes	3				1	B	
571		Myrtle Point Drive				No	Community system	Municipal	Yes	Yes		20	No	Yes	Yes	No	Yes	No	No	No	No	No	No		Yes	No	6				3	B	
572		View Road				Yes	Drilled deep well		No			13	No	Yes		Yes	No	No	No	No	No	No	No		Yes	Yes	2				6	C	
573		Cedar Crest Road				No	Drilled deep well		Yes			10	Yes			Don't Know	No	No	No	No	No	No	No		Yes	Yes	4				1	B	
574		Hwy 101				No	Dug well				12	17	No	Yes		Yes	No	No	No	No	No	No	No		No	No	5				2	B	
575		Byron Road				No	Community system	Myrtle Creek									Yes								Yes	No	2				1	B	
576		Donkersley Road				No	Dug well					50	No	Yes		No	No	No	No	No	No	No	No		Yes	No	2 to 5				6	C	
577		Palm Beach Road				No	Community system	Lang Bay					Yes			No	Yes	No	No	No	No	No	No		Yes		2				Lang Bay	C	
578							Community system	Numan WS					Yes	Yes		Yes		No								Yes	4+ homes						2 drilled wells: info from CO

Appendix B
Vancouver Coastal Health Authority
Community Water System Records

Vancouver Coastal Health Authority Community Water System Records

System Name	System type	Pop'n. served	Water source	Primary Treatment	Secondary treatment	BWA	ERP completed /updated	Meeting monitoring criteria	Maintenance (poor/ moderate/ excellent)	Operator trained/ certified	Bact. Issues in past 6 months
Seaside Villa Motel	WS3	35	500' Deep well	Chlorine	none	No	Yes Needs update	Yes	Excellent	Trained	Yes
Vanderkemp Sales and Service	WS3	20	Shallow well	Cartridge filter	UV	No	No	No	Moderate	Trained	No
Devito Water System	WS3	10	327' Deep well	none	none	No	No	Yes	Moderate	No	Yes
Malaspina Self Storage Waterworks System	WS3	15	300' Deep Well	Arsenic removal	Cartr. filter/ UV	No	Yes	Yes	Moderate	No	Yes
Pebble Beach Apartments	WS3	25	Shallow well	Cartridge filter	UV	No	No	Yes	Moderate	No	Yes
Myrtle Pond Water System	WS2	80	510' Deep well	None	None	No	Yes	Yes	Excellent	Certified	Yes
Centennial Drive Water Utility Society	WS2	90	Deep well	None	None	No	Yes	Yes	Excellent	Certified	Yes
Oceanside Resort	WS2	40	Deep well	None	None	No	Yes	Yes	Moderate	Trained	Yes
Myrtle Point Golf Club	WS3	50+	140' Deep Well	Cartridge filters	None	No	No	Yes	Poor	No	No
Padgett CWS	WS3	15	360' Deep	None	None	No	No	No	Poor	No	No
Springbrook Park WS	WS2	80	400' deep well	Chlorine	None	No	Yes	Yes	Moderate	Trained	Yes
Garnet Rock Mobile Home Park	WS2	80	450' deep well	Auto Chlorine	Rapid sand filter	No	Yes	Yes	Moderate	Certified	Yes
Anchor Way Strata	WS3	10	Shallow well	none	none	Yes	No	No	Poor	No	Yes
Numan Water System	WS3	8	Deep well	none	none	No	No	No	Poor	No	No
Numan Water System #2	WS3	8	Deep Well	none	none	No	No	No	Poor	No	No
Black WS	WS3	8	140' deep well	none	none	No	Yes	No	Moderate	No	Yes
Palmer Road Rentals	WS3	10	Shallow well	Cartridge filters	UV	No	No	No	Moderate	No	Yes
Sunshine Coast Health Centre	WS3	50	150' deep well	chlorine	none	No	Yes	Yes	Moderate	Trained	Yes

System Name	System type	Pop'n. served	Water source	Primary Treatment	Secondary treatment	BWA	ERP completed /updated	Meeting monitoring criteria	Maintenance (poor/ moderate/ excellent)	Operator trained/ certified	Bact. Issues in past 6 months
Sunshine Coast MHP	WS2	30	12' shallow well	Rapid sand filter	UV	No	Yes	Yes	Moderate	Trained	Yes
Skeeter Jacks Outback Shack	WS3	20+	200' deep	none	none	No	Yes	Yes	Moderate	No	Yes
Lord Water System	WS3	10	Shallow well	Cartridge filter	UV	No	Yes	Yes	Excellent	No	No
Pine Tree Place ID	WS2	100	116' deep well	Auto. Chlorine	none	No	Yes	Yes	Excellent	Certified	No
Woodlynn ID	WS2	25	126' deep well	none	none	No	Yes	Yes	Excellent	Certified	Yes
Black Point Store	WS3	25+	Deep Well	None	None	No	No	Yes	Poor	No	Yes
Malaspina Fire Hall #1	WS3	6	Shallow well	Cartr. filters	UV	No	Yes	No	Moderate	No	No
Nimh Farm	WS3	10	Shallow well	Cartr. filters	UV	No	Yes	No	Moderate	Trained	No
Brew Bay ID	WS2	100+	creek	Roughing filter	Chlorine	No	Yes	Yes	Excellent	Certified	No
Kelly Creek School	WS3	75	Deep well	NOT IN USE DUE TO ARSENIC ISSUES							
Mountain Ash Farms W.S	WS3	5	Shallow well	Cartridge filter	UV	No	No	No	Moderate	No	No
Stoltz Daycare	WS3	10	Shallow well	Cartridge filter	UV	No	No	No	Moderate	No	No
Camp Nassichuk	WS3	30	Shallow well	Chlorine	none	No	Yes	No	Moderate	No	No
Camp Orenda	WS3	20	Shallow well	Chlorine	none	No	No	No	Poor	No	No
Nelson Water System	WS3	20	creek	None	None	Yes	No	No	Poor	No	Yes
Lang Bay Utility WS	WS2	400+	Infiltration Gallery	Chlorine	None	Yes	Yes	Yes	Excellent	Certified	Yes
Lang Bay Store WS	WS3	30+	Shallow well	none	none	No	Yes	Yes	Moderate	No	Yes
Westcoast Fishculture Fish Process. Plant	WS3		Lang Bay Utility	Cartridge Filter	UV	No	Yes	No	Excellent	No	No
Barry Hay WS	WS3	6	50' Deep well	None	None	No	Yes	No	Moderate	No	Yes
Kent's Beach Cabins & Campsite	WS3	60+	Shallow well	Chlorine	None	No	No	Yes	Moderate	Certified	Yes
Stillwater ID	WS2	200	creek	chlorine	none	No	Yes	Yes	moderate	Certified	Yes

System Name	System type	Pop'n. served	Water source	Primary Treatment	Secondary treatment	BWA	ERP completed /updated	Meeting monitoring criteria	Maintenance (poor/ moderate/ excellent)	Operator trained/ certified	Bact. Issues in past 6 months
Saltery Bay Provincial Park Camp Site	WS3	60+	Deep Well	none	none	No	No	Yes	Moderate	No	No
Saltery Bay Prov. Park Day Area	WS3	20+	Shallow well	None	None	No	No	Yes	Moderate	No	No
Saltery Bay Snack Bar WS	WS3	10+	40' deep well	None	None	Yes	Yes	Yes	Moderate	No	Yes
BCFC Saltery Bay Terminal	WS3	?	Deep well	None	None	Yes	Yes	Yes	Excellent	No	Yes
Paradise Valley Mobile Home Park	WS2	140	120' Deep well	None	None	No	Yes	Yes	Moderate	Trained	No
Powell River Reformed Church Water Supply System	WS3	20?	Shallow well	None	None	No	No	No	Poor	No	No
Goodburn Water Supply System	WS3	6	Deep well	None	None	No	No	No	Poor	No	No
Barta WS	WS3	8	Shallow well	Cartridge filter	UV	No	Yes	No	Moderate	No	Yes
Powell River Trailriders	WS3	?	Shallow well	None	None	Yes	No	No	Poor	No	Yes
Open Air Market WS	WS3	?	Deep Well	None	None	No	Yes	No	Moderate	No	No
Nassichuck MHP	WS3	20	Deep well	none	none	No	Yes Needs update	Yes	Moderate	No	Yes
Nootka Street Water System	WS3	10	494' Deep Well	none	none	No	No	no	Moderate	No	No
Nootka Dunes Golf Course Water System	WS3	?	Deep well	None	None	Yes	No	Yes	Moderate	No	Yes
Powell Heights Modular Home Park	WS2	50	400' deep well	None	None	No	Yes	Yes	Moderate	Trained	No
Gunther Rd. WS	WS3	6	50' deep well	None	None	No	No	No	Poor	No	Yes
Valley Marine WS	WS3	8	40' deep well	None	None	No	Yes	Yes	Moderate	No	Yes
Valley Auto WS	WS3	*No Info yet – New to Files*									

Contacts for larger WS's:

- Lang Bay Water Utility – Tom Burns (owner/operator) 414-9699
- Brew Bay ID – Mel Waldron (chair) 487-4294
- Stillwater ID – Bill and Louise Fleming (operator/chair) 487-9191
- Centennial Drive WUS – Bill Taylor (operator) 487-4461; Vic Taylor (chair) 485-7275
- Pine Tree Place ID – Al Glass (operator) 487-1448
- Woodlynn ID – Robert Collen (operator) 487-9091

Sample Range Report

Vancouver Coastal Health

Facility Name: Stillwater ID Water System
Facility Type: WS2
Date Range: Jan 1 2007 to Nov 14 2007
Date Created: Nov 14 2007

Operator Louise Fleming
R.R.#3 Scotchfir Pt. Road
Powell River, BC V8A 5C1

Sampling Site	Date Collected	Total Coliform	E. Coli	Fecal Coliform
Fleming Residence, Stillwater				
	1/8/2007	18	L1	
	2/5/2007	L1	L1	
	3/19/2007	L1	L1	
	4/24/2007	EST 42	L1	
	5/7/2007	**EST 100**	1	
	6/13/2007	L1	L1	
	7/9/2007	L1	L1	
	8/21/2007	L1	L1	
	9/24/2007	L1	L1	
	10/24/2007	L1	L1	
	Total Positive:	3	10	
Miscellaneous Residence, Stillwater - Any Residence				
	4/16/2007	L1	L1	
	4/16/2007	L1	L1	
	5/7/2007	EST 1-160	1	
	5/7/2007	**EST 1-160**	1	
	5/7/2007	**EST 100**	1	
	5/14/2007	L1	L1	
	Total Positive:	3	30	
Storage tank,				
	5/14/2007	L1	L1	
	10/24/2007	L1	L1	
	Total Positive:	0	00	
Miller residence,				
	1/8/2007	L1	L1	
	2/5/2007	L1	L1	
	3/19/2007	9	L1	
	4/24/2007	**EST 16**		L1
	5/14/2007	L1	L1	

6/13/2007	1	L1
7/9/2007	L1	L1
8/21/2007	1	L1
9/24/2007	L1	L1
10/24/2007	1	L1
Total Positive:	5	00

Shed by Smith's,

1/8/2007	L1	L1
2/5/2007	L1	L1
3/19/2007	L1	L1
4/24/2007	4	L1
5/7/2007	EST 30	1
6/13/2007	L1	L1
7/9/2007	L1	L1
8/21/2007	L1	L1
9/24/2007	L1	L1
10/24/2007	L1	L1
Total Positive:	2	10

Smith Residence, Stillwater

5/14/2007	L1	L1
Total Positive:	0	00

Storage Tank, Stillwater

1/8/2007	L1	L1
2/5/2007	L1	L1
3/19/2007	L1	L1
4/24/2007	21	L1
5/7/2007	EST 29	EST 1
6/13/2007	L1	L1
7/9/2007	2	L1
8/21/2007	L1	L1
9/24/2007	L1	L1
Total Positive:	3	10

Result Values: **E - estimated** **L - less than** **G - greater than**

Samples that contain total coliform:	16	33.33% of total
Samples that contain e. coli:	6	12.50% of total
Samples that contain fecal coliform:	0	0.00% of total
Number of consecutive samples that contain total coliform:	6	
Number of samples that contain total coliform in last 30 days:	1/4	
Total number of samples:	48	

Comments:

Environmental Health Officer
Nov 14 2007

FOR FURTHER INFORMATION PLEASE CALL: Dan Glover (604) 485-3310

Sample Range Report

Vancouver Coastal Health

Facility Name: Centennial Drive Water Utility Society
Facility Type: WS2
Date Range: Jan 1 2007 to Nov 14 2007
Date Created: Nov 14 2007

Operator Victor Taylor
8240 Centennial Dr.
Ph. 485-7275
C-28, Centennial Dr., RR#1 STELLA MARIS.
Powell River, BC V8A 4Z2

Sampling Site	Date Collected	Total Coliform	E. Coli	Fecal Coliform
Lot 47, Centennial Drive				
	1/23/2007	L1	L1	
	2/20/2007	L1	L1	
	3/20/2007	L1	L1	
	4/17/2007	L1	L1	
	5/22/2007	L1	L1	
	6/18/2007	L1	L1	
	7/23/2007	L1	L1	
	8/20/2007	L1	L1	
	9/19/2007	L1	L1	
	10/22/2007	L1	L1	
	Total Positive:	0	00	
Lot 25, Centennial Drive				
	1/23/2007	L1	L1	
	2/20/2007	L1	L1	
	3/20/2007	L1	L1	
	4/17/2007	L1	L1	
	5/22/2007	L1	L1	
	6/18/2007	L1	L1	
	7/23/2007	L1	L1	
	8/20/2007	L1	L1	
	9/19/2007	L1	L1	
	10/22/2007	L1	L1	
	Total Positive:	0	00	
Lot 39, Centennial Drive				
	1/22/2007	L1	L1	
	2/20/2007	L1	L1	
	3/20/2007	L1	L1	
	4/17/2007	L1	L1	
	5/22/2007	L1	L1	

	6/18/2007	L1	L1
	7/23/2007	L1	L1
	8/20/2007	L1	L1
	9/19/2007	L1	L1
	10/22/2007	L1	L1
	Total Positive:	0	00
Storage Tank, Centennial Drive			
	1/23/2007	L1	L1
	2/20/2007	L1	L1
	3/20/2007	L1	L1
	4/17/2007	L1	L1
	5/22/2007	L1	L1
	6/18/2007	L1	L1
	7/23/2007	EST 57	L1
	8/7/2007	**EST 36**	**L1**
	8/20/2007	**EST 12**	**L1**
	8/29/2007	**EST 29**	**L1**
	9/19/2007	**9**	**L1**
	10/3/2007	**EST 36**	**L1**
	10/22/2007	L1	L1
	Total Positive:	6	00
Lot 11, Centennial Drive			
	1/23/2007	L1	L1
	2/20/2007	L1	L1
	3/20/2007	L1	L1
	4/17/2007	L1	L1
	5/22/2007	L1	L1
	6/18/2007	L1	L1
	7/23/2007	1	L1
	8/20/2007	L1	L1
	9/19/2007	L1	L1
	10/22/2007	L1	L1
	Total Positive:	1	00

Result Values: **E - estimated** **L - less than** **G - greater than**

Samples that contain total coliform:	7	13.21% of total
Samples that contain e. coli:	0	0.00% of total
Samples that contain fecal coliform:	0	0.00% of total
Number of consecutive samples that contain total coliform:	5	
Number of samples that contain total coliform in last 30 days:	0/5	
Total number of samples:	53	

Comments:

Environmental Health Officer
Nov 14 2007

FOR FURTHER INFORMATION PLEASE CALL: Dan Glover (604) 485-3310

Sample Range Report

Vancouver Coastal Health

Facility Name: Brew Bay Improvement District Water System
Facility Type: WS2
Date Range: Jan 1 2007 to Nov 14 2007
Date Created: Nov 14 2007 **Boil Water Advisory remains in place on this water supply**

Operator Brew Bay Improvement District
R.R.#3 Patrick Road C26
Powell River, BC V8A 5C1

Sampling Site	Date Collected	Total Coliform	E. Coli	Fecal Coliform
Stamp-Vincent Home, Nassichuck Road @ Hwy 101				
	7/3/2007	L1	L1	
	7/25/2007	1	L1	
	Total Positive:	1	00	
Standpipe at the end of Patrick Road, Brew Bay				
	1/2/2007	L1	L1	
	1/8/2007	L1	L1	
	1/15/2007	L1	L1	
	1/23/2007	L1	L1	
	1/29/2007	L1	L1	
	2/6/2007	L1	L1	
	2/14/2007	L1	L1	
	2/20/2007	L1	L1	
	2/27/2007	L1	L1	
	3/5/2007	L1	L1	
	3/13/2007	A		
	3/19/2007	L1	L1	
	3/27/2007	L1	L1	
	4/2/2007	L1	L1	
	4/11/2007	L1	L1	
	4/17/2007	L1	L1	
	4/24/2007	L1	L1	
	5/1/2007	L1	L1	
	5/7/2007	L1	L1	
	5/15/2007	L1	L1	
	5/22/2007	L1	L1	
	6/11/2007	L1	L1	
	6/18/2007	L1	L1	
	6/26/2007	L1	L1	
	7/3/2007	L1	L1	
	7/10/2007	L1	L1	
	7/17/2007	L1	L1	
	7/25/2007	L1	L1	

7/31/2007	L1	L1
8/7/2007	1	L1
8/15/2007	L1	L1
8/22/2007	L1	L1
8/27/2007	1	L1
9/5/2007	L1	L1
11/13/2007		
Total Positive:	2	00

2035 Mahood Rd., Brew Bay

4/11/2007	L1	L1
4/17/2007	L1	L1
4/24/2007	L1	L1
5/1/2007	L1	L1
5/7/2007	L1	L1
5/15/2007	L1	L1
5/29/2007	L1	L1
6/11/2007	L1	L1
6/18/2007	L1	L1
6/26/2007	1	L1
7/10/2007	L1	L1
7/17/2007	L1	L1
7/31/2007	L1	L1
8/15/2007	L1	L1
8/22/2007	L1	L1
8/27/2007	1	L1
9/5/2007	L1	L1
Total Positive:	2	00

Hudec residence, Brew Bay

1/2/2007	L1	L1
1/8/2007	L1	L1
1/15/2007	L1	L1
1/23/2007	L1	L1
1/29/2007	L1	L1
2/6/2007	L1	L1
2/14/2007	L1	L1
2/20/2007	L1	L1
2/27/2007	L1	L1
3/5/2007	L1	L1
3/13/2007	A	
3/19/2007	L1	L1
3/27/2007	L1	L1
4/2/2007	L1	L1
5/22/2007	L1	L1
5/29/2007	L1	L1
8/7/2007	L1	L1
Total Positive:	0	00

Pumphouse, Brew

Bay			
	1/2/2007	L1	L1
	1/8/2007	L1	L1
	1/15/2007	L1	L1
	1/23/2007	L1	L1
	1/29/2007	L1	L1
	2/6/2007	L1	L1
	2/14/2007	L1	L1
	2/20/2007	L1	L1
	2/27/2007	L1	L1
	3/5/2007	L1	L1
	3/13/2007	A	
	3/19/2007	L1	L1
	3/27/2007	L1	L1
	4/2/2007	L1	
	4/11/2007	L1	L1
	4/17/2007	L1	L1
	4/24/2007	L1	L1
	5/1/2007	L1	L1
	5/7/2007	L1	L1
	5/15/2007	L1	L1
	5/22/2007	L1	L1
	5/29/2007	L1	L1
	6/11/2007	L1	L1
	6/18/2007	L1	L1
	6/26/2007	L1	L1
	7/3/2007	L1	L1
	7/10/2007	8	L1
	7/17/2007	L1	L1
	7/25/2007	1	L1
	7/31/2007	L1	L1
	8/7/2007	L1	L1
	8/15/2007	L1	L1
	8/22/2007	2	L1
	8/27/2007	L1	L1
	9/5/2007	1	L1
	9/19/2007	L1	L1
	10/1/2007	L1	L1
	10/9/2007	L1	L1
	10/16/2007	L1	L1
	10/24/2007	L1	L1
	10/31/2007	L1	L1
	11/7/2007	L1	L1
	Total Positive:	4	00

Beardmore Residence 2136 Brew Bay Rd, Brew Bay			
	9/19/2007	L1	L1
	10/1/2007	L1	L1
	10/9/2007	L1	L1
	10/16/2007	L1	L1
	10/24/2007	L1	L1

	10/31/2007	L1	L1
	11/7/2007	L1	L1
	Total Positive:	0	00

Waldren Residence
10475 Patick Rd.,
Brew Bay

	9/19/2007	L1	L1
	10/1/2007	L1	L1
	10/9/2007	L1	L1
	10/16/2007	L1	L1
	10/24/2007	L1	L1
	10/31/2007	L1	L1
	11/7/2007	L1	L1
	Total Positive:	0	00

Result Values: **E - estimated** **L - less than** **G - greater than**

Samples that contain total coliform:	9	7.09% of total
Samples that contain e. coli:	0	0.00% of total
Samples that contain fecal coliform:	0	0.00% of total
Number of consecutive samples that contain total coliform:	0	
Number of samples that contain total coliform in last 30 days:	0/13	
Total number of samples:	127	

Comments:

Environmental Health Officer
Nov 14 2007

FOR FURTHER INFORMATION PLEASE CALL: Dan Glover (604) 485-3310

Sample Range Report

Vancouver Coastal Health

Facility Name: Woodlynn Improvement District Water System
Facility Type: WS2
Date Range: Jan 1 2007 to Nov 14 2007
Date Created: Nov 14 2007

Operator Robert Collen
RR#1 C26 Pinetree Place
Powell River, BC V8A 4Z2

Sampling Site	Date Collected	Total Coliform	E. Coli	Fecal Coliform
Miscellaneous, Woodlyn Improvement District				
	1/23/2007	L1	L1	
	2/27/2007	L1	L1	
	3/27/2007	L1	L1	
	4/24/2007	L1	L1	
	5/22/2007	L1	L1	
	6/5/2007	L1	L1	
	6/5/2007	L1	L1	
	6/19/2007	L1	L1	
	7/17/2007	2	L1	
	8/21/2007	L1	L1	
	9/18/2007	L1	L1	
	10/16/2007	L1	L1	
	10/23/2007	L1	L1	
	Total Positive:	1	00	
Ernst Residence, Woodlyn Improvement District Water System				
	1/3/2007	L1	L1	
	2/6/2007	L1	L1	
	3/6/2007	L1	L1	
	4/3/2007	L1	L1	
	5/1/2007	L1	L1	
	5/29/2007	L1	L1	
	6/26/2007	L1	L1	
	7/24/2007	L1	L1	
	8/28/2007	L1	L1	
	10/2/2007	L1	L1	
	11/6/2007	L1	L1	
	Total Positive:	0	00	
Neilson residence, Woodlyn				

Improvement District Water System			
	1/15/2007	L1	L1
	2/13/2007	L1	L1
	3/13/2007	A	
	4/17/2007	L1	L1
	5/15/2007	L1	L1
	6/12/2007	L1	L1
	7/10/2007	L1	L1
	Total Positive:	0	00
McInnes Residence, Woodlyn Improvement District Water System			
	1/15/2007	L1	L1
	2/20/2007	L1	L1
	3/20/2007	L1	L1
	4/17/2007	L1	L1
	5/15/2007	L1	L1
	7/10/2007	L1	L1
	8/14/2007	L1	L1
	Total Positive:	0	00
Santiago Residence, Woodlyn Improvement District			
	1/9/2007	L1	L1
	2/20/2007	L1	L1
	3/20/2007	L1	L1
	4/10/2007	L1	L1
	7/3/2007	L1	L1
	8/7/2007	L1	L1
	9/4/2007	L1	L1
	10/9/2007	L1	L1
	Total Positive:	0	00
Collen's Residence, Woodlyn Improvement District			
	1/9/2007	L1	L1
	2/13/2007	L1	L1
	3/13/2007	A	
	4/10/2007	L1	L1
	5/8/2007	L1	L1
	7/3/2007	L1	L1
	8/7/2007	38	L1
	9/4/2007	L1	L1
	10/9/2007	L1	L1
	Total Positive:	1	00

Result Values: **E - estimated** **L - less than** **G - greater than**

9705 Evergreen Road, Pine Tree - Lister Residence			
	1/9/2007	L1	L1
	1/23/2007	L1	L1
	2/6/2007	L1	L1
	2/20/2007	L1	L1
	3/6/2007	L1	L1
	3/20/2007	L1	L1
	4/3/2007	L1	L1
	4/17/2007	L1	L1
	5/2/2007	L1	L1
	5/15/2007	L1	L1
	5/29/2007	L1	L1
	6/26/2007	L1	L1
	7/31/2007	L1	L1
	8/14/2007	L1	L1
	8/28/2007	L1	L1
	9/25/2007	L1	L1
	10/9/2007	L1	L1
	10/23/2007	L1	L1
	Total Positive:	0	00
Pine Tree Place - Eagles Landing Bistro, 1929 Twin Eagles Powell River			
	1/15/2007	L1	L1
	2/13/2007	L1	L1
	3/12/2007	A	
	5/8/2007	L1	L1
	6/5/2007	L1	L1
	7/10/2007	L1	L1
	8/7/2007	L1	L1
	9/5/2007	L1	L1
	10/2/2007	L1	L1
	11/6/2007	L1	L1
	Total Positive:	0	00
Ken Moir Residence 9642 Evergreen Rd. , Pine Tree Place Improvement District			
	1/30/2007	L1	L1
	2/28/2007	L1	L1
	3/27/2007	L1	L1
	5/22/2007	L1	L1
	6/19/2007	L1	L1
	8/21/2007	L1	L1
	9/18/2007	L1	L1
	10/16/2007	L1	L1

	Total Positive:	0	00

Ed Vincent 2032
Pine Tree Place,
Pine Tree Place
Improvement District

1/30/2007	L1	L1
2/28/2007	L1	L1
5/22/2007	L1	L1
6/19/2007	L1	L1
8/21/2007	L1	L1
9/18/2007	L1	L1
10/16/2007	L1	L1
Total Positive:	0	00

Result Values: **E - estimated** **L - less than** **G - greater than**

Samples that contain total coliform:	0	0.00% of total
Samples that contain e. coli:	0	0.00% of total
Samples that contain fecal coliform:	0	0.00% of total
Number of consecutive samples that contain total coliform:	0	
Number of samples that contain total coliform in last 30 days:	0/6	
Total number of samples:	72	

Comments:

Environmental Health Officer
Nov 14 2007

FOR FURTHER INFORMATION PLEASE CALL: Dan Glover (604) 485-3310

Samples that contain total coliform:	2	3.64% of total
Samples that contain e. coli:	0	0.00% of total
Samples that contain fecal coliform:	0	0.00% of total
Number of consecutive samples that contain total coliform:	0	
Number of samples that contain total coliform in last 30 days:	0/3	
Total number of samples:	55	

Comments:

Environmental Health Officer
Nov 14 2007

FOR FURTHER INFORMATION PLEASE CALL: Dan Glover (604) 485-3310

Sample Range Report

Vancouver Coastal Health

Facility Name: Pine Tree Place Improvement District
Facility Type: WS2
Date Range: Jan 1 2007 to Nov 14 2007
Date Created: Nov 14 2007

Operator Al Glass
C-2 Twin Eagles Rd.RR#1
Powell River , BC V8A 4Z2

Sampling Site	Date Collected	Total Coliform	E. Coli	Fecal Coliform
Storage Tank, Pine Tree Place				
	1/9/2007	L1	L1	
	1/23/2007	L1	L1	
	2/6/2007	L1	L1	
	2/20/2007	L1	L1	
	3/6/2007	L1	L1	
	3/20/2007	L1	L1	
	4/3/2007	L1	L1	
	4/17/2007	L1	L1	
	5/2/2007	L1	L1	
	5/15/2007	L1	L1	
	5/29/2007	L1	L1	
	6/12/2007	L1	L1	
	6/26/2007	L1	L1	
	7/17/2007	L1	L1	
	7/31/2007	L1	L1	
	8/14/2007	L1	L1	
	8/28/2007	L1	L1	
	9/25/2007	L1	L1	
	10/9/2007	L1	L1	
	10/23/2007	L1	L1	
	Total Positive:	0	00	
1981 Twin Eagles Road, Pine Tree Place				
	1/15/2007	L1	L1	
	2/13/2007	L1	L1	
	3/12/2007	A		
	5/8/2007	L1	L1	
	6/5/2007	L1	L1	
	7/10/2007	L1	L1	
	8/7/2007	L1	L1	
	9/5/2007	L1	L1	
	11/6/2007	L1	L1	
	Total Positive:	0	00	

Appendix C
2007 Water Quality Sampling Data
- Hammil Lake
- Lois Lake

Powell River Regional District - Southern Region Water Source Study

Water Quality - Hammil (West) Lake

November 2007

Water Quality Parameter	Unit	MDL	Hammil (West) Lake										
			70ft	60ft	50ft	40ft	30ft	20ft	10ft	Max	Min	Average	CGDWQ
Alkalinity	mg/L (CaCO3)	10 mg/L (CaCO3)	<10	<10	<10	<10	<10	<10	<10				30 to 500 mg/L as CaCO3
Chloride	mg/L	0.2 mg/L	3.4	3.4	3.4	3.4	3.4	3.5	3.5	3.5	3.4	3.4	≤250 mg/L
Fluoride	mg/L	0.1 mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				1.5 mg/L
Nitrate (N)	mg/L	0.01 mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				45 mg/L
Nitrite (N)	mg/L	0.01 mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				
Sulphate	mg/L	0.2 mg/L	2	2.1	2.1	2.1	2.1	2	2.1	2.1	2	2.1	≤500 mg/L (AO)
Bromide	mg/L	0.1 mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
Apparent Colour	Colour units	5 Colour units	10	8	9	8	8	8	7	10	7	8	
True Color	Colour units	5 Colour units	5	<5	5	5	5	5	<5	5	5	5.0	<15 (AO)
Conductivity	uS	1 uS	30.2	30.2	30.9	30.7	30.4	30.3	30.3	30.9	30.2	30.4	<700 US/cm
Hardness (CaCO3)	mg/L	mg/L	7.7	7.3	7.1	7.3	7.1	7.3	7.3	7.7	7.1	7.3	<120 mg/L as CaCO3
DOC - Dissolved Organic Carbon	mg/L	0.5 mg/L	3.1	2.1	1.4	1.6	1.8	2	1.6	3.1	1.4	1.9	
Total Suspended Solids	mg/L	5 mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0				
Turbidity	NTU's	0.5 NTU's	0.9	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.9	0.9	0.9	0.3/1.0/0.1 NTU***
UV Transmittance	%/cm	0.1 %/cm	82	90.1	89.8	89.3	89.4	89	88.6	90.1	82	88.3	
T-Mercury	mg/L	0.0001 mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001				0.001 mg/L
Mercury - dissolved	mg/L	0.0001 mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001				
pH			6.72	6.71	6.61	6.67	6.66	6.66	6.66	6.72	6.61	6.67	6.5-8.5 (AO)
Total Dissolved Phosphate (P)	mg/L	0.05 mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05				
Total Dissolved Solids	mg/L dried at 180 °C	7 mg/L dried at 180	<7	<7	<7	<7	20	<7	27				≤500
Total Organic Carbon	mg/L	0.5 mg/L	3.6	4.8	2.3	1.9	2.1	2.2	2.1	4.8	1.9	2.7	(iv) Archived**
T-Aluminum	mg/L	0.005 mg/L	0.018	0.02	0.016	0.017	0.015	0.017	0.014	0.02	0.014	0.017	0.1/0.2* (OG)
T-Antimony	mg/L	0.0002 mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002				0.006 mg/L
T-Arsenic	mg/L	0.0002 mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0002	0.0002	0.0002	0.0002	0.010 mg/L
T-Barium	mg/L	0.001 mg/L	0.003	0.004	0.003	0.003	0.003	0.003	0.003	0.004	0.003	0.003	1 mg/L
T-Beryllium	mg/L	0.0001 mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001				
T-Bismuth	mg/L	0.0005 mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005				
T-Boron	mg/L	0.002 mg/L	0.004	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.003	0.003	5 mg/L
T-Cadmium	mg/L	0.00001 mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001				0.005 mg/L
T-Calcium	mg/L	0.2 mg/L	2.1	2.0	2.0	2.0	2.0	2.0	2.0	2.1	2.0	2.0	
T-Chromium	mg/L	0.0005 mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005				0.05 mg/L
T-Cobalt	mg/L	0.0001 mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001				
T-Copper	mg/L	0.001 mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.003	<0.001	0.003	0.001	0.002	≤1.0 (AO)
T-Iron	mg/L	0.1 mg/L	0.2	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.1	0.2	≤0.3 (AO)
T-Lead	mg/L	0.0001 mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001				0.01 mg/L
T-Lithium	mg/L	0.001 mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001				
T-Magnesium	mg/L	0.1 mg/L	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
T-Manganese	mg/L	0.005 mg/L	0.012	0.006	0.008	0.006	0.006	0.006	0.006	0.012	0.006	0.007	≤0.05 mg/L
T-Molybdenum	mg/L	0.001 mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001				
T-Nickel	mg/L	0.0005 mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005				
T-Potassium	mg/L	0.4 mg/L	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4				
T-Selenium	mg/L	0.0002 mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002				0.01 mg/L
T-Silicon	mg/L	0.05 mg/L	0.72	0.68	0.7	0.7	0.7	0.68	0.67	0.72	0.67	0.7	
T-Silver	mg/L	0.0001 mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001				
T-Sodium	mg/L	0.4 mg/L	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	≤200 mg/L
T-Strontium	mg/L	0.001 mg/L	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	
T-Sulphur	mg/L	0.3 mg/L	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	

Powell River Regional District - Southern Region Water Source Study

Water Quality - Hammil (West) Lake

November 2007

Water Quality Parameter	Unit	MDL	Hammil (West) Lake										
			70ft	60ft	50ft	40ft	30ft	20ft	10ft	Max	Min	Average	CGDWQ
T-Thallium	mg/L	0.00005 mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005				
T-Tin	mg/L	0.001 mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001				
T-Titanium	mg/L	0.0005 mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	0.0005	0.0005	
T-Vanadium	mg/L	0.0001 mg/L	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	
T-Zinc	mg/L	0.001 mg/L	0.004	0.003	0.002	0.002	0.002	0.002	0.002	0.004	0.002	0.002	≤0.5 mg/L
d-Aluminum	mg/L	0.005 mg/L	<0.005	<0.005	<0.005	0.005	<0.005	<0.005	0.005	0.005	0.005	0.005	
d-Antimony	mg/L	0.0002 mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002				
d-Arsenic	mg/L	0.0002 mg/L	<0.0002	<0.0002	<0.0002	0.0002	0.0002	<0.0002	<0.0002	0.0002	0.0002	0.0002	
d-Barium	mg/L	0.001 mg/L	0.004	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.003	0.003	
d-Beryllium	mg/L	0.0001 mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001				
d-Bismuth	mg/L	0.0005 mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005				
d-Boron	mg/L	0.002 mg/L	0.002	0.003	0.002	0.003	0.002	0.002	0.003	0.003	0.002	0.002	
d-Cadmium	mg/L	0.00001 mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001				
d-Calcium	mg/L	0.2 mg/L	2.1	2.1	2	2.1	2	2.1	2.1	2.1	2	2.1	
d-Chromium	mg/L	0.0005 mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005				
d-Cobalt	mg/L	0.0001 mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001				
d-Copper	mg/L	0.001 mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.001	0.001	0.001	
d-Iron	mg/L	0.01 mg/L	0.06	0.02	0.03	0.02	0.02	0.02	0.02	0.06	0.02	0.03	
d-Lead	mg/L	0.0001 mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001				
d-Lithium	mg/L	0.001 mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001				
d-Magnesium	mg/L	0.2 mg/L	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.5	0.5	
d-Manganese	mg/L	0.005 mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005				
d-Molybdenum	mg/L	0.001 mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001				
d-Nickel	mg/L	0.0005 mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005				
d-Potassium	mg/L	0.4 mg/L	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4				
d-Selenium	mg/L	0.0002 mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002				
d-Silicon	mg/L	0.05 mg/L	0.68	0.65	0.65	0.65	0.64	0.63	0.63	0.68	0.63	0.65	
d-Silver	mg/L	0.0001 mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001				
d-Sodium	mg/L	0.4 mg/L	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	
d-Strontium	mg/L	0.001 mg/L	0.018	0.018	0.018	0.018	0.017	0.018	0.018	0.018	0.017	0.018	
d-Sulphur	mg/L	0.3 mg/L	0.8	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.8	
d-Thallium	mg/L	0.00005 mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005				
d-Tin	mg/L	0.001 mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001				
d-Titanium	mg/L	0.0005 mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005				
d-Vanadium	mg/L	0.0001 mg/L	0.0002	0.0002	0.0002	0.0002	0.0002	0.0001	0.0001	0.0002	0.0001	0.0002	
d-Zinc	mg/L	0.001 mg/L	0.003	0.003	0.002	<0.001	0.002	<0.0001	0.002	0.003	0.002	0.002	

d = dissolved
T = total
MDL = minimum detectable level
AO = Aesthetic Objective
OG = Operational Guidance Values

*0.1 mg/L applies to conventional treatment plants. 0.2 mg/L applies to other types of treatment systems
** archived as parameters no longer found in Canadian drinking water. TOC recommended to <3.0 mg/L per Water Quality Sourcebook (Environment Canada)
*** based on conventional treatment/slow sand or diatomaceous earth filtration/membrane filtration

Powell River Regional District - Southern Region Water Source Study

Water Quality - Lois Lake

November 2007

Water Quality Parameter	Unit	MDL	Lois Lake			Max	Min	Average	CGDWQ
			30ft	20ft	10ft				
Alkalinity	mg/L (CaCO3)	10 mg/L (CaCO3)	<10	<10	<10				30 to 500 mg/L as CaCO3
Chloride	mg/L	0.2 mg/L	0.5	0.5	0.5	0.5	0.5	0.5	≤250 mg/L
Fluoride	mg/L	0.1 mg/L	<0.1	<0.1	<0.1				1.5 mg/L
Nitrate (N)	mg/L	0.01 mg/L	0.04	0.04	0.04	0.04	0.04	0.04	45 mg/L
Nitrite (N)	mg/L	0.01 mg/L	<0.01	<0.01	<0.01				
Sulphate	mg/L	0.2 mg/L	0.8	0.8	0.9	0.9	0.8	0.8	≤500 mg/L (AO)
Bromide	mg/L	0.1 mg/L	<0.1	<0.1	<0.1				
Apparent Colour	Colour units	5 Colour units	11	13	12	13	11	12	
True Color	Colour units	5 Colour units	10	10	10	10	10	10	<15 (AO)
Conductivity	uS	1 uS	14.7	14.7	15.1	15.1	14.7	14.8	<700 US/cm
Hardness (CaCO3)	mg/L	mg/L	5.1	5.1	5.1	5.1	5.1	5.1	<120 mg/L as CaCO3
DOC - Dissolved Organic Carbon	mg/L	0.5 mg/L	1.4	2.3	1.4	2.3	1.4	1.7	
Total Suspended Solids	mg/L	5 mg/L	<5.0	<5.0	<5.0				
Turbidity	NTU's	0.5 NTU's	<0.5	<0.5	<0.5				0.3/1.0/0.1 NTU***
UV Transmittance	%/cm	0.1 %/cm	78.5	78.8	78.6	78.8	78.5	78.6	
T-Mercury	mg/L	0.0001 mg/L	<0.0001	<0.0001	<0.0001				0.001 mg/L
Mercury - dissolved	mg/L	0.0001 mg/L	<0.0001	<0.0001	<0.0001				
pH			6.6	6.6	6.59	6.6	6.59	6.6	6.5-8.5 (AO)
Total Dissolved Phosphate (P)	mg/L	0.05 mg/L	<0.05	<0.05	<0.05				
Total Dissolved Solids	mg/L dried at 180 °C	7 mg/L dried at 180	<7	<7	<7				≤500
Total Organic Carbon	mg/L	0.5 mg/L	2	2.6	2.1	2.6	2	2.2	(iv) Archived**
T-Aluminum	mg/L	0.005 mg/L	0.06	0.059	0.092	0.092	0.059	0.070	0.1/0.2* (OG)
T-Antimony	mg/L	0.0002 mg/L	<0.0002	<0.0002	<0.0002				0.006 mg/L
T-Arsenic	mg/L	0.0002 mg/L	<0.0002	<0.0002	<0.0002				0.010 mg/L
T-Barium	mg/L	0.001 mg/L	0.002	0.003	0.003	0.003	0.002	0.003	1 mg/L
T-Beryllium	mg/L	0.0001 mg/L	<0.0001	<0.0001	<0.0001				
T-Bismuth	mg/L	0.0005 mg/L	<0.0005	<0.0005	<0.0005				
T-Boron	mg/L	0.002 mg/L	<0.002	<0.002	<0.002				5 mg/L
T-Cadmium	mg/L	0.00001 mg/L	<0.00001	<0.00001	<0.00001				0.005 mg/L
T-Calcium	mg/L	0.2 mg/L	1.7	1.6	1.7	1.7	1.6	1.7	
T-Chromium	mg/L	0.0005 mg/L	<0.0005	<0.0005	<0.0005				0.05 mg/L
T-Cobalt	mg/L	0.0001 mg/L	<0.0001	<0.0001	<0.0001				
T-Copper	mg/L	0.001 mg/L	<0.001	<0.001	0.003	0.003	0.003	0.003	≤1.0 (AO)
T-Iron	mg/L	0.1 mg/L	<0.1	<0.1	<0.1				≤0.3 (AO)
T-Lead	mg/L	0.0001 mg/L	<0.0001	<0.0001	0.0003	0.0003	0.0003	0.0003	0.01 mg/L
T-Lithium	mg/L	0.001 mg/L	<0.001	<0.001	<0.001				
T-Magnesium	mg/L	0.1 mg/L	0.2	0.2	0.2	0.2	0.2	0.2	
T-Manganese	mg/L	0.005 mg/L	<0.005	<0.005	<0.005				≤0.05 mg/L
T-Molybdenum	mg/L	0.001 mg/L	<0.001	<0.001	<0.001				
T-Nickel	mg/L	0.0005 mg/L	<0.0005	<0.0005	<0.0005				
T-Potassium	mg/L	0.4 mg/L	<0.4	<0.4	<0.4				
T-Selenium	mg/L	0.0002 mg/L	<0.0002	<0.0002	<0.0002				0.01 mg/L
T-Silicon	mg/L	0.05 mg/L	1.38	1.38	1.41	1.41	1.38	1.39	
T-Silver	mg/L	0.0001 mg/L	<0.0001	<0.0001	<0.0001				
T-Sodium	mg/L	0.4 mg/L	0.9	0.9	0.9	0.9	0.9	0.9	≤200 mg/L
T-Strontium	mg/L	0.001 mg/L	0.006	0.006	0.006	0.006	0.006	0.006	
T-Sulphur	mg/L	0.3 mg/L	0.4	0.4	0.4	0.4	0.4	0.4	
T-Thallium	mg/L	0.00005 mg/L	<0.00005	<0.00005	<0.00005				
T-Tin	mg/L	0.001 mg/L	<0.001	<0.001	<0.001				
T-Titanium	mg/L	0.0005 mg/L	0.0006	0.0007	0.0015	0.0015	0.0006	0.0009	
T-Vanadium	mg/L	0.0001 mg/L	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	
T-Zinc	mg/L	0.001 mg/L	0.003	0.002	0.006	0.006	0.002	0.004	≤0.5 mg/L
d-Aluminum	mg/L	0.005 mg/L	0.042	0.043	0.041	0.043	0.041	0.042	
d-Antimony	mg/L	0.0002 mg/L	<0.0002	<0.0002	<0.0002				
d-Arsenic	mg/L	0.0002 mg/L	<0.0002	<0.0002	<0.0002				
d-Barium	mg/L	0.001 mg/L	0.003	0.002	0.003	0.003	0.002	0.003	
d-Beryllium	mg/L	0.0001 mg/L	<0.0001	<0.0001	<0.0001				
d-Bismuth	mg/L	0.0005 mg/L	<0.0005	<0.0005	<0.0005				
d-Boron	mg/L	0.002 mg/L	<0.002	<0.002	<0.002				
d-Cadmium	mg/L	0.00001 mg/L	<0.00001	<0.00001	<0.00001				
d-Calcium	mg/L	0.2 mg/L	1.7	1.7	1.7	1.7	1.7	1.7	
d-Chromium	mg/L	0.0005 mg/L	<0.0005	<0.0005	<0.0005				
d-Cobalt	mg/L	0.0001 mg/L	<0.0001	<0.0001	<0.0001				

Powell River Regional District - Southern Region Water Source Study

Water Quality - Lois Lake

November 2007

Water Quality Parameter	Unit	MDL	Lois Lake						
			30ft	20ft	10ft	Max	Min	Average	CGDW
d-Copper	mg/L	0.001 mg/L	<0.001	<0.001	0.002	0.002	0.002	0.002	
d-Iron	mg/L	0.01 mg/L	0.02	0.02	0.02	0.02	0.02	0.02	
d-Lead	mg/L	0.0001 mg/L	<0.0001	<0.0001	<0.0001				
d-Lithium	mg/L	0.001 mg/L	<0.001	<0.001	<0.001				
d-Magnesium	mg/L	0.2 mg/L	0.2	0.2	0.2	0.2	0.2	0.2	
d-Manganese	mg/L	0.005 mg/L	<0.005	<0.005	<0.005				
d-Molybdenum	mg/L	0.001 mg/L	<0.001	<0.001	<0.001				
d-Nickel	mg/L	0.0005 mg/L	<0.0005	<0.0005	<0.0005				
d-Potassium	mg/L	0.4 mg/L	<0.4	<0.4	<0.4				
d-Selenium	mg/L	0.0002 mg/L	<0.0002	<0.0002	<0.0002				
d-Silicon	mg/L	0.05 mg/L	1.4	1.39	1.4	1.4	1.39	1.4	
d-Silver	mg/L	0.0001 mg/L	<0.0001	<0.0001	<0.0001				
d-Sodium	mg/L	0.4 mg/L	0.7	0.7	0.7	0.7	0.7	0.7	
d-Strontium	mg/L	0.001 mg/L	0.006	0.006	0.006	0.006	0.006	0.006	
d-Sulphur	mg/L	0.3 mg/L	0.3	0.3	0.3	0.3	0.3	0.3	
d-Thallium	mg/L	0.00005 mg/L	<0.00005	<0.00005	<0.0005				
d-Tin	mg/L	0.001 mg/L	<0.001	<0.001	<0.001				
d-Titanium	mg/L	0.0005 mg/L	<0.0005	<0.0005	<0.0005				
d-Vanadium	mg/L	0.0001 mg/L	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	
d-Zinc	mg/L	0.001 mg/L	0.002	0.002	0.002	0.002	0.002	0.002	

d = dissolved
T = total
MDL = minimum detectable level
AO = Aesthetic Objective
OG = Operational Guidance Values

*0.1 mg/L applies to conventional treatment plants. 0.2 mg/L applies to other types of treatment systems
** archived as parameters no longer found in Canadian drinking water. TOC recommended to <3.0 mg/L per Water Quality Sourcebook (Environment Car
*** based on conventional treatment/slow sand or diatomaceous earth filtration/membrane filtration

Appendix D
Field Review Photographs

Photo 1: 300Igal Pneumatic Tank

Photo 2: Well Pump Building

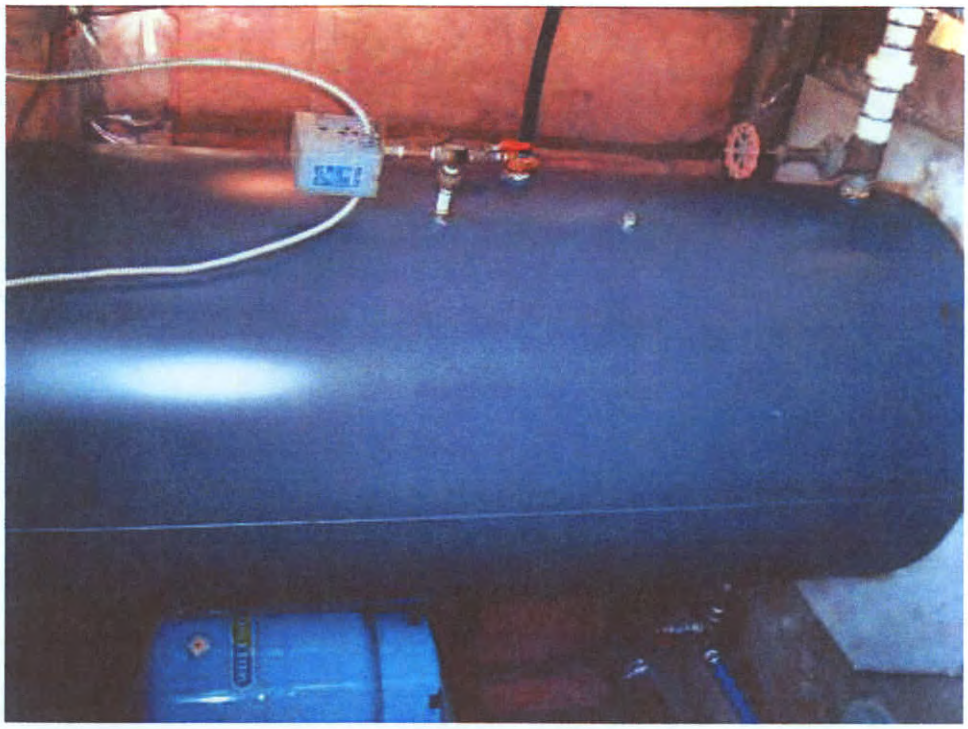


Photo 3: Storage Tank

Photo 4: Storage Tank Discharge to 50mm Distribution System

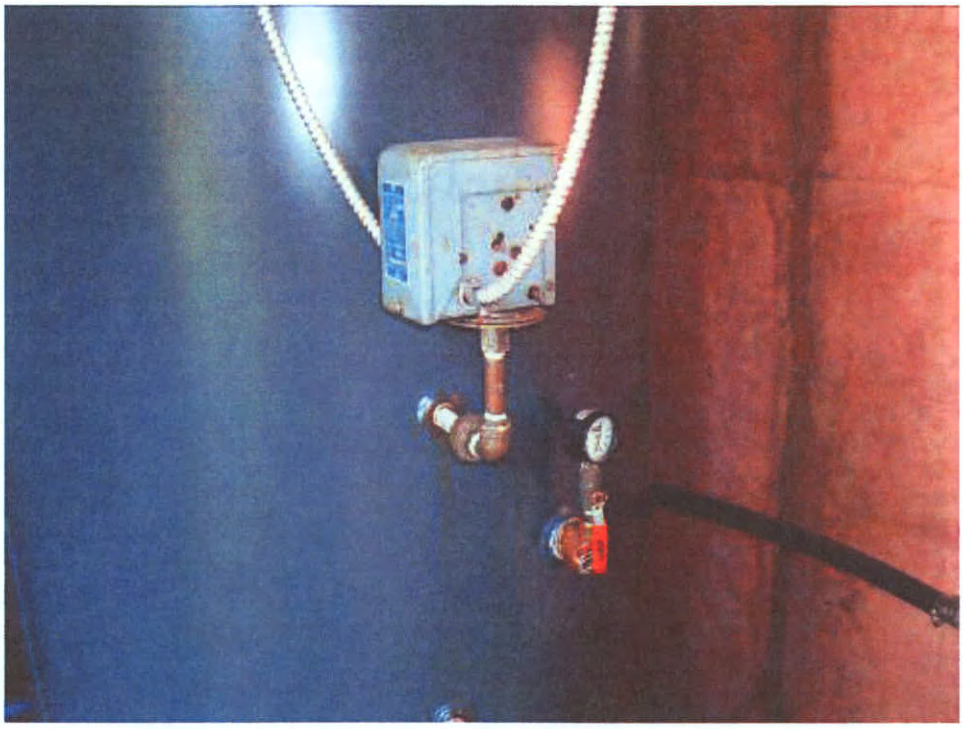


Photo 5: Pressurized Storage Tank

Photo 6: Well (capped)

Photo 1: Typical Standpipe Hydrant

Photo 2: Typical Valves and Manhole for Hydrant Isolation

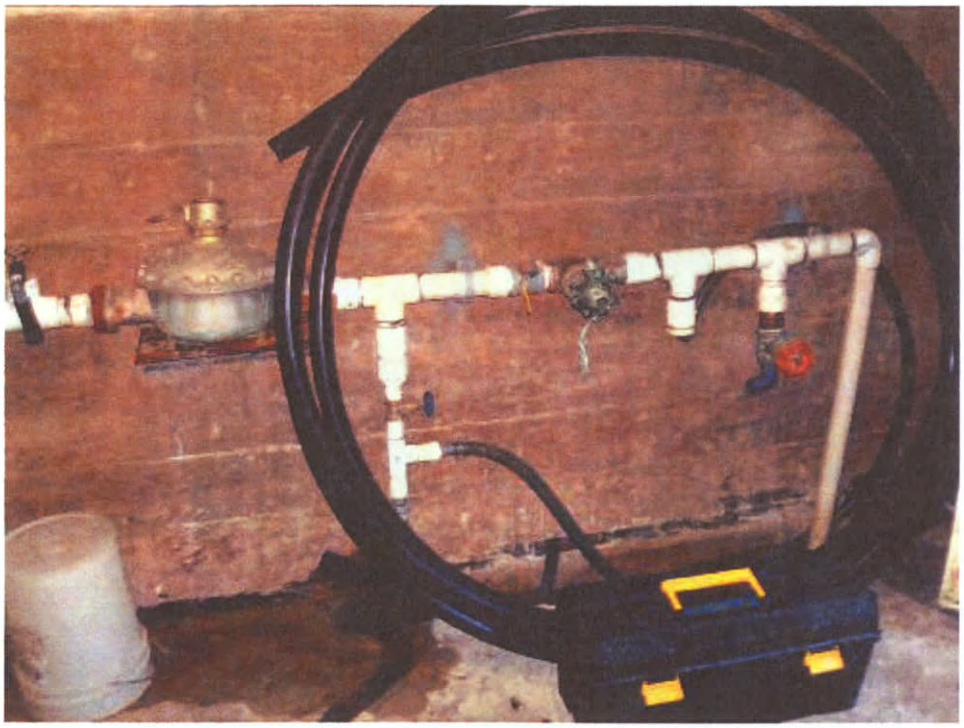


Photo 3: Inlet Piping to Chlorination Building

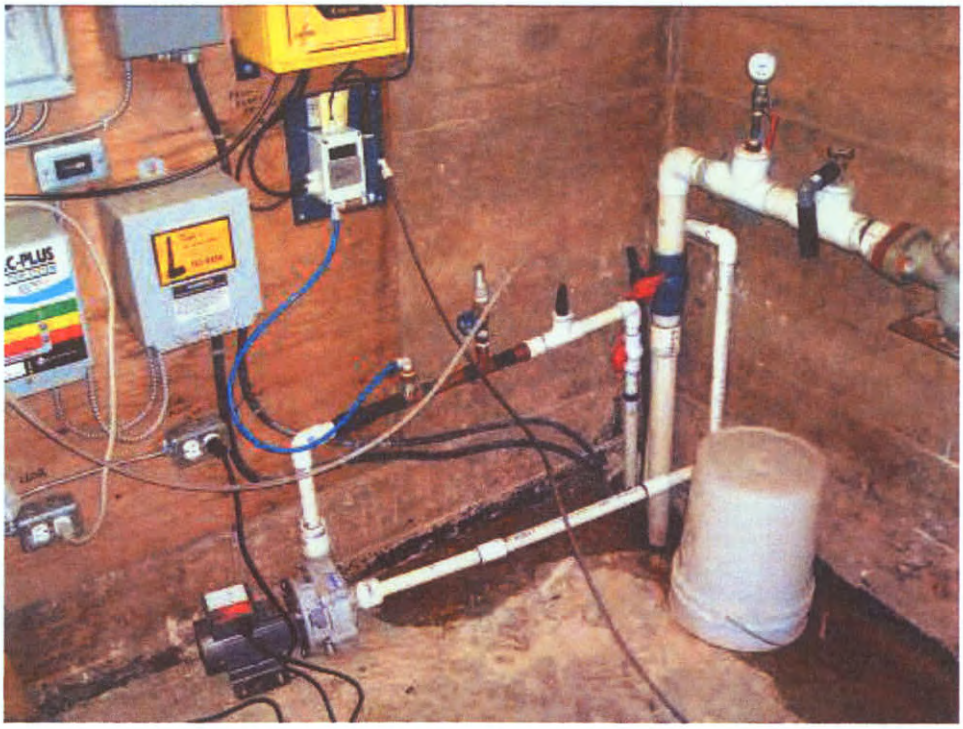


Photo 4: Discharge Piping

Photo 5: Failed Chlorination Building Foundation

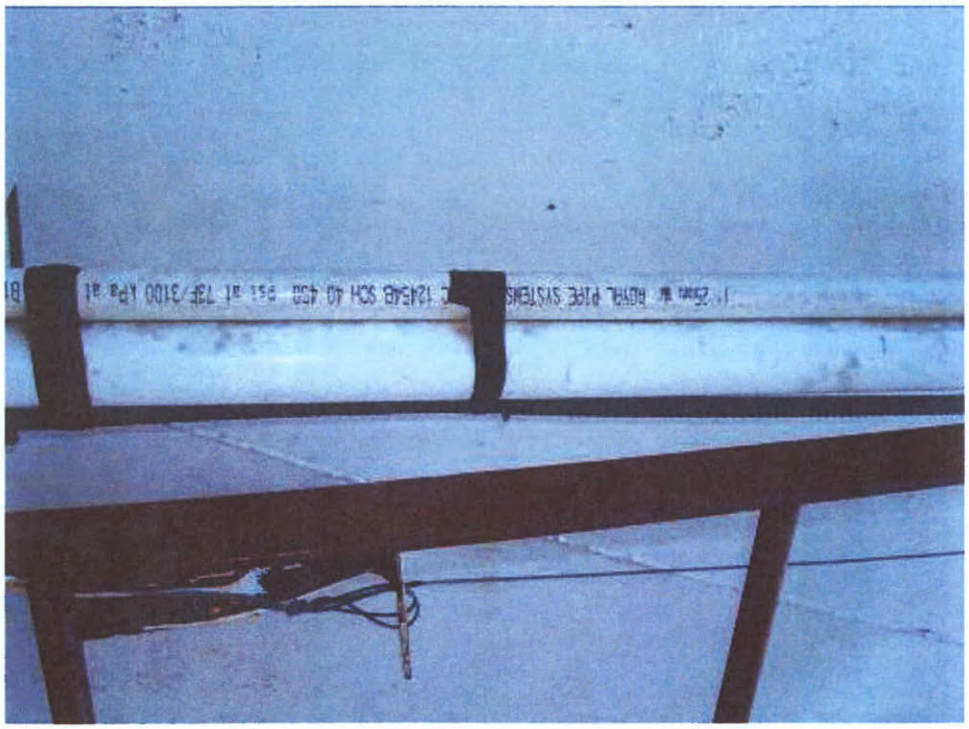


Photo 6: Piping

Photo 7: Storage Tank

Photo 8: Distribution System Outlet from Storage Tank

Photo 9: _____

Photo 10: _____Manhole

Photo 12: Well Pump Manhole

Photo 13: Old Well Pump – now used for Fire Truck Supply

Photo 13: Storage Tank

Brew Bay Water System

Photo 1: Booster Pump Station

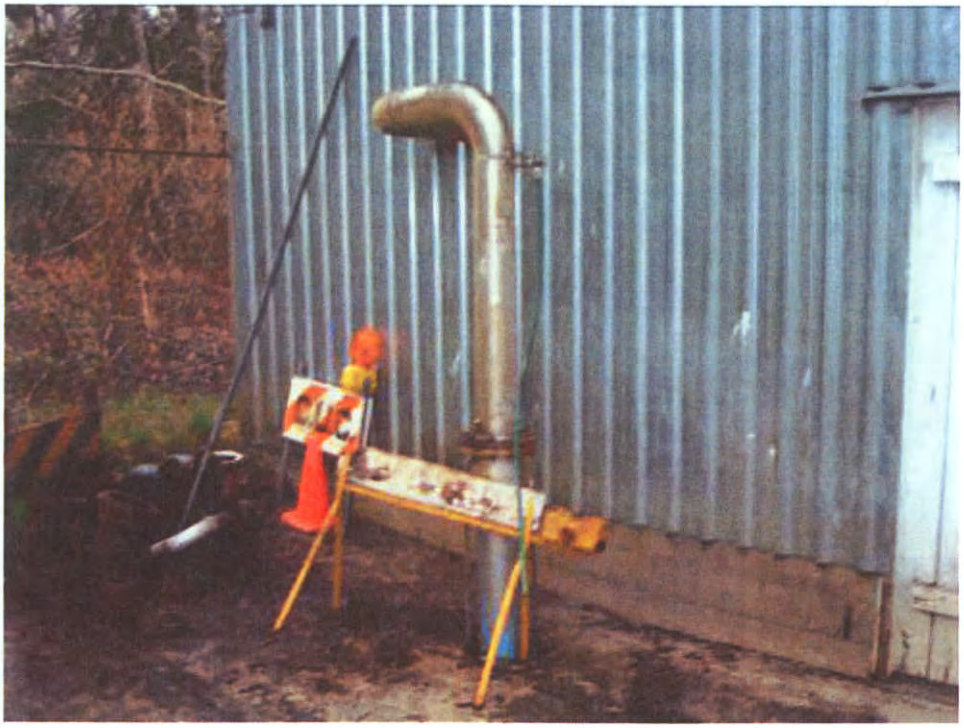


Photo 2: Distribution System Discharge – 60-80psi

Photo 3: Inlet to Steel Storage Tank

Photo 4: Outlet from Storage Tanks to Pumphouse

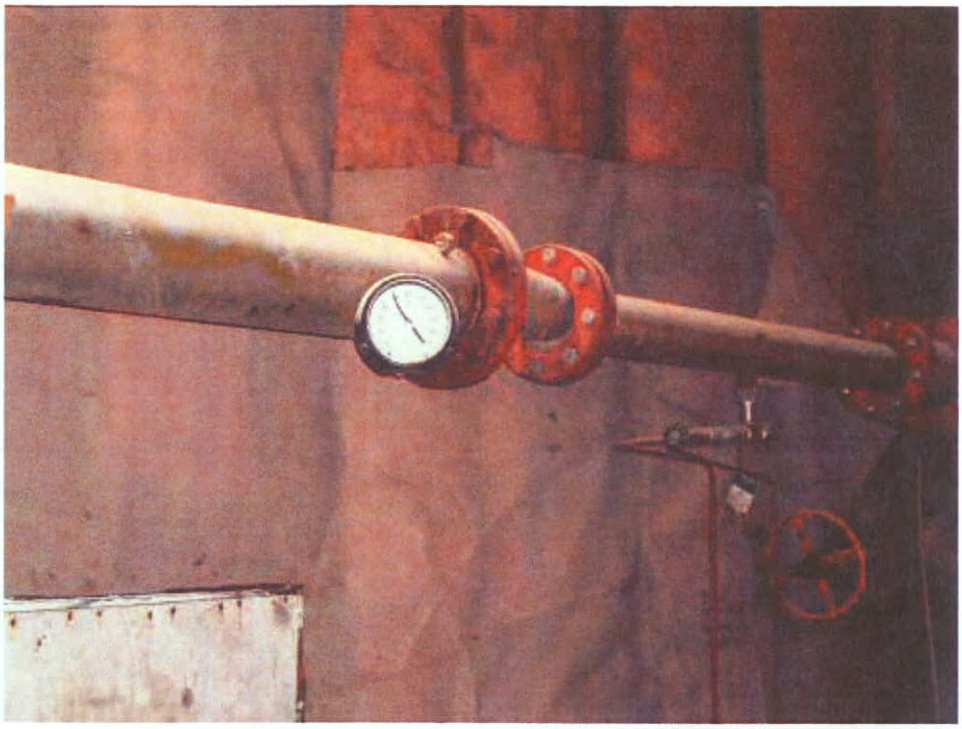


Photo 5: Discharge Header – 80psi

Photo 6: Booster Pumps 2-225 USgpm Berkley and 1-500USgpm Fore

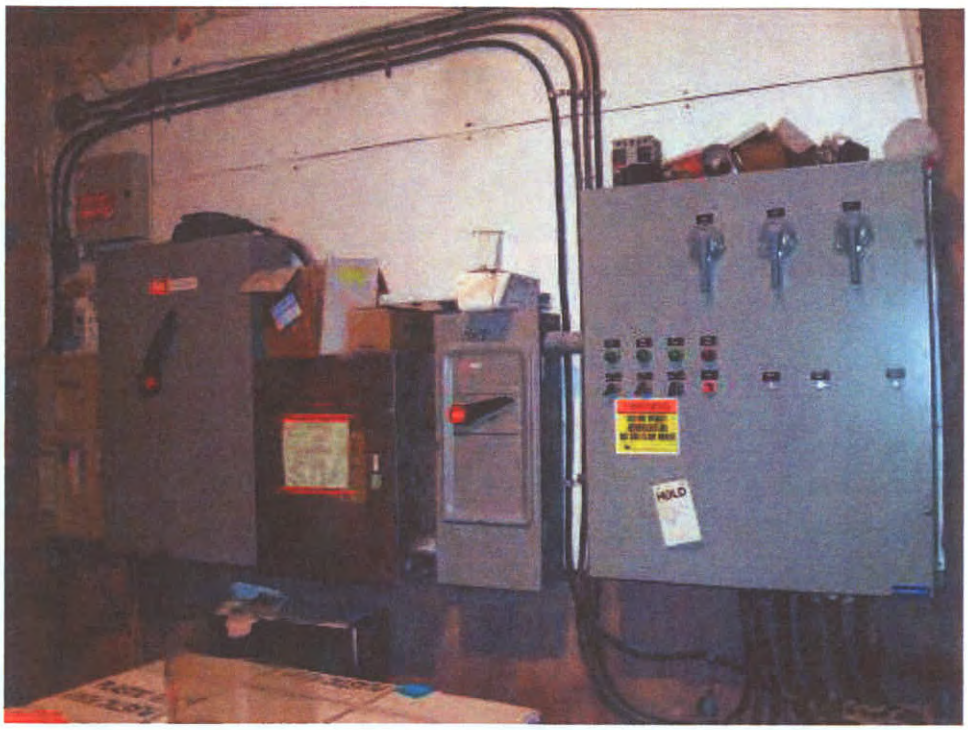


Photo 7: Control Panels

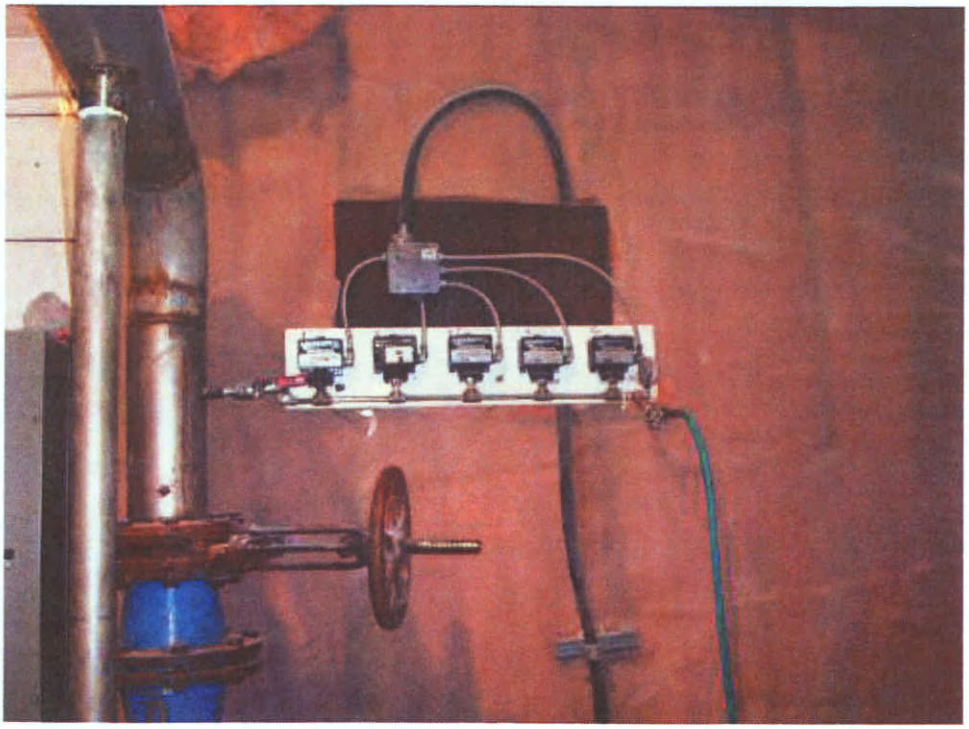


Photo 8: Chlorine Injection

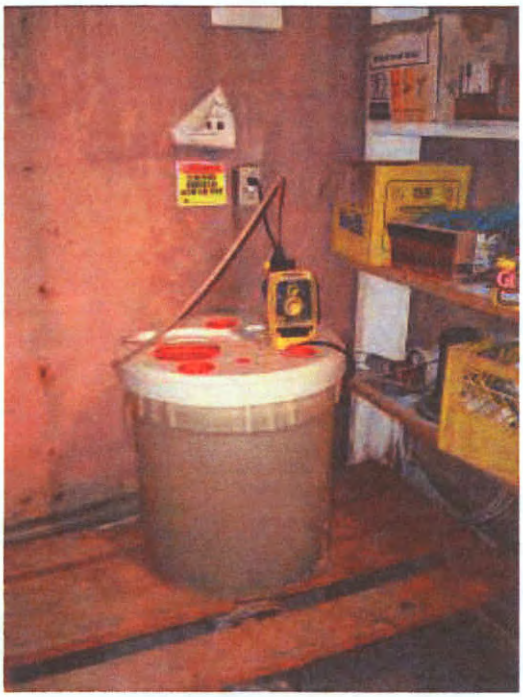


Photo 9: Chlorine Feed Pump

Photo 10: Pneumatic Tank

Lang Bay Water System

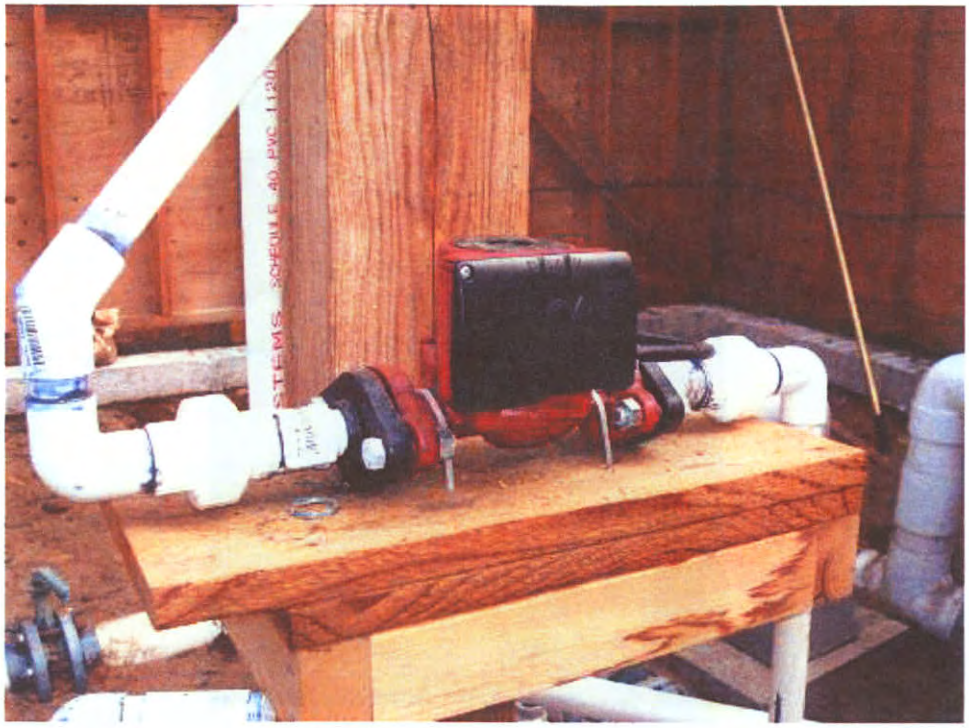


Photo 1: _____

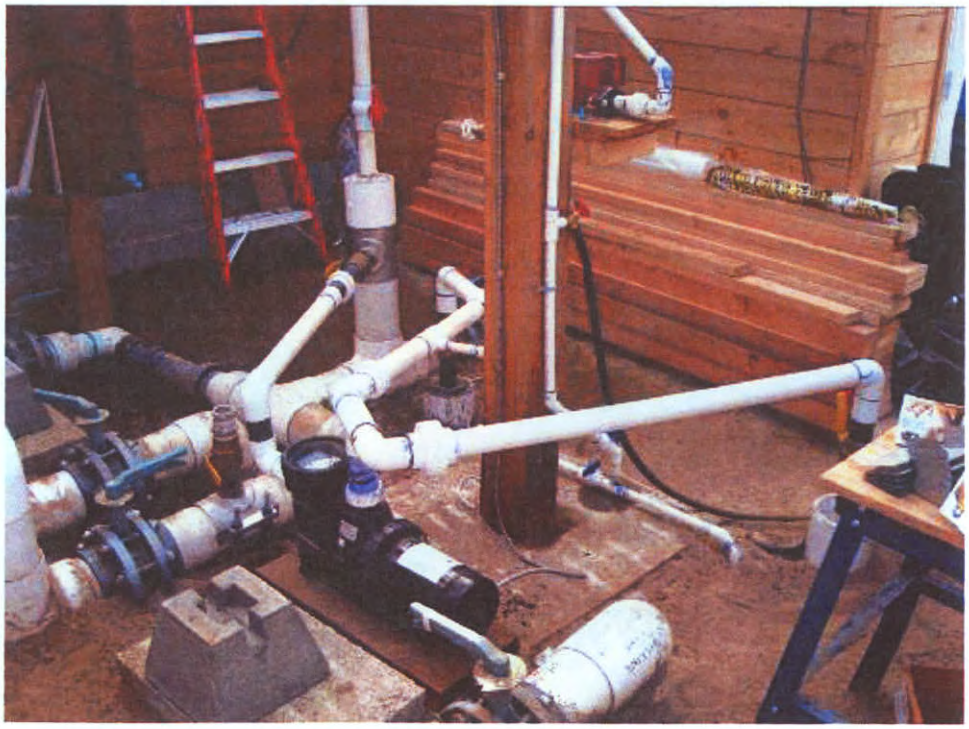


Photo 2: Piping Arrangement

Photo 3: Piping Arrangement – Chlorination Builder

Photo 4: Piping Arrangement

Photo 5: Reservoir Overflow

Photo 6: Bolted Steel Reservoir with Cover

Photo 7: Storage Reservoir

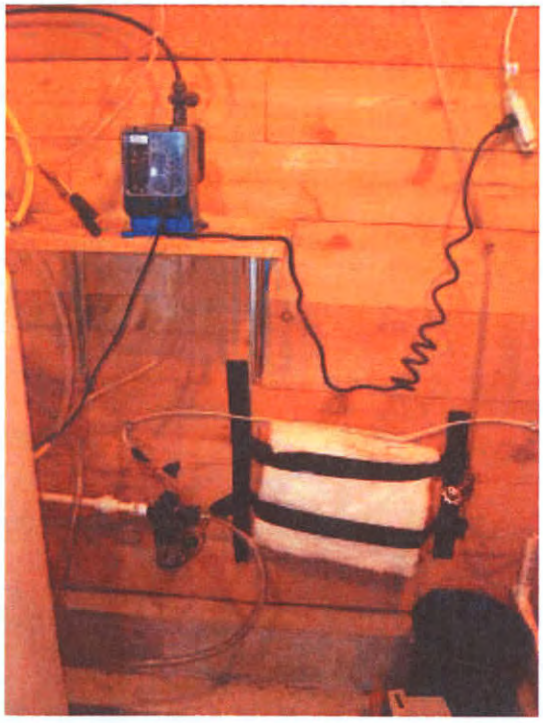


Photo 8: Chlorine Feed

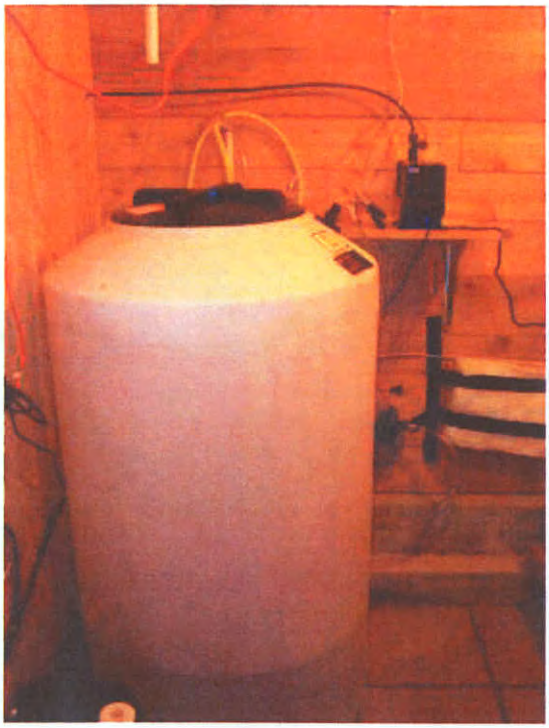


Photo 9: Chlorine Feed

Photo 10: Chlorine Feed Controls

Photo 11: Flowmeter

Stillwater Water System

Photo 1: Acrylic Storage Tanks; 4 – 1250 Igal

Photo 2: Flowmeter and Chlorination Building

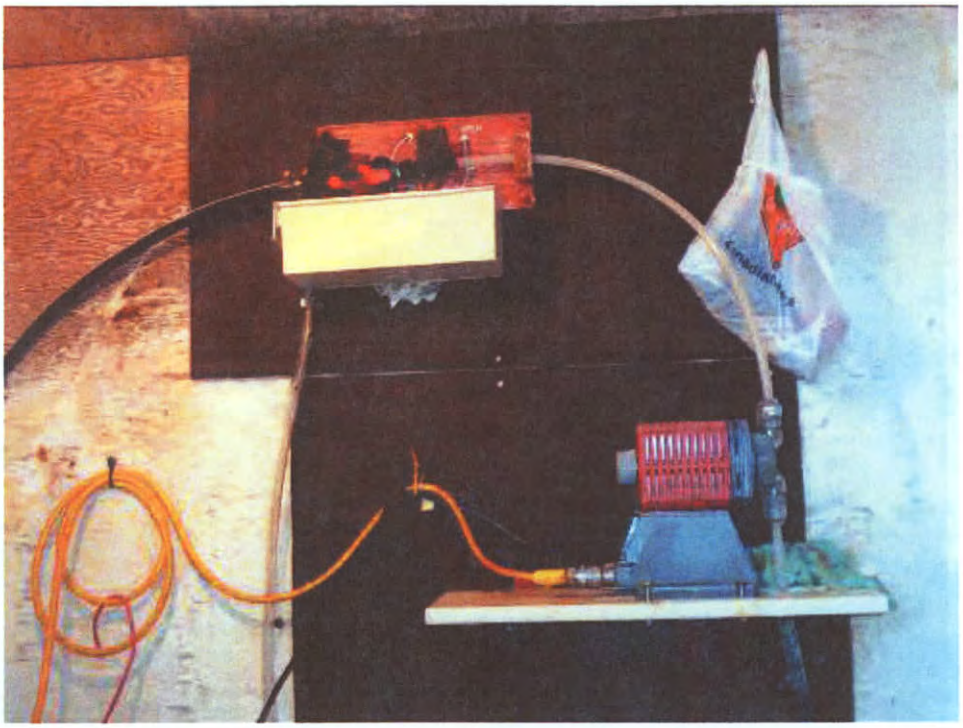


Photo 3: Chlorine Feed Pump; feeds Storage Tank via 500m – 19mm line

Photo 4: Flow Meter & Chlorination Bulding

Photo 5: PRV Chamber

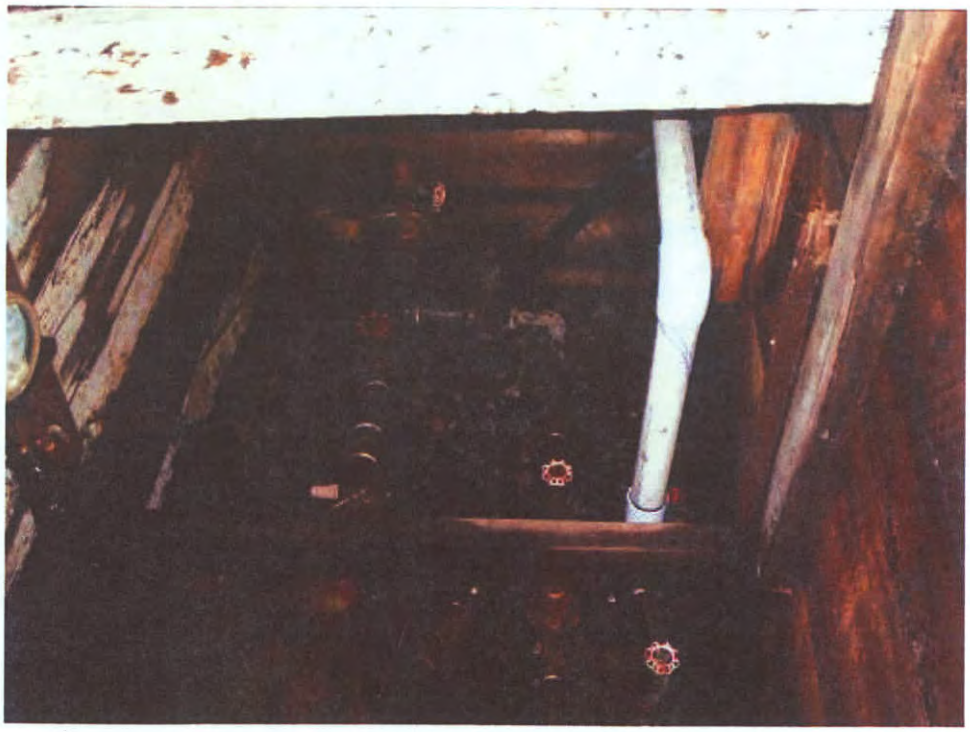


Photo 6: PRV Station

Photo 7: PRV Station

Photo 8: Typical ARV

Photo 9: Supply Line from Intake to Storage Tank

Photo 10: Intake

Photo 11: Inlet Header to Storage Tank

Photo 12: Piping Intake to Storage Tank

Appendix E
Provincial Water Licences
- Haslam Lake
- Hammil Lake
- Lois Lake

Province of British Columbia
Water Act

CONDITIONAL WATER LICENCE

The owner of the land to which this licence is appurtenant is hereby authorized to divert, store and use water as follows:

(a) The stream on which the rights are granted is **Lois Lake**.

(b) The point of diversion is located as shown on the attached plan.

(c) The date from which this licence shall have precedence is **19th October, 1999**.

(d) The purpose for which this licence is issued is **industrial (fish culture)**.

(e) The maximum quantity of water which may be diverted is **500,000 gallons a day**.

(f) Water may be used throughout **the whole year**.

(g) The land upon which the water is to be used and to which this licence is appurtenant is **that that parcel or tract of Unsurveyed Crown Land, Group 1, New Westminster District, tenured under the *Land Act*, held under Lands File 2403659.**.

(h) The works authorized to be constructed are **diversion structure, submersible pump, pipe, hatchery, settling ponds and ditch** which shall be located approximately as shown on the attached plan.

(i) The construction of the said works shall be completed and the water beneficially used prior to **31st December, 2005.** Thereafter, the licensee shall continue to make a regular beneficial use of water in the manner authorized herein.

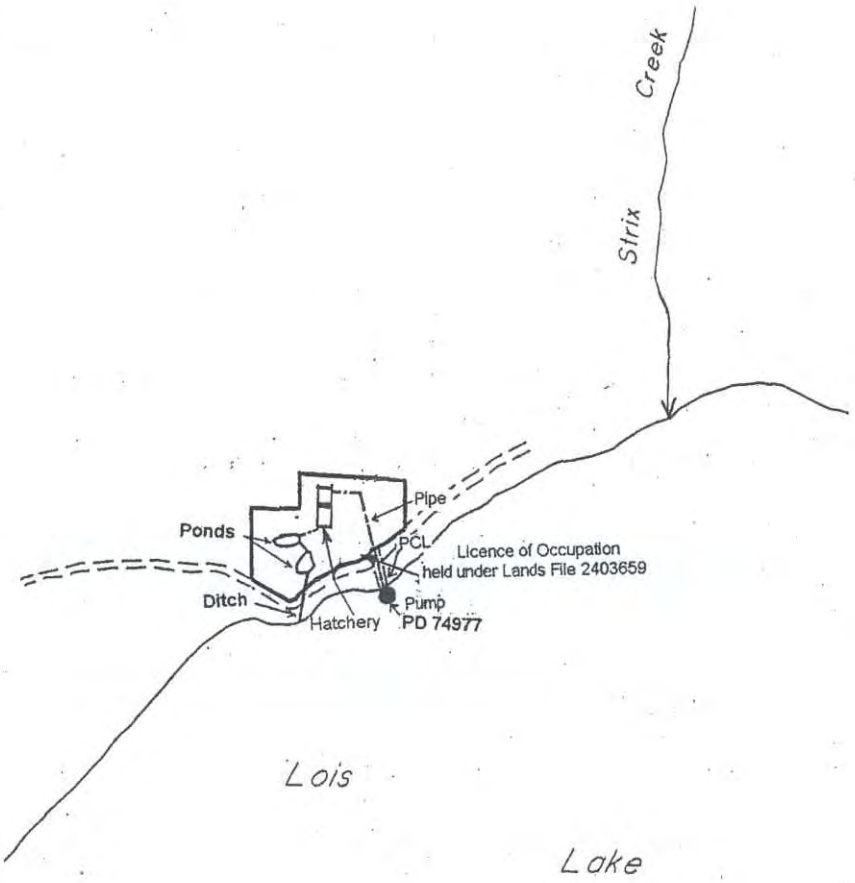
(j) The diversion of water authorized under this licence may be restricted or prohibited at any time by an order in writing of the Engineer for the New Westminster Water District in order to maintain a minimum flow in the stream for the preservation of fish life.

(k) This licence authorizes the use of water for industrial (fish culture) purpose in **one building (hatchery)** located approximately as shown on the attached plan.

Alec Drysdale
Assistant Regional Water Manager

File No. **2002371** Date issued: **15th July, 2002** Conditional Licence: **114763**

BRITISH COLUMBIA



WATER DISTRICT: VANCOUVER
PRECINCT : JERVIS
LAND DISTRICT : NEW WESTMINSTER

Scale : 1 : 25000
Points of Diversion : ● PD 74977
Map Number: : 92F/16b
Pipe : — – —
Permit over Crown Land : ═══

The boundaries of the land to which this license is appurtenant are shown thus: ———

Signature: [signature]

Date: JULY 15, 2002

C.L.: 114763
File: 2002371
P.C.L.: 24077

WATER MANAGEMENT BRANCH

MINISTRY OF ENVIRONMENT, LANDS AND PARKS

THE PROVINCE OF BRITISH COLUMBIA—WATER ACT

CONDITIONAL WATER LICENCE

The owner of the land to which this licence is appurtenant is hereby authorized to store water as follows:

(a) The stream on which the rights are granted is **Lois River and the reservoirs are Lois Lake and Khartoum Lake.**

(b) The storage sites are located as shown on the attached plan.

(c) The date from which this licence shall have precedence is **12th June, 1929.**

(d) The purpose for which this licence is issued is **as set out in Conditional Water Licence 113351.**

(e) The maximum quantity of water which may be stored is **448,960 acre feet per annum.**

(f) Water may be stored throughout **the whole year.**

(g) The land upon which the water is to be used and to which this licence is appurtenant is **as set out in Conditional Water Licence 113351.**

(h) The works authorized to be constructed are **dam** which shall be located approximately as shown on the attached plan.

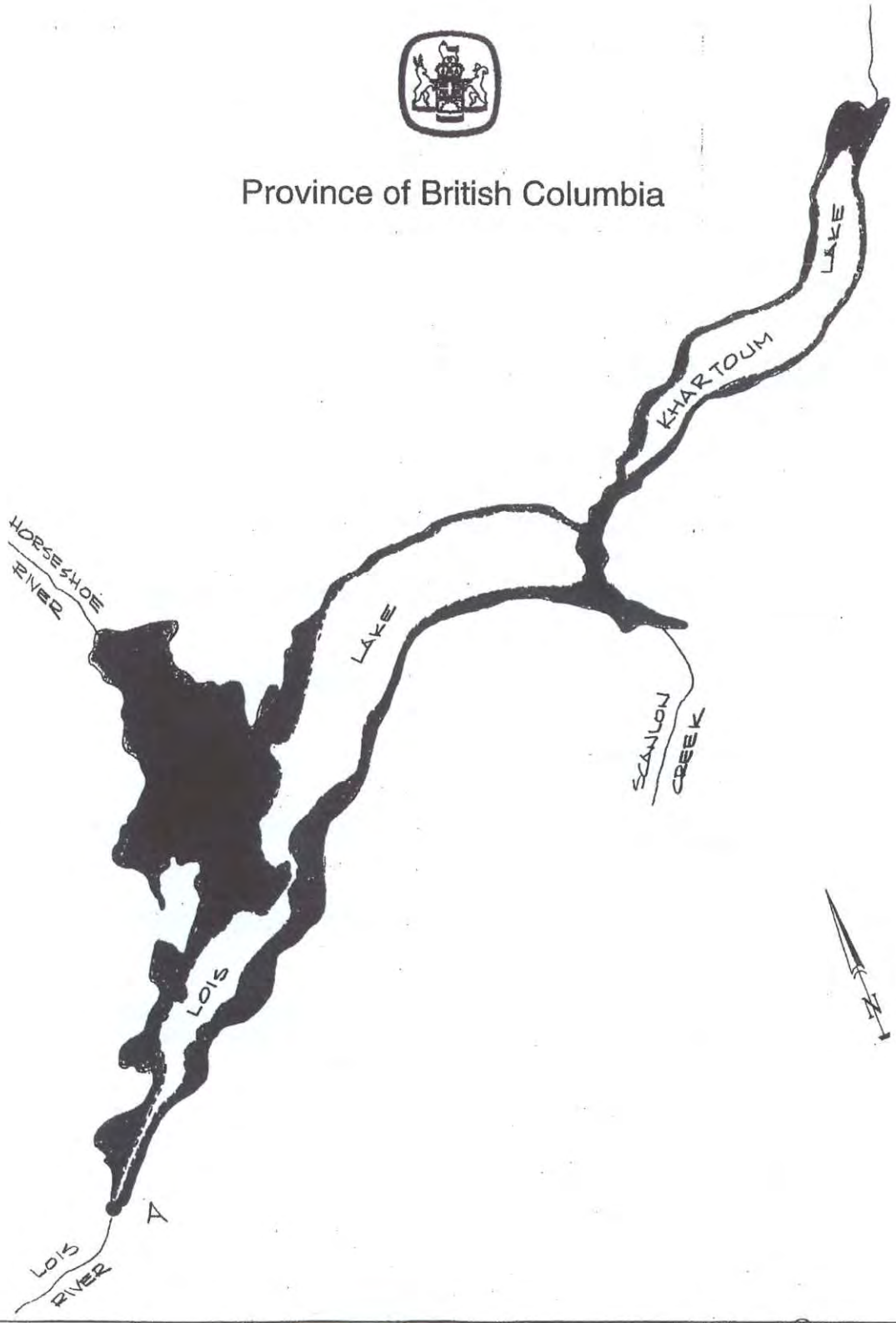
(i) The construction of the said works has been completed and the water is being beneficially used. The licensee shall continue to make a regular beneficial use of water in the manner authorized herein.

(j) This licence is issued in substitution of Final Water Licence 14640, in part.

D. Barry Paterson
Assistant Regional Water Manager

File No: **0086888** Date issued: **1st June, 1998** Conditional Licence: **113353**

Province of British Columbia



WATER DISTRICT: Vancouver
PRECINCT : Jervis
LAND DISTRICT : Group 1, New Westminster

LEGEND

Scale : 1:75000
Dam : •
Map Number : WR 92.F.079.3.4
Flooding : To the 530 foot contour

Signature: [signature]
Date: JUNE 1/98

CL 113353 for FL 14640, in part
File 0086888
PCL 22793 for PCL 3635, In part
For Diversion See CL 113351

WATER MANAGEMENT BRANCH

MINISTRY OF ENVIRONMENT, LANDS AND PARKS

THE PROVINCE OF BRITISH COLUMBIA—WATER ACT

CONDITIONAL WATER LICENCE

The owner of the land to which this licence is appurtenant is hereby authorized to divert and use water as follows:

(a) The stream on which the rights are granted is **Lois River**.

(b) The point of diversion is located as shown on the attached plan.

(c) The date from which this licence shall have precedence is **12th June, 1929**.

(d) The purpose for which this licence is issued is **power (general)**.

(e) The maximum quantity of water which may be diverted is **1297 cubic feet per second**.

(f) Water may be used throughout **the whole year**.

(g) The land upon which the water is to be used is **Statutory Rights of Way BM 139267, BM 139268, BM 139269 and BM 139270 over those portions of District Lots 1571, 5697, 4422, 1631 and 2676, Group 1, New Westminster District shown on Plans LMP 37381, 37382, 37383 and 37384** on which a powerhouse is situated, and the land to which the licence is appurtenant is said land.

(h) The works authorized to be constructed are **dam, intake, penstock and powerhouse** which shall be located approximately as shown on the attached plan.

(i) The construction of the said works has been completed and the water is being beneficially used. The licensee shall continue to make a regular beneficial use of the water in the manner authorized herein.

(j) This licence is issued in substitution of Final Water Licence 14639, in part.

D. Barry Paterson
Assistant Regional Water Manager

File No: **0086888** Date issued: **1st June, 1998** Conditional Licence: **113351**

AMENDING ORDER

Land and Water British Columbia Inc.
A corporation of the government of British Columbia

Files: 113351, ~~113342~~, ~~113347~~, 113357

File: 0086988

DEC 0 6 2002

Russell Storry, P.Eng.
Plant Superintendent
Powell River Energy Inc.
PO Box 278
Powell River BC V8A 4Z6

Dear Mr. Storry:

Further to our letter of September 16, 2002, we have now considered your September 10, 2002 request to amend the conditional Water Licences 113351, 113342, 113347, 113357, changing clause (d) from the purpose of "power (general)" to the purpose of "power". We confirm that rentals are currently charged for these licences at the power (commercial) rate when power is used in the pulp mill. Rentals are only charged as power (general) when there is power generated that is excess to the requirements of the mill.

We are reviewing our policy on the use of the terms that define the purpose in water licences. However it is my decision that for conditional Water Licences 113351, 113342, 113347, 113357, clause (d), be amended as follows: "The purpose for which this licence is issued is power." New conditional water licences will not be issued at this time to reflect this amendment.

Yours truly,

12 06

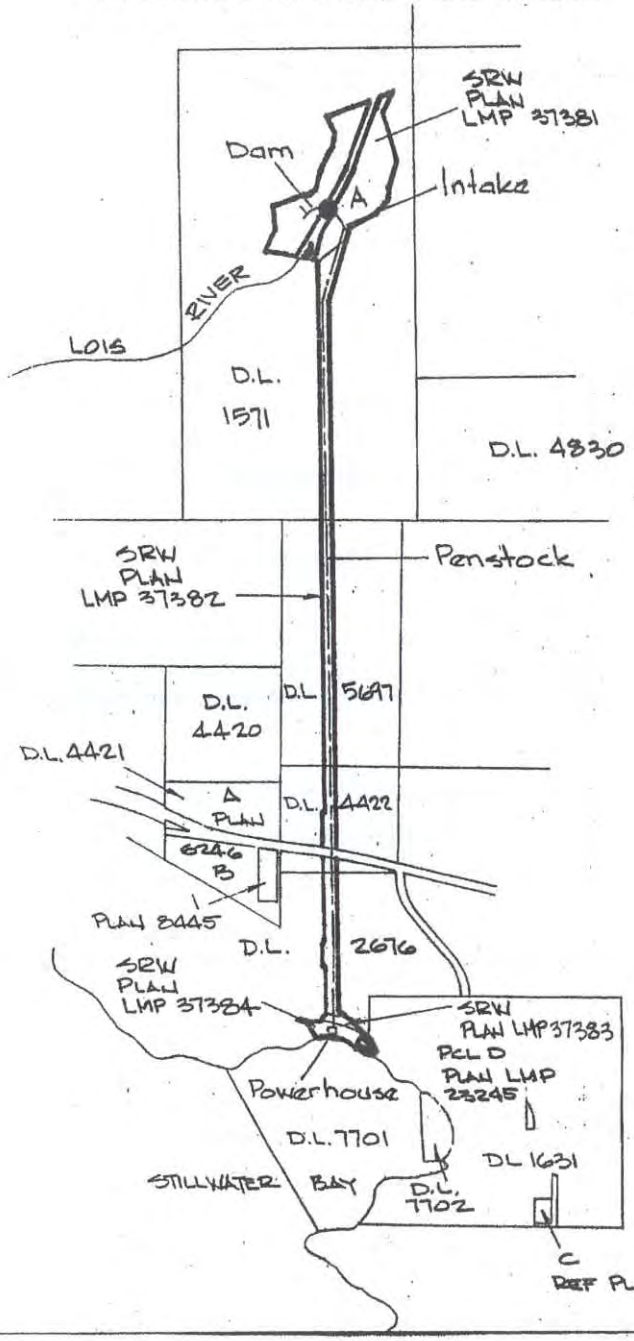
James S. Mattison, P.Eng
Comptroller of Water Rights

MASON/lt
pc: Wenda Mason, Water Management, LWBC
Susan Lewis, Water Management, LWBC
Russell Horner, President & CEO, Norske Skog Canada Ltd.

i:\watershare\water\wmb\director's office\wenda\prel dec 2_02.doc

Water Management Branch
3rd Floor - 2975 Jutland Road, Victoria BC Tel (250) 387-9498 Fax (250) 387-1898
Mailing Address: PO BOX 9340 STN PROV GOVT VICTORIA BC V8W 9M1
Website: www.bcal.bc.ca

Province of British Columbia



WATER DISTRICT: Vancouver
PRECINCT : Jervis
LAND DISTRICT : Group 1, New Westminster

LEGEND

Scale : 1:20000
Point of Diversion : •
Map Number : WR 92.F.079.3.4
Pipe : ——- ——- ——

The boundaries of the land to which this license is appurtenant are shown thus: ————

Signature: [signature]
Date: JUNE 1/98.

CL 113351 for FL 14639, In part
File 0086888
For Storage See CL 113353 & CL 113355

W.R.B. 1002—8M—[illegible]-7327

PROVINCE OF BRITISH COLUMBIA.

WATER RIGHTS BRANCH.

DEPARTMENT OF LANDS.

CONDITIONAL WATER LICENCE.

Westview Light, Power and Waterworks District, of Westview, B.C., is hereby authorized to divert and use water as follows:—

(a.) The source of the water-supply is Hammil (West) Lake, at head of Hammil Creek.

(b.) The point of diversion is located as shown on the attached plan.

(c.) The date from which this licence shall have precedence is 5th April, 1939.

(d.) The purpose for which the water is to be used is Waterworks.

(e.) The maximum quantity of water which may be diverted is 500,000 gallons a day, and such additional quantity as the ~~District~~ Engineer may from time to time determine should be allowed for losses.

(f.) The period of the year during which the water may be used is the whole year.

(g.) The land upon which the water is to be used and to which this licence is appurtenant is the Waterworks undertaking of the licensee within the territorial limits of the District,

(h.) The works for the diversion and carriage of the water are pipes, the construction of which as shown on the attached plan.

(i.) shall be commenced on or before the 31st day of July 1940, and shall be completed and the water beneficially used on or before the 31st day of December, 1950.

ENTERED ON
Map No. B251
By D.D.

E. Davis
Comptroller of Water Rights.

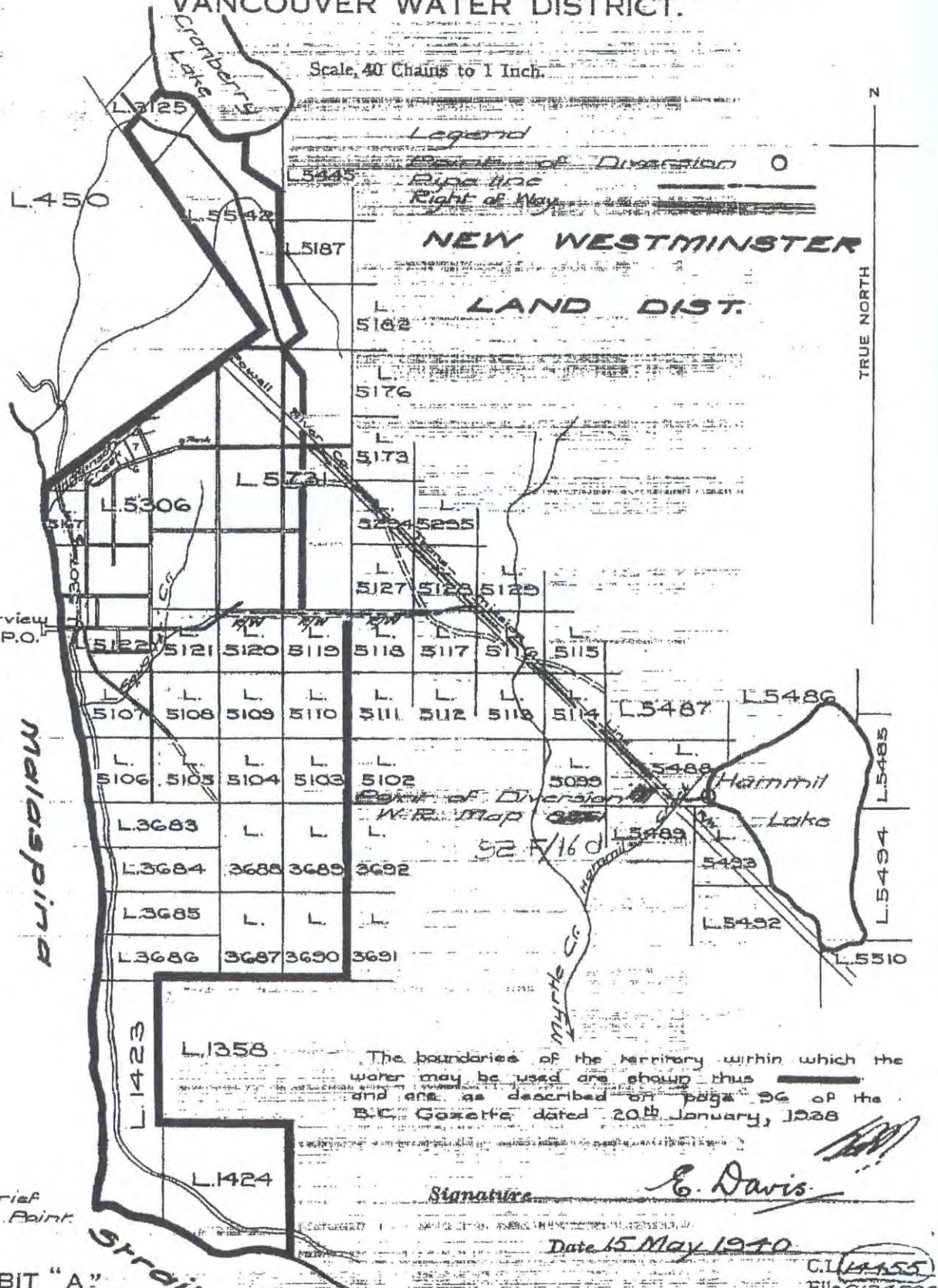
File No. 0134536. Date issued 15th May, 1940. Licence No. 14455

British Columbia.

To accompany Conditional Licence No. 14455
and Permit for Right of Way over Crown Land.

VANCOUVER WATER DISTRICT.

Scale, 40 Chains to 1 Inch.



The boundaries of the territory within which the water may be used are shown thus ——— and are as described on page 96 of the B.C. Gazette dated 20th January, 1938

Signature E. Davis.

Date 15 May 1940

C.L. 14455

File 0134536

For storage see C.L. 14456

EXHIBIT "A"

W.R.B. 100 [redacted] 233-7327

PROVINCE OF BRITISH COLUMBIA.

WATER RIGHTS BRANCH.

DEPARTMENT OF LANDS.

CONDITIONAL WATER LICENCE.

Westview Light, Power and Waterworks District, of Westview, B.C., is hereby authorized to store water as follows:—

(a.) The source of the water-supply is Hammil (West) Lake, and the reservoir is in the said lake.

(b.) The point of storage is located as shown on the attached plan.

(c.) The date from which this licence shall have precedence is 5th April, 1939.

(d.) The purpose for which the water is to be used is as set out in Conditional Water Licence No. 14455

(e.) The maximum quantity of water which may be stored is 250 acre-feet per annum, and such additional quantity as the District Engineer may from time to time determine should be allowed for losses.

(f.) The period of the year during which the water may be stored is the whole year.

(g.) The land upon which the water is to be used and to which this licence is appurtenant is as set out in Conditional Water Licence No. 14455

(h.) The works for the storage of which as shown on the attached plan. of the water are dam, the construction

(i.) 31st day of July, shall be commenced on or before the 19 40 and shall be completed and the water beneficially used on or before the 31st day of December, 1950.

ENTERED ON Map No. B251 By DD

E. Davis

Comptroller of Water Rights.

File No. 0134536. Date issued 15th May, 1940. Licence No. 14456

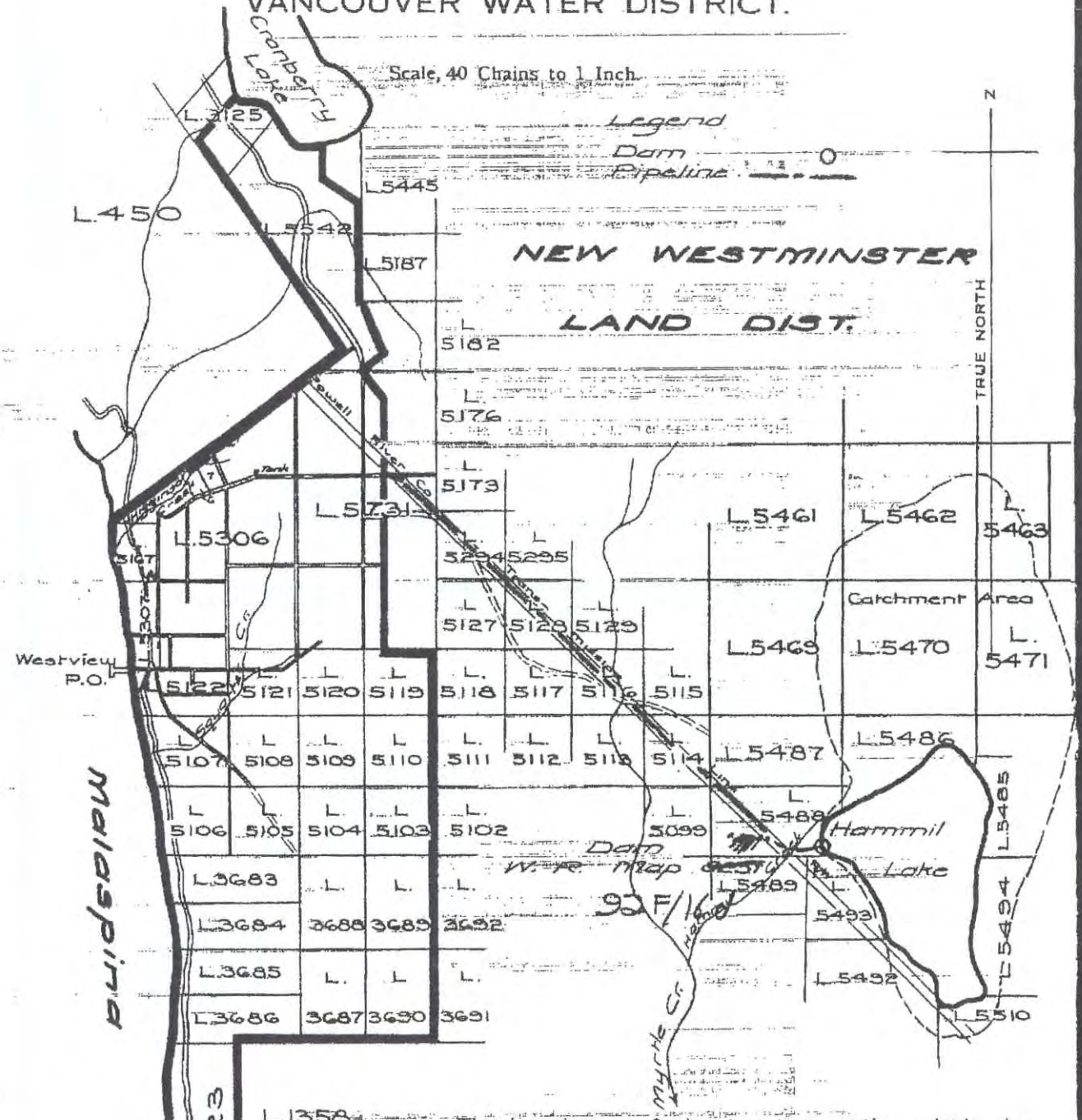
4

British Columbia.

To accompany Conditional Licence No. 14456

VANCOUVER WATER DISTRICT.

Scale, 40 Chains to 1 Inch.



The boundaries of the territory within which the water may be used are shown thus ▬▬ and are as described on page 96 of the B.C. Gazette dated 20th January, 1938

Signature E. Davis

Date 15 May 1940

C.L. 14456

File 0134336

For Diversion see C.L. 14455

EXHIBIT "A"

W.R.B. 13—0

PROVINCE OF BRITISH COLUMBIA

Water Rights Branch

DEPARTMENT OF LANDS AND FORESTS

CONDITIONAL WATER LICENCE

The Corporation of the District of Powell River, of Drawer 40, Powell River, B. C.,

is hereby authorized to divert and use water as follows:—

(a) The source of the water-supply is Haslam Lake.

(b) The point of diversion is located as shown on the attached plan.

(c) The date from which this licence shall have precedence is 17th January, 1957.

(d) The purpose for which the water is to be used is waterworks.

(e) The maximum quantity of water which may be diverted is 25 cubic feet per second and such additional quantity as the Engineer may from time to time determine should be allowed for losses.

(f) The period of the year during which the water may be used is the whole year.

(g) ~~The land upon which the water is to be used and to which~~ This licence is appurtenant ~~is~~ to the Waterworks Undertaking of the Corporation of the District of Powell River.

(h) The works authorized to be constructed are pipe,

and they shall be located approximately as shown on the attached plan.

(i) The construction of the said works ~~shall be~~ has been commenced ~~on or before the~~ ~~day~~ ~~of~~ , ~~19~~ , and shall be completed and the water beneficially used on or before the 31st day of December , 1965 .

(j) A minimum flow of 15 cubic feet per second shall be maintained in the creek below the storage dam at all times and provided further that after due consideration of the demands of the licensee herein, this minimum be increased to 25 cubic feet per second for the months of October and November should flow conditions warrant.

8250
W.L.

A. F. Paget,
Comptroller of Water Rights.

File No. 0208416 Date issued 3rd February, 1958. Licence No. 24035

6

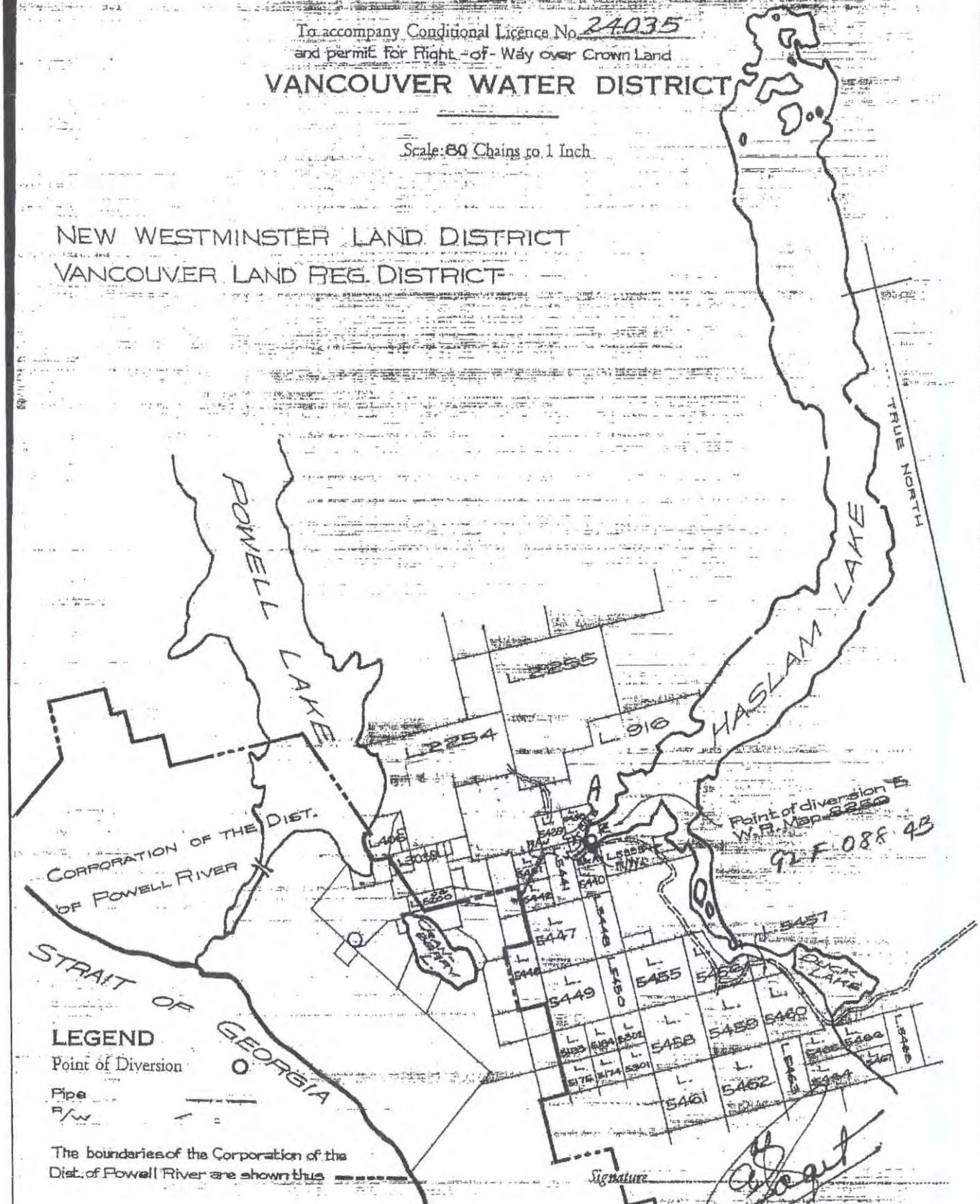
British Columbia

To accompany Conditional Licence No. 24035
and permit for Right-of-Way over Crown Land

VANCOUVER WATER DISTRICT

Scale: 80 Chains to 1 Inch

NEW WESTMINSTER LAND DISTRICT
VANCOUVER LAND REG. DISTRICT



LEGEND

Point of Diversion ○

Pipe ———

R/W - - -

The boundaries of the Corporation of the Dist. of Powell River are shown thus ———

Signature [signature]

Date 11 Jan. 1960

EXHIBIT "A"

100-1060-6201

For R/W see Ref. Map 5(D-6)

C.L. 24035
File 0208416
For storage see C.L. 20436
Permit No. 4588

W.R.B. 13—0

PROVINCE OF BRITISH COLUMBIA

Water Rights Branch

DEPARTMENT OF LANDS AND FORESTS

CONDITIONAL WATER LICENCE

The Corporation of the District of Powell River, of Drawer 40, Powell River, B. C.

is hereby authorized to store water as follows:—

(*a*) The source of the water-supply is Haslam Lake and the reservoir is the said lake.

(*b*) The point of storage is located as shown on the attached plan.

(*c*) The date from which this licence shall have precedence is 17th January, 1957.

(*d*) The purpose for which the water is to be used is as set out in Conditional Water Licence No. 24035.

(*e*) The maximum quantity of water which may be stored is 14,400 acre feet per annum,

and such additional quantity as the Engineer may from time to time determine should be allowed for losses.

(*f*) The period of the year during which the water may be stored is the whole year.

(*g*) The land upon which the water is to be used and to which this licence is appurtenant is as set out in Conditional Water Licence No. 24035.

(*h*) The works authorized to be constructed are dam,

and they shall be located approximately as shown on the attached plan.

(*i*) The construction of the said works ~~shall be~~ has been commenced ~~on or before the~~ ~~day~~ ~~of~~ ~~, 19~~ , and shall be completed and the water beneficially used on or before the 31st day of December, 19 65.

(j) A minimum flow of 15 cubic feet per second shall be maintained in the creek below the storage dam at all times and provided further that after due consideration of the demands of the licensee herein, this minimum be increased to 25 cubic feet per second for the months of October and November, should flow conditions warrant.

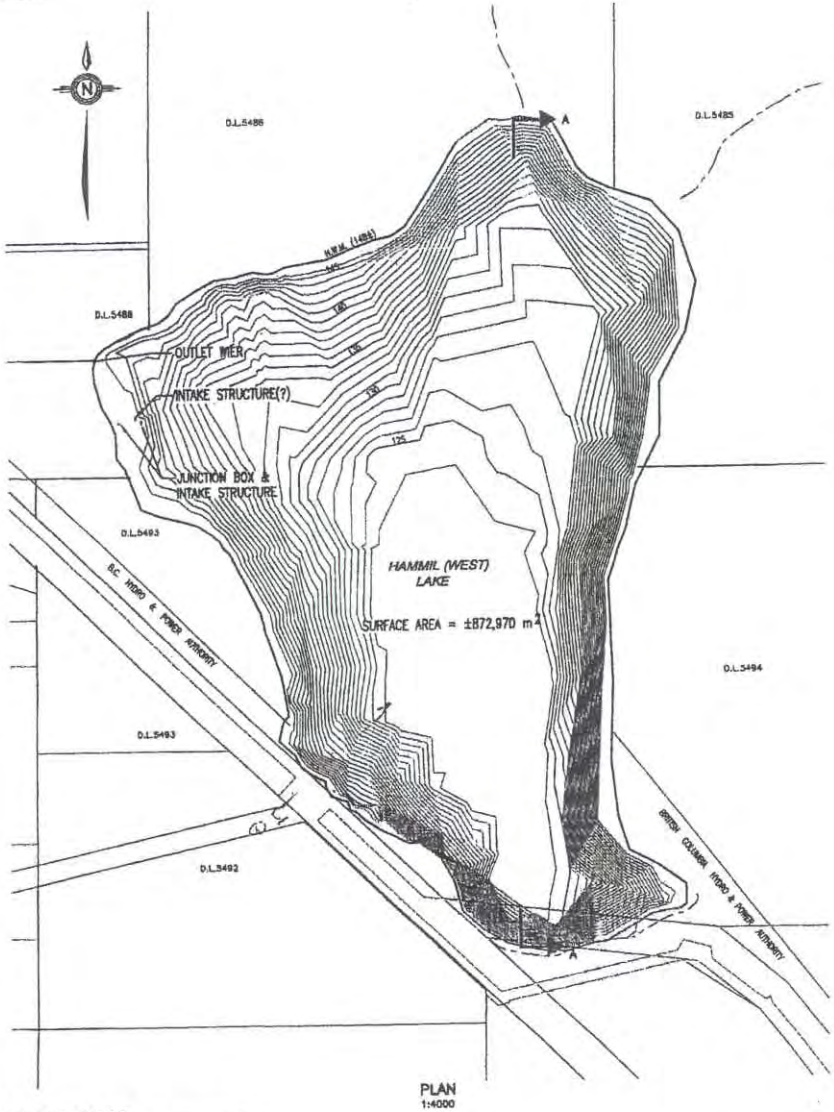
8250 A

A. F. Paget,
Comptroller of Water Rights.

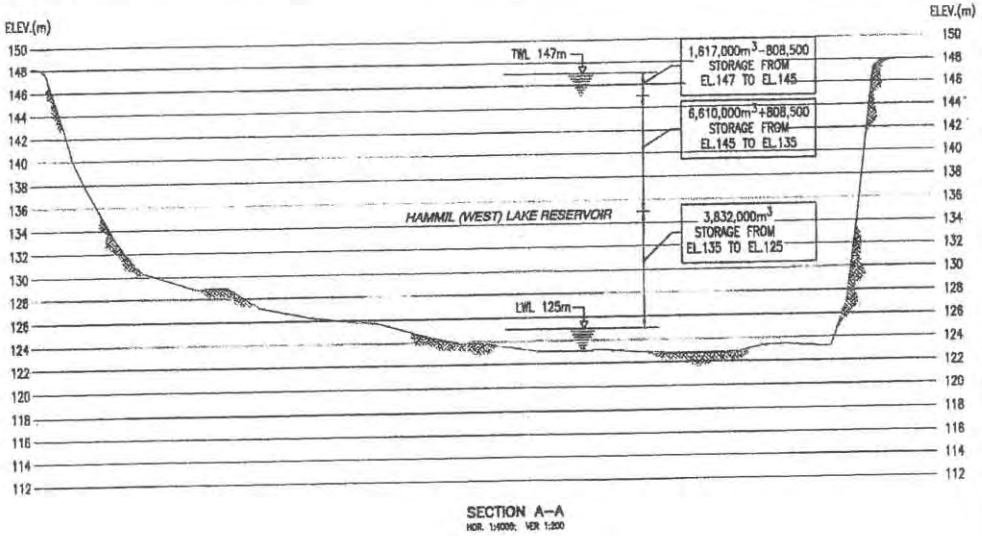
File No. 0208416   Date issued 3rd February, 1958.   Licence No. 24036


To accompany Conditional Licence No 24036
and permit for Right-of-Way, over Crown Land
VANCOUVER WATER DISTRICT
Scale: 80 Chains to 1 Inch
NEW WESTMINSTER LAND DISTRICT
VANCOUVER LAND REG DISTRICT
1031
LAND
CROWN
POWELL LAKE
HASLAM LAKE
565.58 Ft. Contour
565.53 Ft. Contour
STL
32454
L.2254
L.916
L.915
Point of re-diversion
W.R. Map
92.F.088 4.3
CORPORATION OF THE DIST. OF POWELL RIVER
7½ acre parcel R/W
Dam
W.R. Map 8250
92 F 088 4.1
STRAIT OF GEORGIA
LEGEND
Point of Rediversion & Dam
Pipe
Flooding R/W
Signature
Date 11 Jan, 1960
C.L. 24036
File 0208416
Permit No. 4589
For diversion see C.L. 24035
For R/W see Ref. Map 5 (D-6)
EXHIBIT "A"

Appendix F
Hammil Lake Bathymetric and Storage Data

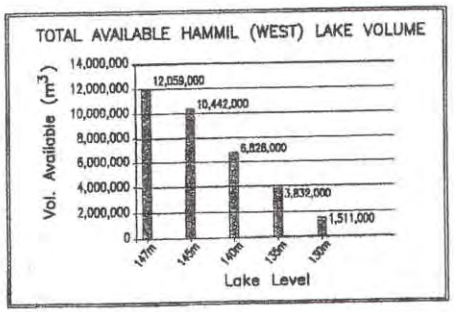


PLAN
1:4000



SECTION A–A
HOR. 1:4000; VER 1:200

VOLUME BETWEEN CONTOURS		CUMULATIVE VOLUME
ELEV	VOLUME (m³)	VOLUME (m³)
147	1,817,000	1,817,000
145	3,614,000	5,231,000
140	2,996,000	8,227,000
135	2,321,000	10,548,000
130	1,511,000	12,059,000
125		



DISTRICT OF POWELL RIVER
LONG TERM WATER SUPPLY
HAMMIL (WEST) LAKE
PLAN AND PROFILE

FIGURE 4-3

Dayton & Knight Ltd.
CONSULTING ENGINEERS