WHISTLER

AGENDA

REGULAR MEETING OF MUNICIPAL COUNCIL
TUESDAY, AUGUST 11, 2015, STARTING AT 5:30 PM

In the Franz Wilhelmsen Theatre at Maurice Young Millennium Place
4335 Blackcomb Way, Whistler, BC V0N 1B4

ADOPTION OF AGENDA

Adoption of the Regular Council agenda of August 11, 2015.

ADOPTION OF MINUTES

Adoption of the Regular Council minutes of July 21, 2015.

PUBLIC QUESTION AND ANSWER PERIOD

PRESENTATIONS/DELEGATIONS

RMOW 40th Anniversary

A presentation by Michele Comeau, Manager of Communications for the Resort Municipality of Whistler (RMOW), regarding the 40th anniversary of the Resort Municipality of Whistler.

MAYOR'S REPORT

INFORMATION REPORTS

2013-2014 Cheakamus River Environmental Monitoring Outcomes
Report No. 15-100
File No. 306

A presentation by municipal staff.

That Information Report No. 15-100 regarding Cheakamus River Environmental Monitoring outcomes be received.

ADMINISTRATIVE REPORTS

Final Sewer Extension Project - Alta Lake Road
Report No. 15-099
File No. 365

A presentation by municipal staff.

That Council support proceeding with the Final Sewer Extension Project along Alta Lake Road on basis of the preferred Shallow Road Alignment Option, as presented to Council in Report 15-099, and a $12,000 Local Area Service charge; and,

That staff be directed to arrange mailings and a public information session with affected property owners to share the proposed project principles.

OTHER BUSINESS

CORRESPONDENCE

Highway Closure for IRONMAN File No. 8216.49	Correspondence from Brian Thiessen, dated July 26, 2015, regarding the highway closure for IRONMAN.
Olympic Plaza File No. 8200.05.14	Correspondence from John Wood, dated July 31, 2015, regarding the height of the stage at Olympic Plaza, and suggesting that a first nation display near the plaza be moved.
Traffic in Lakeside Park Area File No. 3009	Correspondence from David Berkowitz, dated August 2, 2015, regarding traffic and safety concerns in the Lakeside Park area.
Fuel Management Project File No. 3009	Correspondence from Danyta Welch, Policy & Programs Officer, for the Local Government Program Services at the Union of BC Municipalities (UBCM), dated July 28, 2015, regarding completion of Fuel Management Project for the Horstman Operational Treatment, 2013.
Environmental Legacy Fund File No. 3009	Correspondence from Carol Coffey, dated July 6, 2015, regarding the fund statement for the Environmental Legacy Fund for 2014.
World Mental Health Day File No. 3009.1	Correspondence from Lauren Yip, Youth Ambassador, and Jan McNeill, Amanda Todd Legacy Administrator, requesting October 10, 2015 be proclaimed World Mental Health Day, and requesting support for the Light Up the World Purple Awareness Campaign on World Mental Health Day.

ADJOURNMENT

WHISTLER

MINUTES

REGULAR MEETING OF MUNICIPAL COUNCIL TUESDAY, JULY 21, 2015, STARTING AT 5:30 PM

In the Franz Wilhelmsen Theatre at Maurice Young Millennium Place
4335 Blackcomb Way, Whistler, BC V0N 1B4

PRESENT:

Mayor N. Wilhelm-Morden

Councillors: S. Anderson, J. Crompton, J. Ford, J. Grills, A. Janyk, S. Maxwell

Chief Administrative Officer, M. Furey
General Manager of Infrastructure Services, J. Paul
General Manager of Corporate and Community Services, N. McPhail
General Manager of Resort Experience, J. Jansen
Corporate Officer, S. Story
Director of Planning, M. Kirkegaard
Manager of Communications, M. Comeau
Manager of Special Projects, T. Battiston
Manager of Building Department, J. Mooney
Manager of Transportation and Waste Management, J. Hallisey
Manager of Resort Parks Planning, M. Pardoe,
Manager of Village Animation & Events, B. Andrea
Manager of Development Services and Deputy Approving Officer, J. Ertel
Recording Secretary, A. Winkle

ADOPTION OF AGENDA

Moved by Councillor J. Ford
Seconded by Councillor J. Crompton

That Council adopt the Regular Council agenda of July 21, 2015 with the removal of the Information Report "Gateway Loop – Reporting Back." Report No. 15-098.

CARRIED

ADOPTION OF MINUTES

Moved by Councillor A. Janyk
Seconded by Councillor J. Grills

That Council adopt the Regular Council minutes of July 7, 2015, and Special Council minutes of July 13, 2015.

CARRIED

PUBLIC QUESTION AND ANSWER PERIOD

There were no questions from the public.

MAYOR'S REPORT

Mayor Wilhelm-Morden reported that the thirty-second annual Whistler Children's Festival from July 10 to 12 was a success again this year. There were four thousand children and parents in attendance. The weekend offered live performances, fifty-six different creative workshops, entertainment and free activities.

Mayor Wilhelm-Morden reported that volunteers cleared garbage from five of Whistler's Lakes for the third annual Great Lake Cleanup on July 12. Many large items were removed that had been found during previous cleanups. These difficult items included five large propane cylinders and two rowboats in Alta Lake. Each lake had teams cleaning the shoreline as well as the lake bottom. A team of divers, from Divers for Cleaner Lakes and Oceans, were pleased to report that Alta Lake is very healthy and has lots of aquatic life throughout its various depths. Mayor Wilhelm-Morden thanked all the volunteers for participating and to Roger McCarthy for organizing the event. Councillor A. Janyk reported that the lakes are cleaner each year. Councillor S. Anderson commented on the number of golf balls in the lakes.

Mayor Wilhelm-Morden reported that Whistler's fire danger rating has returned to extreme. With the high risk, everyone in Whistler is urged to be vigilant about fire prevention all summer long. Although rain reduces the risk briefly, we are likely to have a raised fire risk until the fall. She reminded everyone that there are no campfires allowed anywhere and there is no smoking in parks and trails at any time. Please report any signs of fire, at any time of the day or night, to 9-1-1 in Whistler or *5555 on your cellphone outside of Whistler.

Mayor Wilhelm-Morden reported that Whistler is hosting the third Subaru IRONMAN Canada on Sunday, July 26. Everyone is encouraged to come out to the event and to cheer on the athletes. She commented on key spot for viewing the event at Alpine Way and Highway 99, or any of the transition stages of the event. IRONMAN's course covers much of Whistler and Pemberton as well as Highway 99 between the Callaghan and Pemberton. The best form of transportation on Sunday will be by bike or foot along the Valley Trail. Drivers should expect major disruptions, including significant road closures and parking shortages, from 7 a.m. until 5:30 p.m. Visit whistler.ca/ironman for more information.

Mayor Wilhelm-Morden reminded everyone in Whistler to conserve water this summer. With the raised fire risk, the dry spring, and the low snow pack, water conservation is even more important than usual. Whistler's water levels are low this year due to a low snowpack and dry conditions. There is an unseasonably low amount of fresh water melting into 21 Mile Creek, our main surface water source. To reduce water usage, individuals can water plants and lawns less, avoid washing cars or hosing down driveways and sidewalks. Please see whistler.ca/waterconservation for details. The municipality is also conserving water by:

- Monitoring neighbourhoods, speaking with residents and stratas, and issuing tickets for improper use;
- Replacing the Alpine Water Main and reducing leaks in Whistler's water mains;
- Reducing the amount of water used to irrigate parks by 20 per cent; and,
- Cancelling this year's water main flushing program, equivalent to 870,000 toilet flushes.

Mayor Wilhelm-Morden reported that June 2015 is now Whistler's busiest June on record. Resort-wide paid room nights grew 26 per cent over last year, and all other key performance indicators also posted notable year over year growth. The growth was driven by strong conference and group business, events, and the weather.

Mayor Wilhelm-Morden reported that she and Suzanne Muscat met with MP John Weston last Friday to discuss next steps for the cell tower proposed for the corner of Lorimer Road and Highway 99. The municipality's letter of non-concurrence has gone out and it is now in the hands of the minister to make a decision. They met with MP Weston to get his advice on what we could do next, and what he might do next. There is not a lot that can be done at this time; the letters have been delivered. MP Weston said he was impressed with the work of numerous groups and individuals in Whistler, and as a result of that work he was going to make a recommendation to the minister that the application not be approved. He was unable to give a timeline as to when the minister might make a decision. He did confirm that although Minister Moore is not running for re-election, he will continue to sit as an MP and in that ministerial seat until the election. At this point, we have to wait and see.

INFORMATION REPORTS

Key Community Performance Indicator Update (2014)
Report No. 15-093
File No. 8362

Moved by Councillor J. Ford
Seconded by Councillor J. Crompton

That Information Report No. 15-093 regarding the 2014 annual update to Whistler's key community performance reporting program be received.

CARRIED

Planning and Building Departments Application Activity Report – 2015 Second Quarter
Report No. 15-095
File No. 7006.01

Moved by Councillor S. Anderson
Seconded by Councillor J. Ford

That Information Report No.15-095 summarizing the Planning Department and Building Departments application activity for the second quarter of 2015 be received.

CARRIED

Gateway Loop – Reporting Back
Report No. 15-098
File No. 573

This item was removed from the agenda.

ADMINISTRATIVE REPORTS

2015 Le Diner En Blanc Catering License Capacity
Report No. 15-096
File No. 8216

Moved by Councillor A. Janyk
Seconded by Councillor J. Grills

That Council endorse a requested capacity of over 500 people for a catering licensed event, subject to Liquor Control & Licensing Branch (LCLB), Whistler Fire Rescue and Whistler RCMP approvals for “Le Diner en Blanc” event to be held Friday, August 21, 2015 at an RMOW approved location.

CARRIED

RBC GranFondo Whistler Catering Liquor License
Report No. 15-097
File No. 8216

Moved by Councillor J. Crompton
Seconded by Councillor J. Ford

That Council approve the Catering License capacity of over 500 for the RBC GranFondo Whistler to be held on Saturday, September 12, 2015, subject to Liquor Licensing and Distribution Branch (LCLB), Whistler Fire Rescue and RCMP approvals.

CARRIED

Skatepark Phase 3 – Project Update and Construction Contract Award
Report No. 15-092
File No. 8075.01

Moved by Councillor J. Grills
Seconded by Councillor A. Janyk

That Council receive Administrative Report 15-092; and,

That Council direct staff to amend the Five-Year Financial Plan 2015-2019 Bylaw No. 2085, 2015 to increase the Skate Park Rejuvenation Plan budget to $907,600, an increase of $100,000, to be funded by an external grant; and further,

That Council award the Skatepark Phase 3 construction contract to EHR Contracting Ltd. of Chilliwack BC for a value of $791,000.

CARRIED

District Energy System (DES) Update
Report No. 15-094
File No. 481.6

Moved by Councillor S. Anderson
Seconded by Councillor S. Maxwell

That Council endorse the planned DES initiatives for 2015 as set out in Administrative Report No. 15-094.

CARRIED

Whistler Solid Waste Management Strategy Update
Report No. 15-091
File No. 604

Moved by Councillor J. Crompton
Seconded by Councillor J. Ford

That Council receive Administrative Report No. 15-091 on the actions taken to improve waste diversion and reduce solid waste costs as set out in the 2013 Whistler Solid Waste Management Strategy; and,

That Council approve the framework for the proposed bylaw to improve diversion of organics and recyclables in the commercial and strata sectors as described in Council Report 15-091.

CARRIED

MINUTES OF COMMITTEES AND COMMISSIONS

May Long Weekend Committee

Moved by Councillor J. Grills
Seconded by Councillor A. Janyk

That minutes of May Long Weekend Committee meeting of May 6, 2015 be received.

CARRIED

Recreation and Leisure Advisory Committee

Moved by Councillor A. Janyk
Seconded by Councillor S. Maxwell

That minutes of the Recreation and Leisure Advisory Committee meeting of June 11, 2015 be received.

CARRIED

BYLAWS FOR ADOPTION

Zoning Amendment Bylaw (Heidi Haus Pension) No. 2073, 2015

Moved by Councillor J. Crompton
Seconded by Councillor S. Anderson

That Zoning Amendment Bylaw (Heidi Haus Pension) No. 2073, 2015 be adopted.

CARRIED

Employee Housing Service Charge Amendment Bylaw No. 2078, 2015

Moved by Councillor A. Janyk
Seconded by Councillor J. Grills

That Employee Housing Service Charge Amendment Bylaw No. 2078, 2015 be adopted.

CARRIED

OTHER BUSINESS

There were no items of Other Business.

CORRESPONDENCE

Smoking on Golf Course File No. 3009

Moved by Councillor J. Grills
Seconded by Councillor A. Janyk

That correspondence from Brad Sevenko, dated July 9, 2015, regarding smoking on the Chateau Whistler Golf Course be received.

CARRIED

Strategic Wildfire Prevention Initiative
File No. 8337.01

Moved by Councillor J. Crompton
Seconded by Councillor J. Ford

That correspondence from Peter Ronald, Programs Officer, dated July 8, 2015, regarding approval of the Strategic Wildfire Prevention Initiative grant for Fuel Management Prescription (SWPI-500: Block 7 (Big Timber) & Block 8 (Part 2) Prescriptions, 2015) be received and a letter of thanks be sent.

CARRIED

International Day of Older Persons 2015
File No. 3009.1

Moved by Councillor A. Janyk
Seconded by Councillor J. Grills

That correspondence from Lorraine Logan, President of the Council of Senior Citizens' Organizations of BC (COSCO) dated June 29, 2015, requesting a proclamation of support of the "International Day of Older Persons" and prominent display of the Canadian version of the "International Day of Older Persons" flag on October 1, 2015 be received and "International Day of Older Persons" be proclaimed.

CARRIED

ADJOURNMENT

Moved by Councillor J. Crompton

That Council adjourn the July 21, 2015 Council meeting at 8:01 p.m.

CARRIED

Mayor N. Wilhelm-Morden

Corporate Officer: S. Story

WHISTLER

REPORT | INFORMATION REPORT TO COUNCIL

PRESENTED:	August 11, 2015	**REPORT:**	15-100
FROM:	Infrastructure Services	**FILE:**	306
SUBJECT:	2013-2014 CHEAKAMUS RIVER ENVIRONMENTAL MONITORING OUTCOMES		

COMMENT/RECOMMENDATION FROM THE CHIEF ADMINISTRATIVE OFFICER

That the recommendation of the General Manager of Infrastructure Services be endorsed.

RECOMMENDATION

That Information Report No. 15-100 regarding Cheakamus River Environmental Monitoring outcomes be received.

REFERENCES

Appendix A The Influence of Discharge from the Whistler Wastewater Treatment Plant on Water Quality and Periphyton Biomass in the Cheakamus River 2013-2014

PURPOSE OF REPORT

The purpose of this to inform Council and the Whistler community regarding the outcomes of the 2013/2014 Cheakamus River Environmental Monitoring study, and the change in effects on the river that have now been determined to have resulted from the 2009/2010 Waste Water Treatment Plant (WWTP) upgrade.

DISCUSSION

The Cheakamus River is regarded as having two sections, with the "upper" section extending 21 km from Cheakamus Lake to the Daisy Lake Dam. The "lower" section extends from the dam 28 km to the Squamish River, and also has a 12 km tunnel connection which was constructed to a penstock and power house on the Squamish River.

The primary source of the Upper Cheakamus River ("the Upper Cheakamus") is the Cheakamus Glacier, with additional contributions from streams and creeks. The RMOW's WWTP discharges into the Upper Cheakamus 11 km from Cheakamus Lake, at which point the river has an average annual flow of 20 cubic metres per second. The WWTP average annual discharge is 140 litres per second, about $^{7}/_{10}$ of 1% of the River flow at the point of discharge. From there the river travels 10 km to Daisy Lake. On the way it receives flow from the Miller, Brandywine and Callaghan Creeks, among others, so that when it reaches Daisy Lake it has an average annual flow of about 54 meters cubes per second.

The Upper Cheakamus is cold and generally low in the nutrients needed to support life. The essential nutrient in shortest supply is phosphorus, so the quantity of biologically available phosphorus determines the amount of life in the Upper Cheakamus.

Cheakamus River environmental monitoring studies were undertaken in 1996 and 2000, as a result of public concerns over unpleasant algal blooms in the river, and the potential that the RMOW's WWTP was causing or contributing to the scale of the these blooms.

The type of algae that was the subject of these concerns ("didymo") was subsequently found to occur naturally throughout the Sea-to-Sky region not only in the Cheakamus River but in tributaries not subject to flows from the WWTP. It was also determined that didymo blooms, contrary to common perceptions, occur only in low nutrient conditions. As a result, it was determined the RMOW's WWTP was not a contributing factor in the bloom events.

The RMOW's current (2008) and previous 2004 Liquid Waste Management Plans (LWMP's) have required that biological assessment be conducted on the Upper Cheakamus up and down-stream of the WWTP on five year intervals to determine whether the major upgrades undertaken in 2009/2010 have been effective in mitigating potential negative effects on the river ecology, using the historic 1996 and 2000 studies as a baseline. See Figure 1 "WWTP Volume - Technology Timeline".

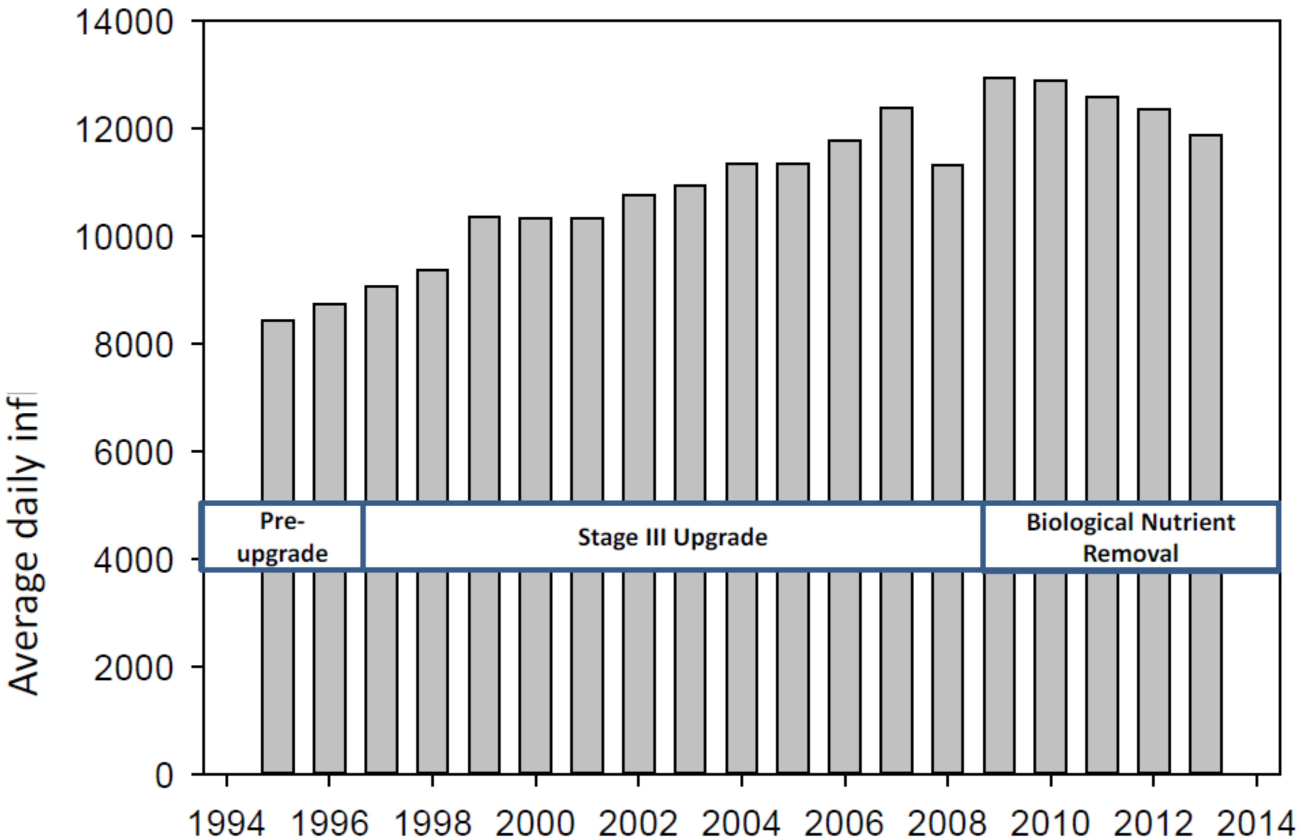

Figure 1 WWTP Volume - Technology Timeline

In comparing current WWTP Plant impacts to historic values, it is important to consider that treated volumes have increased by about 50% since 1994.

The subject of this information report is the most current assessment, undertaken over a 12-month period beginning in the fall of 2013. This is the first such assessment since the WWTP was upgraded to Biological Nutrient Removal Technology in 2009/2010. The subject area of the study covered the area from upstream of the WWTP to the Daisy Lake Dam, including Daisy Lake itself, and included six sampling locations. (see Fig. 2 “Sampling Locations”)

The study

The final report, entitled The Influence of Discharge from the Whistler Wastewater Treatment Plant on Water Quality and Periphyton Biomass in the Cheakamus River 2013-2014 is included as Appendix A.

As is evident from the report title, the focus of the report is on “periphyton biomass”, in other words, the mass of algae in the river. Periphyton mass is of central importance to the biology of the river as it is the foundation of all other river life. Algae is the essential food needed to support other micro-organisms, insects, and fish. If too many nutrients are available in a water body, excessive amounts of periphytons can grow with various negative biological and aesthetic effects. In extreme conditions periphyton growth is capable of consuming all available oxygen in the water.

The most important nutrients for promoting algal growth in the Cheakamus River are biologically available phosphorus and nitrogen. Of the two, *only* phosphorus is limited in availability in the River. As are result the WWTP operating permit is focussed on phosphorus, not nitrogen.

The operating permit for the WWTP includes nutrient emission limits, specifically, it requires that the WWTP effluent should have phosphorus concentration not more than 1.75 milligrams per litre, and that during the summer months (May 15 – September 15) should not emit more than 36.6 kilograms of phosphorus per month.

Under pre-upgrade conditions and volumes (8000 cubic metres per day), the WWTP contributed 5% of the Upper Cheakamus’ phosphorus in summer, and about 50% in winter. Post-upgrade, treating about 13,000 cubic meters per day, the WWTP contributed about 6% of summer phosphorous and about 9% in the winter.

It is clear from this analysis that the plant upgrade was hugely successful in meeting its primary objective – reducing phosphorus loading on the Upper Cheakamus.

The WWTP upgrade also provided the capability to treat various forms of nitrogen, especially ammonia which is toxic to fish in high concentrations. The WWTP permit has no nitrogen-related emission requirements, however the WWTP does contribute significant amounts of biologically available nitrogen. The plant nitrogen loading on the river from the plant decreased by 13% after the 2009/2010 upgrade.

A third criterion not included in the WWTP Operating Permit, but still applicable, is a Provincial requirement that river algal concentrations should not exceed 10 micrograms of chlorophyll-a per square centimetre. The study found that, in the very low water level conditions in the winter of 2013/2014, algal concentrations of about 20 micrograms of chlorophyll-a per square centimetre were present. It has been indicated to the RMOW that these algae levels had no aesthetic impact and would have been beneficial to river life such as insects and fish.

In order to determine the degree to which Whistler's WWTP might be contributing to these elevated levels of algae in the winter, and to more fully understand the effect of these levels on insect and fish populations, the RMOW has commissioned a computer model of the river ecosystem, with results due in September 2015.

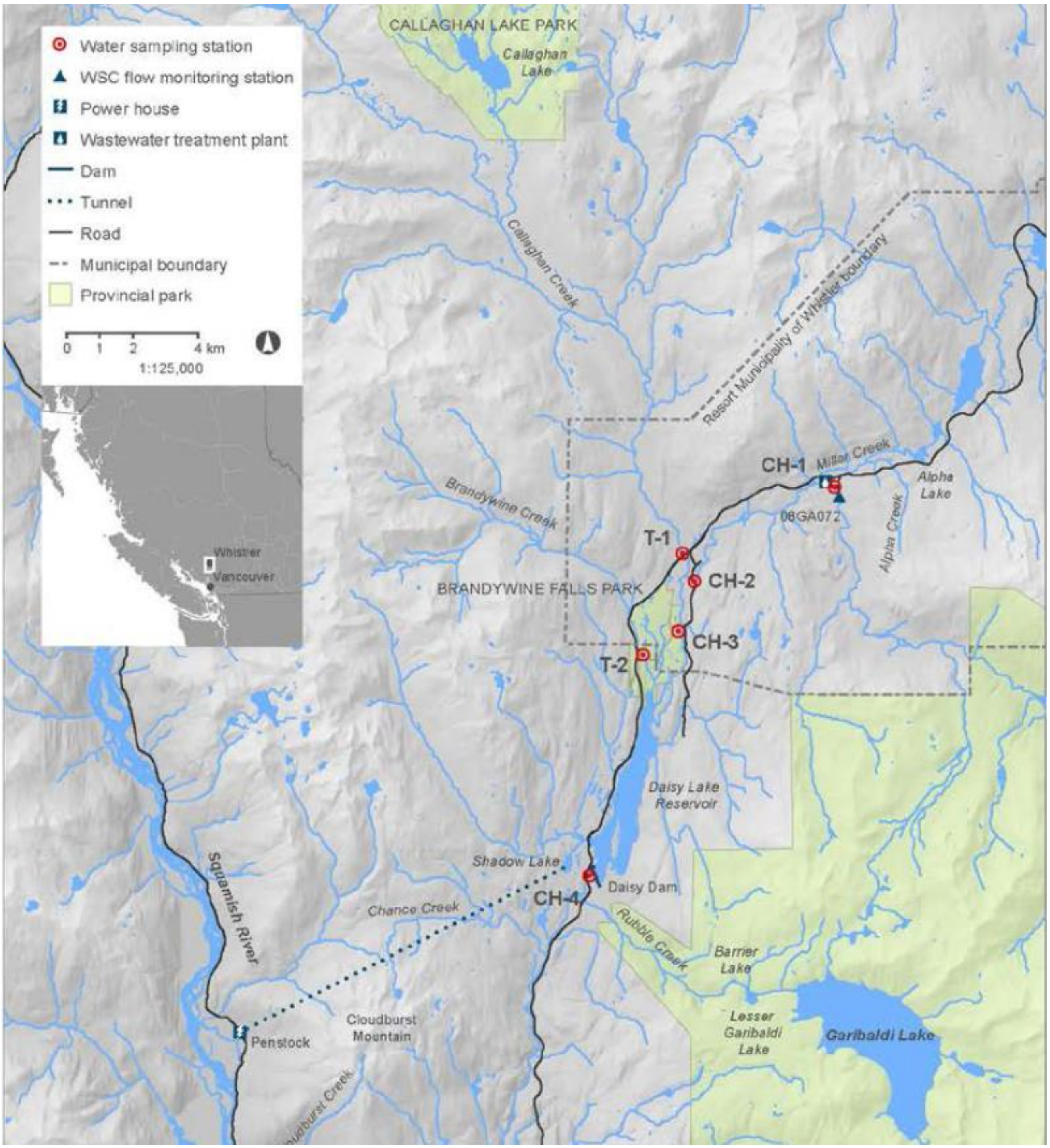

Figure 2: Sampling Locations

The study resulted in three formal recommendations:

Recommendation 1

That a rationale be developed for changing the algal biomass criterion in the upper Cheakamus River to a value greater than the Provincial Criterion of 10 µg chl-a·cm^{-2} to match existing science showing that higher levels of algal biomass can be beneficial to fish.

This recommendation has been accepted by staff. Once this rationale has been developed it will be incorporated into the 2015 Liquid Waste Management Plan Update (in progress) and therein presented to the Ministry of Environment.

Recommendation 2

In order to inform the rationale, that a computer model be developed to show peak biomass of periphyton (PB) in the upper Cheakamus River as a function of the concentration of soluble reactive phosphorus (SRP) in the Cheakamus River that is available for biological uptake from natural sources and the WWTP under various operating scenarios at the WWTP.

In other words, the computer model will confirm the degree to which Whistler's WWTP is increasing the amount of algae in the upper River, and also show what affect this extra algae is having on insect and fish populations. This information is essential to pending discussing with the B. C. MOE regarding Whistlers LWMP and WWTP permit.

This recommendation has been accepted by staff, and a purchase order issued to the consultant to develop the model and the rationale. This work is to be received by September 11, 2015.

Recommendation 3

That monthly water chemistry sampling at CH1 (upstream of the plant) and CH2 (downstream of the plant) be done as part of plant operations every year and that periphyton sampling be done in winter and summer once every five years at CH1 and CH2 as part of plant operations. These data will be used to improve precision of data used to assess plant performance and river condition in future years.

This recommendation has been accepted by staff, scheduled for 2015, and included in the RMOW Sewer Fund five year financial plan.

WHISTLER 2020 ANALYSIS

W2020 Strategy	**TOWARD** Descriptions of success that resolution moves us toward	Comments
Water	Wastewater and Biosolids are readily assimilated in nature	While this study doesn't change the impact of the WWTP on nature, it does provide information confirming the positive effect of 2009/2010 WWTP upgrade.
Water	Healthy streams, rivers, lakes and wetlands support thriving populations of fish, wildlife and aquatic invertebrate	While this study doesn't change the impact of the WWTP on nature, it does provide information confirming the positive effect of 2009/2010 WWTP upgrade.

W2020 Strategy	**AWAY FROM** Descriptions of success that resolution moves away from	Mitigation Strategies and Comments
	None.	

OTHER POLICY CONSIDERATIONS

The outcome of the subject study, and the modelling to be completed in September, will inform both pending Liquid Water Management Plan update discussions with the B. C. Ministry of Environment (MOE), and pending MOE permit reviews stemming from the ongoing Federal/Provincial Waste Water Treatment permit consolidation initiative.

BUDGET CONSIDERATIONS

The Cheakamus River Environmental Monitoring project was 50% funded from a Gas Tax Grant. The modelling work was included in the 2015 Sewer project budget.

COMMUNITY ENGAGEMENT AND CONSULTATION

This report to Council constitutes the full extent of intended community engagement.

SUMMARY

It's now clear that the upgrade was hugely successful in reducing phosphorus emissions to the River, which was the primary objective of the upgrade, while also providing reductions in nitrogen and other deleterious materials.

The first Cheakamus River Environmental Monitoring project completed since the plant was upgraded in 2009/2010 demonstrates the upgrade has allowed Whistler to grow and yet still decrease negative environmental change in the Upper Cheakamus River stemming from operation of the WWTP.

Respectfully submitted,

Michael Day, P. Eng.
UTILITIES GROUP MANAGER
for
Joe Paul
INFRASTRUCTURE SERVICES GENERAL MANAGER

WHISTLER

THE INFLUENCE OF DISCHARGE FROM THE WHISTLER WASTEWATER TREATMENT PLANT ON WATER QUALITY AND PERIPHYTON BIOMASS IN THE CHEAKAMUS RIVER, 2013-14

FINAL REPORT

December 18, 2014

LIMNOTEK

THE INFLUENCE OF DISCHARGE FROM THE WHISTLER WASTEWATER TREATMENT PLANT ON WATER QUALITY AND PERIPHYTON BIOMASS IN THE CHEAKAMUS RIVER, 2013-2014

FINAL REPORT

Submitted to

Resort Municipality of Whistler

Prepared by

C.J. Perrin, MSc., RPBio and S. Bennett, MSc., RPBio

December 18, 2014

Citation: Perrin, C.J. and S. Bennett. 2014. The influence of discharge from the Whistler wastewater treatment plant on water quality and periphyton biomass in the Cheakamus River, 2013-14. Report prepared by Limnotek Research and Development Inc. for the Resort Municipality of Whistler. 37p.

Cover photo: Cheakamus River at CH-1 in February, 2014. Photo by Chris Perrin.

EXECUTIVE SUMMARY

Water chemistry and periphyton sampling in the Cheakamus River in 2013-14 provided data for an updated analysis of the role of nitrogen and phosphorus discharge from the Whistler wastewater treatment plant (WWTP) in contributing to algal biomass in the upper Cheakamus River. The analysis compliments monitoring requirements that are laid out in the current Operational Certificate ME-01452 issued by the BC Ministry of Environment to the Resort Municipality of Whistler (RMOW). Analyses included comparisons of nitrogen and phosphorus concentration and transport, by source, between present operation of the biological nutrient removal (BNR) plant and the earlier chemical phosphorus removal (CPR) plant. Algal biomass accrued over a standard period of time to show "peak biomass" (PB) was compared upstream and downstream of the plant between high flows in summer and low flows in winter. This algal biomass sampling and associated descriptions of algal assemblages were compared between times when the BNR and CPR plants were operating by mining historical data from past studies and using the new data from 2013-14. Biomass data were compared to the Provincial Criterion for algal biomass.

The present BNR plant is effective in maintaining algal PB in the Cheakamus River at less than the Provincial Criterion of 10 µg chl-a·cm^{-2} in summer. The summertime algal biomass downstream of the plant in 2013 was the same as was found during operation of the CPR plant in 1996 and 2000. Both the BNR and CPR technology combined with high dilution of the treated effluent in the high summer flows of the Cheakamus River produced this result by limiting change in soluble phosphorus concentration in the river. Soluble phosphorus measured as soluble reactive phosphorus (SRP) was important because chemical analyses showed that algal growth in the Cheakamus River is more limited by availability of phosphorus than nitrogen. Both nutrients must be considered when assessing potential limitation of algal growth and biomass in rivers by nutrients.

In winter 2014, when river flows were low, the combination of discharge of treated effluent and low dilution yielded SRP concentrations exceeding those known to saturate growth rates of benthic algae. The SRP concentrations along with surplus nitrogen supported algal biomass that was more than double the Provincial Criterion. The nutrient loading supported a bloom of the cold water alga known as *Hydrurus foetidus* downstream of the plant. The algal biomass in winter 2014 was double that found in winter during operation of the CPR plant because of differences in SRP load from the plant and less dilution.

The high algal biomass in winter 2014 was not considered harmful to the river. Evidence from nutrient addition experiments in other rivers show that algal biomass exceeding that found in the Cheakamus River are beneficial to fish, particularly salmonids, including those that rear in the Cheakamus River.

Three recommendations resulting from this study are as follows:

Recommendation 1: We recommend that a rationale be developed for changing the algal biomass criterion in the upper Cheakamus River to a value greater than the Provincial Criterion of 10 µg chl-a·cm^{-2} to match existing science showing that higher levels of algal biomass can be beneficial to fish.

Recommendation 2: We recommend that a regression model be developed to show peak biomass of periphyton (PB) in the upper Cheakamus River as a function of the concentration of soluble reactive phosphorus (SRP) in the Cheakamus River that is available for biological uptake from natural sources and the WWTP under various operating scenarios at the WWTP.

Recommendation 3: We recommend that monthly water chemistry sampling at CH1 (upstream of the plant) and CH2 (downstream of the plant) be done as part of plant operations every year and that periphyton sampling be done in winter and summer once every 5 years at CH1 and CH2 as part of plant operations. These data will be used to improve precision of data used to assess plant performance and river condition in future years.

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1 INTRODUCTION

The Cheakamus River has a history of anomalous algal blooms. Many reports of blooms have been anecdotal mainly from observations in lower reaches near Squamish where episodic and unpleasant algal biomass has occurred in past years. MOE (1989) showed a positive relationship between algal biomass and the concentration of soluble phosphorus in the lower Cheakamus River, consistent with general knowledge that phosphorus is a nutrient that can determine algal growth and biomass in rivers (Bothwell 1989, Wetzel 2001). MOE (1989) speculated that phosphorus enrichment, leading to algal blooms, was derived from deep withdrawal of water from Daisy Lake Reservoir. However, later measurements showed a decline in soluble phosphorus concentration between inflows and outflows of Daisy Lake Reservoir, which did not support the MOE ideas (Perrin, 1995). That later data showed net retention of soluble phosphorus in the reservoir by formation of phosphorus complexes, making it less available for biological uptake in the lower river than in reaches upstream of Daisy Lake Reservoir. More extensive measurements in 1996 showed that phosphorus discharge from the Whistler wastewater treatment plant (WWTP) could produce high periphyton biomass in the river upstream of the reservoir but natural sources of phosphorus from tributary inflows were most responsible for periphyton biomass in the lower river (Perrin 1998). Statistical modelling in that study (Perrin 1998) and later (Perrin 2001) predicted that discharge of phosphorus from the present wastewater treatment plant at Whistler that incorporates biological nutrient removal (BNR) would decrease the amount of periphyton biomass in the upper Cheakamus River by up to 46% compared to biomass in 1996 when a chemical phosphorus removal (CPR) plant was operating, given the same load to the plant. The WWTP has been upgraded numerous times since 1996 when the first model was produced. The models showed that greatest decrease in periphyton biomass from operation of the BNR plant would occur in winter when dilution of treated effluent in the river is lowest and a smaller decrease in biomass would occur in summer during higher dilution. Dayton and Knight (2004) found the 2001 model (Perrin 2001) to be accurate based on comparison of predicted to actual measured periphyton biomass when the CPR plant was operating but this kind of comparison has not been done during operation of the BNR plant.

Time course comparisons of algal biomass in the lower Cheakamus River reported by Perrin (2010) showed that algal biomass was greater in 2008 and 2009 than before 2000. The high biomass in the lower river in 2008-09 was due to the occurrence of the stalk forming diatom called *Didymosphenia geminata*, also known as Didymo, which was not found in the earlier years (Perrin 2010). Didymo actually forms greater biomass at or below the method detection limit for soluble phosphorus (typically 1 $\mu g \cdot L^{-1}$) by forming long polysaccharide stalks that can smother river substrata (Bothwell and Kilroy 2011, Kilroy and Bothwell 2011) as it did in some places of the Cheakamus River in 2008 and 2009 (Perrin 2010). Observations of Didymo support a hypothesis that phosphorus availability for algal growth was lower in 2008-09 than it was earlier in the

Cheakamus River. Algal blooms mainly among non-stalk forming diatoms before 2008 may have been caused by high bioavailability of phosphorus, while high algal biomass after 2008 may be due to lower bioavailability of phosphorus that promoted stalk formation of Didymo.

This report addresses three questions about the potential benefit of the change from the CPR to BNR plants with respect to water quality and periphyton biomass in the Cheakamus River. These questions follow recommendations in the Whistler liquid waste management plan (Dayton and Knight 2004) that water quality monitoring be undertaken to address uncertainty about effectiveness of plant upgrades both in comparison to water quality guidelines for the Cheakamus River and with respect to perceived improvements achieved by the BNR plant compared to the CPR plant. The questions are listed as follows:

1. What is the concentration of bioavailable N and P in the upper Cheakamus River that is from the CPR and BNR plants? Concentration is important here, not load, because it is concentration that defines the availability of N and P to algae in a river.

2. What proportion of N and P from all sources in the upper Cheakamus River watershed originates from the present BNR plant and past CPR plant?

3. What is the effect of discharge from the BNR plant on algal biomass and composition in the upper Cheakamus River and how does that effect compare to the effect of N and P discharge on periphyton that was assessed in 1996 and 2000 when the CPR plant was operating?

This study was designed to answer each of these questions and address an overall objective to determine if the BNR plant is effective in maintaining periphyton biomass in the upper Cheakamus River at levels less than the Provincial Criterion of 10 µg of chlorophyll-a per cm^2 (summarized as µg chl-a·cm^{-2}) (Nordin 1985) and determine if changes to the WWTP operational certificate are permissable. The study provides an updated analysis of the role of nitrogen and phosphorus discharge from the plant in contributing to algal biomass in the Cheakamus River. The analysis compliments monitoring requirements that are laid out in the current Operational Certificate ME-01452 that was issued by the BC Ministry of Environment to the Resort Municipality of Whistler (RMOW). Results can be used to verify if criteria in the operational certificate are acceptable or should be modified to meet water quality guidelines for the Cheakamus River.

2 METHODS

2.1 Study Site Description

The Cheakamus River (Figure 1) originates as a third order stream from Cheakamus Lake, which receives snowmelt and glacial outwash from mountains within Garibaldi Provincial Park in British Columbia. Headwaters are at elevations >2,400 m. From Cheakamus Lake, the river flows north for 11 km on the west side of the Fitzsimmons Range and drops to an elevation of 600 m adjacent to boundaries of the Resort Municipality of Whistler (RMOW). At this point, the mean annual flow is 20 $m^3 \cdot s^{-1}$ and the river receives treated discharge from the Whistler wastewater treatment plant. The river then turns southwest before emptying into Daisy Lake Reservoir, which is operated by BC Hydro for producing power, flood control, and other water uses described by Marmorek and Parnell (2002). Over this 10 km reach between the wastewater treatment plant and Daisy Lake Reservoir, tributaries including Millar Creek, Callaghan Creek (another 3rd order system), and Brandywine Creek join the Cheakamus River producing a mean annual inflow to Daisy Lake Reservoir of approximately 54 $m^3 \cdot s^{-1}$. The entire catchment area for Daisy Lake Reservoir is 721 km^2 (Bourdin 2013) while the catchment for the Cheakamus River upstream of the Reservoir is 565 km^2. From Daisy Lake Reservoir, a portion of the inflow water is diverted for power production through a 12 km long tunnel and penstock to a powerhouse located on the Squamish River. Remaining water is released to the lower Cheakamus River via control at the Daisy Dam. From the dam, the river continues southward through a high gradient canyon and drops 450 m to the valley floor where it joins the Squamish River, 28 km downstream. Flows in the lower Cheakamus River increase above flows released from the dam due to inflow from Rubble Creek, Chance Creek, Culliton Creek, Swift Creek, and the Cheekye River (Figure 1).

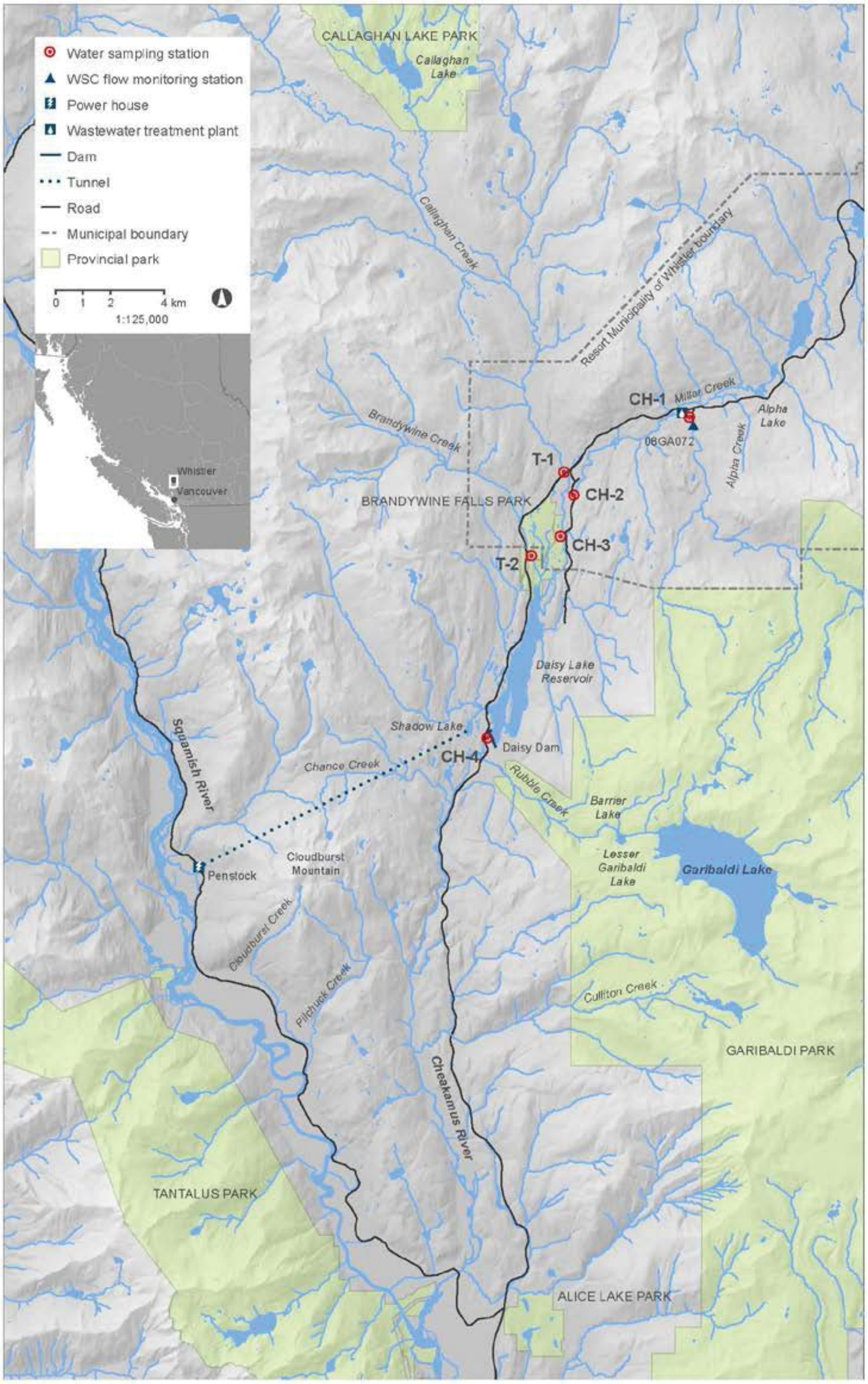

Figure 1. Cheakamus River showing water quality sampling stations.

The population of Whistler has grown over the past 20 years, resulting in load to the wastewater treatment plant (WWTP) increasing from 8,000 $m^3 \cdot day^{-1}$ in 1995 to 12,000 $m^3 \cdot day^{-1}$ in 2013 (Figure 2). The highest average daily influent flows occurred during years preceding and during the 2010 Winter Olympic and Paralympic Games (2009 and 2010). To prevent discharge of pathogens and limit the discharge of suspended solids, labile organic matter, and nutrients and minimize the risk of algal blooms in the Cheakamus River the WWTP has been upgraded in phases shown in Figure 2. Up to 1996, the WWTP provided liquid and solids handling capacity for 32,500 bed units or a peak winter day flow of 15,275 $m^3 \cdot d^{-1}$ and a peak winter week flow of 12,700 $m^3 \cdot d^{-1}$ (Dayton and Knight 1994). An expansion was implemented in 1996 and completed in 1997 to handle wastewater from 52,500 bed units or a peak flow of 24,000 $m^3 \cdot d^{-1}$ (Dayton and Knight 2001) (shown as “Stage III Upgrade” on Figure 2). It included influent pumping, expansion of screening and grit removal, expansion of primary sedimentation, expansion of chemical phosphorus removal, and odour control. In 2009 the plant was changed to a system using a biological nutrient removal bioreactor capable of phosphorus, ammonia, and nitrate removal (http://www.whistler.ca/wastewater-treatment-plant) (shown as “Biological Nutrient Removal” on Figure 2). It was supported with a new 700 m^3 fermenter for the production of volatile fatty acids from the organic sludge. The fatty acids are sent to the bioreactor and utilized by nutrient consuming microorganisms. Two new fine screens were added that remove influent solids greater than about 3 mm. Additional secondary clarification was added with alum trim and ultraviolet disinfection. A floatation tank was added for solids concentration with centrifuge dewatering. The biosolids are now processed by composter.

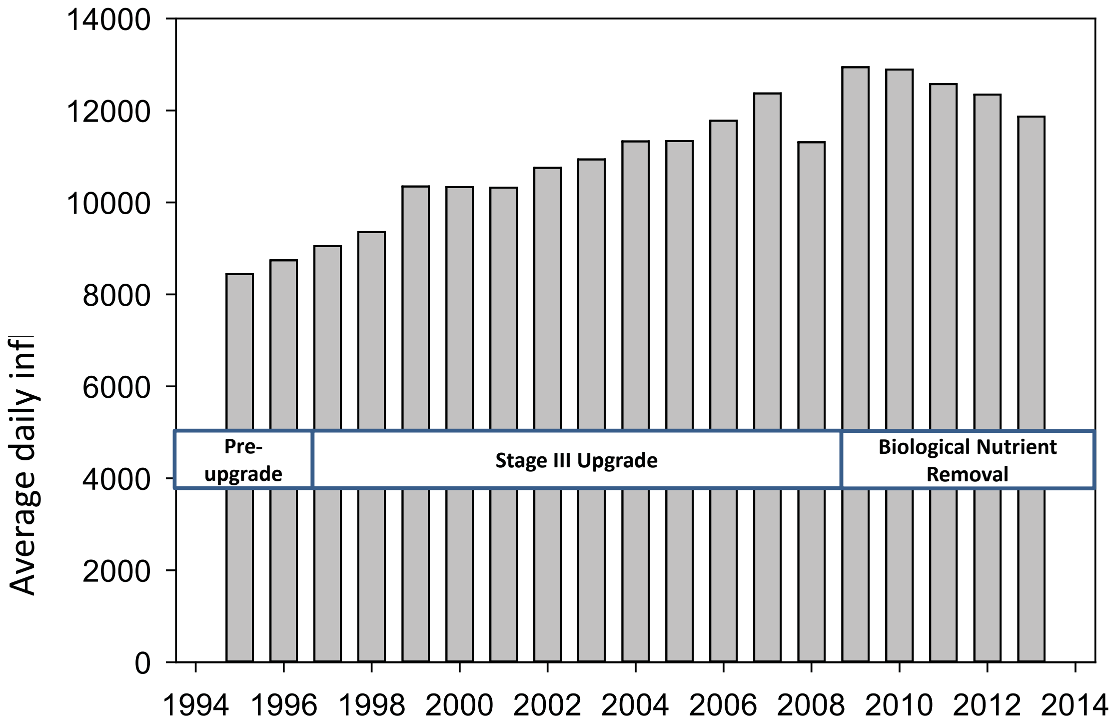

Figure 2 Average daily load to the Resort Municipality of Whistler wastewater treatment plant, 1995 to 2013. Time course phases of treatment plant upgrades are labelled over the load data.

All treated wastewater from the WWTP is discharged to the Cheakamus River through a diffuser located approximately 500 m upstream of the Miller Creek confluence (Figure 1). The permitted maximum concentration of soluble reactive phosphorus in plant discharge as listed in the 2004 liquid waste management plan for Whistler is 1.75 mg $P \cdot L^{-1}$ with an additional restriction that SRP mass loading to the river must not exceed 36.6 kg P per month from May 15 through September 15 (Dayton and Knight 2004).

2.2 Sampling sites

Six sites were selected for water chemistry sampling, including four on the Cheakamus River mainstem and two on tributaries flowing into the Cheakamus River (Table 1, Figure 1). An upstream control site (CH-1) was located 150 m upstream of the WWTP diffuser immediately downstream of a Water Survey of Canada hydrological monitoring station (08GA072). CH-2 was downstream of the diffuser but upstream of the Callaghan Creek (T-1) inflow. CH-3 was downstream of the Callaghan Creek inflow but upstream of Daisy Lake Reservoir. CH-4 was immediately downstream of the Daisy Dam and showed changes in chemistry associated with the reservoir and the inflow from Brandywine Creek (T-2).

Table 1. List of sample sites in the study area

Site Name	Description	Distance downstream of WWTP (km)	UTM zone	Easting	Northing	Watershed Area (km^2)
CH-1	Upstream of the WWTP	n/a	10U	497229	5547928	296
CH-2	Downstream of the WWTP and upstream of Callaghan Creek confluence	6.6	10U	492963	5545069	352
T-1	Callaghan Creek	7.0	10U	492605	5545901	195[a]
CH-3	Downstream of the Callaghan Creek confluence	9.0	10U	492474	5543534	565
T-2	Brandywine Creek	12	10U	491394	5542806	53
CH-4	Cheakamus River immediately downstream of the Daisy Dam	18	10U	489752	5536086	n/a

Notes:

a. Estimated by drawing a rough polygon of the watershed on iMap BC

2.3 Water chemistry

Questions 1 and 2 (Section 1.0) required information about chemistry of the Cheakamus River and the partitioning of nitrogen and phosphorus concentrations in the river between the WWTP and natural sources.

Water chemistry was contrasted between high flows in summer and low flows in winter by sampling all river sites and the final treated effluent once every three weeks in each of July - September, 2013 and January – March, 2014. The water samples from the treated effluent, CH-1, CH-2, CH-3, and CH-4 were analysed within 24 hours of collection using standard methods as reported in certificates of analysis at ALS Environmental Ltd for NH_4-N, NO_3-N, TN, TP, TDP, SRP, total suspended solids (TSS), fecal and total coliforms, and carbonaceous 5-day biological oxygen demand (BOD_5). The samples from T-1 and T-2 were handled the same way but were analysed only for NH_4-N, NO_3-N, TN, TP, TDP, and SRP. The TSS, coliforms and BOD_5 analyses were run for descriptive purposes while the nitrogen and phosphorus data were used to examine the availability of nutrients for algal growth. All samples for analysis of the dissolved parameters were filtered in the field at the time of collection through Waterra 0.45 µm FHT-45 polyethersulphone filters (http://www.waterra.com/pages/Product_Line/filters/filters_2011.html) using an Alexis peristaltic pump (http://pegasuspumpcompany.com/alexis-peristaltic-pumps). Field blanks and duplicates were processed on each sampling episode for tests of precision and contamination. Instantaneous temperature, pH, total dissolved solids (TDS), specific conductance, and dissolved oxygen concentration (DO) was measured with a YSI Sonde (model 6920) that was calibrated with fresh standards on the day before each sampling episode. These YSI data were used for descriptive purposes.

Water chemistry from sampling of the same sites in 1996 were accessed from raw data files compiled by Perrin (1998) to examine chemical conditions in the river during operation of the CPR plant. Samples from 1996 were handled using the same procedures as those in 2013 – 2014 except that field filtrations were done using a hand pump and membrane filters. Analytical principles in 1996 were the same as those in 2013 – 2014 and lab methods were those reported in APHA (1985).

In both of the 2013-14 and 1996 data various forms of phosphorus were distinguished because different sizes of particles containing phosphorus can determine what part of total phosphorus is available for algal growth. In natural waters, dissolved phosphorus can occur as orthophosphate, polyphosphates and organic phosphates. The particulate fraction is composed of phosphate minerals, adsorbed phosphate, and organic particulate phosphate. The different fractions are commonly referred to as total phosphorus (TP), particulate phosphorus (PP), total dissolved phosphorus (TDP), and soluble reactive phosphorus (SRP). The analysis for total phosphorus (TP) includes all dissolved and particulate size fractions. Total dissolved phosphorus (TDP) is a subset of TP and includes the complete dissolved fraction (<0.45 µm) including SRP. Some of the larger molecular weight fractions contained in TDP can be biologically available but only after enzymatic hydrolysis to release phosphate ions. Particulate phosphorus (PP) is determined as the difference between TP and TDP. The analysis for SRP always includes the orthophosphate ion (PO_4), which is considered biologically available but it can also include acid-labile P compounds (Harwood et al. 1969) and thus overestimate biologically available P (Rigler 1968). For our purposes, SRP will be considered the free orthophosphate component of TDP and the most biologically available phosphorus fraction. The TDP fraction, which requires degradation by bacterial or algal phosphatases before biological uptake, can be used as a P source but only when simpler phosphate supplies are depleted. In rivers and lakes receiving loads of mineral particulate phosphorus, some of the TP component is not tied up in biomass but rather as part of mineral particulates, and may become bioavailable only through dissolution of the minerals - a process occurring over long time scales. Thus, in the Cheakamus River, which receives inputs of glacial silts from a region with apatite bearing volcanic rocks, the total phosphorus fraction can greatly overestimate the amount of truly bioavailable phosphorus within the system and carries with it a large component of mineral particulate P.

Combinations of results from the lab were used to define the biological availability of N and P. The sum of NH_4-N and NO_3-N was called dissolved inorganic nitrogen (DIN), which represents biologically available nitrogen. SRP was considered the most biologically available form of P as noted above. The molar N:P ratio indicated potential limitation of N and P among the benthic algae. Rhee (1978) showed that for a given species of algae there is a sharp transition between P-limited and N-limited growth. Assuming all other nutrients are in excess of algal requirements, N-limitation will occur at low N:P supply ratios, while at high ratios, P-limitation will prevail. The particular ratio at which the transition from N-limitation to P-limitation will occur is species dependent, varying from as low as 7:1 for some diatoms (Rhee and Gotham 1980) to as high as 50:1 for some blue-green algae (Healey 1985). A molar N:P ratio of 16 (i.e. mass ratio of 7) is commonly regarded as an optimum supply ratio for algal growth at the community level and it may separate P-limited systems (those with ratios greater than 16) from nitrogen limited systems (ratios less than 16) (Wetzel 2001). Because the optimum ratio can vary among algae, the range between 13 and 20 may be regarded as a transition range in a community where some species will be P-limited and others will be N-limited.

Quality assurance procedures included analysis of each analyte from a blind duplicate (a second sample collected from a site unknown to the lab) and blank (deionized water) sample collected during each sampling episode and handled and analysed using the same procedures as the other samples. The blank analysis showed presence or absence of contamination from handling and the duplicate provided information on analytical precision associated with field and lab processes. There were eight blanks and eight duplicates, corresponding to the eight sampling dates. Precision

(D_f) was calculated as relative percent difference of an analyte concentration between a sample and its corresponding duplicate using the following equation recommended by the Ministry of Environment Lands and Parks (1988):

$$D_f = \left(\frac{A-B}{(A+B)/2}\right) * 100$$ Equation 1

where A is the concentration of an analyte in sample A and B is the concentration of the same analyte in the duplicate sample. Only duplicate concentrations that were five times the method detection limit were used in the test of precision because precision is influenced by how close values are to the method detection limit. Tests of precision at five times the method detection limit avoided this confounding.

Chemical statistics included mean and standard deviations by season to qualitatively compare analyte concentrations among sites in summer 2013 and winter 2014 and to compare concentrations in the river between years when the different wastewater treatment plants were operating (CPR plant in 1996, BNR plant in 2013-14).

2.4 N and P by source in the Upper Cheakamus River

Bioavailable P (SRP) and N (DIN) load and relative contribution to that load by source was calculated to show the importance of the BNR plant and the CPR plant in contributing DIN and SRP to the upper Cheakamus River. A first calculation was to determine the concentration of DIN and SRP that was added to the river upon full mixing of the treated discharge of effluent from the WWTP at CH-2. This calculation was run for conditions in summer 2013 and winter 2014 when the BNR plant was operating and in summer and winter 1996 when the CPR plant was operating. Concentration of DIN and SRP in the river without input from the WWTP was that measured at CH-1. The DIN or SRP concentration added to the river from the plant was determined as the rate of effluent dilution in the river multiplied by average concentration of DIN or SRP in the treated effluent as follows:

$$D_p = \frac{Q_w}{Q_w + Q_i} * P_p$$ Equation 2

where:

D_p is the fully diluted concentration of DIN or SRP in the Cheakamus River that is from the WWTP.

Q_w is treatment plant flow

Q_i is flow at station i, which is CH-2 in this case where discharge from the WWTP would be expected to be fully mixed but did not include discharge from the WWTP

P_p is the concentration of DIN or SRP in treated discharge from the WWTP.

Values for P_p were from water samples collected once every three weeks during each season as described in Section 2.3. Q_w was provided by RMOW. Q_i was determined as follows:

$$Q_i = Q_{CH1} * \frac{A_i}{A_{CH1}} \quad \text{Equation 3}$$

where:

Q_i is flow at station i , which is CH-2 in this case

Q_{CH1} is flow at CH-1 as measured at Water Survey of Canada station 08GA072.

A_i is watershed area upstream of station i , which is CH-2 in this case

A_{CH1} is watershed area upstream of CH-1.

Equations 2 and 3 were run for each time of sample collection in each of the winter and summer periods in both of the BNR and CPR plant scenarios. Absence of NO_3-N data in the treated effluent in 1996 limited the 1996 DIN calculations to winter.

Sources of DIN and SRP to the upper Cheakamus River were the WWTP, the Cheakamus River upstream of the WWTP as measured at CH-1, Callaghan Creek, and Brandywine Creek. DIN and SRP load from each of these sources for each of the summer and winter periods with operation of the BNR plant (summer 2013 and winter 2014) and the CPR plant in 1996 was calculated. Total load to the Cheakamus River was the sum of load from these four sources and relative load was load from each source expressed as a percent of the total load. Load was calculated as average flow multiplied by average concentration of DIN or SRP for each period where daily flow was determined using Equation 3.

2.5 Periphyton

In summer 2013 and winter 2014, periphyton was sampled from 30 x 30 x 0.64 cm plates of open celled Styrofoam (Floracraft Corp. Pomona Corp. CA) attached to plywood plates that were waterproofed with fibreglass resin and bolted to concrete blocks (Figure 3). Styrofoam is an effective substratum because its rough texture allows for rapid seeding by algal cells, it can host a complex periphyton assemblage, and the adhered biomass is easily sampled (Perrin et al. 1987). This sampler design was used in all previous periphyton monitoring projects in the Cheakamus River and was used again to maintain consistency for linking present data to that from earlier years.

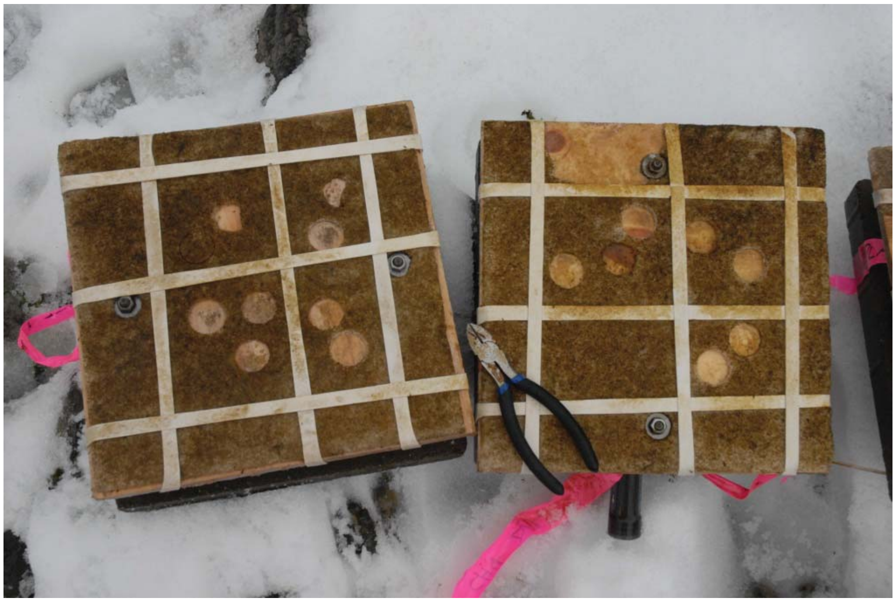

Figure 3. Image of periphyton plates following incubation over 7 weeks in the Cheakamus River in winter. The holes are spaces where samples were removed using a plastic vial. The brown colour is algal biomass that accrued on the Styrofoam during incubation.

Three replicate plates were installed in riffle or run type flows at each of CH-1 and CH-2 for seven weeks in each of summer (July 18 to Sept. 5, 2013) and winter (Jan. 23 to March 13, 2014). The plates were sampled weekly during the final four weeks of incubation to measure peak biomass (PB), which was the highest concentration of chlorophyll-a (a measure of living algal biomass) found on a plate during incubation. PB occurs in the final month of accrual of biomass on substrates installed in a river (Bothwell 1989). Each week, a 2 cm diameter core of the styrofoam and the adhered biomass was removed from a random location on each plate using the open end of a 7 dram plastic vial. The sample was packed on ice and frozen at the end of each sampling day at -15ºC for later analysis of chlorophyll-a concentration using fluorometric procedures reported by Holm-Hansen et al (1965) and Nusch (1980). These procedures were the same as those used for periphyton monitoring during operation of the CPR plant in 1996 (Perrin 1998) and the expanded CPR plant in 2000 (Perrin 2001).

Periphyton biomass and composition was compared between locations (CH-1 and CH-2), by season (summer and winter), and plant type (BNR, CPR in 1996, expanded CPR in 2000). This layout facilitated a three factor analysis of variance (ANOVA) to test for effect of season, location, and plant type on algal metrics. Plant type integrated the type of treatment plant and change in load to the plant associated with increasing size of the population over time. Effect of climate change and other upstream process was controlled with use of data from CH-1 that was not affected by discharge from the WWTP. Prior to statistical testing, PB values were log-transformed to meet the assumptions of equal variance and normal distribution of the data for ANOVA. Given no other source of nitrogen and phosphorus between CH-1 and CH-2, any statistically significant difference in PB or composition of algae between those two sites was attributed to discharge from the WWTP. All ANOVAs were run in SYSTAT v11 (Systat 2004) and the significant probability level was set at 0.05. PB was compared to Provincial water quality criterion for chlorophyll-a.

On the final periphyton sampling day of each incubation time series, one additional core was removed from each plate and preserved in Lugol's solution for later identification of cells to species and cell enumeration. Cells were removed from the Styrofoam using a fine spray from a dental cleaning instrument inside the sample vial. Contents were dispensed to a Utermohl chamber for settlement over 24 hours. Cell counts were made at 500x magnification under an inverted microscope. Only cells containing cytoplasm were enumerated. A minimum of 100 individuals of the most abundant species and a minimum of 300 cells in total were counted per sample. Biovolume, by species, was determined by multiplying cell counts by volume of a geometric shape or combination of shapes that most closely approximated the shape of cells. Diversity metrics including species richness (number of unique species per sample) and Simpson's Index of Diversity were calculated from the cell counts. Simpsons Index was determined on algal species biovolume run in PRIMER (Clarke and Gorley 2006) using the following equation:

$$(1-D) = 1 - \sum(p_i)^2 \qquad \text{Equation 4}$$

Where:

$(1-D)$ is Simpson's index of diversity and p_i was the proportion of biovolume of species *i* in a sample of the community. Simpson's Index measures the probability that two organisms randomly drawn from a sample belong to the same species. Krebs (1999) defines this probability as a measure of heterogeneity. It tends to weight the common taxa more than rare taxa and it provides a contrast to species richness (a simple count of taxa) that weights all taxa evenly.

Mean and the standard deviation of biovolume of the algal divisions, species richness, and Simpsons Index of Diversity were contrasted between CH-1 and CH-2 in years when the different treatment plants were operating (CPR plant in 1996, enhanced CPR in 2000, BNR plant in 2013-14) and season (winter and summer). This comparison was used to examine variation in algal divisions between sites under the different operating conditions.

The multivariate similarity percentages procedure called SIMPER, run in Primer v6 (Clarke and Gorley 2006), was used to identify genera and species of algae cumulatively contributing to >90% of dissimilarities of assemblages between CH-1 and CH-2 by type of treatment plant in each of summer and winter. This analysis showed the individual taxa that drove variation among algal divisions between sites, years, and seasons.

3 RESULTS

3.1 Water chemistry

Concentrations of all measured analytes in the eight blanks were less than the method detection limits. These results showed no contamination during sample handling and analysis.

Relative percent differences of analyses between the sample duplicates ranged between 1% and 8% (Table 2). Precision is considered high when R_p is less than 25% (Ministry of Environment, Lands and Parks, 1988). This high precision was found among all tests. Some variability between replicate water samples is expected not only related to sample handling and processing but due to natural variability between the sample and it's duplicate.

Table 2. Relative percent differences of analyte concentrations between field replicates. Data are shown for sample pairs having analyte concentrations greater than five times the method detection limit following protocols reported by the Ministry of Environment Lands and Parks (1988).

Analyte	Average value of relative percent differences between replicate pairs of samples (%)
Total suspended solids	No values >5 times the method detection limit
Nitrate-N	1
Ammonium-N	No values >5 times the method detection limit
Total Nitrogen	2
Soluble Reactive Phosphate	8
Total Phosphate	5
Total Dissolved Phosphate	No values >5 times the method detection limit

Chemical attributes in Tables 3 and 4 showed that in summer 2013 and winter 2014, the Cheakamus River was well oxygenated with circumneutral or slightly alkaline pH and moderate dissolved solids concentration and specific conductance. Water temperature was 12 – 13ºC during the summer sampling and near 2ºC in winter. Turbidity was 4-7 NTU and TSS was 2 – 7 $mg \cdot L^{-1}$ in summer but with freezing in the alpine in winter that limited transport of glacial silt, turbidity dropped to 0.4 – 0.8 NTU and TSS dropped to <3 $mg \cdot L^{-1}$. Based on changes to river chemistry between CH-1 and CH-2, discharge from the WWTP increased TDS, specific conductance, and TSS in the river in summer and it increased TDS, specific conductance, and coliforms including fecal coliforms in winter. Differences in chemistry between CH-2 and CH-3 showed that Callaghan Creek increased river turbidity and TSS, and fecal and total coliforms in summer and it lowered water temperature in winter. Differences in chemistry, not including nutrients, between CH-3 and CH-4 showed that the Daisy Reservoir retained TSS. Relatively clear water in Brandywine Creek in summer would have provided some dilution of those particles. Fecal coliforms that would have been associated with particle transport and settlement in the reservoir coincidentally declined between CH-3 and CH-4 in both summer and winter.

Table 3: Mean concentration (±sd) of descriptive chemical analytes, by site, in summer 2013.

Analyte	Final Plant Effluent[A]	Cheakamus River stations in summer, 2013				Tributary inflow to Cheakamus River in summer, 2013	
		CH-1	CH-2	CH-3	CH-4	Callaghan	Brandywine
DO ($mg{\cdot}L^{-1}$)	n/a	10.2±0.3	10.0±0.3	10.2±0.2	10.2±0.2	10.4±0.4	10.6±0.2
pH	n/a	7.1±0.4	7.1±0.2	7.1±0.4	7.0±0.3	6.7±0.4	6.9±0.4
TDS ($mg{\cdot}L^{-1}$)	n/a	21±1	24±1	23±1	23±1	19±1	20±4
Specific conductance ($\mu S{\cdot}cm^{-1}$)	n/a	33±1	36±2	35±1	35±1	30±2	30±5
Temperature (ºC)	n/a	12.2±0.7	12.9±0.7	12.4±0.7	13.4±1.2	11.5±1.4	10.4±0.7
Turbidity (NTU)	n/a	4±1	4±2	7±4	4±2	15±11	1±1
TSS ($mg{\cdot}L^{-1}$)	9.8±6.8	2.4±1.8	3.8±2.5	7.2±7.4	2.3±1.6[B]	17.3±13.6	2.0±0.9
Fecal Coliforms ($cfu{\cdot}100mL^{-1}$)	Not measured	3±2	3±1	7±7	3±2	Not measured	Not measured
Total Coliforms ($cfu{\cdot}100mL^{-1}$)	Not measured	87±91	50±33	155±257	122±154	Not measured	Not measured
BOD_5 ($mg{\cdot}L^{-1}$)	Not measured	<2	<2	<2	<2	Not measured	Not measured

Table 4: Mean concentration (±sd) of descriptive chemical analytes, by site, in winter 2014.

Analyte	Cheakamus River stations in winter, 2014					Tributary inflow to Cheakamus River in winter, 2014	
	Final Plant Effluent[C]	CH-1	CH-2	CH-3	CH-4	Callaghan	Brandywine
DO ($mg \cdot L^{-1}$)	n/a	12.8±0.7	12.8±0.3	13.1±0.5	13.2±0.4	13.4±0.4	13.1±0.4
pH	n/a	7.3±0.6	7.5±0.2	7.4±0.3	7.2±0.4	7.4±0.3	7.3±0.3
TDS ($mg \cdot L^{-1}$)	n/a	35±1	53±5	56±2	54±5	58±4	57±4
Specific conductance ($us \cdot cm^{-1}$)	n/a	54±1	82±7	86±4	84±7	89±6	88±6
Temperature (ºC)	n/a	2.2±1.5	2.7±0.8	1.9±1.4	2.5±0.2	0.7±0.6	1.4±1.0
Turbidity (NTU)	n/a	0.6±0.6	0.5±0.4	0.4±0.3	0.8±0.8	0.4±0.2	0.2±0.2
TSS ($mg \cdot L^{-1}$)	5.8±2.5	<3	<3	<3	≤3	<3	<3
Fecal Coliforms ($cfu \cdot 100mL^{-1}$)	Not measured	3±1	30±5	21±3	11±15	Not measured	Not measured
Total Coliforms ($cfu \cdot 100mL^{-1}$)	Not measured	7±3	235±217	120±51	46±39	Not measured	Not measured
BOD_5 ($mg \cdot L^{-1}$)	Not measured	<2	<2	<2	<2	Not measured	Not measured

Macronutrient concentrations changed upstream to downstream both in relation to discharge from the WWTP, inflows from tributaries, and processes in Daisy Reservoir (Tables 5 and 6). In summer 2013, little difference in nutrient concentrations between CH-1 and CH-2 showed little influence of discharge from the plant on river chemistry. In contrast, relatively high concentrations of various forms of phosphorus in Callaghan Creek almost doubled SRP concentrations (to 1.5 $\mu g \cdot L^{-1}$ at CH-3) and increased TP concentrations by about 20% (to 12 $\mu g \cdot L^{-1}$ at CH-3) in summer. This influence of Callaghan Creek shifted the molar N:P from 64 at CH-2 to 24 at CH-3, potentially increasing demand for nitrogen among some of the benthic algae. Between CH-3 and CH-4, a decline in SRP concentration from 1.5 $\mu g \cdot L^{-1}$ to <1 $\mu g \cdot L^{-1}$ was likely due to biological uptake and adsorption following by settlement to sediments. This change and an increase in DIN concentration caused the molar N:P to increase from 24 to 92 between CH-3 and CH-4, potentially increasing demand for phosphorus in the reservoir and in the lower Cheakamus River. In winter, an opposite condition was apparent with discharge from the plant having a greater influence on river chemistry than did Callaghan Creek (Table 6). High NO_3-N concentrations in plant effluent increased NO_3-N concentrations in the river from 48 $\mu g \cdot L^{-1}$ at CH-1 to 209 $\mu g \cdot L^{-1}$ at CH-2. With relatively low concentrations of NH_4-N in the plant effluent, a four times increase in DIN concentration in the river between CH-1 and CH-2 was due entirely to NO_3-N loading from the plant. This change in winter was different than in summer when little change in NO_3-N concentration was found between CH-1 and CH-2. Low SRP concentrations in plant effluent in winter resulted in no change to SRP concentrations in the river but there was a larger concentration of TP from plant effluent that increased TP concentrations in the river by about 50%. Given that SRP is the bioavailable form of phosphorus, the low concentration of SRP and higher concentration of NO_3-N in discharge from the plant resulted in an upward shift in molar N:P in the river from 25 at CH-1 to 122 at CH-2, indicating a potential increase in demand for phosphorus in the river downstream of plant discharge in winter. Low concentrations of DIN and SRP between CH-2 and CH-3 showed that the inflow of Callaghan Creek diluted DIN and SRP concentrations in the Cheakamus river in winter, which was opposite to conditions in summer. SRP concentration declined between CH-3 and CH-4 in winter, inducing further potential phosphorus deficiency in the lower river in winter (molar N:P of 579). With low rates of nutrient uptake by biota in winter, processes contributing to most of the phosphorus retention in Daisy Reservoir were likely related to adsorption followed by settlement of particles to sediment. This process might be most effective in winter because low river flow would increase water residence time in the reservoir, increase contact time for binding of phosphate to particles, and allow more time for settlement of sediments than during high flows of summer.

Table 5: Mean concentration (±sd) of macronutrients, by site, in summer 2013.

Analyte	Final Plant Effluent	Cheakamus River stations in summer, 2013				Tributary inflow to Cheakamus River in summer, 2013	
		CH-1	CH-2	CH-3	CH-4	Callaghan	Brandywine
NH_4-N ($\mu g \cdot L^{-1}$)	324±258	<5	<5	<5	7.2±7.2	<5	<5
NO_3-N ($\mu g \cdot L^{-1}$)	2186±1856	11.4±6.1	17.7±4.4	13.3±3.2	13.6±6.0	<5	10.3±2.6
DIN ($\mu g \cdot L^{-1}$)	2510	14	21	16	21	<5	13
SRP ($\mu g \cdot L^{-1}$)	61.7±38.4	<1	<1	1.5±0.3	<1	3.1±1.2	2.5±0.2
N:P	111	61	64	24	92	4	12
TDP ($\mu g \cdot L^{-1}$)	138.1±48.1	1.3±0.5	2.0±0.7	2.7±0.4	<1	4.2±0.6	4.2±0.4
TN ($\mu g \cdot L^{-1}$)	4070±2117	35±19	42±19	40±17	77±52	34±17	53±19
TP ($\mu g \cdot L^{-1}$)	432±152	6.5±2.6	10.7±4.3	12.0±5.6	6.6±1.9	23.9±14.3	5.4±1.0

Table 6: Mean concentration (±sd) of macronutrients, by site, in winter 2014.

Analyte	Cheakamus River stations in winter, 2014					Tributary inflow to Cheakamus River in winter, 2014	
	Final Plant Effluent	CH-1	CH-2	CH-3	CH-4	Callaghan	Brandywine
NH_4-N ($\mu g \cdot L^{-1}$)	701±380	<5	<5	<5	22±11	<5	<5
NO_3-N ($\mu g \cdot L^{-1}$)	5618±1267	48±13	209±48	150±24	131±7	36±9	73±10
DIN ($\mu g \cdot L^{-1}$)	6318	51	214	153	153	38	76
SRP ($\mu g \cdot L^{-1}$)	17.7±3.9	4.8±1.5	4.0±1.0	3.3±1.2	<1	2.6±1.7	1.8±1.0
N:P	831	25	122	111	579	51	135
TDP ($\mu g \cdot L^{-1}$)	94±15	6.1±0.8	7.3±0.9	5.7±0.6	2.9±0.3	4.4±1.1	3.8±0.7
TN ($\mu g \cdot L^{-1}$)	7925±1288	63±26	272±36	187±18	228±25	62±8	102±5
TP ($\mu g \cdot L^{-1}$)	244±96	7.3±0.7	10.4±0.8	7.9±0.7	8.5±1.3	4.8±1.0	3.4±0.3

Similarities and differences in river nutrient concentrations were found during operation of the CPR plant (Table 7) compared to the BNR plant (Table 5) in summer. Without nitrogen removal by the CPR plant, NH_4-N concentrations increased almost 4 times and NO_3-N concentrations doubled between CH-1 and CH-2 (Table 7). Phosphorus removal in 1996 resulted in little change in SRP concentration in the river downstream compared to upstream of plant discharge. TP concentrations did increase between CH-1 and CH-2 but given no change in soluble P, this increase was due to particulate phosphorus that is not biologically available. The result was an increase in molar N:P from 61 at CH-1 to 112 at CH-2. Little change in molar N:P occurred between CH-1 and CH-2 with the BNR plant in summer. Inflow of Callaghan Creek having low concentrations of inorganic nitrogen resulted in dilution of DIN and lower DIN concentrations at CH-3 than at CH-2 in 1996. Relatively high SRP and particularly TP concentrations in Callaghan Creek increased soluble and total phosphorus concentrations in the Cheakamus River between CH-2 and CH-3, as was found in summer 2013. The addition of soluble phosphorus from Callaghan Creek resulted in a larger decline in molar N:P from 112 at CH-2 to 44 at CH-4 than was found in summer 2013 when the molar N:P dropped from 64 at CH-2 to 24 at CH-3. SRP concentration declined by 50% between CH-3 and CH-4 in summer 1996, but there was little change in DIN concentrations between these stations. This result showed similar potential demand for N and P in the lower river based on molar N:P using either the BNR or CPR plants.

In winter 1996, the lack of nitrogen removal in the CPR plant again caused DIN concentrations to increase between CH-1 and CH-2 (Table 8) as was found in summer (Table 7) but by a larger margin. In winter, this same change was found with operation of the BNR plant (Table 6) because treated effluent from the BNR plant had double the NO_3-N concentration compared to summer but river flows were lower than in summer, thus producing a greater increase in DIN concentration at CH-2 in winter than in summer. There were no chemical data from CH-3 in winter 1996 but results from CH-4 showed that tributary inflows combined with processes in Daisy Reservoir lowered DIN concentration at CH-4 (129 $\mu g \cdot L^{-1}$) from CH-2 (244 $\mu g \cdot L^{-1}$), a directional change that was the same as in summer, 1996. SRP concentration also declined between CH-2 and CH-4 in winter 1996, likely due to biological uptake and adsorption followed by settlement. This change was greater than in summer, producing greater potential phosphorus deficiency at CH-4 in winter (molar N:P of 236) than in summer (molar N:P of 91).

With both types of plant processes, at all locations the molar N:P was always within a range indicating potential phosphorus limitation of algal growth (Figure 4). In summer the potential phosphorus limitation was greater when the CPR plant was operating than with operation of the present BNR plant. With both types of plants, the potential phosphorus limitation of algal growth increased over the upstream to downstream gradient in winter but there was no clear spatial change in summer.

Table 7: Mean concentration (±sd) of macronutrients, by site, in summer 1996.

Analyte	Cheakamus River stations in summer, 1996				Tributary inflow to Cheakamus River in summer, 1996	
	CH-1	CH-2	CH-3	CH-4	Callaghan	Brandywine
NH_4-N ($\mu g \cdot L^{-1}$)	11.9±11.0	42.9±13.7	16.4±6.9	13.4±3.8	8.2±2.8	8.7±3.1
NO_3-N ($\mu g \cdot L^{-1}$)	22.3±8.6	44.8±13.0	27.6±4.8	31.6±9.7	4.1±1.7	9.0±3.3
DIN ($\mu g \cdot L^{-1}$)	34	88	44	45	12	18
SRP ($\mu g \cdot L^{-1}$)	1.5±0.7	1.8±0.5	2.3±0.5	1.2±0.5	3.7±1.8	2.6±0.8
N:P	61	112	44	91	8	16
TDP ($\mu g \cdot L^{-1}$)	2.4±0.5	2.7±0.5	2.8±0.7	2.1±0.8	4.2±1.4	3.6±1.1
TN ($\mu g \cdot L^{-1}$)	no data	no data	no data	no data	no data	no data
TP ($\mu g \cdot L^{-1}$)	6.9±3.8	10.2±4.6	15.6±7.7	7.3±1.8	21.5±9.7	5.6±1.5

Table 8: Mean concentration (±sd) of macronutrients, by site, in winter 1996.

Analyte	Cheakamus River stations in winter, 1996				Tributary inflow to Cheakamus River in winter, 1996	
	CH-1	CH-2	CH-3	CH-4	Callaghan	Brandywine
NH_4-N ($\mu g \cdot L^{-1}$)	15±28	157±132	no data	65±9	3.8±2.3	3.5±2.7
NO_3-N ($\mu g \cdot L^{-1}$)	30±10	87±25	no data	64±16	13±6	38±14
DIN ($\mu g \cdot L^{-1}$)	45	244	no data	129	17	42
SRP ($\mu g \cdot L^{-1}$)	4.1±0.6	3.8±1.6	no data	1.3±0.3	1.3±1.0	1.6±1.0
N:P	25	135	no data	236	79	72
TDP ($\mu g \cdot L^{-1}$)	5.5±1.4	6.4±3.3	no data	3.1±0.5	2.5±0.7	2.7±1.1
TN ($\mu g \cdot L^{-1}$)	no data	no data	no data	no data	no data	no data
TP ($\mu g \cdot L^{-1}$)	12.1±6.0	14.5±6.6	no data	7.2±1.1	3.5±0.5	5.3±3.7

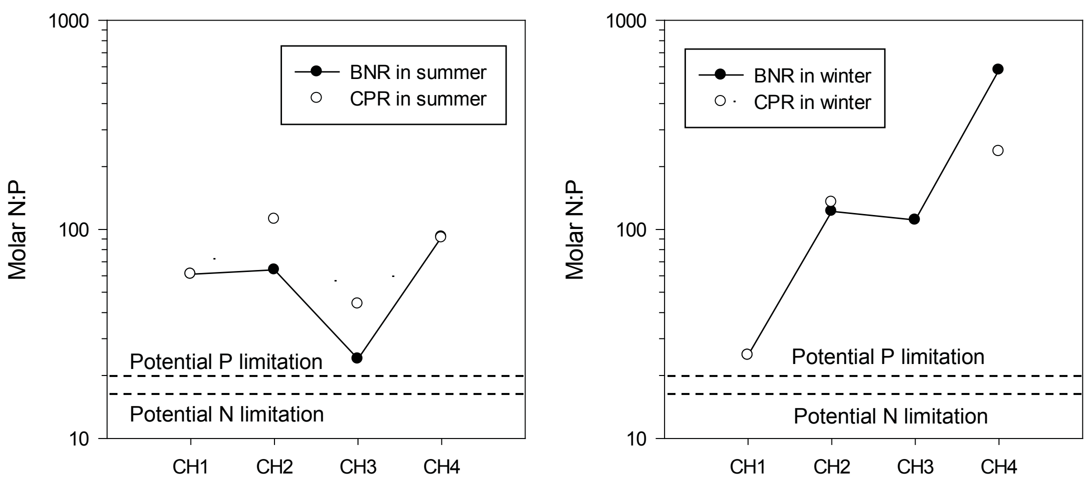

Figure 4. Molar N:P by station and type of treatment plant in summer (left) and winter (right). The dotted horizontal lines indicate a band of molar N:P separating potential nitrogen limitation (molar N:P <13) and potential phosphorus limitation (molar N:P >20) of algal growth with a transition range in between.

3.2 N and P by source in the Upper Cheakamus River

Summary statistics of flow data used in Equations 2 and 3 are listed in Table 9. They show that the rate of effluent discharge from the WWTP was similar in winter 2014 and summer 2013 but when the CPR plant was operating in 1996, summer discharge from the plant was 23% lower than in winter. The winter discharge in 1996 was the same as in 2014. Cheakamus River flows were high in summer and low in winter, corresponding with snow accumulation in the alpine in winter and snow melt in summer. The estimated inflow from Callaghan Creek increased Cheakamus flows by 60% in both years and seasons in relation to the increase in watershed area. Brandywine Creek was the smallest inflow in the study area. Flow at CH-4 (outflow of Daisy Dam) was lower than the inflow to Daisy Reservoir because water is diverted to the Squamish River from Daisy Reservoir as part of water management for power production by BC Hydro. This diversion was greater in 1996 than in 2013-14 due to changes in flows determined from water use planning (https://www.bchydro.com/about/sustainability/conservation/water_use_planning/lower_mainland/cheakamus.html).

Winter flows in 1996 were greater than in 2013-14 (Table 9). This difference resulted in greater dilution of treated effluent in winter 1996 than in winter 2014. In summer, flows were more similar between years than in winter, resulting in approximately the same dilution of treated effluent that was discharged to the river.

Table 9. Mean flow (±sd) by station and season in 2013-14 and 1996.

Source	**Station**	**Mean flow ($m^3 \cdot s^{-1}$)**			
		Winter 1996	**Summer 1996**	**Winter 2014**	**Summer 2013**
WWTP	Final plant effluent[A]	0.13±0.02	0.10±0.01	0.13±0.01	0.12±0.01
Cheakamus River stations	CH-1[B]	7.9±2.5	33±12.9	3.4±0.8	37.4±12.0
	CH-2[C]	9.4±3.0	39.3±15.3	4.1±0.9	44.5±14.3
	CH-3[C]	15.0±4.7	63.1±24.6	6.6±1.5	71.5±22.9
	Daisy Lake Inflow[D]	29.9±19.8	84.4±40.5	14.2±6.2	66.0±27.1
	CH-4[E]	2.1±0.1	54.6±49.5	10.6±6.0	27.7±21.0
Tributary inflow to Cheakamus River	Callaghan[C]	5.2±1.6	21.8±8.5	2.3±0.5	24.3±7.9
	Brandywine[C]	1.4±0.4	5.9±2.3	0.6±0.1	6.6±2.2

A. Flow data from RMOW
B. Flow data from Water Survey of Canada station 08GA072
C. Flows based on WSC station 08GA072 corrected for watershed area of the station.
D. Flows provided by BC Hydro for Daisy Lake Reservoir inflows
E. Flows provided by BC Hydro for Daisy Lake Reservoir releases

In all combinations of type of treatment plant and season, the sum of SRP concentration at CH-1 and the SRP concentration in the river that was from the plant was greater than or equal to the measured concentration of SRP in the river at CH-2 where plant effluent would be expected to be fully mixed (Table 10). The difference between the predicted SRP concentration (uptake by biota absent) and measured concentration (uptake by biota present) at CH-2 was the amount taken up by biota. That amount was negligible in summer during high river flows but it was 9.3 $\mu g \cdot L^{-1}$ in winter during operation of the BNR plant and 4.6 $\mu g \cdot L^{-1}$ when the CPR plant was operating. The concentration of SRP in the river that was from the plant ranged from 20% of upstream sources at CH-1 during operation of the CPR plant in summer to 177% of upstream sources during operation of the BNR plant in winter. In the other combinations (BNR plant in summer and CPR plant in winter) the concentration of SRP added to the river from the plant was similar to that from upstream sources.

Table 10. Net change in SRP concentration in the Cheakamus River from natural sources, wastewater treatment plant, and uptake.

Plant type and season	**SRP concentration ($\mu g \cdot L^{-1}$)**				
	At CH-1*	**Added to the river at CH -2 from the plant****	**Calculated at CH-2*****	**Measured at CH-2***	**Uptake******
BNR plant in summer	<1	0.5	1	<1	<1
CPR (1996) plant in summer	1.5±0.7	0.3	1.8	1.8±0.5	0
BNR plant in winter	4.8±1.5	8.5	13.3	4.0±1.0	9.3
CPR (1996) plant in winter	4.1±0.6	4.3	8.4	3.8±1.6	4.6

*From Tables 5 to 8.
**From equation 2.
***Sum of SRP concentration at CH-1 and SRP concentration added to the river and fully mixed at CH-2.
****Difference between predicted and measured concentration. A positive value showed uptake of SRP between CH-1 and CH-2.

The same net uptake in the river was found for DIN among all combinations of plant type and season (Table 11). The amount taken up by biota ranged from 3 $\mu g \cdot L^{-1}$ in summer during operation of the BNR plant to 116 $\mu g \cdot L^{-1}$ in winter during operation of the CPR plant. The concentration of DIN in the river that was from the plant ranged from 71% of upstream sources during operation of the BNR plant in summer to 7 times greater than upstream sources during operation of the CPR plant in winter.

Table 11. Net change in DIN concentration in the Cheakamus River from natural sources, wastewater treatment plant, and uptake.

Plant type and season	DIN concentration (µg·L^{-1})				
	At CH-1*	Added to the river at CH -2 from the plant**	Calculated at CH-2***	Measured at CH-2*	Uptake****
BNR plant in summer	14±6	10	24	21±5	3
CPR (1996) plant in summer	34±12	no plant data	no data	88±18	no data
BNR plant in winter	51±13	275	326	214±50	112
CPR (1996) plant in winter	45±8	315	360	244±156	116

*From Tables 5 to 8.
**From equation 2.
***Sum of DIN concentration at CH-1 and DIN concentration added to the river and fully mixed at CH-2.
****Difference between predicted and measured concentration. A positive value showed uptake of DIN between CH-1 and CH-2.

The relative and absolute loads of SRP and DIN by source in the upper Cheakamus River is shown in Tables 12 and 13 respectively. The BNR plant added 6% of the SRP load to the upper river in summer and 9% in winter. Callaghan Creek was the largest single contributor of SRP in summer 2013 (64%) while upstream sources were largest in winter (64%). The CPR plant contributed a small SRP load to the river in summer 1996 (5% of total load). It was the largest contributor in winter (49% of total load) but close to that from upstream sources (40% of total SRP load). The BNR plant added 29% of DIN load to the river in summer and 73% in winter. Upstream sources were the largest contributor of DIN in summer 2013 (51%) while the plant was the largest in winter. The CPR plant contributed most of the DIN load to the river in winter 1996 (86% of total load).

Table 12. Comparison of SRP loading by source in the upper Cheakamus River in each combination of plant type and season.

Season and plant type	SRP transport (kg during the season) with percent of total load shown in brackets				
	CH-1	WWTP	Callaghan	Brandywine	Total
CPR (1996) plant in winter	248 (40%)	304 (49%)**	52 (8%)	18 (3%)	622
BNR plant in winter	129 (64%)	18 (9%)	46 (23%)	8 (4%)	201
CPR (1996) plant in summer	398 (32%)	67 (5%)**	642 (52%)	124 (10%)	1231
BNR plant in summer	149 (16%)	58 (6%)	606 (64%)	131 (14%)	944

** Chemistry data from RMOW, no Limnotek sampling of plant effluent in 1996

Table 13. Comparison of DIN loading by source in the upper Cheakamus River in each combination of plant type and season.

Season and plant type	DIN transport (kg during the season) with percent of total load shown in brackets				
	CH-1	WWTP	Callaghan	Brandywine	Total
CPR (1996) plant in winter	2404 (9%)	21,787 (86%)**	676 (3%)	464 (2%)	25,331
BNR plant in winter	1359 (15%)	6487 (73%)	676 (8%)	365 (4%)	8,887
CPR (1996) plant in summer	8990	no data	2123	836	Data incomplete
BNR plant in summer	4127 (51%)	2346 (29%)	970 (12%)	705 (9%)	8,148

** Chemistry data from RMOW, no Limnotek sampling of plant effluent in 1996

3.3 Periphyton

The ANOVA to examine the effect of location (CH-1 and CH-2), plant type (CPR, expanded CPR, BNR), and season (winter and summer) on periphyton PB showed a significant interaction of all three factors (P=0.003). This outcome meant that PB at CH-1 changed differently than at CH-2 between seasons and/or plant types. Figure 5 shows this interaction. In summer, PB was <5 µg $chl\text{-}a \cdot cm^{-2}$ at both stations and during operation of all plant types. These PB values were less than half of the Provincial Criterion of 10 µg $chl\text{-}a \cdot cm^{-2}$. In winter, PB at CH-1 was again less than the Provincial Criterion but at CH-2, PB was less than the criterion only during operation of the CPR plant. With enhanced CPR and more so during operation of the BNR plant, winter time PB increased to 12.4 µg $chl\text{-}a \cdot cm^{-2}$ and 21.4 µg $chl\text{-}a \cdot cm^{-2}$ respectively. This winter time PB during operation of the BNR plant was more than double the Provincial Criterion.

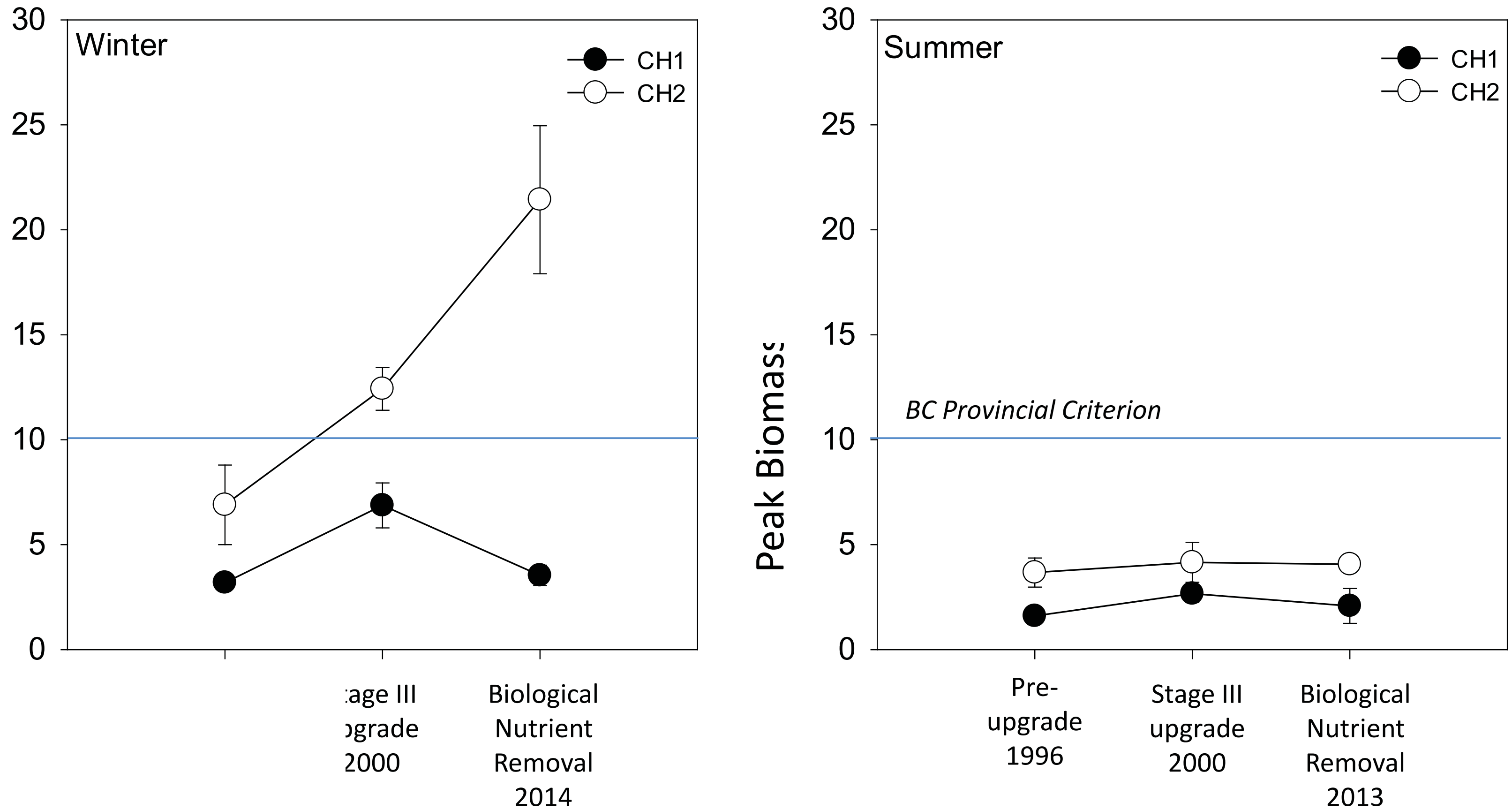

Figure 5. Interactions of season, location, and plant type on mean periphyton PB (±sd) in the Cheakamus River. The BC Provincial Criterion for algal biomass (10 µg chl-a·cm^{-2}) is shown for reference.

Diatoms comprised 77-99% of total biovolume among algal divisions during operation of all types of plants, location, and season except at both sites in winter 2014 when the chrysophyte (golden-brown algae), *Hydrurus foetidus*, had greatest biovolume (57% at CH-1 and 71% at CH-2) among all taxa (Tables 14 to 17). Taxa from the cyanophytes (blue green algae), chlorophytes (green algae), chrysophytes other than *Hydrurus*, cryptophycophyta, and charophytes (stoneworts) were less common among all sites and times. The taxa contributing most to dissimilarities of assemblages between CH-1 and CH-2 in summer 1996 were diatoms but in summer 2013 they included a more diverse assemblage of four diatoms (*Didymosphaenia geminata*, *Eunotia, Achnanthidium,* and *Encyonema*) and taxa from other divisions including *Chilomonas, Lyngbya, Oocystis, Zygnema, and Cladophora* (Tables 15 and 16). Sample richness increased in 2013-14 compared to the earlier years (Table 14). In summer 2013, Didymo was most important among all taxa in distinguishing assemblages between sites with its biovolume being greater at CH-1 than at CH-2 (Table 16). The taxa contributing most to dissimilarities of assemblages between sites in winter were the diatoms *Cymbella, Gomphonema, Hannaea, Fragilaria, Melosira, Diatoma,* as well as the chrysophyte, *Hydrurus* and the chlorophyte, *Ulothrix* (Tables 15 and 17). *Hydrurus* was the most important taxon because it alone contributed to 72% of differences in assemblages between CH-1 and CH-2 (Table 15). Biovolume of *Hydrurus* was 5 times greater at CH-2 than it was at CH-1 (Table 17).

The temporal differences in species richness and assemblages contributing to dissimilarities among assemblages at CH-1 and CH-2 were due to time course changes unrelated to plant discharge because they occurred at both of CH-1 and CH-2. They may indicate changes to the river upstream of the plant.

Simpsons diversity, a measure of heterogeneity of taxa, was 0.69 to 0.81 which is moderate to high among all sites and times except in winter 2014 when it was 0.64 at CH-1 and 0.45 at CH-2 (Table 14). The low values in winter 2014 were due to the dominance by *Hydrurus foetidus* that occurred in such high biovolume that many other taxa were excluded, which indicates bloom conditions. The higher biovolume of *Hydrurus* downstream of the plant compared to upstream shows a response to the nutrient loading from the BNR plant in winter.

All taxa found at both sites in each season were typical of cool, pristine rivers having low or moderate levels of nutrient enrichment. The same taxa are found in unpolluted coastal rivers (e.g Perrin et al 1987), and in nutrient-deficient and slightly P-enriched reaches of the upper Thompson River (Bothwell 1989). Most are also common in nutrient deficient northern waters of British Columbia (Perrin and Richardson 1997). What is unusual was the bloom of *Hydrurus*. It is a cold water alga commonly found at temperatures lower than 2°C (Klaveness and Lindstrom 2011, Cevik et al. 2007), which was typical in winter 2014. It occurred in bloom proportions at both sites but the high biovolume at CH-2 showed a response to N and P enrichment from the BNR plant.

Table 14. Mean algal biovolume (µm³ x 10⁹·m⁻²) or metric value (±SD) by location, season, and plant type.

Metric	Location	Algal biovolume or metric value (µm³ x 10⁹·m⁻² unless otherwise shown)					
		Winter			Summer		
		CPR (n=3)	Enhanced CPR (n=1)	BNR (n=4)	CPR (n=3)	Enhanced CPR (n=1)	BNR (n=4)
Cyanophyceae	CH1	0 ± 0	0	397 ± 391	11 ± 20	8	49 ± 39
	CH2	0 ± 0	0	409 ± 306	6 ± 11	16	107 ± 120
Chlorophyceae	CH1	49 ± 43	247	15 ± 29	0 ± 0	0	87 ± 89
	CH2	0 ± 0	1713	0 ± 0	0 ± 0	0	36 ± 15
Chrysophyta	CH1	0 ± 0	0	2971 ± 1183	0 ± 0	7	33 ± 55
	CH2	60 ± 14	0	14649 ± 2805	0 ± 0	0	9 ± 7
Bacillariophyceae (Diatoms)	CH1	1070 ± 683	5216	1662 ± 396	569 ± 87	783	1033 ± 963
	CH2	830 ± 209	12223	5703 ± 3271	918 ± 308	369	601 ± 222
Cryptophytes	CH1	0 ± 0	0	0 ± 0	0 ± 0	0	76 ± 68
	CH2	0 ± 0	0	0 ± 0	0 ± 0	0	16 ± 11
Charophyta	CH1	0 ± 0	0	143 ± 150	0 ± 0	0	22 ± 38
	CH2	0 ± 0	0	0 ± 0	0 ± 0	0	7 ± 8
Total Biovolume	CH1	1119 ± 703	5463	5188 ± 1213	581 ± 71	798	1299 ± 1184
	CH2	889 ± 196	13937	20760 ± 6031	924 ± 319	385	776 ± 252
Species richness (number of species)	CH1	8.0 ± 1.7	7	14.8 ± 1.5	7.3 ± 1.2	8	16.8 ± 2.9
	CH2	9.0 ± 1.4	9	11.3 ± 1.7	7.3 ± 1.5	8	16.5 ± 1.3
Simpson's Index of Diversity (relative value)	CH1	0.71 ± 0.06	0.74	0.64 ± 0.16	0.81 ± 0.04	0.65	0.77 ± 0.12
	CH2	0.69 ± 0.14	0.77	0.45 ± 0.12	0.74 ± 0.09	0.79	0.73 ± 0.13

Table 15. Percent contribution by taxa cumulatively contributing to >90% of dissimilarities of assemblages defined in SIMPER between CH-1 and CH-2 by type of treatment plant and season.

Algal Division	Genus and species	Percent contribution to dissimilarity of assemblages between CH-1 and CH-2					
		Summer			Winter		
		CPR plant	Expanded CPR plant	BNR plant	CPR plant	Expanded CPR plant	BNR plant
Bacillariophyceae	*Achnanthes or Achnanthidium all*	33.66	dnc	6.52	dnc	dnc	dnc
Bacillariophyceae	*Cymbella all*	22.07	4.67	dnc	5.21	58.16	dnc
Bacillariophyceae	*Gomphonema all*	9.92	5.63	2.77	7.3	dnc	3.38
Bacillariophyceae	*Hannaea arcus*	9.52	64.6	dnc	33.21	10.25	7.12
Bacillariophyceae	*Fragilaria all*	7.6	dnc	dnc	dnc	5.85	dnc
Bacillariophyceae	*Nitzschia sp.*	4.7	dnc	dnc	dnc	dnc	dnc
Bacillariophyceae	*Tabellaria all*	4	6.22	1.71	dnc	dnc	dnc
Bacillariophyceae	*Cocconeis all*	dnc	6.88	dnc	dnc	dnc	dnc
Bacillariophyceae	*Synedra sp.*	dnc	5.21	2.26	dnc	dnc	dnc
Bacillariophyceae	*Didymosphaenia geminata*	dnc	dnc	46.86	dnc	dnc	dnc
Bacillariophyceae	*Eunotia sp.*	dnc	dnc	6.31	dnc	dnc	dnc
Bacillariophyeae	*Melosira varians*	dnc	dnc	dnc	dnc	dnc	3.31
Bacillariophyeae	*Diatoma all*	dnc	dnc	dnc	30.57	dnc	3.58
Bacillariophyceae	*Encyonema caespitosum*	dnc	dnc	2.79	dnc	dnc	3.06
Cryptophycophyta	*Chilomonas sp.*	dnc	dnc	5.92	dnc	dnc	dnc
Chrysophyta	*Hydrurus foetidus*	dnc	dnc	dnc	8.03	dnc	71.7
Cyanophyceae	*Lyngbya sp.*	dnc	dnc	4.49	dnc	dnc	dnc
Cyanophyceae	*Tolypothrix sp.*	dnc	dnc	4.27	dnc	dnc	dnc
Chlorophyceae	*Oocystis lacustris*	dnc	dnc	2.6	dnc	dnc	dnc
Charophyta	*Zygnema sp.*	dnc	dnc	2.12	dnc	dnc	dnc
Chlorophyceae	*Cladophora sp.*	dnc	dnc	2.06	dnc	dnc	dnc
Chlorophyceae	*Ulothrix all*	dnc	dnc	dnc	6.07	17.3	dnc
Average dissimilarity between CH-1 and CH-2		**37%**	**49%**	**50%**	**41%**	**44%**	**63%**

*dnc means the taxon did not contribute to dissimilarities of assemblages between CH-1 and CH-2.

Table 16. Mean biovolume of species (±sd) contributing to >90% of dissimilarities of algal assemblages defined in SIMPER between CH-1 and CH-2 by plant type and sampling site in summer.

Algal Division	Genus and species	Mean biovolume of species contributing to 90% of dissimilarities between CH-1 and CH-2 by type of plant in summer					
		CPR plant		Expanded CPR plant		BNR plant	
		CH-1	CH-2	CH-1	CH-2	CH-1	CH-2
Bacillariophyceae	*Achnanthes or Achnanthidium all*	155±25	342±89	dnc*	dnc	112±35	54±27
Bacillariophyceae	*Cymbella all*	92±32	216±55	56	29	dnc	dnc
Bacillariophyceae	*Gomphonema all*	117±41	143±90	42	10	46±21	25±11
Bacillariophyceae	*Hannaea arcus*	69±49	91±49	437	67	dnc	dnc
Bacillariophyceae	*Fragilaria all*	66±24	73±55	dnc	dnc	dnc	dnc
Bacillariophyceae	*Nitzschia sp.*	26±29	0	dnc	dnc	dnc	dnc
Bacillariophyceae	*Tabellaria all*	8±13	23±40	36	0	18±12	1±2
Bacillariophyceae	*Cocconeis all*	dnc	dnc	64	104	dnc	dnc
Bacillariophyceae	*Synedra sp.*	dnc	dnc	0	30	23±12	2±3
Bacillariophyceae	*Didymosphaenia geminata*	dnc	dnc	dnc	dnc	620±859	346±214
Bacillariophyceae	*Eunotia sp.*	dnc	dnc	dnc	dnc	155±69	97±38
Cryptophycophyta	*Chilomonas sp.*	dnc	dnc	dnc	dnc	76±68	16±11
Cyanophyceae	*Lyngbya sp.*	dnc	dnc	dnc	dnc	42±33	54±41
Cyanophyceae	*Tolypothrix sp.*	dnc	dnc	dnc	dnc	0	41±81
Bacillariophyceae	*Encyonema caespitosum*	dnc	dnc	dnc	dnc	27±23	51±14
Chlorophyceae	*Oocystis lacustris*	dnc	dnc	dnc	dnc	50±25	34±15
Charophyta	*Zygnema sp.*	dnc	dnc	dnc	dnc	20±39	0
Chlorophyceae	*Cladophora sp.*	dnc	dnc	dnc	dnc	36±67	2±3

*dnc means the taxon did not contribute to dissimilarities of assemblages between CH-1 and CH-2.

Table 17. Mean biovolume of species (±sd) contributing to >90% of dissimilarities of algal assemblages defined in SIMPER between CH-1 and CH-2 by plant type and sampling site in winter.

Algal Division	Genus and species	Mean biovolume of species contributing to 90% of dissimilarities between CH-1 and CH-2 by type of plant in winter					
		CPR plant		Expanded CPR plant		BNR plant	
		CH-1	CH-2	CH-1	CH-2	CH-1	CH-2
Bacillariophyeae	*Hannaea arcus*	430±304	447±264	2206	3074	116±49	1362±736
Bacillariophyeae	*Diatoma all*	413±263	128±4	dnc	dnc	379±134	982±973
Chrysophyta	*Hydrurus foetidus*	0	60±14	dnc	dnc	2,971±1,183	14,649±2,805
Bacillariophyeae	*Gomphonema all*	81±57	82±70	dnc	dnc	256±115	862±671
Chlorophyceae	*Ulothrix all*	49±43	0	247	1713	dnc	dnc
Bacillariophyeae	*Cymbella all*	72±55	40±34	249	5177	dnc	dnc
Bacillariophyeae	*Fragilaria all*	dnc	dnc	552	1048	dnc	dnc
Bacillariophyeae	*Melosira varians*	dnc	dnc	dnc	dnc	141±65	545±1051
Bacillariophyeae	*Encyonema caespitosum*	dnc	dnc	dnc	dnc	431±177	943±292

*dnc means the taxon did not contribute to dissimilarities of assemblages between CH-1 and CH-2.

4 DISCUSSION

Statistical modelling from 13 years ago (Perrin 1998, 2001) predicted that for a given load, a change to a BNR plant at RMOW would decrease the amount of periphyton biomass in the upper Cheakamus River by up to 46% compared to biomass during operation of the chemical phosphorus removal (CPR) plant that was operating at the time. That prediction, however, did not consider change in load to the plant that increased by 40% over those 13 years (Figure 2) and the influence of load on effectiveness of the BNR plant to remove N and P. With the present influent load, the BNR plant is effective in maintaining algal PB in the Cheakamus River at less than the Provincial Criterion of 10 µg chl-a·cm^{-2} in summer. It is also effective in keeping summertime fecal coliform concentrations unchanged between sites upstream and downstream of the plant. The summertime algal biomass downstream of the plant in 2013 was the same as was found during operation of the CPR plant in 1996 and 2000. The BNR technology and high dilution of the treated effluent in the high summer flows of the Cheakamus River produced this result by limiting change in SRP concentration in the river by an amount that was too small to increase algal biomass to amounts approaching or exceeding the Provincial Criterion. SRP was the form and nutrient of importance because molar N:P ratios showed that algal growth during operation of the CPR and BNR plants was potentially limited by phosphorus and SRP was the form of phosphorus that is biologically available.

The change from a CPR plant to BNR plant with increased load over time resulted in different contributions of SRP to the Cheakamus River between summer and winter. In summer, both types of plants contributed the same proportionate amount of SRP to the river. The CPR plant contributed 5% of total load and the BNR plant contributed 6% of total load in summer. Relative loading from the plant to the river was the smallest of all sources in summer in both 1996 and 2013. In winter the CPR plant contributed about half of the total load of SRP to the upper Cheakamus River but the contribution dropped to only 9% with operation of the BNR plant. Given increased load to the plant between the time the CPR plant was operating and present time, these differences were the result of increased effectiveness of the plant in removing SRP and time course differences in phosphorus transport from the different sources.

In contrast, the plant, regardless of design, contributed most of the DIN to the upper river compared to other sources. Only winter data were available for comparison. They show the plant contributed 86% of the DIN load to the upper river with operation of the CPR plant and 73% of the load with operation of the BNR plant. Given that algal growth was limited more by availability of phosphorus than nitrogen, this anomalous loading of inorganic nitrogen had little effect on the accrual of algal biomass at any time.

In summer 2013, SRP concentration was low enough that the ubiquitous but undesirable diatom called *Didymosphaenia geminata* (often called Didymo) was favoured as has been observed in other rivers having very low concentrations of SRP (Bothwell and Kilroy 2011, and Kilroy and Bothwell, 2011). Didymo did not form dense mats in the Cheakamus River in 2013 but its presence in high biovolume compared to other taxa coincided with a SRP concentration <1 $\mu g \cdot L^{-1}$ (the method detection limit) both upstream and downstream of the WWTP. The presence of Didymo showed low bioavailability of phosphorus that promoted stalk formation and high biomass.

Water quality was different in winter. In winter 2014, effluent flow was the same as in the previous summer but river flow in winter was 10% of that in summer, resulting in less dilution of the treated effluent. Fecal coliform concentration in the river increased 10 times from that occurring upstream of the plant. A mean count of close to 30 $cfu \cdot 100mL^{-1}$ in the river that was from the plant would not pass drinking water criteria (Warrington and Johnson, 2001) but it would be acceptable for recreation use of the river (Provincial guideline is 200 $cfu \cdot 100mL^{-1}$, Warrington and Johnson, 2001). DIN concentrations increased 4 times, resulting in a five times increase in the molar N:P that increased potential phosphorus demand by the benthic algae. Hence, there was surplus bioavailable N compared to bioavailable P with respect to demand from algae. The SRP concentrations declined from 4.8 $\mu g \cdot L^{-1}$ at CH-1 to 4 $\mu g \cdot L^{-1}$ at CH-2 but this change was the net effect of addition of SRP from the plant and uptake by biota responding to that demand for phosphorus (Table 10). The available SRP at CH-2 determined from dilution calculations was 13 $\mu g \cdot L^{-1}$ but the measured concentration of 4 $\mu g \cdot L^{-1}$ shows that 9 $\mu g \cdot L^{-1}$ was taken up in the 6.6 km from the plant to CH-2. A bio-available concentration of 13 $\mu g \cdot L^{-1}$ is in excess of a concentration close to 1 $\mu g \cdot L^{-1}$ that can saturate cellular growth rates of periphytic algae (Bothwell 1989). As a result, conditions were suitable for high biomass of periphyton to occur, which happened as a bloom of the chrysophyte, *Hydrurus foetidus*, to the exclusion of many other taxa. Discharge from the plant caused this relatively high biomass compared to the lower biomass upstream that was less than the Provincial Criterion because there were no factors other than nutrient discharge from the plant occurring between CH-1 and CH-2 that could contribute to the observed differences in PB. In winter 1996, river flows were more than double those in 2014, which for a similar discharge from the plant would have produced half the available SRP concentration. Lower discharge from the plant in 1996 than in 2014 would have produced even greater differences. Those conditions resulted in lower algal biomass measured as PB in winter 1996 (7 μg $chl\text{-}a \cdot cm^{-2}$) than in 2014 (21 μg $chl\text{-}a \cdot cm^{-2}$).

The winter 2014, PB was more than double the Provincial Criterion of 10 μg $chl\text{-}a \cdot cm^{-2}$. This excursion does not mean that the algal biomass was harmful to the river. The water was well oxygenated, there was no BOD, and TSS concentrations remained low. These conditions mean that decomposition of senescent algal biomass did not exert demand for oxygen that could lead to low dissolved oxygen concentrations and potentially harm benthic invertebrates and fish. The criterion mainly applies to sustaining aesthetic values of a river, which is thought to protect ecological processes as well. It is well known, however, that algal biomass above the criterion can have positive effects on river biota. A PB of 20 µg chl-a·cm^{-2} increased fish growth in pristine nutrient deficient rivers on Vancouver Island (Perrin et al. 1987, Johnston et al. 1990) and Alaska (Deegan et al. 1997). Nutrient addition to other coastal rivers that produced a PB of 32 µg chl-a·cm^{-2} resulted in a four-fold increase in rainbow trout abundance (Wilson et al. 2003). This level of biomass was greater than that found in the Cheakamus River in winter 2014. While aesthetics are important, these ecological data suggest that algal biomass higher than the Provincial Criterion in the upper Cheakamus River may be positive for fish. In addition, algal biomass at CH-2 in winter at the time PB was measured was not aesthetically unpleasant. Hence, there may be need to develop a site specific criterion for the upper Cheakamus River with regulatory authorities that focusses on fish and the supporting food web as well as aesthetic values. These discussions are needed before consideration is given to potential changes to the WWTP operational certificate.

Recommendations following this rationale are as follows:

Recommendation 1: We recommend that a rationale be developed for changing the algal biomass criterion in the upper Cheakamus River to a value greater than the Provincial Criterion of 10 µg chl-a·cm^{-2} to match existing science showing that higher levels of algal biomass can be beneficial to fish.

Recommendation 2: We recommend that a regression model be developed to show peak biomass of periphyton (PB) in the upper Cheakamus River as a function of the concentration of soluble reactive phosphorus (SRP) in the Cheakamus River that is available for biological uptake from natural sources and the WWTP under various operating scenarios at the WWTP.

Many comparisons of nutrient concentrations in the river between sites made between times when the CPR and BNR plants were operating were made only between single years, mainly 1996 (CPR plant) and 2013-14 (BNR plant). This approach was statistically weak because it only included a single year for comparison of the various measurements, although it was unavoidable because in-river chemical data were only available for those single years. It is possible that variability in river flows and load to the plant in different years would produce different nutrient concentrations among sites and possibly different algal assemblages and biomass. However, the large difference in algal biomass between CH-1 and CH-2 in winter 2014 and the lack of difference in summer 2013 with the BNR plant was clearly different than was found from monitoring effects of the CPR plant in 1996. Statistics were not needed to see the differences. The results are unequivocal in showing added enrichment effects in the river from present operation of the BNR plant. Notwithstanding this outcome, routine sampling of water chemistry and periphyton as part of plant operations would improve precision of the data and allow for statistical tests of significance of comparisons between effects of present and future plant operations on water quality in the Cheakamus River. That precision would be needed to support future decisions on plant upgrades and design and assess ongoing operation of the plant. A third recommendation is as follows:

Recommendation 3: We recommend that monthly water chemistry sampling at CH1 (upstream of the plant) and CH2 (downstream of the plant) be done as part of plant operations every year and that periphyton sampling be done in winter and summer once every 5 years at CH1 and CH2 as part of plant operations. These data will be used to improve precision of data used to assess plant performance and river condition in future years.

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WHISTLER

REPORT | ADMINISTRATIVE REPORT TO COUNCIL

PRESENTED: August 11, 2015 **REPORT:** 15-099

FROM: Infrastructure Services **FILE:** 365

SUBJECT: FINAL SEWER EXTENSION PROJECT - ALTA LAKE ROAD

COMMENT/RECOMMENDATION FROM THE CHIEF ADMINISTRATIVE OFFICER

That the recommendation of the General Manager of Infrastructure Services be endorsed.

RECOMMENDATION

That Council support proceeding with the Final Sewer Extension Project along Alta Lake Road on basis of the preferred Shallow Road Alignment Option, as presented to Council in Report 15-099, and a $12,000 Local Area Service charge; and,

That staff be directed to arrange mailings and a public information session with affected property owners to share the proposed project principles.

REFERENCES

Appendix A – Proposed Project Principles

Appendix B – Evaluated Project Options Total Cost Summary

Appendix C – Administrative Report No. 14-032 from April 1, 2014

Appendix D – Administrative Report No. 13-097 from October 15, 2013
(including Information Report 12-141 "Alta Lake Sewer Options Update" and 10-077 "Westside Alta Lake Sewer Cost Update" in appendices)

PURPOSE OF REPORT

The purpose of this report is to update Council on property owners' response to the preferred alignment option, provide an updated cost estimate, and to recommend measures that will move this project to completion.

DISCUSSION

<u>Background</u>

Whistler's Official Community Plan (OCP) and Liquid Waste Management Plan (LWMP) both require all properties to be connected to the municipal sewer system. Providing sewer service to the remaining Alta Lake Road properties is important primarily from a sanitary and homeowner convenience perspective – prior scientific studies have shown no environmental impact from the septic systems and holding tanks at these remaining Alta Lake Road properties on Alta Lake itself.

Prior reports to Council and informal updates to Committee of the Whole have described various "alignment" options as well as various funding approaches to completing the final phase of the Alta Lake Road Sewer project.

The original project concept, dating back more than a decade, was to install a sewer on the then BCRail right-of-way by the shore of Alta Lake, downhill or level-with all the properties. Council decided that this sewer was only to be installed if senior government funding was available. This concept and approach had been communicated at various times to the owners of the 37 properties lacking sewer services. Costs to private property owners were historically estimated at $45,000 - $60,000 per parcel.

In recent years, BC Rail was purchased by CN Rail and the agreement that had existed between the RMOW and BC Rail was set aside.

Seven applications for senior government grants, including one as recently as 2014, were made by staff, without success. It has been the conclusion of staff that no senior funding for this project will likely become available at any time.

In 2012 Council directed staff to explore alternative technical and funding approaches in an effort to reduce costs and bring this project to fruition.

The resulting Alta Lake Sewer Options Update in 2013 identified capital costs, alternative funding approaches, and non-financial issues related seven possible approaches to the project, including the previously proposed Rail Alignment. It also recommended allowing a private five-lot sewer extension to proceed at the southern end of this project.

With detailed evaluation, the previously supported Rail Alignment option was found to have some significant challenges, despite the advantage of providing gravity connections from the houses. These challenges were:

- 50% higher cost than the lowest cost alignment
- Known feasibility, scheduling and cost risks associated with building in CN right-of-way
- Existing private home owner landscaping improvements on the proposed alignment path
- Significant geographic alterations affecting view points from the lake side

In 2013 Council endorsed the lowest cost option ("Shallow Road Alignment"), and directed staff to advance this preferred option information and project principles to the affected property owners then report back to Council. Council also supported the private sewer five-lot extension in principle. The seven sewer alignment options presented in 2013 have been provided as Appendix B.

The five lot private sewer extension was completed in 2014, with the RMOW ultimately responsible for 60% of the overall cost, including upsizing and deepening the sewer to support further future expansion.

<u>Property Owner Survey</u>

The preferred option information, approved project principles, and a voluntary survey form were provided to the private property owners in early 2014. At that time the project scope included all 37 private lots. The project principles indicated costs to the property owners as follows:

Total service area charge per parcel (approximate)	$28,000
Resulting annual charge per parcel (20 year amortization)	$1,826

The comments provided by the survey respondents provided a strong indication that their opposition was rooted primarily in the likely cost of the project.

<u>Updated Project Cost Estimate</u>

The Shallow Road Alignment project cost estimate has been adjusted to reflect project cost inflation since the estimate provided in the 2013 report.

The project cost directly related to the shallow road alignment sewer servicing for the remaining 32 lots is estimated to be approximately $2,400,000. When the installation of services and pump stations at Rainbow Park and The Point, and repaving is added on, the total overall cost is now estimated at $3,500,000.

The cost for the local sewer project is estimated at $2,400,000. The overall project cost is now estimated at $3,500,000

Staff's past recommendations to Council have consistently been to adhere to the cost-sharing principals used for many other Municipal projects, the most recent being Emerald Estates sewer. The basic cost-sharing principal for that project was that once federal/provincial contributions are deducted, the property-owners' share and the municipal share would each be 50% of the remainder. The Emerald Estates property-owners, under that cost-sharing arrangement, enjoyed the benefit of senior government funding, and each ended up paying approximately $8,000, with the RMOW also paying $8,000 per parcel. These two amounts each represented 28% of the overall capital cost, with the senior government funding partners paying the remaining 44%.

It is now apparent to staff that no senior government funding assistance will likely be provided for this project

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Even though there is little firm evidence of environmental damage being caused by these septic installations, it is nonetheless important to proceed with this project, and provide modern sanitary sewers to the last remaining neighbourhood without them. Also, even though many of these systems now appear to be adequately functioning, these systems may fail in the future potentially causing damage to the Alta Lake system at that future time. For these reasons, staff wish to continue to advance this project with a reduced cost-sharing amount for the property-owners, as an incentive to obtain complete support for this project.

Staff have evaluated a range of cost-sharing alternatives that will help the property-owners bear the added burden of losing senior government funding assistance. Our inclination at this point is to better align with the per-parcel amounts paid in Emerald Estates. That amount was $8,000 per parcel which was 28% of the project costs. If the Emerald percentage (28%) is applied to the new project cost estimates, the total payable by the owners for each parcel would be $21,000. Staff are proposing that we meet somewhere between the actual cost paid by the Emerald owners ($8,000) and the percentage paid by the Emerald owners if calculated for this project ($21,000). That middle ground is proposed to be $12,000 per parcel.

This total amount would still provide $384,000 towards the RMOW capital costs for construction of the sewer.

Proposed Local Area Service area charge per parcel: ***$12,000***

It should be highlighted that making this very low proposed cost available to the home owners is completely contingent upon proceeding with the Shallow Road Alignment Option. If the home owners reject this sewer alignment choice, this very low cost option will not be available.

WHISTLER 2020 ANALYSIS

W2020 Strategy	TOWARD Descriptions of success that resolution moves us toward	Comments
Built Environment	The built environment anticipates and accommodates the needs of the resident community while also satisfying the expectations of guests.	1. Avoided harm to recreation potential.
Finance	The long-term consequences of decisions are carefully considered.	
Finance	Financial principles, practices and tools employed by both the public and private sectors encourage behaviour that moves Whistler toward success and sustainability	

W2020 Strategy	AWAY FROM Descriptions of success that resolution moves away from	Mitigation Strategies and Comments
Finance	The resort community effectively and efficiently manages its costs and expenditures.	1. Business-as-usual (no change) is the least-cost option over 20 years. The recommended option is the second least-expensive in this time frame. 2. Over the very long term all properties would otherwise end up with holding tanks, which would then impose higher environmental and financial costs. Recommended option avoids this future condition.

OTHER POLICY CONSIDERATIONS

The RMOW's OCP and LWMP require that all Whistler properties be connected to the municipal sewer system.

BUDGET CONSIDERATIONS

The current five year plan (Project E026 "Westside Alta Lake Sewers") includes funding for this project in 2015 and 2016, specifically, $1.9 million dollars from the Sewer Fund and $300K from the General Fund for repaving. No amount is currently budgeted from the General Fund to support sewer infrastructure at Rainbow Park and The Point.

It is proposed that the 2016-2019 five year plan be updated to include current cost estimates for road work, public sewer, and the proposed Rainbow Park and Point connections totalling $3,500,000.

The 2016-2019, and subsequent budgets should also reflect the proposed $384,000 in revenue amortized over an appropriate period.

COMMUNITY ENGAGEMENT AND CONSULTATION

This report includes a summary of the outcome of past consultation with affected home owners.

This report also proposes further steps to engage and inform the home owners.

SUMMARY

The RMOW's OCP and LWMP require that all properties in Whistler be provided with municipal sewer service. The most practical, speedy, low impact and low cost approach to providing sewer service to remaining 32 unconnected lots is to construct a 'shallow' sewer along Alta Lake Road.

Staff recommend to Council that:

- Council support proceeding with the Final Sewer Extension Project along Alta Lake Road on basis of the preferred Shallow Road Alignment Option and a $12,000 Local Area Service charge
- Staff arrange mailings and a public information session with affected property owners to share the revised project principles

Respectfully submitted,

Michael Day
Utilities Group Manager
for
Joe Paul
GENERAL MANAGER, INFRASTRUCTURE SERVICES

APPENDIX A

PROPOSED PROJECT PRINCIPLES

1. The Municipality will be wholly responsible for costs related to public road resurfacing;
2. The property owners' share of the cost will be set at $12,000
3. Each private property will be subject to a uniform portion of project costs related to the Municipal works
4. As compensation for any required sewer right-of-way, the Municipality will;
    a. waive the $250 sewer connection fee; and
    b. credit the owners the value of the works and service charge ($3781)
5. The Municipality will relax the requirement to connect to the sewer within 180 days after official notice to do so, and will instead require the property owners of the specified area to connect within 365 days
6. Municipal works will extend services to the property line or the edge of the right-of-way, and no further
7. The Municipality will purchase and supply standard residential lift stations to any property that requires one to connect to the sewer. These standard lift stations will then belong to the private property owner, who will be responsible for installation, maintenance, and future replacement. Alternatively, if the opportunity exists and the relative costs warrant, the Municipality will work with the property-owners to determine if interior plumbing modifications can achieve service to areas too low to be serviced by gravity.
8. Any works on private property will be solely the responsibility of the private property owner

APPENDIX B

EVALUATED PROJECT OPTIONS TOTAL COST SUMMARY

Reproduced here from Administrative Report No. 13-097 “Alta Lake Sewer Options Update” from October 15, 2013.

This table shows the estimate 20-Year Cost of Ownership for each seven considered “alignment” options. It should be noted that “Business as Usual” is currently the lowest cost option, but over time it would gradually be converted to the much more expensive “Holding Tanks for all Lots” option as existing homes with septic fields were replaced with new homes, which are required by Vancouver Coastal Health to install holding tanks.

These costs reflect neither Consumer Price Index (CPI) nor Engineering News Record (ENR) based inflation adjustments, nor subsequent reduction in project scope from 37 to 32 private lots. Updating the table to reflect these changes would have no effect on relative ranking, as all options would be effected equally.

Option	RMOW Capital Cost	Private Capital Cost	Present Value of O&M Cost	Present Value of Future Capital Costs	20-Year Cost of Ownership	Difference from Total BAU
1.Business as Usual	$ -		$ 1,712,000	$ 244,500	$ 1,958,000	$ -
2.Shallow Alta Lake Road Alignment	$ 2,360,000	$ 1,203,000	$ 410,000	$ 120,700	$ 4,109,000	$ 2,151,000
3.Deep Alta Lake Road Alignment	$ 2,675,000	$ 1,119,000	$ 368,000	$ 100,000	$ 4,278,000	$ 2,320,000
4.Holding Tanks for all Lots	$ 931,000	$ -	$ 3,950,000	$ 244,500	$ 5,135,000	$ 3,177,000
5.Rail Alignment	$ 4,377,500	$ 1,017,500	$ 343,000	$ -	$ 5,754,000	$ 3,796,000
6.Gravity Collector with pumping to Alta Lake Road	$ 4,723,750	$ 1,017,500	$ 347,000	$ -	$ 6,104,000	$ 4,146,000
7.Homeowner Lot Alignment	$ 5,451,250	$ 1,017,500	$ 347,000	$ -	$ 6,832,000	$ 4,874,000

WHISTLER

REPORT | ADMINISTRATIVE REPORT TO COUNCIL

PRESENTED: April 1st, 2014 **REPORT:** 14-032

FROM: Infrastructure Services **FILE:** 365

SUBJECT: ALTA LAKE SEWER PHASE 1 SUB-PROJECT

COMMENT/RECOMMENDATION FROM THE CHIEF ADMINISTRATIVE OFFICER

That the recommendation of the General Manager of Infrastructure Services be endorsed.

RECOMMENDATION

That Council authorize the Mayor and Corporate Officer to enter into a Servicing Agreement with the five properties identified within the Phase 1 Sub-Project area as described in Administrative Report No. 13-097, dated October 15th, 2013, and further

That the RMOW fund a portion of the Phase 1 Sub-Project as follows:

i. That Council agrees to fund the incremental cost to make the sub-project compatible with the Municipal design up to $30,000 including GST.
ii. That Council agrees that the remaining cost for the sub-project will be cost-shared equally between the group of property-owners (50%) and the RMOW (50%) up to a maximum of $134,412.50 (excluding GST).
iii. The RMOW will purchase and provide residential lift stations to any property that requires one to connect to the sewer.

REFERENCES

Appendix A – Term Sheet

Appendix B - Summary of Project Costs

PURPOSE OF REPORT

At the October 15, 2013 Regular Meeting of Council, staff were directed to work with the five southernmost property owners within the Alta Lake Road Sewer catchment area, to accelerate the construction of a Phase 1 “Sub-Project”, in advance of the larger Alta Lake Road sewer project schedule. Prior to Council providing final agreement, staff were directed to return to Council with a “Servicing Agreement” setting out the construction specifications, project guarantees and final cost-sharing arrangements and amounts.

DISCUSSION

A group of homeowners at the southern end of the proposed Alta Lake Road sewer service area have asked if the initial section of sewer could be advanced regardless of the timeline for the larger project. The Owners have specifically requested that the municipality allow them to construct the initial phase of the sewer within the public roadway. The construction will be to the standards set out by the Municipality and compatible with the overall larger sewer project.

Staff have worked with this group of five property owners and have received written confirmation that they are all willing to participate in this accelerated sub-project based upon the following principals:

iv. That Council agrees in principal that the incremental cost to make the sub-project compatible with the Municipal design would be funded by the RMOW up to $30,000 including GST.
v. That Council agrees in principal that the remaining cost for the sub-project will be cost-shared equally between the group of property-owners (50%) and the RMOW (50%).
vi. The property-owners backing on the railway land will be required to enter into a statutory right-of-way agreement in the event that the larger sewer project requires an alignment adjacent to the railway corridor, with that agreement to be discharged if the ultimate project alignment is determined to be within the roadway. (Requirements for a statutory right-of-way has been further reviewed and deemed not necessary).
vii. The Municipality will relax the requirement to connect to the sewer within 180 days and will instead require the property owners of the sub-project area to connect within 2 years from the date that the sewer installation is declared substantially complete.
viii. The Municipality will purchase and supply standard residential lift stations to any property that requires one to connect to the sewer. These standard lift stations will then belong to the private property owner, who will be responsible for installation, maintenance, and future replacement.
ix. Any works on private property will be solely the responsibility of the private property owner.

The Owners commissioned a design from R.F. Binnie & Associates that demonstrates two sewer scenarios. The shallow sewer alignment is capable of servicing the five lots and is used to establish the 50% cost sharing calculation. The deeper configuration is required to ensure compatibility with the RMOW's ultimate sewer requirements. The costs for those two configurations are as follows:

Interim Profile (Shallow sewer to serve only five lots):	$268,825.00
Ultimate Profile (Deep sewer to municipal specifications):	$297,238.00

Council is being asked to pay the incremental costs attributable to the deeper RMOW sewer (approximately thirty thousand dollars). In addition, Council is being asked to fund 50% of the remaining project costs regardless of how the larger Alta Lake Road sewer project proceeds. (see budget considerations below)

The RMOW's contribution towards this project will be administered through a Servicing Agreement and follow the applicable procedures outlined in Council policy E-2. A professional engineer will certify that the works have been constructed and tested in accordance with all applicable standards and submit progress draws for the portion of works completed.

WHISTLER 2020 ANALYSIS

W2020 Strategy	TOWARD Descriptions of success that resolution moves us toward	Comments
Built Environment	The built environment anticipates and accommodates the needs of the resident community while also satisfying the expectations of guests.	1. Avoids environmental harm. 2. Avoids harm to recreation potential.
Finance	Financial principles, practices and tools employed by both the public and private sectors encourage behaviour that moves Whistler toward success and sustainability	

OTHER POLICY CONSIDERATIONS

The RMOW's Liquid Waste Management Plan indicates that the West Side Alta Lake Road area is to be serviced with Municipal sanitary sewers. Our Official Community Plan mirrors that sentiment.

BUDGET CONSIDERATIONS

The following table summarizes the project costs:

Item	Contract price	
	Interim Profile	Ultimate Profile
Bid price by Coastal Mountain Excavations	$201,250	$223,800
Engineering services	$16,000	$ 16,000
Rock Blasting and removal	$41,575	$ 47,438
Contingency	$10,000	$ 10,000
Project Cost (excluding GST)	$268,825	$ 297,238

Property-Owners' Share of 50% Cost Sharing:	($268,825 *50%) =	$134,412.50
RMOW Share of 50% Cost Sharing:	($268,825 *50%) =	$134,412.50
RMOW Incremental costs for deeper sewer:	($297,238 - 268,825) =	$ 28,413.00
RMOW total cost (excluding GST)	($134,412.50 +28,413) =	$162,825.50

COMMUNITY ENGAGEMENT AND CONSULTATION

Engagement and consultation has been limited to the five property owners within the Phase 1 Sub-Sewer project Area.

SUMMARY

As described to Council at the October 15th Regular Meeting, there are five properties at the southern end of the proposed Alta Lake Road sewer project area that wish to construct the first phase of the larger Alta Lake sewer project. Staff have drafted a Servicing Agreement for council's consideration, containing the guarantees necessary for construction within a public roadway, and

The RMOW fund a portion of the Phase 1 Sub-Project as outlined in this report.

Respectfully submitted,

Jeff Ertel
MANAGER OF DEVELOPMENT SERVICES
for
Joe Paul
GENERAL MANAGER, INFRASTRUCTURE SERVICES

Appendix "A"
Term sheet

(a) The scope of the project is based on "the Consulting Professional," R.F. Binnie and Associated Ltd drawing No. 13-316-S1-1 Rev C.

(b) There is a fixed priced contract between the Owners and Coast Mountain Excavations Ltd.

(c) The Owners shall, at the Owners' cost, substantially complete the Works and obtain a Certificate of Substantial Completion within four months of the date of execution of the Servicing Agreement.

(d) The RMOW has agreed to pay the incremental cost to deepen the sanitary sewer to the Ultimate Profile. These costs have been estimated at $30,000.00 including GST.

(e) The RMOW has agreed that the remaining cost of the sub-project will be shared equally between the Owners (50%) and the RMOW (50%) – see summary of project costs below.

(f) Rock volumes are the only variable to the contract pricing, therefore the Consulting Professional will quantify actual rock removal volumes for both the Interim and Ultimate Profile. The contract unit rate of $125.00 per cu.m. will be applied to measured volumes of blasted and disposed rock. The projected volume of rock to be blasted and disposed of is estimated at 379.5 cu.m. or $47,438.00 plus GST.

(g) The RMOW will pay its share of the costs relative to the percentage of works completed using the applicable procedures outlined in Council Policy E-2. The Consulting Professional will submit monthly progress draws for the Works completed, using the procedure outlined in the Servicing Agreement. Payment is due within 30 days of receiving the consultant's monthly progress draw.

(h) Changes to the contract scope or quantities must be preapproved in writing by the RMOW.

(i) At regular intervals during the construction of the Works, R.F. Binnie & Associates will oversee the installation of the Works.

(j) Upon completion of the Works and prior to issuance of the Certificate of Substantial Completion the Owners' Consulting Professional shall certify in writing that the Works have been constructed in accordance with the approved plans for the Works in accordance with the approved plans for the Works and the other requirements of this Agreement.

(k) Staff recommends that council offer residents an extended connection date from the standard 6 months to a full two years from the date of Substantial Completion.

Summary of Project Costs

Item	Contract Price	
	Interim Profile	Ultimate Profile
Bid price by Coastal Mountain Excavations	$201,250	$223,800
Engineering services	$16,000	$16,000
Rock Blasting and removal ($125.00/cu.m)	$41,575	$47,438
Contingency	$10,000	$10,000
Project Cost (excluding GST)	$268,825	$297,238

Property-Owners' Share of 50% Cost Sharing:	($268,825 *50%) =	$134,412.50
RMOW Share of 50% Cost Sharing:	($268,825 *50%) =	$134,412.50
RMOW Incremental costs for deeper sewer:	($297,238 - 268,825) =	$ 28,413.00
RMOW total cost (excluding GST)	($134,412.50 +28,413) =	$162,825.50

WHISTLER

REPORT | ADMINISTRATIVE REPORT TO COUNCIL

PRESENTED: October 15, 2013 **REPORT:** 13-097

FROM: Infrastructure Services **FILE:** 365

SUBJECT: ALTA LAKE SEWER OPTIONS UPDATE

COMMENT/RECOMMENDATION FROM THE CHIEF ADMINISTRATIVE OFFICER

That the recommendation of the General Manager of Infrastructure Services be endorsed.

RECOMMENDATION

That Council authorize staff to bring the options assessment, the recommended alignment, and the proposed "project principals" information to the public for the consultation outlined within Administrative Report No. 13-097, and for staff to report back to Council upon completion of the consultation elements; and further,

That Council direct staff to work with the five property-owners proposing the construction of a phase 1 "sub-project", in advance of the larger sewer project schedule, based upon the following principals:

i. That Council agrees in principal that the incremental cost to make the sub-project compatible with the Municipal design would be funded by the RMOW up to $30,000 including GST.
ii. That Council agrees in principal that the remaining cost for the sub-project will be cost-shared equally between the group of property-owners (50%) and the RMOW (50%).
iii. That prior to Council providing final agreement to any cost-sharing described in i) and ii) above, staff will return to Council with a "Servicing Agreement" that will set out the construction specifications, project guarantees and final cost-sharing arrangements and amounts.
iv. The property-owners backing on the railway land will be required to enter into a statutory right-of-way agreement in the event that the larger sewer project requires an alignment adjacent to the railway corridor, with that agreement to be discharged if the ultimate project alignment is determined to be within the roadway.

REFERENCES

See Appendix A – Information Report to Council 12-141 "Alta Lake Sewer Options Update"
See Appendix B – Information Report to Council 10-077 "Westside Alta Lake Sewer Cost Update"
See Appendix C – Completed Paper Survey Example
See Appendix D – Emerald Estates Sewer Project Principles
See Appendix E – List of Additional Reference Documents
See Appendix F – Drawings

PURPOSE OF REPORT

At its December 18, 2012 meeting Council requested staff develop and report on updated costs and options for an Alta Lake sewer. The updated costs were to incorporate total costs of ownership for all parties, and to be compared with a do-nothing, business-as-usual scenario.

This report provides new information including: updated construction costs based on revised actual recent project costs, new field and paper survey information, total cost of ownership (TCO) for all parties, and a comparison with "business-as-usual" to provide net new TCO.

DISCUSSION

Past reports to Council (attached as Appendices ‘A’ and ‘B’) have been presented to the public with some early “pre-design” construction cost estimates for the sanitary sewer extension to the residences on Alta Lake Road. These earlier estimates were based upon varying cost-sharing arrangements and limited options assessments.

In December 2012 a report was presented to Council providing an update to the 2010 information based primarily on inflating costs by 4% per year and correcting some errors and refining some assumptions. At that time, Council requested a more comprehensive analysis of overall project options, to reduce costs. This report provides that analysis and contains staff recommendations for advancing this project.

Information Gathering

Staff and the consultant gathered substantial new information in order to ensure the updated estimates to Council were as accurate as they could be without undertaking a detailed engineering design and incurring large costs.

The new information included:

- Basic elevation and location for each building to be connected
- Owner survey information regarding serviced floors
- Review of building plans on file for each house
- Historic holding and septic tank pumping and hauling activity
- Project costs for recent Whistler water and sewer main projects
- Information from CN Rail regarding current costs for work undertaken on its lands:
    - Flagging and Signal Protection $1010 per day
    - Easements $62 per linear metre

Locations and elevations for Alta Lake Road centreline, existing manholes, house front door sills, municipal buildings, and identifiable holding tanks were completed.

Staff also sent a paper survey to each property owner, requesting information related to which floors in their houses currently had plumbing fixtures or pumping equipment, and the rough elevation of holding tanks relative to the house. Surveys were sent to the owners of the 37 lots, and 28 owners (76%) responded (see “Appendix C: Completed Paper Survey” for an example of one of the completed surveys).

Gaps or ambiguities in the paper survey information were filled by using archived design drawings placed in Municipal files when the houses were originally built or modified.

Septic tanks and holding tank hauling information was gathered from internal RMOW billing and Utility department records, as well as information graciously provided by Carney’s.

This relatively rich information was used by staff to create elevation drawings and excavation/blasting estimates, which in turn informed the new Total Cost estimates requested by Council for the options evaluated. The drawings resulting from this exercise are included as Appendix F.

Evaluated Project Options

In the past, only the CN Rail right-of-way alignment was the sewer alignment used to estimate the likely construction cost for this project. In keeping with Council’s instructions, staff explored a number of conceivable alignments and configurations including a “business as usual” configuration to provide a baseline cost. Cost estimates were developed for each of these optional configurations, using a “whole-project” approach.

Essentially, the whole-project approach looks at the costs to be incurred for all aspects of the project, whether the costs are part of the public project within public lands, or they are within private property, to be paid for by the owner connecting to the sewer. Also, this whole-project approach incorporates estimated operating costs and future capital costs related to equipment replacement into the evaluation.

Staff are of the view that this whole-project approach leads to an evaluation that does not simply favour the option that provides the least up-front Municipal Capital cost, but looks at what option will provide the overall long-term least cost, including costs that will be incurred by others.

The specific options evaluated were:

1. Business-as-usual: existing costs for holding tanks, septic systems.
2. Shallow Alta Lake Road Alignment: resulting in 13 lots with pump stations
3. Deep Alta Lake Road Alignment: resulting in eight lots with pump stations
4. Holding Tanks for all lots
5. Gravity collector with pumping to Alta Lake Road: multiple small pump stations
6. Rail Alignment: alongside the rail line, within CN Rail property
7. Homeowner Lot Alignment: sewer adjacent to rail line, on private property

Table 1: Evaluated Project Options Total Cost Summary below shows the whole-project cost of ownership over a 20 year period (in 2012 dollars) for capital works and O&M costs for each project scenario. Since the 2012 reports, we have refined the costing philosophy specifically by excluding the costs for the connection to Rainbow Park and the Hostel property, as these are purely Municipal projects. In addition, we have further driven the project budget down for some of the options by recognizing that our roadway reconstruction budget already contemplates replacement of the Alta Lake Road pavement in the very near future regardless of this sewer project, so those costs do not get included in the project costs and do not need to be recovered from the residents within the Local Area Service.

Please note: The costs identified throughout this report are estimates, which are done before the detailed design for this project, and actual costs may vary once the detailed design is complete and the project is tendered for construction. These estimates are presented only for assessing the options, and are not for determining the ultimate final project costs nor to precisely determine the costs to be recovered through the Local Area Service parcel tax.

For the purposes of this analysis, it is assumed that future costs beyond 2013, which are heavily influenced by energy and commercial goods costs, will increase by 2% per year in real terms (i.e. 2% more than inflation). The Options are presented here ordered from lowest to highest 20-Year Total Cost of Ownership.

Option	RMOW Capital Cost	Private Capital Cost	Present Value of O&M Cost	Present Value of Future Capital Costs	20-Year Cost of Ownership	Difference from Total BAU
1.Business as Usual	$ -		$ 1,712,000	$ 244,500	$ 1,958,000	$ -
2.Shallow Alta Lake Road Alignment	$ 2,360,000	$ 1,203,000	$ 410,000	$ 120,700	$ 4,109,000	$ 2,151,000
3.Deep Alta Lake Road Alignment	$ 2,675,000	$ 1,119,000	$ 368,000	$ 100,000	$ 4,278,000	$ 2,320,000
4.Holding Tanks for all Lots	$ 931,000	$ -	$ 3,950,000	$ 244,500	$ 5,135,000	$ 3,177,000
5.Rail Alignment	$ 4,377,500	$ 1,017,500	$ 343,000	$ -	$ 5,754,000	$ 3,796,000
6.Gravity Collector with pumping to Alta Lake Road	$ 4,723,750	$ 1,017,500	$ 347,000	$ -	$ 6,104,000	$ 4,146,000
7.Homeowner Lot Alignment	$ 5,451,250	$ 1,017,500	$ 347,000	$ -	$ 6,832,000	$ 4,874,000

Table 1: Evaluated Project Options Total Cost Summary

Analysis of Project Options

The cost to do 'nothing', identified here as Business as Usual, has been determined, and provides a basis for comparison with the various potential projects. This cost presented here is very conservative, for example, it includes an assumption that Septic Tanks will be serviced every two years in accordance with best practice, and that a few septic tanks will be replaced with holding tanks within 20 years.

Of particular note are the very large forecast costs for all considered downhill sewer options – Options 5, 6 and 7 above. These costs are influenced by the high on-going cost to operate and maintain municipal pumping stations, and the significant costs related to completing the proposed works and restoration on both private and CN Rail Lands.

Additionally, the long term cost associated with providing holding tanks to all lots is extremely high due primarily to the frequent expensive pump outs required. This is despite the fact many homes already have holding tanks, and doesn't take into consideration the high greenhouse gas emissions and homeowner inconvenience associated with hauling sewage.

The two least-cost project options are the Alta Lake Road alignments, options 2 and 3. These alignments are of lower cost partly because they avoid the railway alignment, eliminate the need for easements within properties, and do not have any ongoing operating and maintenance costs from municipal pumping stations. This is a simple gravity system. Given the obvious lower whole-project costs associated with the simple roadway alignment taken by these two options, it is staff's recommendation that the roadway alignment presents the best value for all stakeholders involved in this project, and staff will provide this recommendation through the public consultation phase of this project (see "Community Engagement and Consultation" section following). For either of the two sewer configurations within this roadway alignment, costs of rock removal are not precisely known, with the deeper sewer more likely to incur a higher cost. Also, private costs would be quite variable on a per-lot basis, due to variation in house elevation, site conditions and location and type of existing site infrastructure.

The Shallow Road Alignment includes special provisions for up to 13 lots with main floor doorsills below the sewer. Two of these would likely be able to continue to use their existing pumping systems installed for their holding tanks (dependent on detailed design outcomes), with the remainder needing pumping stations or some internal plumbing modifications to deal with fixtures on the lower floors of the homes. The Deep Alta Lake Road Alignment reduces the number of houses requiring lift pumps stations or modifications, to either seven or eight (dependent on detailed design outcomes).

Local Area Service – Cost Recovery

As with many other neighbourhood infrastructure improvement projects, a Local Area Service parcel tax arrangement is proposed to recover the property-owners' share of the costs. The whole-project assessment carried out above analysed the capital and operating costs for the seven options, and then provided staff with the basis for our recommendation to Council. The total "whole-project" cost for the preferred Alta Lake Road – Shallow Alignment is estimated to be in excess of $4.1 Million.

However that cost does not represent the basis for determining the amount to be recovered with the eventual parcel tax. It is instead, calculated based upon the cost of only the public part of the capital project, as follows:

Total RMOW Capital Project Cost:	$2,360,000
Less Final Paving Costs :	$ 312,000
Remaining Costs For 50% Cost Sharing:	$2,048,000
Property-Owners' Share of 50% Cost Sharing:	$1,024,000
RMOW Share of 50% Cost Sharing:	$1,024,000

Please note: The amounts presented within this report represent the estimated cost, for decision-making and information purposes. The actual cost of construction cannot be determined until the project is offered for tender and actual construction contracts are awarded.

The above amounts represent a total charge per parcel of approximately twenty-eight thousand dollars ($28,000). Previous estimates determined this amount to be approximately forty-five thousand dollars ($45,000) to sixty thousand dollars ($60,000), depending on how the cost-sharing was calculated and how much Senior Government funding assistance was anticipated. We have achieved this significant reduction largely by simplifying the alignment, removing expensive Municipal pumping stations from the design, taking roadway resurfacing out of the cost, and taking purely Municipal parts of the project out of the project scope.

Project Principles

The Emerald Sewer project was the last major infrastructure project undertaken by establishment of a Local Area Service. It was completed in 2004 and it included a number of specific project principles that were arrived at through our consultation program with the Emerald residents. Staff are of the view that the principals arrived at through consultation with Emerald residents, represents a good starting point for establishing the project principals for this project. The draft project principals are listed below for your consideration:

1. The Municipality will be wholly responsible for costs related to public road resurfacing;
2. The Municipality will share the public sewer construction cost equally with the property owners of the specified area;
3. The Municipality will share any grant monies equally with the property owners of the specified area;
4. The Municipality will undertake this project as a "Council Initiative for a Local Area Service"
5. The Municipality will amortize the property owners' share of the cost over a 20-year period at a rate to be determined by the RMOW
6. Each private property will be subject to a uniform portion of project costs related to the Municipal works
7. As compensation for any required sewer right-of-way, the Municipality will;
    a. waive the $250 sewer connection fee;
    b. credit the owners the value of the works and service charge ($3781); and
    c. endeavor to restore landscaping to original conditions.
8. The Municipality will relax the requirement to connect to the sewer within 180 days after official notice to do so, and will instead require the property owners of the specified area to connect within 365 days
9. Municipal works will extend services to the property line or the edge of the right-of-way, and no further
10. The Municipality will purchase and supply standard residential lift stations to any property that requires one to connect to the sewer. These standard lift stations will then belong to the private property owner, who will be responsible for installation, maintenance, and future replacement. Alternatively, if the opportunity exists and the relative costs warrant, the Municipality will work with the property-owners to determine if interior plumbing modifications can achieve service to areas too low to be serviced by gravity.
11. Any works on private property will be solely the responsibility of the private property owner

As noted above, if these principles are followed the Local Area Service tax would total about $1,024,000 for the 37 subject lots, and the final cost would be amortized and charged to the specified area homeowners over 20 years at the RMOW's interest rate (currently about 2.8%).

The previous report to Council identified the annual Specified Area Charge as approximately $2,830 per lot over 20 years. This report updates the annual specified area charge to approximately $1,825 per lot (a 35% reduction).

Proposed Sewer Sub-Project

Understanding that the larger sewer project will be subject to numerous future steps including a consultation program, and an opportunity for property owners to petition against the project, a group of homeowners at the southern end of the proposed service area have asked if the initial section of sewer could be advanced regardless of the timeline for the larger project. They have specifically requested that the municipality allow them to construct the initial phase of the sewer shown in the plan below, within the public roadway, immediately. The construction would be to the standards set out by the Municipality, to be compatible with the overall larger project.

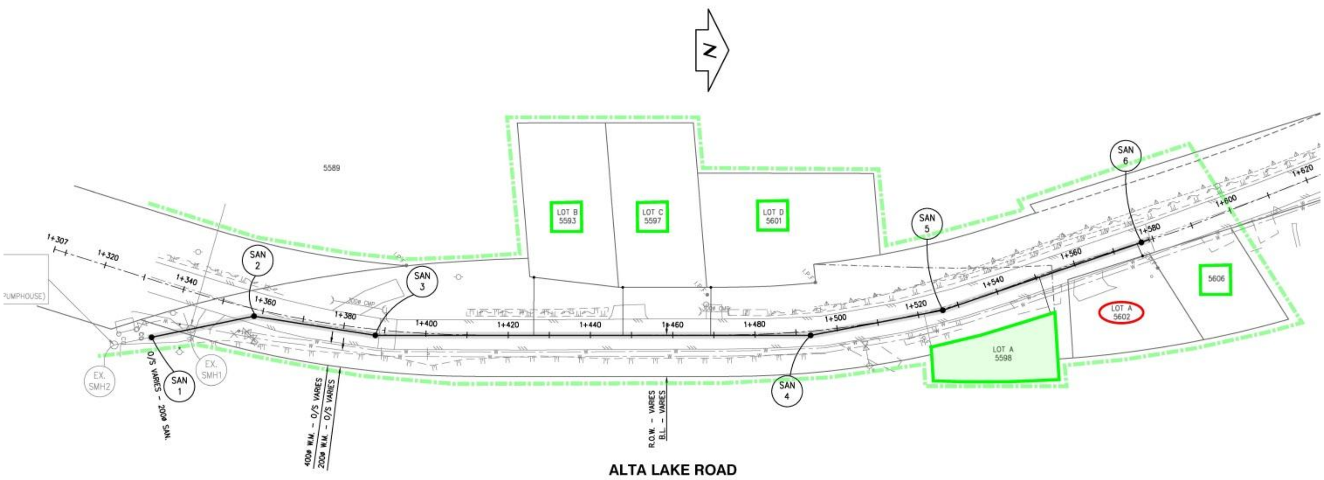


Figure 1: Key Plan

In order to advance matters, the Owners commissioned a design from Binnie Engineering for a sewer capable of servicing their five lots. Of the six lots that <u>can</u> be serviced by this sub-project, five of the property-owners have provided some acknowledgement that they would be willing to participate in this accelerated sub-project.

In order to understand how this sub project may proceed independent of the larger project, the group of owners prepared design information showing how a sewer would be installed solely targeted at servicing their parcels, and another configuration that is enhanced to be made compatible with the design requirements put forward by the RMOW. The costs for those two configurations are as follows:

Shallow sewer (to serve only six lots): $258,825
Deep sewer to municipal specifications: $287,238

The owners have requested that Council consider paying for the incremental costs attributable to the enhancements required for the deeper RMOW sewer (approximately thirty thousand dollars). In addition, the owners have requested that Council consider a commitment to fund 50% of the remaining project costs regardless of how the larger project proceeds.

If Council were agreeable to an accelerated sub-project, staff believe that a "servicing agreement" mechanism must be established in order to provide the structure for how this smaller project would proceed. It would be modelled on how we deal with the servicing required for subdivisions, and would set out the specifications and contain the indemnities and guarantees necessary for construction in the public roadway. Also, staff believe it prudent to require that a statutory right-of-way be obtained for each of the sub-project parcels backing onto the CN Rail right-of-way, just in case the larger project eventually requires an alignment adjacent to the railway line.

Staff therefore recommends that Council direct staff to proceed with a Servicing Agreement with the sub-project properties and bring that agreement back to Council for consideration.

WHISTLER 2020 ANALYSIS

W2020 Strategy	TOWARD Descriptions of success that resolution moves us toward	Comments
Built Environment	The built environment anticipates and accommodates the needs of the resident community while also satisfying the expectations of guests.	1. Avoided environmental harm. 2. Avoided harm to recreation potential.
Finance	The long-term consequences of decisions are carefully considered.	
Finance	Financial principles, practices and tools employed by both the public and private sectors encourage behaviour that moves Whistler toward success and sustainability	

W2020 Strategy	AWAY FROM Descriptions of success that resolution moves away from	Mitigation Strategies and Comments
Finance	The resort community effectively and efficiently manages its costs and expenditures.	1. Business-as-usual (no change) is the least-cost option over 20 years. The recommended option is the second least-expensive in this time frame. 2. Over the very long term all properties would otherwise end up with holding tanks, which would then impose higher environmental and financial costs. Recommended option avoids this future condition.

OTHER POLICY CONSIDERATIONS

Our Liquid Waste Management Plan indicates that the West Side Alta Lake Road area is to be serviced with Municipal sanitary sewers. Our Official Community Plan mirrors that sentiment.

BUDGET CONSIDERATIONS

The following table shows the costs the RMOW would be subject to if this approximately $2,360,000 (2012 equivalent cost) public project went ahead with RMOW funding, exclusive of any costs related to connecting the municipal Hostel property and Rainbow Park.

Total RMOW Capital Project Cost:	$2,360,000
Less Final Paving Costs :	$ 312,000
Remaining Costs For 50% Cost Sharing:	$2,048,000
Property-Owners' Share of 50% Cost Sharing:	$1,024,000
RMOW Share of 50% Cost Sharing:	$1,024,000

As with every other property in the Municipality, once the sewer is installed, the residents would also pay a one-time works and services charge of up to $3,781, a $250 connection fee, and the on-going annual sewer parcel tax and usage fees, currently totalling $427 per year (a portion of the latter fee is already levied on properties with holding tanks).

COMMUNITY ENGAGEMENT AND CONSULTATION

If the recommendations of this report are accepted by Council, staff will proceed with advertising and holding two public information meetings. At these meetings staff will provide answers as to the scope and characteristics of the project, cost estimates and project principles, and provide information to homeowners on the counter-petitioning process.

SUMMARY

Funding assistance for an Alta Lake Road Sewer is highly unlikely. In the past, Council has taken the position that they do not wish to proceed with this project unless Senior Government funding assistance is received to help offset the capital cost to the property-owners, the RMOW and the other users/ratepayers of the sewer utility.

Staff recommends that Council endorse the “preferred” roadway alignment for the Alta Lake Road sewer, and advance the preferred option information to the public for the recommended consultation within Report No. 13-XXX, and for staff to report back to Council upon completion of the consultation elements; and

That Council direct staff to draft a Servicing Agreement with the proponents of the smaller sewer sub-project, and return to Council with that agreement.

Respectfully submitted,

Michael Day
MANAGER, ENVIRONMENTAL OPERATIONS
for
Joe Paul
GENERAL MANAGER, INFRASTRUCTURE SERVICES

WHISTLER

REPORT | INFORMATION REPORT TO COUNCIL

PRESENTED: December 18, 2012 **REPORT:** 12-141

FROM: Infrastructure Services **FILE:** 365

SUBJECT: ALTA LAKE SEWER OPTIONS UPDATE

COMMENT/RECOMMENDATION FROM THE CHIEF ADMINISTRATIVE OFFICER

That the recommendation of the General Manager of Infrastructure Services be endorsed.

RECOMMENDATION

That Council receives Information Report No. 12-141, “Alta Lake Sewer Options Update.”

REFERENCES

See Appendix A – Information Report to Council 10-077 “Westside Alta Lake Sewer Cost Update”

See Appendix B – Additional Reference Document List

PURPOSE

At its September 14, 2012 meeting Council requested staff develop and report on updated costs and additional funding and infrastructure options for a Alta Lake Sewer, and raised questions regarding lake health and tourism impacts arising from failed private septic systems along Alta Lake Road.

This report provides new information regarding lake safety and biology, and a review of previously enacted and proposed funding approaches and new funding options.

Additional infrastructure options and updated cost estimates including total costs of ownership will follow in a subsequent report. That report will likely also provide further information regarding the implications of the rail right-of-way change of ownership from BC Rail to CN Rail.

DISCUSSION

Lake Health

Comments with respect to public health effects from unmaintained or failed septic systems have arisen in the past.

In support of previous infrastructure funding applications, NovTech Consultants Inc. conducted a field study of various properties on the West Side of Alta Lake in 2006. Their report concluded there was clear evidence of coliform presence in soils, but no evidence that these septic systems were causing elevated fecal coliform and e. coli levels in the lake.

This conclusion seems to be supported by beach bacteriological testing and the beach closure history, and by a 2012 BC MOE review of Alta Lake Water Quality (described below).

Coliforms

Coliforms are indicator bacteria that occurs naturally, and they are present in most soils. A subset of these bacteria are Fecal coliforms, which originate from the feces of warm-blooded animals including humans. From 2003 to present, no Whistler lake has experienced beach closures due to Fecal Coliforms. Most measurements have yielded values below the detectable limit, and both Lost Lake and Alpha Lake have experienced values higher than those at Alta Lake in some years during that period. The following table summarizes results for 2009 – 2012.

Fecal Coliform Level (Peak/Average)

Year	Lakeside	Wayside	Rainbow	Alpha Lake	Lost Lake
2012	50 / 11	25 / 8	**100 / 19**	23 / 11	10 / 6
2011	35 / 5	25 / 6	32 / 6	**573 / 74**	77 / 7
2010	15 / 5	5 / 5	**55 / 7**	20 / 7	5 / 5
2009	5 / 5	32 / 5	32 / 5	55 / 10	**215 / 5**

Goose presence at grassy beach areas results in clearly observable levels of goose scat on the shore and covering the lake bottom. There appears to be some correlation between large numbers of geese and elevated fecal coliforms in the water. This apparent pattern was most evident in 2012, where geese were frequently present in groups of up to 50 birds at Rainbow Park.

Swimmer’s Itch

Council has previously expressed concerns with regard to “Swimmer’s Itch” and its relationship to failing septic fields or the deterioration of the lake health. Swimmers’ Itch is, caused by snail parasites, and it can occur in both fresh and salt water. Weedy areas are a particular concern. All of the Whistler lakes have had instances of “Swimmers Itch” as summarized in the following table:

Swimmer's Itch Reports

Year	Lakeside	Wayside	Rainbow	Alta Lake Total	Alpha Lake	Lost Lake
2012	1			**1**		
2011	1		1	**2**	1	
2010	1			**1**		
2009	1	1		**2**	1	1
2008			1	**1**		
2007			1	**1**		
2006						
2005				**2**	1	

The data seems to indicate a modestly higher frequency of occurrence in Alta Lake, but Staff also observe that there is a much higher amount of public usage at Rainbow Park. Staff cannot confirm any direct relationship between occurrences of Swimmer Itch and septic systems on Alta Lake Road.

<u>Lake Chemistry</u>

The BC Ministry of Environment reviewed sample data for the years 2009 through 2011 and, in their Memorandum dated October 24, 2012 concluded that Alta Lake has “low concentrations of nutrients”, and that “Overall, water quality indicator parameters are not a concern at this time…”

<u>Lake Health - Conclusion</u>

To conclude, staff is not presently in a position to support claims of impact to lake biology, nor of threats to public health or tourism, resulting from failed septic systems on Alta Lake Road. Staff will continue to monitor lake data and will inform Council should a new pattern emerge.

Jurisdiction and Compliance

Under provincial law septic system owners are obligated to maintain septic and private treatment systems in good operating condition. NovaTech specifically identified nine “secondary treatment” systems on Alta Lake Road as having a higher degree of failure than conventional septic systems. Where these failures were identified, they found the soil on and adjacent to private properties had elevated levels of indicator bacteria.

Construction, compliance, monitoring, and enforcement with regard to private septic systems is within the jurisdiction of Vancouver Coastal Health, however, not the RMOW, so the RMOW is not in a position to directly address deficiencies in these provincially-regulated systems.

Funding Alternatives

Past Councils have resolved to proceed with this project only after securing external funding. The principal behind this is that the net cost to the taxpayer and the properties within the local sewer service area would be reduced if Senior Government funding assistance was received. Based on the rejection of the RMOW’s five prior grant submissions and re-submissions (1999, 2004, 2005, 2007, 2008, 2009), and the fact that the current funding assistance program is extensively over-subscribed, it’s clear that securing external funding is highly uncertain at this time.

Therefore, at the direction of Council, staff have undertaken a review of past project funding models and updated the analyses of this project to provide more insight into likely funding models.

Prior RMOW Water/Sewer Projects

Prior Project Funding

Project	Year	Provincial Portion	RMOW Portion	Resident %
White Gold Sewer	1980	26%	65%	9%
Alpine Meadows Sewer	1981	19%	66%	15%
Whistler Cay Sewer	1981	37%	55%	8%
Scotia Creek Water	1986	0%	50%	50%
Nancy Green Sewer	1986	0%	50%	50%
Chaplinville Water	1988	0%	50%	50%
Emerald Sewer	2001	44%	28%	28%

Major RMOW water and sewer projects prior to 1986 received senior government funding. The RMOW provided substantial financial support for these projects ranging from 55% to 66% of total project cost. Projects since 1986 were cost shared with residents on a 50:50 basis with the RMOW, regardless of the level of external funding. For illustration purposes subsequent sections of the report include a 50:50 RMOW:Resident split scenario for consistency with some previous projects. The final distribution of costs for this project will ultimately be at the discretion of Council.

Project Costs and Payments

The original (2004) consultant pre-feasibility assessment and subsequent updates compared two sewer alignments: along Alta Lake Road and along the BC Rail lands. The BC Rail (now CN Rail) option was estimated to be 10% more expensive, but advantageous for various operational reasons, including the elimination of individual home sewage lift pumps.

Various factors would affect actual Municipal project costs and property-specific owner's costs, including:

- Whether properties are currently on septic or holding tank
- Whether a holding-tank property has previously paid works and services charges
- Whether a home sewer lift pump is required
- Cost of municipal utility rights-of-ways on private and CN rail lands
- Elimination of HST in 2013

In August 2010 report 10-077 was presented to Council. That report provided an estimated cost update, as well as indicating likely homeowner costs should no grant be available.

The following table shows both the 2010 and equivalent 2012 costs the RMOW and Alta Lake Road property owners would be subject to if the project went ahead with various levels of grant and RMOW funding. The 2012 estimates below include a 0:50:50 split option.

Cost Split Scenarios

	Project Cost	Grant %	RMOW %	Resident %	RMOW Amount	Property Owner Amount
2010 Report	**$ 3,390,000**					
	With Grant	33%	33%	33%	$ 1,130,000	$ 1,130,000
	No Grant	0%	33%	67%	$ 1,130,000	$ 2,260,000
2012	**$ 3,540,000**					
	With Grant	33%	33%	33%	$ 1,180,000	$ 1,180,000
	No Grant	0%	33%	67%	$ 1,180,000	$ 2,360,000
	No Grant	0%	50%	50%	$ 1,770,000	$ 1,770,000

2012 costs were calculated by inflating 2010 costs by 4% based on published Engineering News Record capital project cost escalation ("ENRc") values for 2010 and 2012.

The following table shows the approximate resulting 2012 Special Parcel Tax amount on a per-property basis, along with the approximate equivalent annual payment at current interest rate and various amortization periods for both a 0:67:33 and a 0:50:50 scenario.

Amortized 2012 "No Grant" Scenarios

Project Cost	Grant %	RMOW %	Resident %	RMOW Amount	Property Owner Amount	Approx. Special Parcel Tax	Interest Rate (%)	Amortization (Years)	Amortized Project Cost per Resident
$ 3,540,000	0%	33%	67%	$ 1,180,000	$ 2,360,000	$ 61,000	2.9%	20	$4,100
								25	$3,500
								30	$3,100
	0%	50%	50%	$ 1,770,000	$ 1,770,000	$ 46,000	2.9%	20	$3,100
								25	$2,700
								30	$2,400

* current 10 year interest rate 2.90%, with refinanced rate applicable after 10 years
** 39 properties

Past projects have typically been amortized over 20 years. Council, with the support of the Municipal Finance Authority (if borrowing is required for the property-owners' share), may be able to extend the overall amortization period to 30 years. As shown above, this would materially reduce the annual fee payable by the property-owners'.

As with previous projects, property-owners' would have the option of paying the full Special Parcel Tax Amount upfront, or amortizing it so as to pay a lesser annual amount.

In each of these scenarios, once the sewer is installed, residents who have not already paid it would pay a one-time works and services charge of up to $3,781. They would also be subject to the on-going annual sewer parcel tax and usage fee of $427 per year (which they are not currently subject to).

Taking into consideration these annual fees, and council's decision on amortization period, the *minimum* annual cost residents could experience with an amortized Special Parcel Tax would be approximately $2,827 (30 year amortization, RMOW paying 50% of project costs).

Alternative Options

Rainbow Park Connection

In order for Rainbow Park to connect to municipal sewer both a sewer lift station and a very long pipe will be required: such a connection, if included in the shared cost of the project, would significantly elevate the total project cost.

Staff think it reasonable to assign the total cost of the extension to Rainbow Park to the Municipality, with no share of this component to be assigned to the property-owners along Alta Lake Road. As analysis and design progresses, the technical and financial details pertaining to this extension will be further explored by Staff and our consultants.

Other Configurations and Further Study

Prior presentations to Council have described two potential means of providing sewer service to all Alta Lake properties, specifically, a sewer running along Alta Lake Road, or a sewer running along the CN Rail allowance. Staff are working on an updated analysis that will be brought forward to Council shortly, that will:

i) Incorporate 'total costs of ownership' (reflecting the variables listed in the preceding section) in the cost analysis
ii) Reflect possible changes resulting from the change of control of the rail lands by BC Rail to CN Rail
iii) Provide further guidance regarding the costs associated with a Rainbow Park connection
iv) Report on new options to include:
    - Sewer running on new municipal rights-of-ways on homeowner properties downhill of the houses
    - Municipally supported conversion to holding tanks on some or all septic properties
    - Multiple, smaller sewer catchment zones with multiple small municipal sewer lift stations, instead of a single large zone with a central lift station

That future report will make a final recommendation to Council with respect to the technical configuration for this final phase of the Municipal sanitary sewer collection system, and it will also present more refined cost analysis details.

WHISTLER 2020 ANALYSIS

W2020 Strategy	TOWARD Descriptions of success that resolution moves us toward	Comments
	NOT APPLICABLE	

W2020 Strategy	AWAY FROM Descriptions of success that resolution moves away from	Mitigation Strategies and Comments
	NOT APPLICABLE	

OTHER POLICY CONSIDERATIONS

None.

BUDGET CONSIDERATIONS

In August 2010 report 10-077 was presented to Council. That report provided an estimated cost update for the Alta Lake Road sewer project.

The following table shows the costs the RMOW would be subject to if this approximately $3,540,000 (2012 equivalent cost) project went ahead with various levels of grant and RMOW funding.

Project Cost	Grant %	RMOW %	Resident %	RMOW Amount
With Grant	33%	33%	33%	$ 1,180,000
No Grant	0%	33%	67%	$ 1,180,000
No Grant	0%	50%	50%	$ 1,770,000

In each of these scenarios, once the sewer is installed, the residents would also pay a one-time works and services charge of up to $3,781, as well as the on-going annual sewer parcel tax and usage fee, currently $427 per year (which they are not currently subject to).

COMMUNITY ENGAGEMENT AND CONSULTATION

Further consultation will be part of the larger process as this project proceeds once funding assistance is announced.

SUMMARY

Based on the information available, Staff is not presently in a position to support claims of a definite impact to lake biology and threats to public health resulting from deficient septic systems on Alta Lake Road.

Compliance monitoring and enforcement with regard to poorly-functioning septic and secondary treatment systems lays within the jurisdiction of Vancouver Coastal Health, not that of the RMOW.

Connecting Rainbow Park currently looks like a very poor option financially, based upon the current costs of maintaining the existing holding tanks: work is being undertaken by our consultants to clarify the business case for such an extension of the sewer. If it is eventually to be included in the scope of the construction project, the incremental amount of this sewer extension will be subtracted from that project cost amount to be shared with the properties within the local sewer service area.

Additional infrastructure options and updated cost estimates including total costs of ownership will follow in a subsequent report to Council early in 2013, after the receipt of our Consultant report due shortly. That report will likely also provide further information regarding the implications for a utility right-of-way resulting from ownership change of the rail lands from BC Rail to CN Rail.

The likelihood of external funding for an Alta Lake Road Sewer is uncertain. In the past, Council has taken the position that they do not wish to proceed with this project unless Senior Government funding assistance is received, to help offset the capital cost to the property-owners, the RMOW and the other users/ratepayers of the sewer utility. Staff support this continued position by Council.

Respectfully submitted,

Michael Day
MANAGER, ENVIRONMENTAL OPERATIONS
for
Joe Paul
GENERAL MANAGER, INFRASTRUCTURE SERVICES

APPENDIX B

WHISTLER

REPORT | INFORMATION REPORT TO COUNCIL

PRESENTED:	August 3, 2010	**REPORT:**	10 - 077
FROM:	Environmental Services	**FILE:**	365
SUBJECT:	WESTSIDE ALTA LAKE SEWER COST UPDATE		

COMMENT/RECOMMENDATION FROM THE CHIEF ADMINISTRATIVE OFFICER

That the recommendation of the General Manager of Environmental Services be endorsed.

RECOMMENDATION

That Council receive this information report that updates the estimated costs for the Westside Alta Lake Sewer project and options for advancement of this project.

DISCUSSION

Residents of the Westside Alta Lake subdivision have recently requested an update on the status of having a sewer system built for the 39 lots in this area.

The RMOW has applied for funding from the Provincial and Federal governments on several occasions in the past, but to date have not been successful in obtaining grant funding for this project. An environmental study was performed in 2006 to support the grant application at that time, but we did not receive the grant funding despite this effort.

The preliminary design and cost estimate for the project was done in 2004, and our consultants have just updated this cost estimate for 2011 construction. Including a 30% allowance for engineering and construction manangement, and 10% for contingency, the total estimate to construct this project in 2011 is $3.39 million (plus 12% HST).

The current Five-year Financial Plan anticipates this project occurring in 2011 (design & bylaws) and 2012 (construction). The total budget shown in the financial plan is $4.2 million with 67% of that total to be funded by infrastructure grants. At this time it seems unlikely that we will have an infrastructure grant in place for next year, and the project would be delayed unless one of the following options initiates this project:

Council can proceed with a Local Area Service initiative (which this is) in three ways:

1. If they decide to proceed as a Council Initiative, subject to Counter-Petition
2. If they decide to proceed as a Council Initiative, subject to assent of the electors
3. If they are compelled to proceed after a successful petition from the residents within the Local Area.

The first two processes above have Council leading the project, then seeking the consent of the property-owners within the service area. The third is a reversal of that process and it is more common in other municipalities. The property-owners may petition for the provision of a service. A successful petition by the residents within the service area would effectively compel Council to deliver the sewer service. Since some property-owners wish to proceed with the project without senior government funding assistance, and Council does not wish to do so, Staff feel that this petition process is appropriate should the majority of the property-owners within the service area wish to proceed. RMOW staff will also continue to pursue any opportunities for grant funding and Council could pursue this project as a "council initiative" if grant funding does become available. In order to provide absolute clarity into the future, Council may wish to endorse the following resolution:

> *Be it resolved that if the Resort Municipality of Whistler is given senior government funding assistance for the Westside Alta Lake Sewer Project, in an amount of 1/3rd of the costs or greater, Council will proceed with the project as a Council Initiative (S.213 Community Charter), with the remaining costs to be shared equally between the Local Government and the property-owners. In the absence of senior government funding assistance for this project, Council will proceed with the Westside Alta Lake Sewer Project only if petitioned to do so (S.212 Community Charter). If successfully petitioned, Council will fund a maximum of 1/3rd of the total costs of the project.*

WHISTLER 2020 ANALYSIS

W2020 Strategy	TOWARD Descriptions of success that resolution moves us toward	Comments
Water	Wastewater and bio-solids are readily assimilated in nature	Construction of the Westside Alta Lake sewer project will ensure that wastewater from this neighbourhood is properly treated.
Water	With respect to water resources, capital and long-term costs are managed in a financially prudent and fiscally responsible manner	Committing to fund up to a maximum of 1/3 of the project cost will align with the current budget for this project as shown in the 2010 Five-year Plan.

W2020 Strategy	AWAY FROM Descriptions of success that resolution moves away from	Mitigation Strategies and Comments
Water	Water supply, wastewater management and flood control infrastructure minimize energy requirements, and favour sustainably managed materials and resources	Pumps will be sized to ensure proper operation, but minimize energy consumption.
Resident Affordability	Residents have access to affordable goods and services that meet their needs	Proceeding with this project only if an infrastructure grant is secured will help make this project affordable to all residents of this neighbourhood.

OTHER POLICY CONSIDERATIONS

In the past, Council has participated, to a varying degree, when providing funding assistance for infrastructure projects. No formal policy exists, so Council is free to choose the level of participation for this project but should be cognizant of existing taxpayers in Emerald who are currently paying for the Emerald sewer project.

The RMOW's 2004 update of the Liquid Waste Management Plan contains a commitment to provide sewer service to the Westside Alta Lake area, contingent on receiving funding from senior levels of government. This is the last area of Whistler that has onsite wastewater treatment, and provision of sewer to this neighbourhood would remove the potential sources of pollution (the septic fields).

BUDGET CONSIDERATIONS

Recent infrastructure grants have applied for 67% funding for this project (67% funded by senior levels of government), but historically Whistler has never received more than 50% of the total project costs for similar type projects.

Based on the current cost update, the total estimated project cost is $3.39 million (plus 12% HST). Using this estimate, RMOW financial planners developed two possible funding scenarios:

Funding	Grant Funding	%	No Grant Funding	%
Grants	$1,130,000	33	0	0
RMOW	$1,130,000	33	$1,130,000	33
Residents	$1,130,000	33	$2,260,000	67
Total	**$3,390,000**	**100**	**$3,390,000**	**100**

In the first case (RMOW receives 33% grant funding for the project) the cost to each property owner would be a one-time charge of $30,532 plus works and services charges and fees of $3,781 for a total of $34,313. Once the sewer is installed, the property owners would also pay the on-going sewer parcel tax and usage fee of $419.00 per year (which they are not currently charged).

In the second case (no grant funding), the cost to each property owner would be a one-time charge of $61,064 plus works and services charges and fees of $3,781 for a total of $64,845. Once the sewer is installed, the property owners would also pay the on-going sewer parcel tax and usage fee of $419.00 per year (which they are not currently charged).

While these are two likely scenarios, other funding models are possible depending on how large a grant is secured and on Council's decision to cost-share with the residents. In the past the municipality has funded between 30% and 66% of similar projects, while the residents have paid between 9% and 50% of similar projects.

COMMUNITY ENGAGEMENT AND CONSULTATION

Residents of the Westside Alta Lake Local Area should be encouraged to organize a "Petition for Service" (S212 Community Charter) to initiate this project if they are interested in pursuing this project without an infrastructure grant to offset a portion of the capital costs of the project.

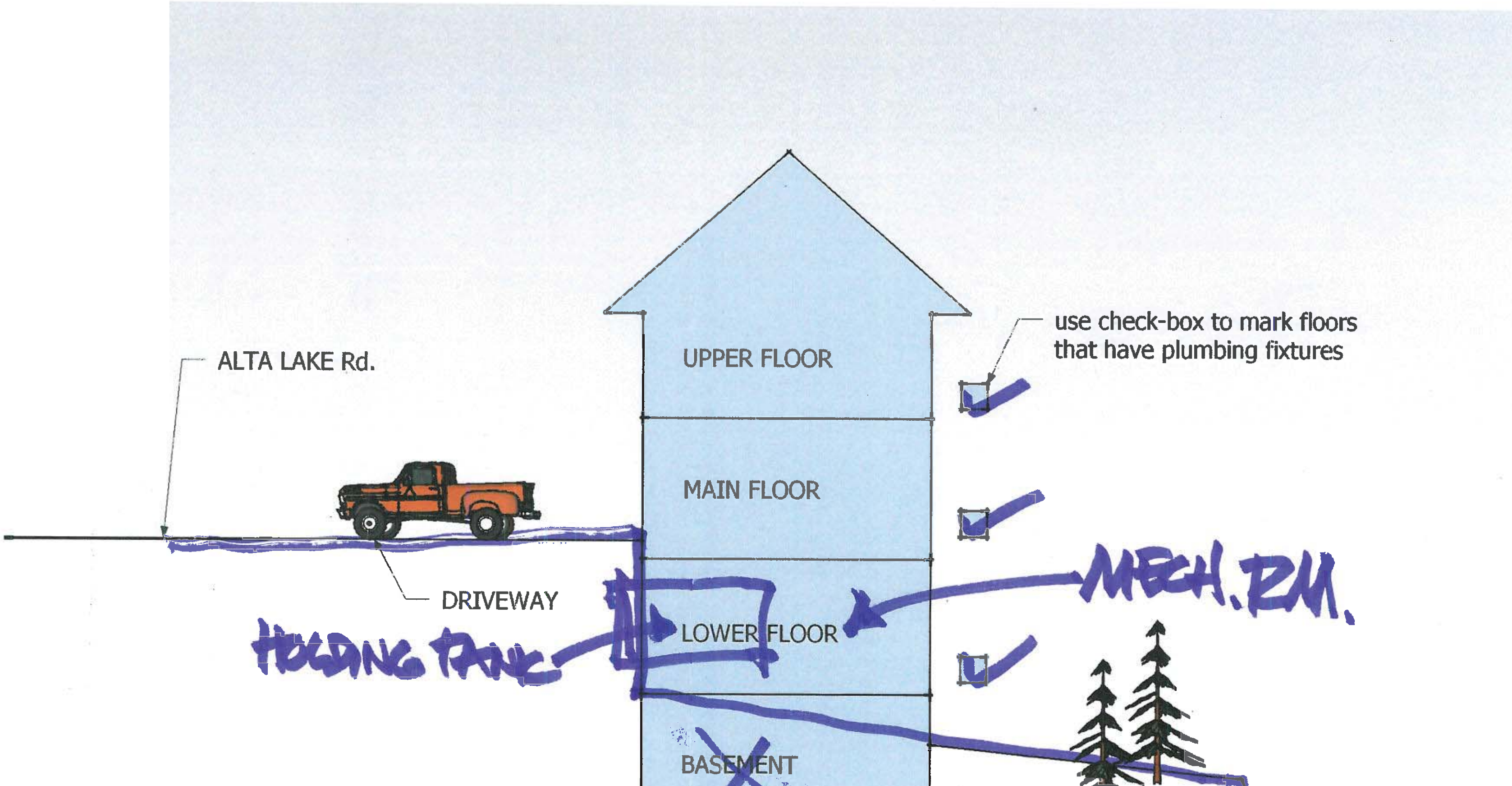
SUMMARY

To date, the RMOW has not been successful in obtaining an infrastructure grant to help offset the capital costs for construction of a sewer for the Westside Alta Lake area. The total project costs have recently been re-estimated at $3.37 million. Council should encourage residents of the Westside Alta Lake Local Area to organize a "Petition for Service" to initiate this project if they are interested in pursuing this project without an infrastructure grant.

Respectfully submitted,

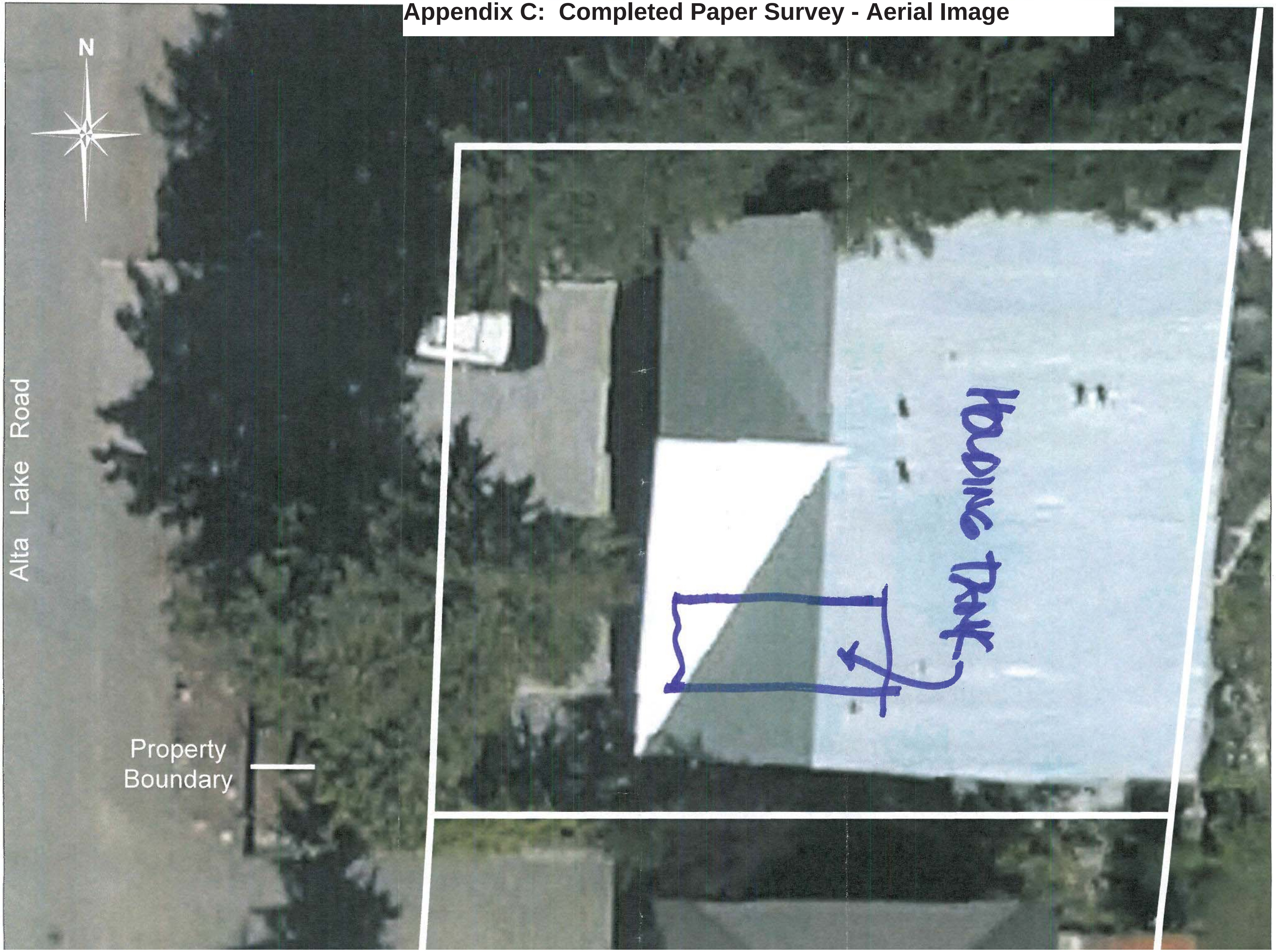
James Hallisey
MANAGER OF ENVIRONMENTAL PROJECTS
for
Harry Kim
GENERAL MANAGER OF ENVIRONMENTAL SERVICES

Appendix C: Completed Paper Survey - Schematic Drawing



Note: Your home may not have all the floors shown above, just check the floors that apply to your home.

Appendix C: Completed Paper Survey - Aerial Image



APPENDIX D

Emerald Estates Sewer Project Principles

(From Council Administrative Report 00-126 "EMERALD ESTATES SEWER COLLECTION SYSTEM AND INFRASTRUCTURE PROJECT", July 17th, 2000**)**

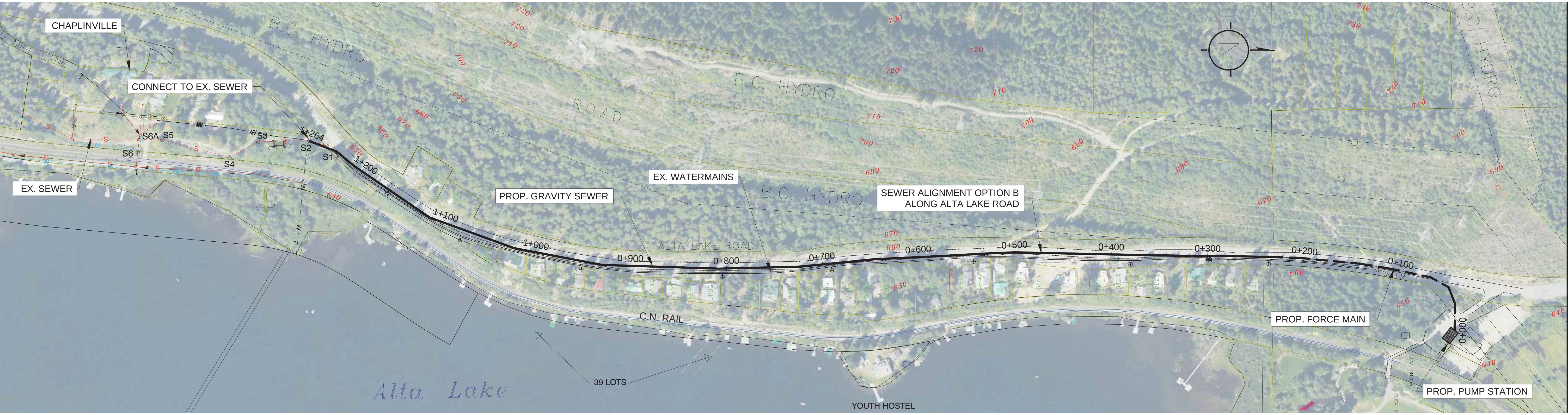
1. The Municipality will share the sewer construction cost equally with the property owners of the specified area;
2. The Municipality will share any grant monies equally with the property owners of the specified area;
3. The Municipality will allow the property owner to commute his/her share of the construction cost as;
   - a single cash payment;
   - amortize his/her share of the cost over a 20-year period; or
   - commute his/her share of the amount payable during any year of the amortization period.
4. As compensation for a sewer right-of-way, the Municipality will;
   - waive the $250 sewer connection fee;
   - credit the owners the value of the works and service charge; and
   - endeavor to restore landscaping to original conditions.
5. The Municipality will relax the requirement to connect to the sewer within 180 days after official notice to do so, and will require the property owners of the specified area to connect within 365 days.
6. The Municipality shall undertake this project as a "Council Initiative".

APPENDIX E

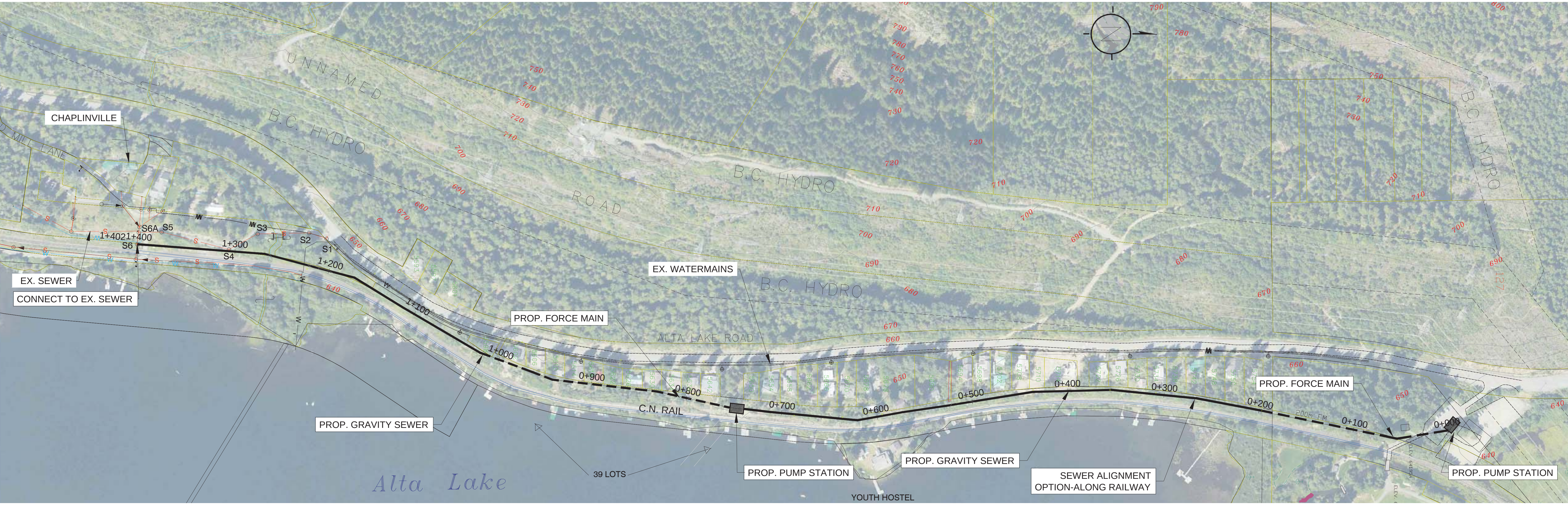
List of Additional Reference Documents

Document	Date	Title/Description
	2013	"West Side Sewer Servicing Pre-Design" (Draft) Opus Dayton & Knight
	24-Oct-12	“Preliminary Results for Alta Lake Water Quality (Data Collected from 2009 to 2011)”, BC Ministry of Environment
	20-Aug-12	“Alta Lake Road Sewer Line”, letter from Caroline Gay Cluer
LU-001	30-Mar-10	“Guideline Regarding Issuance of Permits for Holding Tanks Under the Sewage System Regulation (B. C. Reg. 326/2004)”
22507	1-Jul-09	Canada–British Columbia Building Canada Fund Project - Communities Component - Resubmission
22507	1-Sep-08	Canada–British Columbia Building Canada Fund Project
17228	1-Jan-07	Canada – British Columbia Municipal Rural Infrastructure Fund
1585-03	19-Dec-06	“Alta Lake Subdivision Wastewater Disposal Systems Assessment”, NovaTec Consultants Inc.
11181	1-Feb-05	BC Community Water Improvement Program - Resubmission
11181	1-Aug-04	BC Community Water Improvement Program
179.15.1	May-04	“Pre-Design Update for Westside Sewers”, Dayton & Knight Ltd.
1441, 2001	5-Apr-04	“A By-Law to Impose a Parcel Tax within the Emerald Sewer Specified Area”
	24-Feb-99	BC Rail Ltd. Crossing Agreement
	1-Feb-99	Local Government Grants Program for Water, Sewer and Other Infrastructure Implementation
1063, 1994	18-Jul-94	“A By-Law Regulating the Construction of, Connection to, and Use of Sewer Systems and Holding Tanks Within the RMOW”
551, 1987	15-May-87	“A By-Law Regulating the Construction of, Connection to, and Use of Sewer Systems and Holding Tanks Within the RMOW”

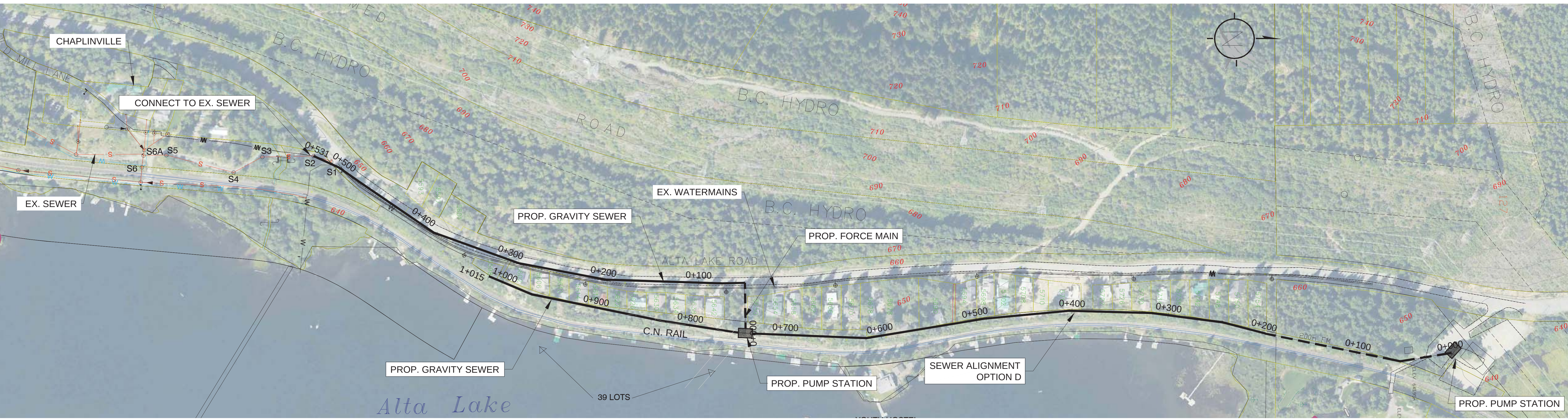
Appendix F-1: Options 2 & 3 - Alta Lake Road Alignment



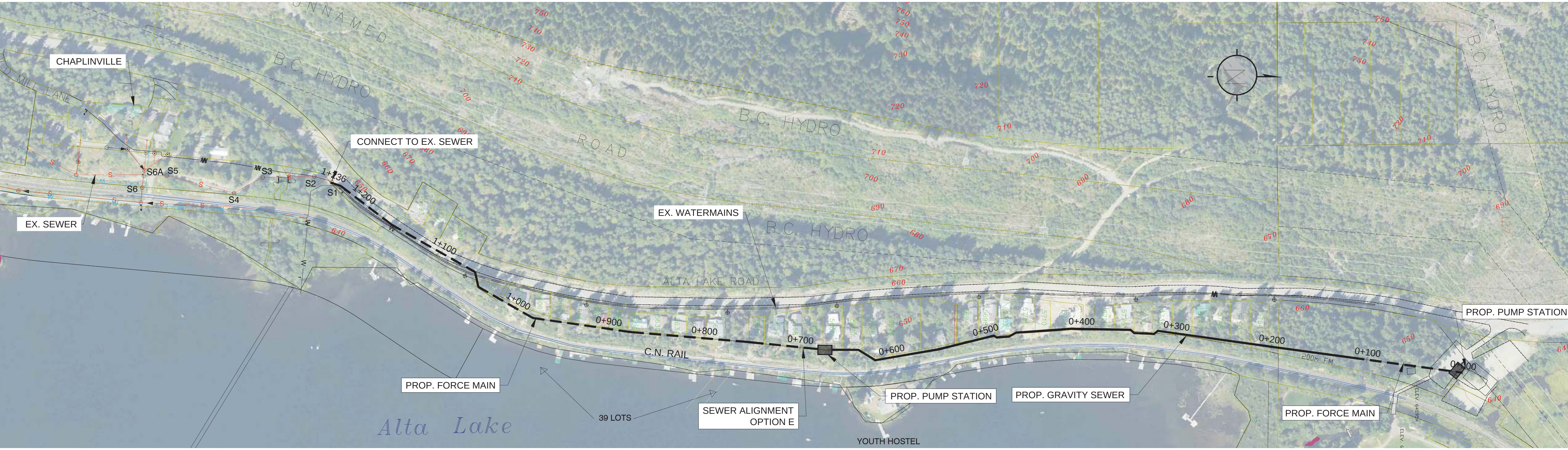
Appendix F-2: Option 5 - Rail Alignment



Appendix F-3: Option 6 - Gravity Collector with pumping to Alta Lake Road



Appendix F-4: Option 7 - Homeowner Lot Alignment



Submitted on Sunday, July 26, 2015 - 09:46

Full Name: Brian Thiessen
Mailing Address: 1478 W 6th Ave, Vancouver BC V6H 4H3
Civic address if different from mailing address:
Email Address: b.thiessen@novuscom.net
Phone Number: 604-861-7048

Message:
Dear Mayor,
Just a comment about this years Ironman weekend. While I understand this is a big weekend for many it is still ludicrous to cut off all access out of the town for 5 hours on a Sunday. I was in a line of cars waiting for the highway to open. I missed a family luncheon back in Vancouver. Another man missed his work shift. Another man had goods to transport to a work site that was waiting for him. These are not simple inconveniences. Route planning and public notification of closures needs to be better for next year.

Submitted on Friday, July 31, 2015 - 18:47

Full Name: John Wood
Mailing Address: 8573 Drifter way, Whistler, V0N 1B8 Civic address if different from mailing address:
Email Address: jkwood2@shaw.ca
Phone Number: 604-932-5109

Message:
A couple of notes regarding olympic plaza area. One I find the stage a bit low particularly when spectators stand at the stage you can not see what is going on as the stage is too low. there seems to be lots of head room. I wonder if it could be set up a few feet higher next year.
A second thought is the lonely first nation display near the plaza that was installed a few years ago on Blackcomb way. It is now isolated and
inaccessible because of the fences and borders installed for the heliport.
Perhaps it should be moved to a location where it can be appreciated.

Thanks for considering these ideas

John Wood

August 2, 2015

Mayor and Council,

We are writing about a traffic and safety concern in the Lakeside Park area.

The refurbishment of Lakeside Park was a huge success and visitor traffic has increased exponentially. Unfortunately the unintended consequence is a significant increase in car traffic and parking on Lakeside Road with drivers trying to get close to the Park. Lakeside between Carlton and Alpine is one of the few unprotected stretches of the Valley Trail in Whistler and there is no barrier between all these cars (and trucks unloading boats) and the users of the Valley Trail - cyclists and pedestrians, many young children riding to the lake. Despite one speed bump on the block most are driving above the speed limit. The problem is exacerbated by parked cars (park users and boaters primarily) taking up half the street.

Daily we see several near misses of cars colliding with cyclists, pedestrians and dogs: drivers swerving onto the Valley Trail as they go around parked cars; drivers backing up on the valley trail; drivers speeding down the street rushing who knows where. Some cars even park right on the Valley Trail, putting cyclists and pedestrians at more risk. The most worrying scenario is when cyclists or skateboarders pick up speed descending Carleton and then make a left turn onto Lakeside.

The Lakeside stretch of the Valley Trail is unique because visitors stroll down the road and interact frequently with local families. We often chat with tourists from our deck and driveway, giving directions and telling them about life in Whistler. The unnecessary increase in car traffic is ruining this gem section of the Valley Trail. From a personal perspective, our family is impacted because drivers are constantly doing U-turns in our driveway where our dog is tied up, and idling in front of our house. The peaceful neighbourhood we moved into years ago has become dangerous & stressful.

There needs to be more of a deterrent for drivers to using this stretch of Lakeside Road. Coming from Alpine Crescent, the only sign says "Traffic Calmed Area." This is ambiguous to most drivers and they simply drive through the neighbourhood trying to get closer to the Park. From the Blueberry/St. Anton direction there is a sign for the Lakeside parking lot but also a sign pointing down Carleton to Lakeside (for bikes) which cars follow too. There is no deterrent signage at all.

Simple & Effective Solutions:

We have a few suggestions which could easily improve the situation:

1) Lakeside Road between Carleton and Alpine should be a No Parking zone. It is absurd that parking is permitted on the stretch of Lakeside that coincides with the Valley Trail, but on the next block to the north, parking is prohibited. The Carlton/Alpine stretch of Lakeside has to deal with the boat launch and park traffic while the other end, equally close to the launch, is No Parking.
2) At a minimum, this stretch should be permit/resident only (perhaps a nominal annual permit so local boaters would have access but visiting tourists would stick to the lot).
3) Clear signage should be installed on Archibald deterring cars from going further. "NO CAR ACCESS OR PARKING FOR LAKESIDE PARK BEYOND THIS POINT – RESIDENTS ONLY", as an example. These signs should be installed at Archibald/Carlton and Archibald/Alpine intersections.
4) White lines should be painted on the corner of Archibald and Carlton, directing traffic to stay on Archibald.
5) Boat launch users should park on the north end of Lakeside Rd.– where the Valley Trail is not running parallel, or they can drop their boat and park further away. Boats are getting bigger and people are backing up their trucks right onto the trail – with very poor visibility of cyclists and skateboarders flying around the corner.
6) Overflow parking should be diverted to Hillcrest Drive rather than Lakeside Road.
7) Improve transit access to Lakeside Park so that users are discouraged from driving. It seems ironic that Whistler is purchasing carbon offsets yet we are encouraging people to drive to the park.

Clear signage and enforcement of the rules will solve this problem before an accident occurs. Alta Vista, one of Whistler's iconic old neighbourhoods, was never meant for this much vehicle traffic. We have been watching the situation worsen each year – the problem has gotten out of hand.

We really hope the municipality can address these concerns before somebody gets seriously hurt. I plan on attending the August 11 council meeting and would be glad to answer your questions.

Thank-you.

David Berkowitz
3338 Lakeside Road
Whistler BC
daveberkowitz@icloud.com
m: 604.862.5700

Representative Photos from August 2, 2015
(these are far from the most worst examples)

Local Government Program Services

...programs to address provincial-local government shared priorities

UBCM

FIRST NATIONS' Emergency Services BRITISH COLUMBIA

BRITISH COLUMBIA
www.gov.bc.ca

The Strategic Wildfire Prevention Initiative is managed by the Provincial Fuel Management Working Group. For program information, visit the Funding Program section at:

www.ubcm.ca

LGPS Secretariat

Local Government House
525 Government Street
Victoria, BC, V8V 0A8

E-mail: lgps@ubcm.ca
Phone: (250) 356-2947

July 28, 2015

RECEIVED
JUL 31 2015
RESORT MUNICIPALITY OF WHISTLER

Mayor Wilhelm-Morden and Council
Resort Municipality of Whistler
4325 Blackcomb Way
Whistler, BC, V0N 1B4

RE: Completion of Fuel Management Project (SWPI-366: Horstman Operational Treatment, 2013)

Dear Mayor and Council,

Thank you for submitting final report documentation for the completion of the above noted operational fuel treatment. The Provincial Fuel Management Working Group has reviewed your submission and the reporting requirements have been met.

The final report notes a total project cost of $362,476.32. Based on this, a cheque in the amount of $45,562.50 will follow shortly under separate cover. This cheque represents full payment for this project and is based on 90% of the total project cost (to a maximum of the approved grant of $182,250.00) minus the progress payment of $136,687.50 made in April 2015.

The Strategic Wildfire Prevention Initiative is a suite of funding programs that is administered by the Union of BC Municipalities and managed through the Provincial Fuel Management Working Group. The First Nations' Emergency Services Society (FNESS) and the BC Wildfire Service provide technical expertise. Funding is provided by the Province of British Columbia.

On behalf of the working group, I would like to congratulate you on the successful completion of this project and offer best wishes for future community safety work in your community.

Sincerely,

Danyta Welch
Policy & Programs Officer

cc: Heather Beresford, Environmental Stewardship Manager, Resort Municipality of Whistler

Tony Botica, Fuels Management Specialist, Coastal Fire Centre

Community Foundation of Whistler

July 6, 2015

Resort Municipality of Whistler
4325 Blackcomb Way
Whistler, BC V0N1B4

Dear Mayor and Council,

The Community Foundation of Whistler is pleased to provide you with the enclosed fund statement for the Environmental Legacy Fund. This statement reflects the contributions to your fund, income generated, and grants distributed for the period from January 1, 2014 through December 31, 2014.

The year 2014 proved to be a reasonably strong year for the investments of the Community Foundation of Whistler. In 2014 our main investment account saw a return of 11.7%. We continue to hold a very broad diversity of investments. Our fund manager, Cypress Capital Management, utilizes an endowment institution approach for the long term growth of the portfolio, while a basket of funds is aside to provide for the shorter term cash flow needs of the Foundation and our fund holders. As of December 31, 2014 the Foundation had $5.19 million in endowed assets.

Our Finance and Investment Committee meets annually with our fund manager and is pleased with their performance. Despite the strong returns experienced in 2014, returns in 2015 are expected to be more modest. We will maintain our current strategy of holding a well-diversified selection of securities managed for our long term outlook, while keeping an eye on our shorter term cash needs. As in 2014, we continue to employ a conservative approach to our 2015 disbursements in order to help build reserves for future years.

We invite you to view our 2014 Audited Financial Statements on our website at www.whistlerfoundation.com.

If you have any questions about your fund statement, please feel free to contact me at ccoffey@whistlerfoundation.com. We are happy to meet with you to provide more information about your fund. Thank you for investing in a long term resource that will continue to help strengthen our community. Together we are growing a strong legacy for Whistler tomorrow.

Yours truly,

Carol Coffey
Executive Director

Community Foundation of Whistler
Box 1184, Whistler, BC
Canada V0N 1B0

T 604.935.8080
E info@whistlerfoundation.com
whistlerfoundation.com

Community Foundation of Whistler

Annual Fund Statement 2014 - Environmental Legacy Fund

Principal Endowed to Date:	2,405,705.00
Opening Fund Balance- Current Year:	3,036,795.94
Contributions in the year:	0.00
Investment Income:	128,723.41
Unrealized Gains (Losses) in the year	233,916.82
Investment Management Fees:	-11,639.23
Administration Fees:	-47,981.16
Annual Grants:	-114,967.00
Closing Fund Balance:	3,224,848.78

There were no contributions during this statement period.

Community Foundation *of Whistler*

Detailed Grants:

Grantee	Date	Amount
Squamish River Watershed Society	**15/04/2014**	**4,891.00**
Get Bear Smart Society	**15/04/2014**	**10,000.00**
AWARE	**15/04/2014**	**7,800.00**
AWARE	**15/04/2014**	**15,000.00**
AWARE	**15/04/2014**	**12,000.00**
AWARE	**15/04/2014**	**2,000.00**
AWARE	**15/04/2014**	**600.00**
The Board of Education of School District No. 48 (Sea to Sky)	**15/04/2014**	**5,000.00**
The Board of Education of School District No. 48 (Sea to Sky)	**15/04/2014**	**10,000.00**
Sea to Sky Invasive Species Council	**15/04/2014**	**9,950.00**
Sea to Sky Invasive Species Council	**15/04/2014**	**15,462.00**
Sea to Sky Invasive Species Council	**15/04/2014**	**21,464.00**
AWARE	**18/08/2014**	**800.00**
***** Total Grants:**		**114,967.00**

Total disbursements from fund to end 2014, since created: $749,123.37

Community Foundation of Whistler
Box 1184, Whistler, BC
Canada V0N 1B0

T 604.935.8080
E info@whistlerfoundation.com
whistlerfoundation.com

From: Lauren Yip [mailto:laureny13@outlook.com]
Sent: Friday, July 31, 2015 1:53 PM
To: Wanda Bradbury; Steve Anderson; Jack Crompton; Jen Ford; John Grills; Andrée Janyk; Sue Maxwell
Subject: Please support The Light Up Purple Campaign for Mental Health!

Dear Whistler Council and Mayor Wilhelm-Morden,

I am Lauren Yip, a resident of West Vancouver and I am writing on behalf of the Amanda Todd Legacy Society and mother Carol Todd as their Youth Ambassador, inquiring about the possibility of Whistler's support and proclamation for an awareness campaign on World Mental Health Day, which will take place on October 10th, 2015. The World Federation of Mental Health has also provided their entire support in this campaign.

Here is a short video explaining our mission with Light Up Purple: http://youtu.be/KpLZvVQS-EU

World Mental Health Day was initiated in 1992 by the World Federation of Mental Heath. This was also the date that Amanda Todd passed away. The awareness related to bullying and mental health is a worldwide concern that continues to need much advocating and awareness messaging. Many of all ages continue to suffer from the effects of bullying, as well as the distresses and tragic consequences which have resulted.

This year on October 10th, will mark the three-year anniversary of Amanda's death. Amanda's Legacy is asking for support for all to "Light Up Purple" in support of World Mental Health Day.

Thank you for your time in reading this email. Even if our request is not possible, please let us know if you are a supporter by having your colleagues talk about purple and mental health and your business/organization will be added to our list of Caring Supporters on the Light Up Purple website – www.lightuppurple.com. We greatly appreciate your generous help in supporting this cause.

With regards,

Lauren Yip
Youth Ambassador
www.amandatoddlegacy.org
#lightuppurple
www.lightuppurple.com

To Legislative Services Department, this is our formal application with our replies to the requirements, listed in the link below.

Copied from link: Please find the link below, describing the steps to receive a proclamation from Council, email to: corporate@whistler.ca

https://www.whistler.ca/municipal-gov/council/frequently-asked-questions

Name of organization/group/individual requesting the proclamation. Contact information including email, phone number, and mailing address for the person or group arranging for the proclamation.

-Carol Todd, founder of Amanda Todd Legacy Society, Non-Profit

-Carol Todd Email: carol@amandatoddlegacy.org

-Address: 1168 Douglas Terrace, Port Coquitlam BC V3C 5X2 Phone: 604-329-0584

Amanda Todd Legacy, Non Profit websites: www.amandatoddlegacy.org - www.lightuppurple.com

Link to supporters confirmed this year: http://lightuppurple.com/supporters-for-2015/

Link to supporters from Light Up Purple on Oct 10 2014: http://lightuppurple.com/supporters-for-2014/

A legal copy of the wording for the proclamation, Information about the proclamation and its purpose.

- We have attached a formal letter from the World Federation of Mental Health http://www.wfmh.org/ and a copy of one of the proclamations we received Oct 10 2014 and our request letter from Amanda Todd Legacy society. Hope this helps to complete the process for officially applying to Whistler for a proclamation for the global awareness campaign on World mental health day Oct 10 2015

World Mental Health Day is an education campaign designed to encourage people to talk, reflect and engage with others on the importance of mental health and the reality of mental illness.

Thank-you for your time and consideration with our request to show support for Light Up Purple on World Mental Health Day, Oct 10 2015

Kind Regards, Jan McNeill

Amanda Todd Legacy Administrator for **Carol Todd**
Email: carol@amandatoddlegacy.org
www.amandatoddlegacy.org

#LightUpPurple For World Mental Health Day **www.lightuppurple.com**

AMANDA TODD LEGACY
'THE DREAM OF HELPING KIDS'

amandatoddlegacy.org | info@amandatoddlegacy.org

The Amanda Todd Legacy Society would like to invite you to participate in our third annual Light Up Purple campaign for World Mental Health Day (WMHDay) on October 10th 2015. WMHDay was first celebrated in 1992 at the initiative of the World Federation of Mental Health.

For the past two years, we have been encouraged by the number of landmarks around the world that have lit up purple to bring increased awareness to mental illness. Not only did these landmarks illuminate purple, but people, organizations, schools and businesses also participated in this event in their own creative way. While the list from previous years has been impressive, we hope to expand it once again this year.

Amanda's lasting message is based on her 'Dream of Helping Kids'. Her story continues to be shared in many countries around the world to people of all ages. Awareness and understanding with respect to exactly what mental health is and how we can educate around it, is so very important.

The You Tube video Amanda created depicts the struggles she felt after endless years of torment due to bullying, cyberbullying and exploitation. It has been viewed cumulatively over 33 million times and within it, she shares her thoughts - "I'm struggling to stay in the world, because everything just touches me so deeply. I'm not doing this for attention. I'm doing this to be an inspiration and to show that I can be strong. I did things to myself to make the pain go away, because I would rather hurt myself than someone else. Haters are haters but please don't hate, although I`m sure I'll get them. I hope I can show you guys that everyone has a story and everyone's future will be bright one day, you just gotta pull through. I'm still here aren't I?"

As told on the Dr Phil Show, to members of government and at various conferences related to children and youth, mental health and cyberbullying, the world needs to stand together as one, united around the globe to MAKE A DIFFERENCE. We need to educate and empower our children/adults and we need to ensure that changes are made in order to avoid more casualties. We need to encourage others to speak up and to reach out to others, in other words "to not be a bystander'. We, as caring communities, as parents, friends, families, and our youth, businesses and work colleagues need to make a UNITED STAND. A stand which the entire world can see, embrace, light up and say "no more" to bullying and the stigma of having a mental illness.

Please join us this year and help make a difference on October 10th.

World Federation for Mental Health

July 15, 2015

Amanda Todd Legacy Society
Carol Todd

Dear Carol:

The World Federation for Mental Health is proud to support the ***Light Up the World Purple Awareness Campaign*** as part of an international effort to increase awareness about mental health and the effects of bullying.

As the creators of World Mental Health Day we are always on board to support campaigns that bring international awareness to mental health issues. Your Light Up the World Purple project is important to create awareness regarding the effects of bullying on a person's mental health. We understand the significance of this date in your family and know how important it is to make sure that October 10th - World Mental Health Day is used to highlight the awareness campaign. It is hoped that we can help spread the word about all that you are doing.

If possible, try to send us pictures of the event so that we can post them on our website to show the world your event!

I would be happy to send you our WFMH logo to use for your WMHDAY Event and if there is anything else we can do, please let me know.

Thank you and good luck with your campaign!

Deborah

Deborah Maguire
WFMH, Director of Administration
WMHDAY Coordinator

Office of the Mayor

CITY OF VANCOUVER

BRITISH COLUMBIA

Proclamation

"WORLD MENTAL HEALTH DAY"

WHEREAS	World Mental Health Day is an education and awareness campaign designed to encourage people to talk, reflect and engage with others on the importance of mental health and the reality of mental illness;
AND WHEREAS	Nearly 1 in 5 Canadians will suffer a mental disorder in their lives; the remaining 4 Canadians will be affected by a mental illness through a family member, friend, or co-worker;
AND WHEREAS	Of the 10 leading causes of disability worldwide, five are mental disorders: major depression, schizophrenia, bipolar disorder, substance abuse disorder and obsessive compulsive disorder: 30 – 40% of disability claims are for depression;
AND WHEREAS	Stigma is the number one reason people do not seek or receive treatment, experience workplace and social discrimination and experience barriers to recovery;
AND WHEREAS	Mental health literacy and education are vital in the prevention, recognition, response and early treatment of mental illness in order to reduce the severity and support the recovery:
NOW, THEREFORE,	I, Gregor Robertson, Mayor of the City of Vancouver, DO HEREBY PROCLAIM Friday, October 10th, 2014 as

"WORLD MENTAL HEALTH DAY"

in the City of Vancouver.

Gregor Robertson

MAYOR