BROWN'S BAY PACKING COMPANY LTD

Wastewater Technical Assessment
December 3, 2018

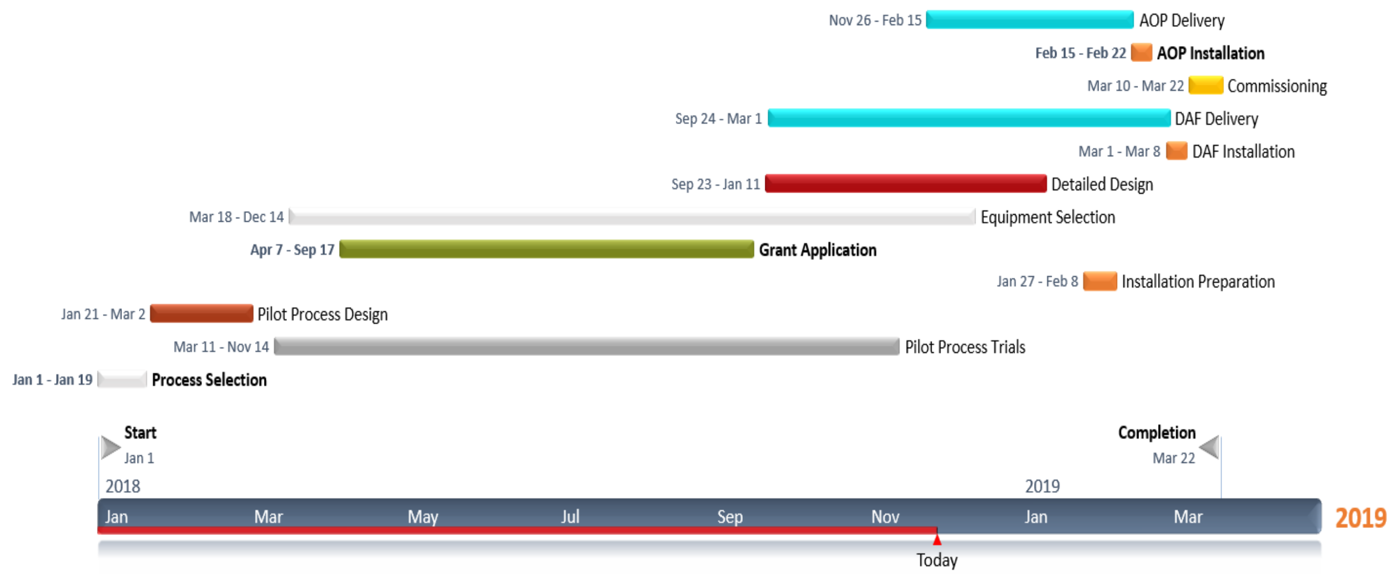
Major Permit Amendment to Permit #8124

Submitted to the British Columbia Ministry of Environment and Climate Action Plan

(Supersedes Technical Assessment, May 2013)

Prepared By:
Lorne Sandberg
H2Ops Water Services Inc
2131 Nikola Place
Campbell River, BC, V9W 6H9
H2Ops@hotmail.ca

Table of Contents


Nov 26 - Feb 15
AOP Delivery
Feb 15 - Feb 22
AOP Installation
Mar 10 - Mar 22
Commissioning
Sep 24 - Mar 1
DAF Delivery
Mar 1 - Mar 8
DAF Installation
Sep 23 - Jan 11
Detailed Design
Mar 18 - Dec 14
Equipment Selection
Apr 7 - Sep 17
Grant Application
Jan 27 - Feb 8
Installation Preparation
Jan 21 - Mar 2
Pilot Process Design
Mar 11 - Nov 14
Pilot Process Trials
Jan 1 - Jan 19
Process Selection
Start
Jan 1
Completion
Mar 22
2018
2019
Jan
Mar
May
Jul
Sep
Nov
Jan
Mar
2019
Today

Executive Summary

The below text and tables are copied from BBPC Technical Assessment, May 2013 (appendix G) and updated to reflect current conditions

Brown's Bay Packing Company (BBPC) operates a fish processing plant in Brown Bay, approximately 15 km north of Campbell River. The plant receives farmed Atlantic Salmon, and produces a head-on eviscerated product that is packaged on ice in Styrofoam boxes. The plant has been in operation since 1989, when the annual production was 1.2 million kilograms. The plant's processing capability has peaked at over 14.5 million kilograms per year, offers full time employment to 50 individuals, and provides an indispensable service to BC's valuable salmon farming industry. Since 2008, annual production has been less than 9 million kilograms. A similar annual production is projected for the next five years, during which the plant will be processing about three days per week.

The facility discharges treated effluent under Permit PE-8124, which was originally issued in the name of J.W. Timber Co. Ltd., but was transferred to BBPC in April, 2010. The plant is located on four parcels of Crown Land, which are leased to Brown's Bay Resort Holdings Ltd. and subleased to BBPC. The outfall discharges to Brown Bay.

In addition to the growth in fish processing capacity achieved over the past two decades, improvements have been incorporated into the wastewater collection system that serve to protect the natural environment of the bay and surrounding waters. These improvements have resulted in achieving practically complete collection, treatment, and deep-water dispersion of process wastewater as well as bloodwater from the holds of the transport boats.

The existing permit allows for the discharge of 28m^3/day of fine screened fish processing effluent plus typical septic tank effluent. The permit also specifies the authorized works and outfall location.

The following amendments to the discharge permit are requested:

1. The permitted daily discharge rate be increased from 28 m^3/d to 720 m^3/d,
2. Acceptance of proposed sewage works upgrades: Installation of an advanced oxidation system for disinfection and nutrient reduction, and a dissolved air floatation system for solids removal.
3. The domestic sewage works described in the permit be changed from two septic tanks to a single 23 m^3 white water treatment system to reflect the installation,
4. The outfall termination location described in the permit be changed from 30m from and 15m below mean low water to 100m from and 25m below mean low water to reflect the installation.

BBPC acknowledges that a major permit amendment will also require that the permit be brought up to current standards, which will increase the effluent monitoring, environmental monitoring and reporting requirements.

Effluent quality criteria used in this report were determined based on provincial water quality guidelines, and scientific research where existing guidelines do not exist. Effluent quality parameters discussed in this technical assessment include 5 Day Biological Oxygen Demand (BOD), Total Suspended Solids (TSS), pH, ammonia/nitrate, enterococci, and the constituents of the three cleaning and disinfection agents used at the facility (Rough Rider II, Savall, and Oxygentle), and the chemicals used in the wastewater treatment process (hydrogen peroxide, hydrochloric acid, sodium hydroxide, and polymer).

All of the effluent parameter concentrations specified in the draft permit are greater than, or encompass the range of, empirical data collected between 2017 and 2018. The domestic sewage concentrations were determined using the Sewerage System Standard Practices Manual to estimate the flows leaving the plant's white-water treatment system.

Provincial water quality guidelines are in place for nitrogenous compounds. The proposed treatment system disinfects and reduces nutrients using hydrogen peroxide, which does not have a water quality guideline in the provincial water quality guidelines. The hydrogen peroxide limit has been determined by Great Pacific Engineering & Environment based on scientific evidence found in published scientific documents. Provincial guidelines set chronic exposure concentration for ammonia and nitrate; chronic exposure concentrations for nitrite are not proposed due to its relatively low toxicity in seawater.

Effluent quality criteria for sodium hydroxide, hydrochloric acid, and the three cleaning agents were determined by comparison to reported values of LC50 for each of the chemical components. For all the constituents, the maximum estimated concentration of undiluted effluent was below any LC50 found in the literature.

The proposed effluent quality from the Browns Bay Packing Company do not meet all applicable water quality guidelines at the end of pipe prior to discharge in the receiving environment. Therefore, an IDZ is requested to achieve environmental protection beyond a dilution zone.

1. Project Description

1.1 Project facility and Processes

The below text and tables are copied from BBPC Technical Assessment, May 2013 (appendix G) and updated to reflect current conditions

1.11 Background

Brown's Bay Packing Company Ltd. operates a fish processing plant located at Brown Bay, approximately 15km north of Campbell River, 4km north of Seymour Narrows in Discovery Passage. The processing plant discharges effluent under Permit Number 8124. The permit was originally issued to J.W. Timber Co. Ltd. in 1989, but a minor amendment to transfer the permit to BBPC was approved in April, 2010. It is included in Appendix A.

The existing permit allows for discharge of up to 28m^3/d of fine screened fish processing effluent plus typical septic tank effluent. Authorized works include coarse floor drains, a sump, a rotostrainer for process wastewater, two septic tanks (2.1 m^3 and 2.9 m^3) for domestic sewage, and a common outfall terminating 30m from and 15m below mean low water. In addition to these works, a manually controlled chlorination/de-chlorination disinfection system was installed in 2003, and upgraded to automatic control in 2009; many of the components were replaced in 2011. Currently, all of the evisceration plant effluent and transport boat hold water are fine screened to 500 microns prior to discharge to the bay.

BBPC has taken measures to ensure complete collection and treatment of all the water used to transport the salmon from the farm sites to the processing plant.

The plant has grown significantly since 1989; the annual production has increased from 1,200 tonnes in 1989 to 18,000 tonnes anticipated per year from 2018 to 2022, and offers full time employment to 50 people. The volume of effluent has increased over this period to average about 300m^3/d on processing days, with peak daily discharges potentially greater than 700 m^3. During the next five years, it is anticipated that the plant will be processing three to six days per week depending on harvest schedules.

This technical assessment has been prepared as a component of an application for a major amendment to Permit 8124. The application requests that the following conditions be changed:

1. The permitted daily discharge rate be increased from 28 m^3/d to 720 m^3/d,
2. Acceptance of proposed sewage works upgrades: Installation of an advanced oxidation system for disinfection and nutrient reduction, and dissolved air floatation system for solids removal,
3. The domestic sewage works described in the permit be changed from two septic tanks to a single 23 m^3 white water treatment system to reflect the installation, and

4. The outfall termination location described in the permit be changed from 30m from and 15m below mean low water to 100m from and 25m below mean low water to reflect the installation.

In 1998, BBPC requested an increase in the allowable daily discharge. Although a draft permit was presented to the company, the request was withdrawn in 2006, and in October 2011 and May 2013 Technical Assessments were submitted to further fulfill the requirements of a major permit amendment. Following the May 2013 Technical Assessment submission, it was recommended by the Ministry of Environment that BBPC follow best management practices until such time as an industry wide permit assessment process is developed, which BBPC has complied with.

1.12 Company Overview

Legal Name:	Brown's Bay Packing Company Ltd.
Incorporation Number:	BC0264186
Previous Company Name:	Millerd Packing Ltd. (Changed on September 27, 1988)
Incorporation Date:	May 18, 1983
Registered Address:	1900 1040 W. Georgia Street, Vancouver, BC, V6E 4H3
Local Address:	15007 Brown Bay Road, Campbell River, BC, V9H 1N9
Contact Person:	David Stover, Managing Partner
Phone Number:	(250) 287-7200
Email Address:	dave@brownsbaypacking.com

1.13 Facility Operations

The below text and tables are copied from BBPC Technical Assessment, May 2013 (appendix G) and updated to reflect current conditions, Appendix xxx

The receiving transport method is dependent on the geographic location of the farm. Fish arrive by sea and over land in harvest vessels or tankers, stunned, bled and chilled. The fish are pumped into the plant using a vacuum pump.

Typically, a single transport boat will arrive at the floating dock adjacent to the wharf early in the morning with its holds full of bled fish suspended in a sea water and ice slurry. In preparation, BBPC staff will have added about 4 totes of ice and fresh water to the dewatering box; this water is required to facilitate the first slug through the vacuum pump. Using a large vacuum pump on the floating dock, the fish are lifted to the dewatering box located adjacent to the packing plant. The water is recycled back to the boat as required, and the fish are conveyed into the processing building. As offloading proceeds, less water is required on the boat, and a portion is pumped up to the screening process. When offloading is complete, the remaining bloodwater is removed from the boat hold, and pumped to the screen. Prior to departure, the boats are loaded with approximately 20 tonnes of ice; this ice is used to keep the next batch of bled fish chilled as it is moved from the farm site to the processing plant.

The fish are moved from the dewatering box to the processing plant using conveyors. The rate of the offloading process varies; at times the rate is quicker than that of the automated evisceration machines, but there are also slow periods. To buffer these surges in offloading rate, 15 to 20 totes are filled with fish and ice water early in the day, and processed during the slower periods of offloading. Within the plant, most of the fish are fed either to one of the three automated evisceration machines or to the hand line. A vacuum collection system captures the offal, and progressing cavity pumps move it to a tanker trailer for offsite disposal. The process water used in the evisceration machines drains by gravity to the wastewater sump under the shop. Floor drains collect wash water not captured within the equipment, and direct it to the same sump. The fish are conveyed to the packaging room, packaged on ice in Styrofoam boxes, stacked on pallets, moved out of the building, shrink-wrapped and labeled before being loaded on trailers for transportation to market.

Throughout the day, lift trucks may also be used to transport open totes loaded with fish or offal around the site. The area in which open totes containing bloodwater are moved is restricted to the wharf and the breezeway between the processing plant and the shop. As open totes are moved, some spillage may occur. As required throughout the day, but primarily after production, tote washing occurs on the wharf, and the entire area is sprayed down to flush spillage off the wharf, breezeway asphalt, and other surfaces. Filtered, UV irradiated fresh water with a chlorine residual is used for this. Roughrider II, a caustic foam solvent is used to clean and disinfect the totes on the wharf.

Washing operations occur at the end of every processing day. Three cleaning compounds are used to wash and disinfect surfaces at the plant: Savall (a quaternary ammonium compound), Oxygentle (hydrogen peroxide), and Roughrider II (a caustic solvent and disinfectant). Either Savall or Oxygentle is used for disinfection on a given processing day; typically, a monthly schedule is followed where Savall is used for three weeks, and then Oxygentle is used for a week. A team of four individuals work concurrently, but in different areas of the plant. Two work in the evisceration area, one in the packing area, and one in the dewatering and wharf area. The first 3 hours of the shift entail rinsing all equipment, floors, walls, and ceilings. Most of the particulate and blood are flushed into the wastewater sump during this period. After a thorough fresh water wash down, Roughrider foam is applied to all the surfaces; respirators are required when working with Roughrider, and the entire team applies the foam concurrently within their specified areas. The areas are then rinsed. The rinse water is collected by floor and equipment drains, and gravity flows to the sump under the shop.

Offal from the evisceration process is combined with screenings from the wastewater treatment process and pumped to a tanker trailer. As required, the trailer is hauled to West Coast Reduction in Vancouver where it is rendered into value added products.

1.2 Processing Products

BBPC processes only farmed Atlantic Salmon that are farmed along the BC Coast by either Cermaq, Grieg, or Marine Harvest.

1.3 Project Site and Surroundings

The below text and tables are copied from BBPC Technical Assessment, May 2013 and updated to reflect current conditions, Appendix xxx

1.3.1 Property Description

The processing plant and ancillary facilities are located on four parcels of Crown Land. All are leased to Brown's Bay Resort Holdings Inc. and are subleased to Brown's Bay Packing Company Ltd. All four properties are located on Lot 1150, Sayward District.

The two water leases include District Lot 1655 (Crown Land File #1404327) on which the wharf and administration building/shop are supported on piles, and District Lot 1693 (Crown Land File #1409124) on which the processing plant is supported on piles. The seaward end of the lots are approximately 20m deep, the seabed slopes steeply towards shore, then starts to level out at a depth of about 3m. The intertidal zone is a gently sloping gravel beach.

The two land leases include District Lot 1664 (Crown Land File #1403960) on which the wastewater treatment system and generator are located, and District Lot 1692 (Crown Land File #1409121) on which the ice plant and truck loading area are located. The flat seaward portions of both lots are covered almost entirely with impermeable surface (asphalt and concrete); a steep bluff at the inland end of the properties forms a natural barrier.

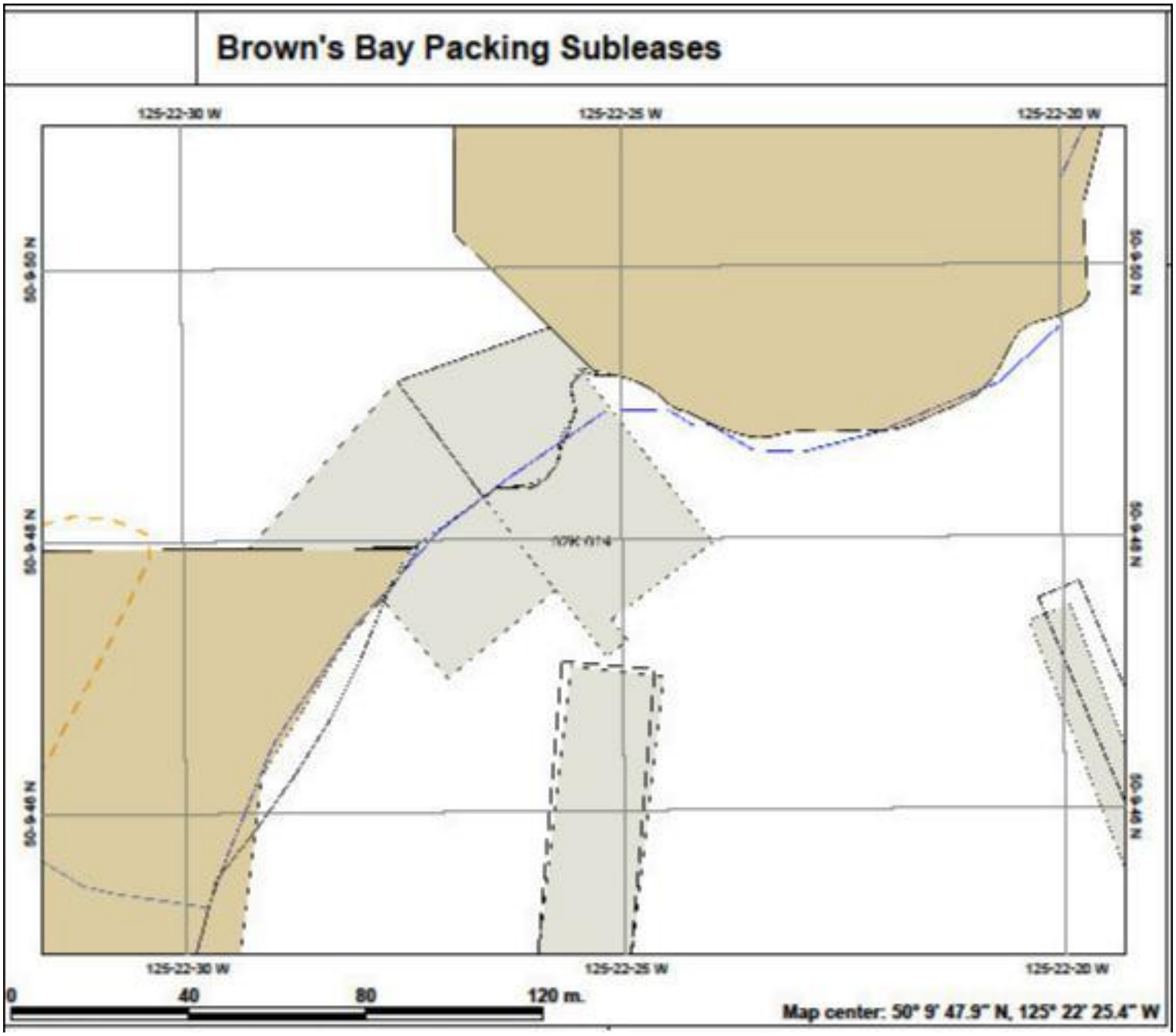


Figure 1.3 Lease properties on which BBPC is located

1.4 Project Site and Surroundings Map

A map showing the general location of Brown's Bay is illustrated in Figure 1.4. Access is via Highway 19, and Browns' Bay Road.

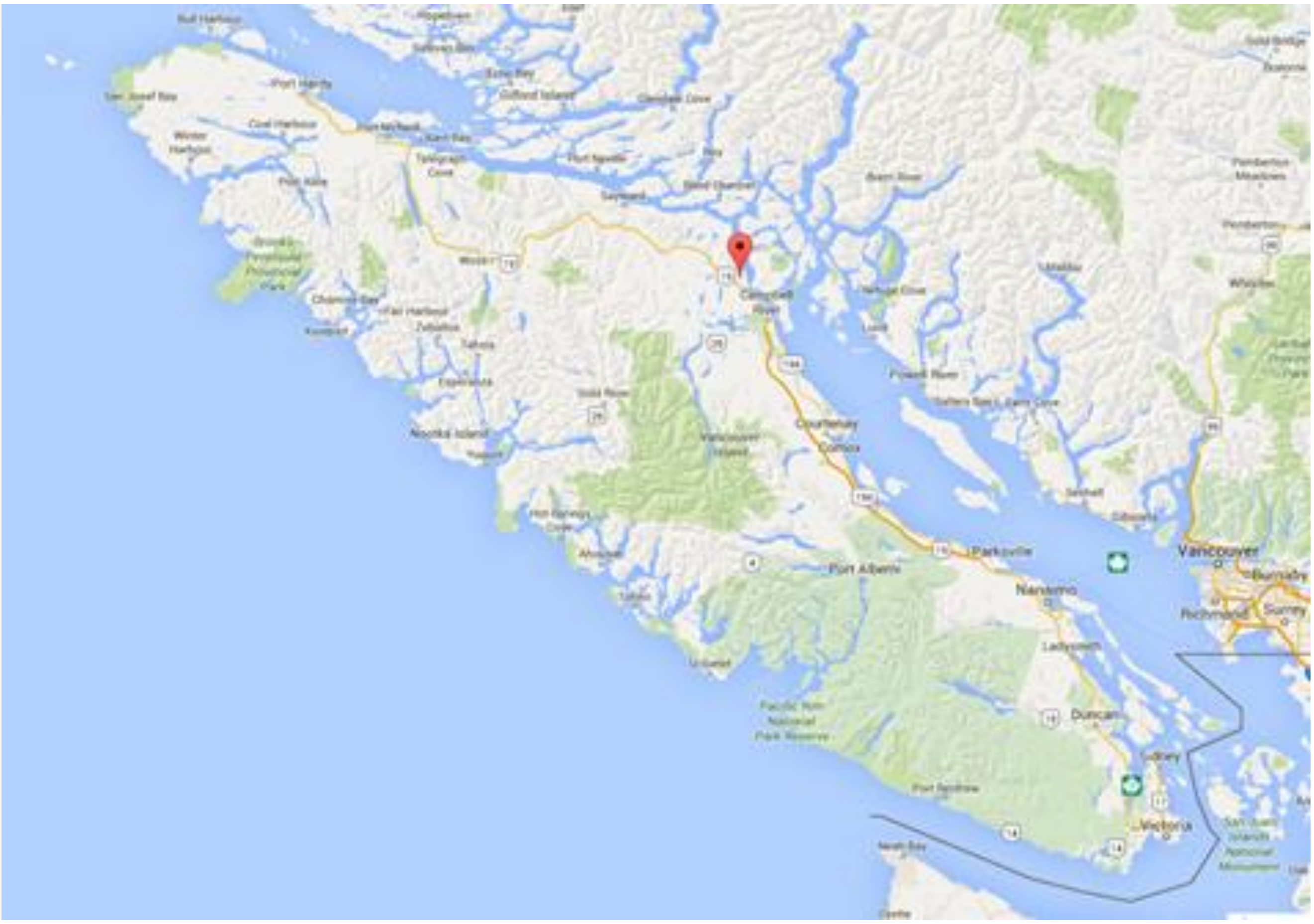


Figure 1.4 Map showing location of Brown's Bay.

1.5 Project Site Plan

The below text and tables are copied from BBPC Technical Assessment, May 2013 (appendix G) and updated to reflect current conditions

The site layout is shown in Figure 1.5. Detailed drawings of the wastewater treatment system are currently being drafted, detailed drawings of the existing treatment process are in the BBPC Technical Assessment, May 3013 (appendix G). The transport boat offloads at the dock indicated in the figure. The fish are separated from bloodwater in the dewatering area; the fish are conveyed to the evisceration plant, whereas the bloodwater is pumped to the WWTP through the plumbing indicated by the red line. Wastewater from the evisceration plant, the packing plant, and wharf is collected, through gravity drain lines, into the Plant WW Sump. The wastewater is pumped from this sump up to the WWTP through the plumbing indicated by the turquoise line. The screening and disinfection occur in the WWTP area indicated in the figure. The outfall, shown as a dark blue line, commences here and leads out to the bay. Figure 1.6 is a photograph of the black outfall as it traverses the intertidal zone; the perpendicular white pipe is the domestic water line.

Product, waste offal, and sludge are hauled away in trailers. Access is via a Right of Way along the shoreline to Brown's Bay Road.

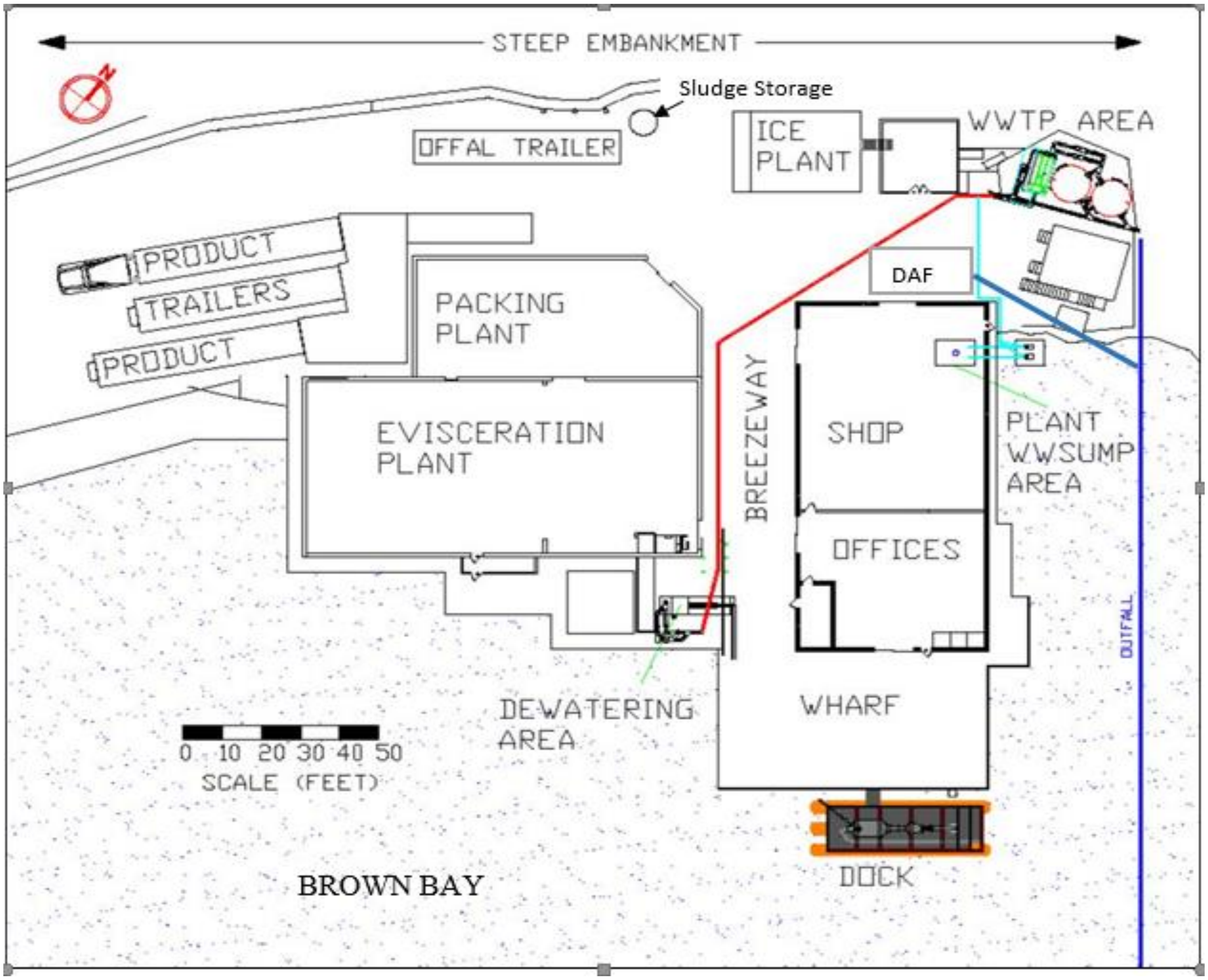


Figure 1.5 Facility layout.

Figure 1.6 Photograph of outfall and intertidal zone.

1.6 Geophysical

The below text and tables are copied from BBPC Technical Assessment, May 2013, Appendix G.

The bedrock of Brown Bay and surrounding area is part of the Karmutsen formation; the volcanic pillow basalts were formed in the Triassic period when magma flows penetrated the overlying Sicker Group, consisting of seafloor and terrestrial volcanic rocks (Earle, 2010). Glaciation and mass wasting have produced Quaternary geological formation, primarily as soils in the valley along which Brown's Bay Road follows. The soils are characterized as predominantly Humo-Ferric Podzol (Watson, 2007). Figure 6.1 illustrates the Karmutsen bedrock and Quaternary geology. Figure 1.6.2 is a photograph of the exposed bedrock and shoreline bluff just north of BBPC. Figure 1.6.3 is a photograph of the exposed Quaternary till in the intertidal zone between the plant and the bluff.

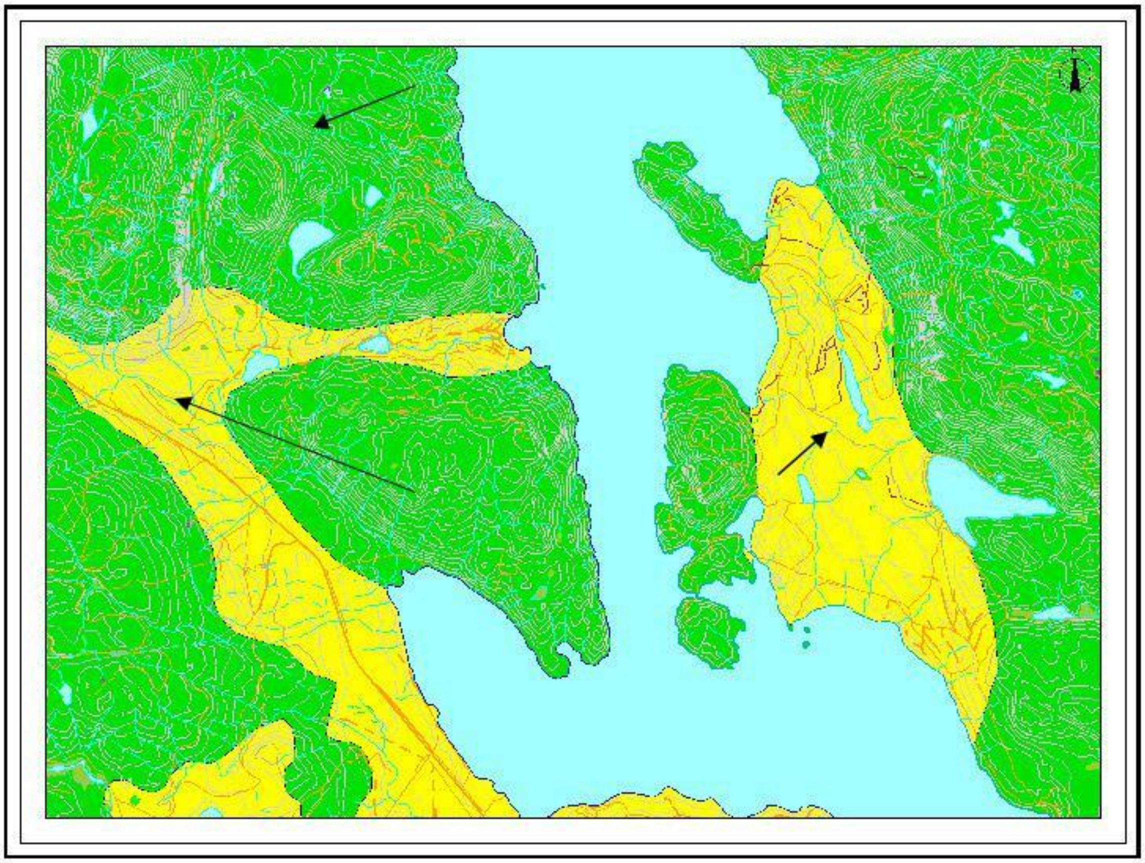


Figure 1.6.1 Map of area geology and topography. Green indicates the basalt bedrock of the Karmutsen formation. Yellow indicates till and fluvial deposits resulting from quaternary glaciations.

Figure 1.6.2 Photograph of exposed bedrock of shoreline bluff immediately north of BBPC.

Figure 1.6.3 Exposed glacial till in the intertidal zone.

The soils underlying the facility consist of an upper layer of gravel fill to depths up to 3m. Under the gravel fill is a brown silty wet gravel to a depth of about 6m. This layer is typically saturated during the wet season, as evidenced by surface water north of the facility and in the drainage ditches along the access road from the south. A thin layer of grey till lies between the silty gravel and bedrock (well lithology from iMapBC).

Several SCUBA surveys of the outfall have been conducted, and the surficial seabed substrates have been identified. Boulders are present from the shoreline to the terminus of the outfall at a depth of 26m and 100m from low low water. In the intertidal zone and to a distance of about 50m from the shore, the seabed slopes very gradually, and clean sand and fine gravel are found amongst the gravel and cobbles. The seabed then slopes steeply to the outfall terminus. At greater depth the seabed substrate is primarily gravel, which is consistent with locations experiencing moderate current.

The terrain to the west of the bay consists of a shallow valley, along which Brown's Bay Road runs. The valley includes two ponds at distances of 1.4km and 2.5km from the bay; the elevations are 100m and 120m above sea level respectively. The upper pond flows west into Menzies Creek, parallels Highway 19 to the southeast, and spills into Menzies Bay. The lower pond flows east into Brown Bay. This is the source of the water system that services Brown's Bay Resort, and Brown's Bay Packing.

The terrain to the south of the bay consists of a 280m hill that slopes steeply from sea level to the 220m level and rounds out towards the peak. The hill sides are mostly vegetated with second growth and old growth forests, with areas of exposed rock and bluff near the top and along discovery passage. Menzies Mountain rises to the north. It peaks at a height of 1220m. None of the numerous major drainages off Menzies Mountain spill into the pond or stream that flow into Brown Bay.

1.7 Socio-political

The below text and tables are copied from BBPC Technical Assessment, May 2013 (appendix G) and updated to reflect current conditions.

The Brown's Bay area is part of the Strathcona Regional District, Menzies Bay Area. Land use on the subject property is designated as Mixed Use (CSRD, 2000). The Brown's Bay Community Currently includes 21 permanent homes, 55 recreational strata sites, a marina with a gas dock, a floating restaurant, an RV park that will accommodate 60 seasonal visitors, and the fish processing plant. Most of the permanent residents are retired, and there are very few children living in the community year-round.

Brown's Bay is located in the traditional homeland of the Kwakwa'ka'wakw people. Three local bands, comprising the Laich-Kwil-Tach Treaty Society (formerly known as the Hamatla Treaty Society) are currently engaged in treaty negotiations encompassing most of Johnston Strait, several of the mainland inlets and portions of Vancouver Island extending beyond Buttle Lake. The region is illustrated in Figure 1.7.1. This range encompasses the properties on which BBPC are located. The treaty is in stage 5 of a six-stage process: Negotiation to finalize a Treaty. Archeologically significant sites on the subleased properties have never been identified.

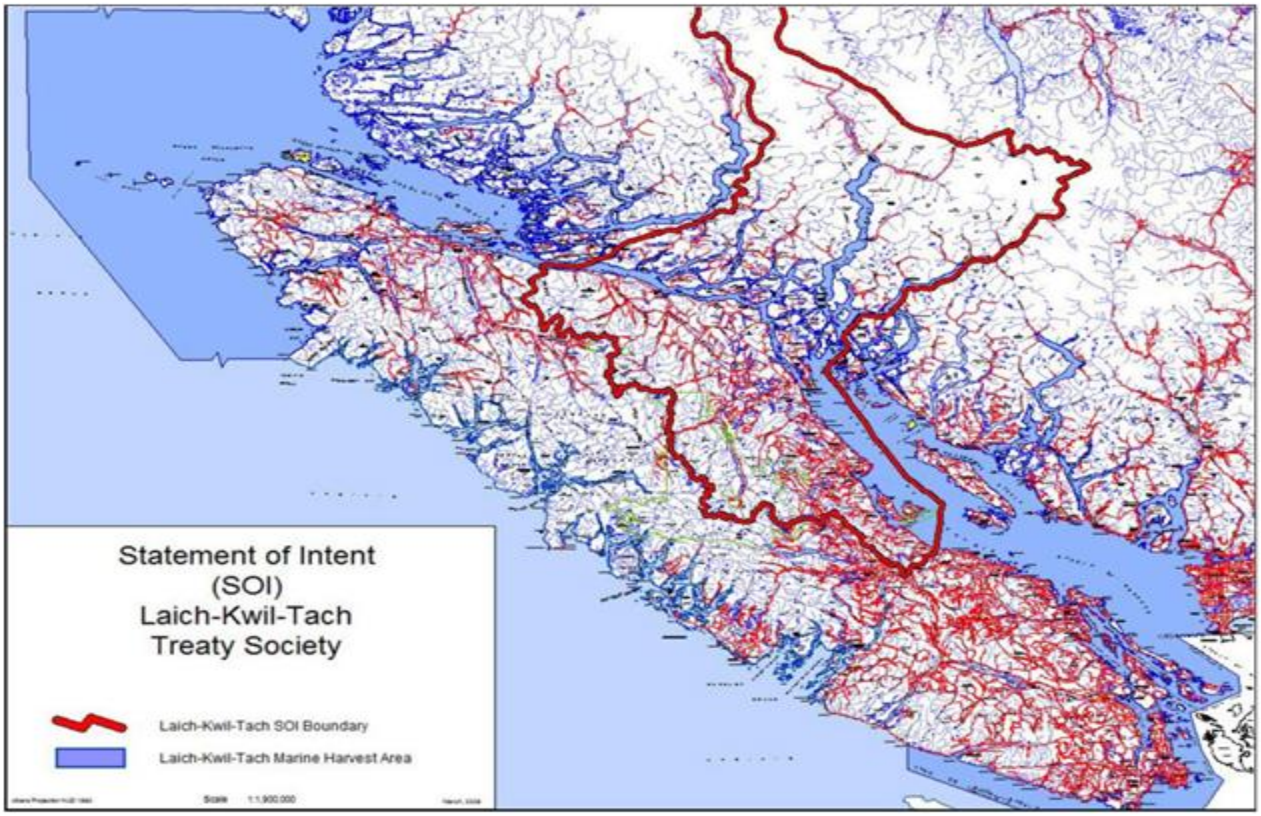


Figure 1.7.1 Laich-Kwil-Tach Treaty Society Statement of Intent boundary.

1.8 List of Project Qualified Professionals

Todd Adamson, P.Eng., Aquarius Engineering, authored the BBPC Technical Assessment May 2013

Monica Stewardson, RPBio, Mainstream Biological Consulting, authored the Brown's Bay Packing Ltd Effluent Outfall Amendment Receiving Environment Assessment Update, November 29, 2018

Peter Howland, EP B. Sc., Great Pacific Engineering & Environment, authored the Brown's Bay Packing Company – Dilution Model Summary, November 30, 2018

Venkatesh Narayan, P.Eng, M.Tech, Archer Separation, Design engineer of the 2018 Treatment Plant Upgrades

Lorne Sandberg, Certified Professional Operator, H2Ops Water Services Inc., Project Manager of the 2018 BBPC Permit amendment and treatment plant upgrade project.

2. Environmental Assessment

2.1 Oceanographic Factors

The below text and tables are copied from BBPC Technical Assessment, May 2013, Appendix G.

Figure 2.1.1 shows the bathymetry in the area of Browns Bay from Race Point in the south, through Seymour Narrows to approximately 0.5 nautical miles (1 km) north of the bay. North of this section, Discovery Passage continues as a 2km wide, 200m deep channel for approximately 10km before the first major channel (Okisollo Channel).

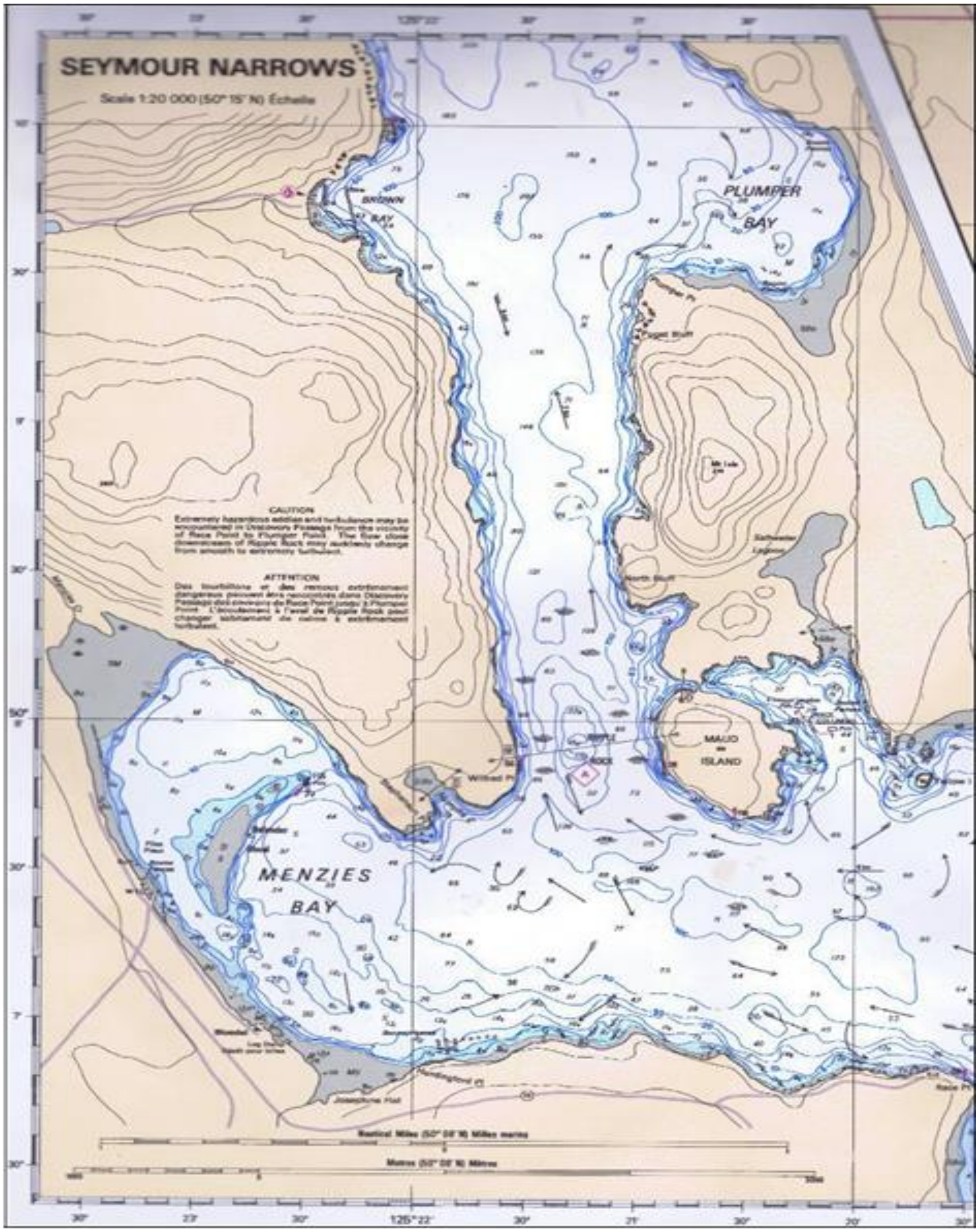


Figure 2.1.1 Bathymetry of Brown's Bay area.

A tide station is located at Brown's Bay. The maximum recorded high tide was 4.7m, and the minimum recorded low tide was -0.1m; the estimated mean low low water is 1.16m, and the mean water level is 2.8m. The mean tidal range in the area is 2.8m.

A current station is located at Seymour Narrows. The maximum observed flood tide during the past two years was 15.6 knots (17May2011); the flood flows towards the south. The maximum observed ebb tide during the past two years was 14.0 knots (09Sep2010); the ebb flows toward the north. Average flood currents are 9.2knots, and average ebb currents are 9.8 knots.

Discovery Passage and Okisollo Channel just to the north are characterized by large energetic eddies, standing waves, and whirlpools. Even during slack tide, the waters in the area never become placid. The observed currents during 2010 are shown in Figure 2.1.2.

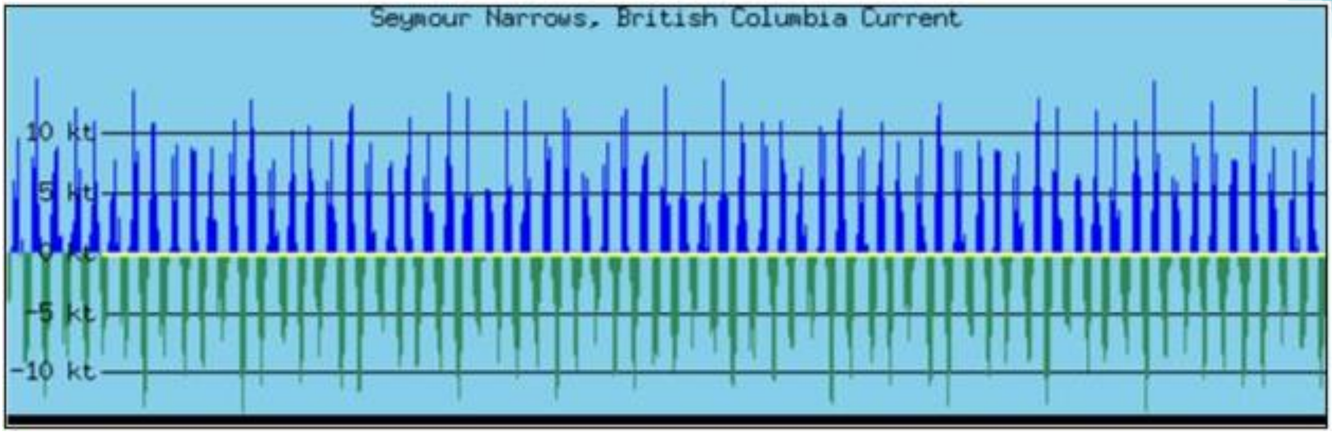


Figure 2.1.2 Currents observed at Seymour Narrows during 2010.

Detailed near bottom current data was collected for this amendment application in 2010. Figures 6.8a and 6.8b present the current speed and current direction data collected from the near bottom current study. Figures 6.8c and 6.8d present histograms of the speed and direction data; these diagrams illustrate the frequency, in percentage of data points, at which the speed or direction was observed. The study was conducted from noon on 06May2010 to noon on 08May2010. Of the 200 data points collected during neap tides (low tidal range and low currents), at a location 5m above the outfall terminus, 10% of the data recorded current velocities in excess of 0.4 knots, and 10% of the data recorded current velocities less than 0.14 knots. Velocity is lowest at the seabed, increases rapidly across a near bottom boundary lay, and then increases slowly towards the surface. Interestingly, the current was almost always was setting south; this indicates that an eddy must develop during ebb tides on the Brown's Bay side of Discovery Channel. Figure 2.1.3 shows the currents recorded at Seymour Narrows during the data collection; these currents are near the lower range expected in the Narrows.

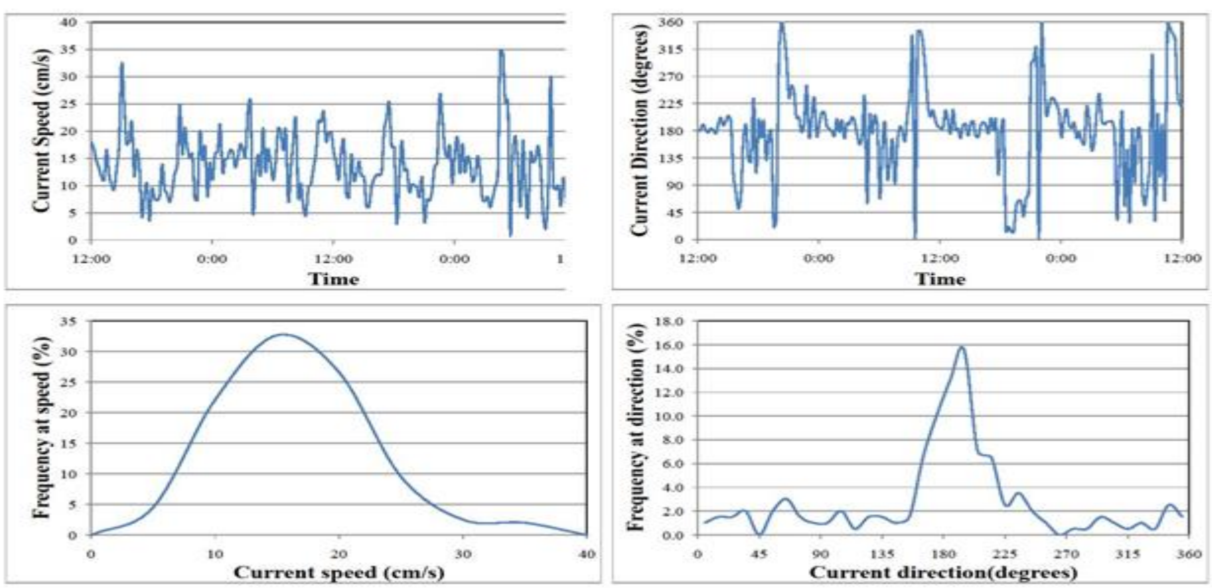


Figure 2.1.3 Observations of near bottom current at outfall terminus. (a) and (b) illustrate the speed and direction of flow during the 48-hour period of the observations. (c) and (d) are histograms showing the frequency at which the current exhibited a specific speed or direction.

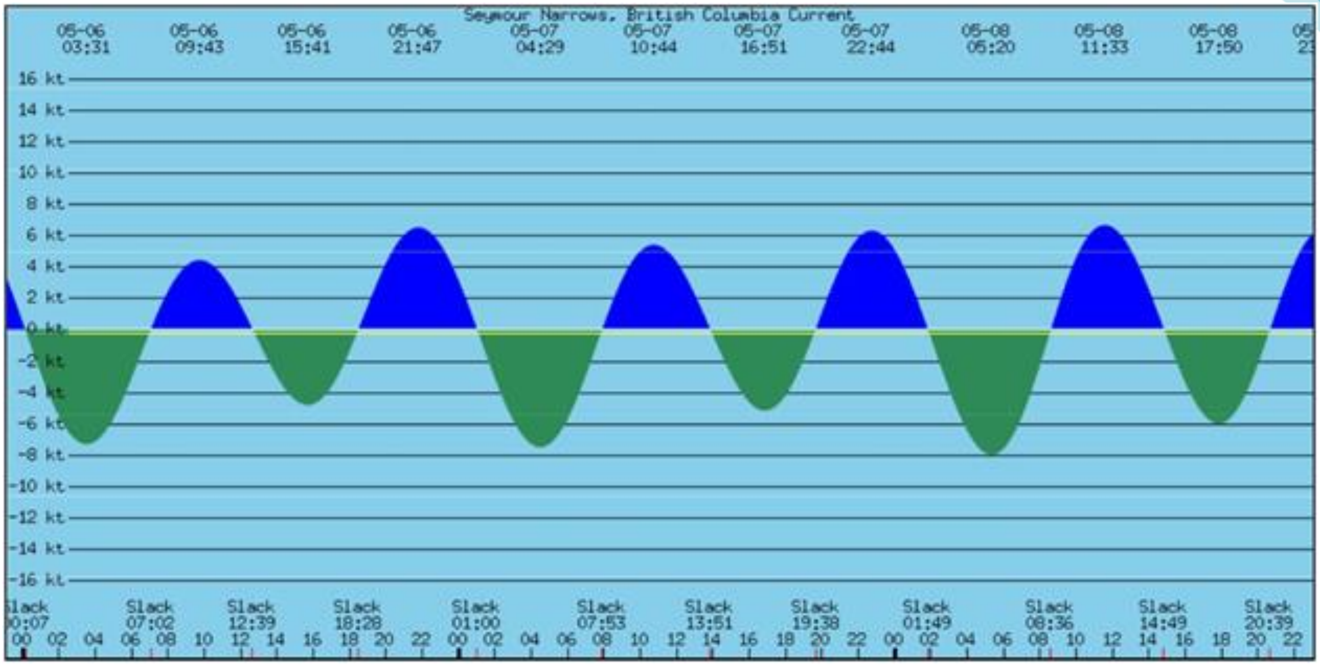


Figure 2.1.4 Current speeds observed at Seymour Narrows during the near bottom current data collection period. These currents are at the low range of those observed at the Narrows; the bottom current data will also be representative of the minimum flow rates expected.

Due to the highly energetic currents and relatively small distances between shorelines, the waters of the bay are unstratified. The temperature, salinity and density of the water in the bay can be assumed to be homogeneous throughout the water column.

The depth is characterized as mid-range. At the floating breakwater the depth is 50m. The outfall terminus is at a depth of 26m. Discovery Passage reaches a depth of 200m east of Brown Bay. Depth and clarity determine the penetration of sunlight, which determines the predominance and density of photosynthetic static marine plants, which in turn provides nutrients and habitat for other organisms.

Salinity levels in the Discovery Passage are polyhaline with a concentration between 15 mg/l and 26 mg/l. These levels are slightly less than those observed in the northern reaches of Johnstone Straight due to the many rivers emptying into the Strait of Georgia and the nearby mainland inlets (MoSRM, 2004).

Discovery Passage is well protected from oceanic wave exposure. Brown's Bay is also protected from much of the wind generated waves produced in Georgia Strait due to its positioning relative to the Passage. Due to the relatively low exposure rating of the area, effects of mechanical wave action on the shore are limited.

Brown Bay and the immediate vicinity of Discovery Passage are characterized by low benthic relief. The seabed exhibits relatively uniform slope into the Passage, and then presents little change in elevation across to Quadra Island. The low relief and low roughness of the seabed in the area is indicative of poor habitat for ground fish species.

Summer water temperatures in the area reach 10°C. Winter temperatures fall to about 7°C. Although the nearby channels between the Discovery Islands can exhibit water temperatures in the summer in excess of 11°C, the significant flood tidal fluxes from Johnstone Strait and substantial ebb tidal fluxes from Georgia Strait result in temperatures consistent with more open water (MoSRM, 2004).

Seabed substrate is derived from the glacial till and glacial fluvial deposits. Although some fines are present in the intertidal zone and at shallow depths, materials finer than gravels have been scoured and swept from the deeper waters due to the strong currents in the bay and passage. Cobbles and boulders are present throughout. Shore zone physical features include a rock and gravel beach, and rock cliffs.

2.2 Receiving Environment Data Tables

Refer to Mainstream Biological Consulting, Brown's Bay Packing Ltd Effluent Outfall Amendment Receiving Environment Assessment Update, November 29, 2018, Appendix C

2.3 Receiving Environment Characteristics

Refer to Mainstream Biological Consulting, Brown's Bay Packing Ltd Effluent Outfall Amendment Receiving Environment Assessment Update, November 29, 2018, Appendix C

3. Effluent Discharges and Treatment

3.1 Raw Water Characteristics

	Quantification Method	**Basis of Value**	**Maximum Value**	**Average Value**
Daily Flow (m^3)	Doppler Flow Meter	Empirical (2012 to 2018)	900	300
TSS (mg/L)	Certified Lab	24 hr Composite (2017 to 2018)	370	171
BOD_5 (mg/L)	Certified Lab	24 hr Composite (2017 to 2018)	1060	515
pH	Certified Lab	24 hr Composite (2017 to 2018)	6.5 to 7.1	6.8
Ammonia (mg/L)	Certified Lab	Empirical (2018)	8.5	3.8
Nitrate (mg/L)	Certified Lab	Empirical (2018)	0.2	0.2
Enterococci (MPN/100mL)	Certified Lab	24 hr Composite (2018)	160,000	60,575

3.2 Existing Wastewater Treatment System

The below text and tables are copied from BBPC Technical Assessment, May 2013 (appendix G) and updated to reflect current conditions.

Three distinct sources of raw water are sent to the treatment system; bloodwater from the transport boats, process water from the evisceration plant, and wash water.

Bled fish are transported to the plant from the farm sites in an icy salt water mixture. A vacuum pump lifts the fish and bloodwater from the boat hold up to the dewatering box. In the dewatering box, the fish are separated and conveyed into the evisceration plant, whereas the bloodwater falls into a 15 m^3 sump. A duplex set of centrifugal pumps move the bloodwater from this sump up to the fine screen; this red coloured water is relatively high in BOD due to the high blood concentration.

Process water drains from the plant through equipment and floor drains into a 3.8 m^3 sump located under the shop. A duplex set of self priming trash pumps lift the wastewater up to the fine screen; this pink-tinged water is relatively high in TSS due to fine fish tissue.

After processing, the entire evisceration plant is thoroughly cleaned. This washwater also drains into the sump under the shop and is lifted to the fine screen by the trash pumps; the water is clear with some particulate and cleaning agents (including Rough Rider II, and either Savall or Oxygentle). MSDSs for the cleaning agents are included in Appendix B.

Prior to disinfection, all the raw wastewater is fine screened by an internally fed rotary drum. The screenings are mostly scales, gills, and small pieces of fish organs and tissue. The separated solids are collected in a screenings hopper at the end of the drum and pumped to the offal trailer for offsite disposal. The filtrate passes through the screen into the 12.5 m^3 sump below. Manually controlled butterfly valves near the screen provide options of either bypassing the screen or bypassing the disinfection system after screening. Normally, neither screening nor disinfection will be bypassed. Bypass of the disinfection system is contrary to the requirements of the primary fish supplier, but may be required in the event of mechanical or electrical failure, and would be directed by management at the plant. Bypass of the screen is contrary to the discharge permit, but could be required due to a major failure leading to raw wastewater overflowing out of the screen; bypass would only be directed by management at the plant.

The wastewater disinfection system at the Brown's Bay Packing Plant is designed to treat up to 1000 m^3/d of finely screened wastewater for Infectious Hematopoietic Necrosis Virus and other fish pathogens. As per the World Organization for Animal Health's recommendation (OIE, 2005), the screened wastewater is chlorinated to a concentration of 0.5mg/l free chlorine, and contacted for 10 minutes. The process treats 40 m^3 batches using sodium hypochlorite. The chlorine solution is metered into the contact tank until the breakpoint is detected by an ORP sensor. After a 10 minutes contact time, the effluent is dechlorinated with sodium sulfite prior to discharge to the marine environment via an authorized outfall. The process is fully automated, includes redundant features, and sensor activated alarms to warn the operator in the event of system failure.

The screened wastewater is transferred from the filtrate sump to the disinfection tanks by a duplex system of 10hp centrifugal pumps controlled by an ultrasonic transducer in the filtrate sump. The duty pump is activated at the high level, and the standby pump is also activated if the water level in the sump rises to the high-high float switch. At low level, the pumps are deactivated. A low-low float switch acts as a redundant off for pump protection.

From the filtrate transfer pumps, the wastewater flows to one of the two contact tanks. When the tank is full, control valves direct the screened wastewater to the other contact tank, which fills while the contents of the first tank are disinfected, dechlorinated and discharged. Each of the two contact tanks are fitted with dedicated chlorination/ de-chlorination systems, which include a centrifugal recirculation pump, chemical injection ports, ORP sensors and pneumatically operated valves. A single chlorine pump and a single sulphite pump are capable of servicing both tanks simultaneously. When a tank is 50% full, the recirculation pumps are activated. A reciprocating diaphragm metering pump injects a 12% sodium hypochlorite stock solution into the recirculation stream to bring the free chlorine concentration in the contact tank to 0.5mg/l. The recirculation loop continues flowing to facilitate mixing; chlorine is injected as required to maintain the concentration setpoint. When the tank is full, an additional 10 minutes chlorine contact time is provided, and then sodium sulfite is injected into the recirculation stream to dechlorinate the wastewater. The amount of chemical required is variable due to the variable nature of the wastewater influent, and controlled on a feedback loop by an Oxidation/Reduction Potential (ORP) probe inserted into the recirculation line. When de-chlorination is complete the recirculation loop control valves are closed, and the contact tank drain control valve is opened. The drain valve closes when the tank is empty.

Calibration between ORP and Free Chlorine concentration is an ongoing process. The operator records ORP readings and corresponding Free Chlorine concentrations at appropriate intervals for both high ORP setting (corresponding to 0.5ppm free chlorine) and low ORP setting (corresponding to 0.01 ppm total chlorine).

Effluent is discharged into Brown Bay via an 8” HDPE outfall. The outfall terminus is located at a depth of 26m and approximately 100m from shore on bearing of approximately 142° from the point at which it submerges.

3.3 Operation of the Proposed Treatment Works

Bled fish are transported to the plant from the farm sites in an icy salt water mixture. A vacuum pump lifts the fish and bloodwater from the boat hold up to the dewatering box. In the dewatering box, the fish are separated and conveyed into the evisceration plant, whereas the bloodwater falls into a 15 m^3 sump. A duplex set of centrifugal pumps move the bloodwater from this sump up to the fine screen; this red coloured water is relatively high in BOD due to the high blood concentration.

Process water drains from the plant through equipment and floor drains into a 3.8 m^3 sump located under the shop. A duplex set of self priming trash pumps lift the wastewater up to the fine screen; this pink-tinged water is relatively high in TSS due to fine fish tissue.

After processing, the entire evisceration plant is thoroughly cleaned. This washwater also drains into the sump under the shop and is lifted to the fine screen by the trash pumps; the water is clear with some particulate and cleaning agents (including Rough Rider II, and either Savall or Oxygentle). MSDSs for the cleaning agents are included in Appendix B.

Prior to treatment, all the raw wastewater is fine screened by an internally fed rotary drum. The screenings are mostly scales, gills, and small pieces of fish organs and tissue. The separated solids are collected in a screenings hopper at the end of the drum and pumped to the offal trailer for offsite disposal. The filtrate passes through the screen into the 12.5 m^3 sump below. Manually controlled butterfly valves near the screen provide options of either bypassing the screen or bypassing the disinfection system after screening. Normally, neither screening nor disinfection will be bypassed. Bypass of the disinfection system is contrary to the requirements of the primary fish supplier, but may be required in the event of mechanical or electrical failure, and would be directed by management at the plant. Bypass of the screen is contrary to the discharge permit, but could be required due to a major failure leading to raw wastewater overflowing out of the screen; bypass would only be directed by management at the plant.

The screened wastewater is transferred from the filtrate sump to a 40 m^3 storage tank by a duplex system of 10hp centrifugal pumps controlled by an ultrasonic transducer in the filtrate sump. The duty pump is activated at the high level, and the standby pump is also activated if the water level in the sump rises to the high high float switch. At low level, the pumps are deactivated. A low low float switch acts as a redundant off switch for pump protection.

Wastewater from the storage tank will be fed to an advanced oxidation process (AOP) at a rate flow ranging between 6.7 l/s and 8.3 l/s from a variable frequency drive controlled 5 hp centrifugal pump, with the AOP feed rate dictated by the fill rate of the storage tank. If inflow to the storage tank exceeds the discharge capacity of the feed pumps management can manually manipulate the pump speed to a maximum flow of 11.1 l/s. The storage tank is also equipped with an overflow that discharges into the bottom of the AOP recirculation tank which is designed for a flow capacity of 23.2 l/s.

The AOP system has retention time of 1.4 hour at normal BBPC flow rates of 8 l/s. Whereas, pilot plant trials have determined that only 0.5 hours of retention time is required to provide full disinfection and BOD reduction.

The AOP system is composed of a 1.7 m^3 recirculation tower that contains a static solid metal catalyst used to react with peroxide to produce hydroxyl free radicals, followed by a 40 m^3 recirculation tank. The wastewater feeds into the tower, the tower then over flows to the recirculation tanks, when the recirculation tank reaches 20% full a 10 hp centrifugal recirculation pump recirculates the wastewater from the recirculation tank through the tower, while the tower is continuously being fed raw wastewater. The raw wastewater feeding into the AOP is injected with hydrogen peroxide and hydrochloric acid via chemical dosing pumps. The rate of peroxide dosing is controlled by an Oxidation/Reduction Potential (ORP) probe, and the rate of the hydrochloric acid dosing is controlled by a pH probe, both inserted near the bottom of the recirculation tower.

When the recirculation tank is full it discharges through an overflow at the rate of the AOP's wastewater feed. The disinfected wastewater from the AOP is then run through a flocculator that is equipped with Total Suspended Solids (TSS), pH, and hydrogen peroxide probes. The TSS probe controls a flocculant dosing pump to inject a polyacrylamide based flocculant that conglomerates small particles into bigger clusters to optimize the solids and colour removal, the pH probe controls the caustic dosing to inject sodium hydroxide to increase the pH to a slightly caustic state, and the peroxide probe sends a signal to the AOP system to indicate that the AOP is being overdosed with peroxide, reducing the amount of peroxide being fed to the system.

When the disinfected wastewater and chemicals complete mixing in the flocculator they then go through a dissolved air floatation system (DAF) where the wastewater is pressurized and saturated with air. The air-saturated water stream is recycled to the front of the float tank and flows through a pressure reduction valve just as it enters the front of the float tank, which results in the air being released in the form of tiny bubbles. Bubbles form on the surface of the suspended particles, adhering to the particles. As more bubbles form, the lift from the bubbles eventually overcomes the force of gravity. This causes the suspended matter to float to the surface where it forms a froth layer which is then removed by a skimmer. The froth-free water exits the float tank as the clarified effluent from the DAF unit. The froth (solids) from the DAF will be stored in a sludge storage tank to then be disposed of either to landfill, compost, or other means of beneficial rendering. The clarified effluent from the DAF goes to BBPC marine outfall.

3.4 New Treatment Works Design Criteria

To develop a treatment process at BBPC to meet water quality requirements with performance measures that can be maintained into the future, the following site-specific considerations were considered;

- Space limitations;
- Power Constraints;
- Ease of operation;
- Ability to adapt to increased demand and/or future permit requirements;
- Capital investment and operating costs;
- Downstream impacts due to achieving best effluent results

To determine the best achievable technology for BBPC literature from jurisdictions where fish processing treatment is required, facilities that treat fish processing wastewater were visited, and consultation with various engineers, suppliers, and facility operators were conducted to determine achievable technologies for BBPC.

Following the research conducted, the goal was to develop a treatment system that;

- Provides disinfection;
- Provides BOD reduction;
- Produces an effluent free of disinfectant by-products;
- Produces an effluent quality that meets or exceeds BC water quality guidelines for turbidity, suspended and benthic sediments;
- Minimize the contamination of the solid waste stream;
- Implement a treatment process that is easy to operate with consistent results

3.5 Best Achievable Technology Assessment

For fish processing plant wastewater treatment, the most commonly used technology currently is the dissolved air flotation (DAF) process. By itself, this process is successful in reducing total suspended solids (TSS) by approximately 90%, reducing biochemical oxygen demand (BOD) by approximately 50%, and removing the blood red colour, producing an effluent that can be disinfected using ultra high-powered ultraviolet treatment. The challenges faced with this process include high chemical usage, labour intensive operation, high energy usage, large quantities of contaminated waste byproduct, and high capital and operating costs. The DAF process makes extensive use of Ferric chemistry which increases the sludge volume by about 50%. In addition, because of the Ferric chemistry the sludge generated by the DAF process is considered toxic by compost facilities, rendering plants, and landfills which makes it difficult to dispose of.

Our team has conducted extensive testing of our waste streams and consulted with various wastewater treatment process suppliers to determine best treatment options to fit our waste stream characteristics, to find an off the shelf system that would address some of, if not all of the challenges identified by ours and other processing plant facility operators, only to realize that there isn't one. So, our team has developed a system using a mix of technologies with proven success to address challenging treatment issues in other industries, and created a pilot plant to test its success.

The pilot plant is an advanced oxidation process (AOP) that uses a static catalyst and peroxide to create free hydroxyl radicals for oxidizing pollutants in the wastewater at the same time as providing pathogen kill. The AOP pilot plant by itself, has been tested and proven to reduce BOD by >50% with the most concentrated blood water that we could attain, and >70% BOD reduction with normal concentrations of blood water, and provides 100% bacteria kill. It reduces chemical costs by more than half of that of the existing treatment processes and produces a non-toxic sludge. In addition, capital and operating costs are substantially lower than other comparable processes. Following the AOP process with a DAF process will remove a significant amount of virus and reduce the TSS and BOD >90%.

Third party testing by the Department of Fisheries and Oceans determined that untreated blood water injected into finfish resulted in 83% infection of the PRV virus, testing of unseparated blood water following the AOP process resulted in 0% infection of the PRV virus. Therefore, the AOP process is confirmed to inactivate the PRV virus.

The AOP is the key component to the treatment process to reduce contaminants in the effluent, and will replace the existing chlorination system for disinfection. The AOP process converts dissolved BOD to insoluble solids which, along with suspended solids in the influent water, needs to be removed by a physiochemical process like DAF technology. The physiochemical process involves pH adjustment and use of coagulant/ flocculant to remove the suspended solids.

The AOP followed by DAF process will produce a final effluent that is low in TSS, BOD, bacteria, and virus, and optically acceptable. The effluent will be free of disinfectant by-products. The system is fully automated and simple to operate, with several built-in fail safes to assure effective and reliable treatment, and its low-tech design makes it easy to troubleshoot. The sludge produced from this process will be almost half the volume of that produced from conventional DAF processes, and is non-toxic and accepted at most disposal receivers. From an average processing day, a full treatment process at BBPC will prevent the release of approx. 300 kg of BOD and 175 kg of TSS to the marine receiving environment.

3.5 Disinfection System

The disinfection system is an advanced oxidation process (AOP) involving Fenton reaction. The Fenton reaction uses the strong catalytic power of iron and other metals to generate highly reactive hydroxyl radicals (·OH) which have higher oxidation reduction potential (ORP) than chlorine or hydrogen peroxide on its own. The conventional Fenton AOP process involves use of ferric chloride or ferric sulphate which precipitates and produces excess sludge as iron hydroxide. The AOP process developed for BBPC is a heterogenous Fenton like reaction which produces free hydroxyl radicals as a conventional Fenton reaction, but without producing the additional iron hydroxide sludge. The process uses solid metal catalysts to replace ferric chloride or ferric sulphate.

Hydrogen peroxide on its own has an ORP of about 1.78V compared to 2.85V for free hydroxyl radicals generated by AOP using a Fenton reaction, which is second only to Fluorine. Chlorine has an ORP of about 1.35V and Ozone of about 2.08V. Therefore, the AOP process provides much higher oxidation compared to other competing chemicals which makes it achieve considerable virus log reduction. Aside from Ultraviolet disinfection the AOP process seems to be the only known disinfection process developed that does not produce disinfectant by-products as any residual hydrogen peroxide breaks down in the process to water and oxygen.

3. 6 Manufacturer Specifications for Proposed Treatment Works

The Advanced Oxidation Process (AOP) is the key component to the treatment process to reduce contaminants in the effluent. The AOP process converts dissolved BOD to insoluble solids which, along with suspended solids in the influent water, needs to be removed by a physiochemical process like Dissolved Oxygen Floatation (DAF) technology. The physiochemical process involves pH adjustment and use of coagulant/ flocculant to remove the suspended solids. See appendix E for the AOP Engineer Specification.

Based on pilot testing with the AOP process followed by a simulated DAF process using bench-top testing, we are confident that the AOP followed by DAF process will produce a final effluent that is low in TSS, BOD, bacteria, and virus, and is optically acceptable. The by-product produced from this process will be almost half the volume of that produced from conventional DAF processes, and is generally considered nontoxic and accepted at land fill and composting facilities. From an average processing day, a full treatment process at BBPC will prevent the release of approx. 300 kg of BOD and 175 kg of TSS to the marine receiving environment. See appendix E for the DAF Engineer Specifications.

3.7 Storm Water Influence

Site designed biosecurity measures to prevent pathogen release, and spill containment result in the capture of all surface water within the processing plant site, and are plumbed to the processing plant wastewater stream for treatment prior to release to the receiving environment. During heavy rainfall events this results in significant increases in flow volume through the wastewater treatment process. The increased flows can reduce the residence time of the treatment process. Due to the increased dilution from the additional fresh water through the system, and the automated control of the treatment process, the additional flows will not reduce the quality of effluent discharge.

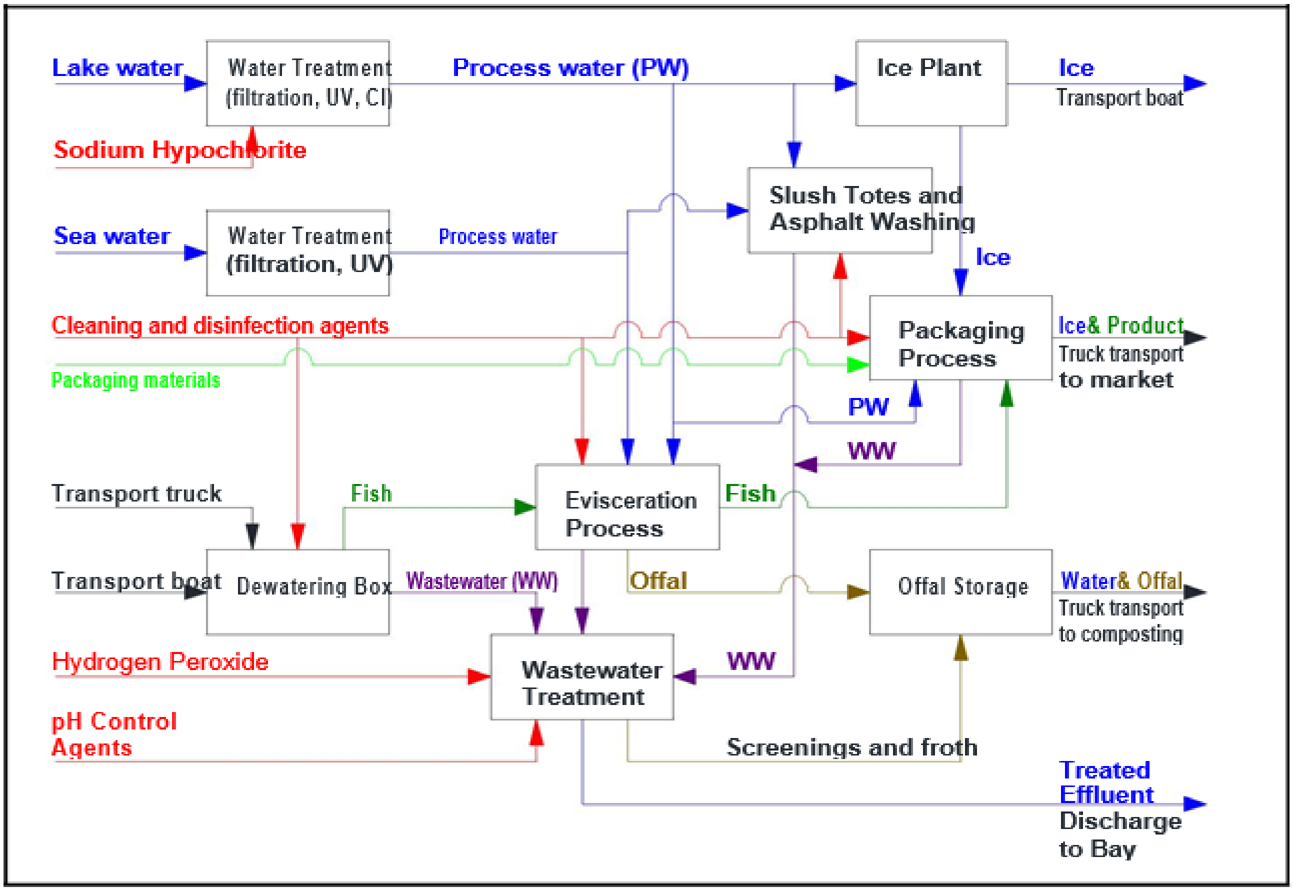
3.8 Open Air Components Engineering Justification

There are two components of the treatment process that are open to air, which are;

1. The solids discharge hopper of the rotostrainer. The hopper remains open for regular inspection, pump down confirmation, and for regular cleaning. The hopper has an open surface area of 18”x16” leaving limited area for vermin attraction and odour release. Any potential overflow from this system drains to the influent stream and will be reprocessed through the wastewater treatment plant.
2. The DAF is to be located in an enclosure with open ends on two sides. The DAF remains open for regular visual inspections, and maintenance. The material in the DAF is treated with minimal odour and minimal waste that would be attractive to vermin and birds. Any potential overflow from this system drains to the influent stream and will be reprocessed through the wastewater treatment plant.

3.9 Process Flows

3.9.1 Flow Diagram



3.9.2 Flow Inputs:

1. Packaging materials - The processed fish are packed on ice in Styrofoam boxes. Several boxes are stacked on pallets and shrink wrapped in preparation for transport to market.
2. Lake water - The evisceration machines require fresh water to maintain cleanliness and smooth operation. A water intake from a nearby lake supplies water to Brown's Bay Resort. Water is provided to BBPC through a lease agreement. The water is fine filtered, irradiated (UV), and chlorinated prior to use. Average flow on a processing day is approximately 180m^3/d.
3. Sea water - Sea water is used to prepare slush totes. The intake is below the wharf, and the water is fine filtered and passed through an ultraviolet disinfection system prior to use. Average flow on a processing day is approximately 80m^3/d.
4. Transport boat offloading - Approximately 80m^3 of ice and water are unloaded with the fish. The ice and water are separated from the fish by the dewatering box. The fish are conveyed to the evisceration plant. Most of the slush is recycled back to the boat as the fish are pumped up to the top of the wharf, and is eventually pumped to the WWTP.
5. Cleaning and disinfection agents - Three chemicals are used at the facility for cleaning and disinfection. They are all captured and passed through the treatment system prior to discharge. The compounds are: Oxygentle (Hydrogen Peroxide), Savall (quaternary ammonium compound), and Rough Rider II (a caustic solvent). The use

of Oxygentle or Savall is alternated; during the course of a month, Savall is used for three weeks, then Oxygentle is used for a week. Consumption rates during a processing day are 5L of Oxygentle or 200ml of Savall and 5L of Rough Rider II. The MSDSs can be found in Appendix B.

6. Sodium Hypochlorite (chlorine) - Chlorine is used as a disinfectant in the water treatment systems. It is added to incoming fresh water to maintain a residual between 0.05ppm and 2ppm.
7. Treatment Process Chemicals – See section 3.8

3.9.3 Flow Outputs:

1. Fish Product - The finished product (fish packed on ice in Styrofoam boxes on pallets) is transported to market using trucks and refrigerated trailers. Approximately 15m^3 of the incoming fresh water leaves the plant via this route on processing days.
2. Offal - Offal from the evisceration process is combined with screenings from the wastewater treatment process, and shipped by tanker trailer to West Coast Reduction Ltd. where it is converted into value added products. Approximately 5m^3 of the incoming fresh water leaves the plant via this route on processing days.
3. Processing Effluent - All process wastewater collected at the facility is passed through a 500-micron screen and disinfected, and treated through a solids and nutrient removal process prior to discharge. Approximately 140m^3 of the incoming fresh water leaves the plant via this route on processing days. The remainder of the 300m^3 of effluent discharged on a processing day consists of treated seawater and bloodwater from the transport boats.
4. Domestic Effluent - All domestic sewage from the facility is collected in and treated via a 23m^3 polyethylene White Water Treatment System located under the shop. Effluent from the system joins the effluent from the WWTP in the outfall in the intertidal zone.
5. Froth – Approximately 400 kg/day of froth, which is a combination of fats, proteins and other contaminants, will be removed from the DAF process on a regular processing day. The froth will be sent to a compost facility in a 6% solid form. Approximately 5m^3 of the incoming fresh water leaves the plant via this route on processing days.
6. Transport boat - The transport boat is loaded with fresh ice prior to departure. The ice is sent to the farm sites and kept on board to chill the next load of fish while it is brought to the packing plant. Approximately 20m^3 of the incoming fresh water leaves the plant via this route on processing days.

3.10 Wastewater Treatment Process Chemicals

3.10.1 Hydrogen Peroxide

Hydrogen Peroxide (50%) is the key chemical used to generate hydroxyl free radicals in the AOP to provide disinfection and nutrient reduction (BOD removal). The liquid is a strong oxidizer that will intensify fires. Ingestion may have serious or deadly effects. Contact could cause severe burns to skin and/or eyes, and respiratory irritation.

Standard handling procedures include use of personal protective equipment including gloves, coveralls or shop coat, and eye protection. Stock solution is delivered in and drawn from 1000L totes to reduce the volume of potential spills. The stored totes and active stock are located in an easily accessible area for transport by lift truck. All open barrels of hydrogen peroxide are kept on spill containment pallets dedicated for hydrogen peroxide. The hydrogen peroxide feed system incorporates dual containment piping and hoses as well as containment for storage of the chemical tanks and totes as per good engineering practice and industry standard to meet or exceed WCB requirements.

This product has no known acute effects on aquatic organisms. Under ambient conditions, quick hydrolysis, reduction, or decomposition into water and oxygen occurs. The product may have some potential to bioaccumulate, but will likely degrade in most environments before accumulation can occur. There is currently no data available on the chronic effects of this product. Due to this information, it is not expected that this product has significant ecological effects.

The MSDS sheet is included in Appendix B.

3.10.2 Hydrochloric Acid

Hydrochloric Acid (35%) is the chemical used to reduce the pH of the wastewater in the AOP to aid in the disinfection and nutrient reduction (BOD removal) processes. The liquid is highly acidic, not flammable, and stable if stored and handled as indicated in the MSDS. Ingestion cause severe burns to the mouth, throat, and gastrointestinal tract. Skin contact will cause chemical burns. Inhalation may be corrosive to the respiratory tract. Eye contact can cause permanent eye damage.

Standard handling procedures include use of personal protective equipment including gloves, coveralls or shop coat, and eye protection. Stock solution is delivered in and drawn from 200L barrels to reduce the volume of potential spills. The stored totes and active stock are located in an easily accessible area for transport by lift truck. All open barrels of hydrochloric acid are kept on spill containment pallets dedicated for hydrochloric acid. The hydrochloric acid feed system incorporates dual containment piping and hoses as well as containment for storage of the chemical tanks and totes as per good engineering practice and industry standard to meet or exceed WCB requirements.

This product is harmful to invertebrates. The toxicity of this product can be mostly attributed to its acidic properties. There is currently no data available on the chronic effects of this product. Due to this information, it is recommended that this product is not discharged into the environment.

Hydrochloric acid will be used in low dosages at BBPC then brought back to a neutral state prior to discharge to the receiving environment.

The MSDS sheet is included in Appendix B.

3.10.3 Sodium Hydroxide (Caustic Soda)

Sodium Hydroxide (50%) is the chemical used to increase the pH of the wastewater following the AOP to aid in the flocculation process. The liquid is highly corrosive. Ingestion may have serious effects. Contact could cause severe burns to skin and/or eyes, and respiratory irritation.

Standard handling procedures include use of personal protective equipment including gloves, coveralls or shop coat, and eye protection. Stock solution is delivered in and drawn from 200L barrels to reduce the volume of potential spills. The stored totes and active stock are located in an easily accessible area for transport by lift truck. All open barrels of sodium hydroxide are kept on spill containment pallets dedicated for sodium hydroxide. The sodium hydroxide feed system incorporates dual containment piping and hoses as well as containment for storage of the chemical tanks and totes as per good engineering practice and industry standard to meet or exceed WCB requirements.

This product is harmful to invertebrates. The toxicity of this product can be mostly attributed to its basic properties. There is currently no data available on the chronic effects of this product. Due to this information, it is recommended that this product is not discharged into the environment.

Sodium Hydroxide will be used in low dosages at BBPC to bring the acidic wastewater to a neutral state that is safe for the receiving environment.

The MSDS sheet is included in Appendix B.

3.11 Processing Plant Chemical Aides and Cleaners

The following list of chemical aides and cleaners are used in small volumes in the processing plant to clean and disinfect equipment following the processing operation;

3.11.1 Savall

Savall is a liquid disinfectant and deodorizer. It is comprised of two quaternary ammonium compounds: N-Alkyl Dimethyl Ethyl Benzyl Ammonium Chloride and Benzalkonium Chloride (n-alkyl Dimethyl Benzyl Ammonium Chloride). It is significantly more toxic than the other cleaning agents. The LC50 concentrations for several species of freshwater fish were found to be as low as 1 mg/l.

3.11.2 Roughrider

Roughrider II is a multipurpose cleaner composed of ethylene glycol monobutylether, sodium metasilicate, potassium hydroxide, and triethanolamine. Ethylene glycol monobutylether breaks down in the presence of air within a few days; it has not been identified as an environmental contaminant of concern, and does not bioaccumulate. For two species of freshwater fish, the LC50 was determined to be about 1000 mg/l. Sodium metasilicate does not pose a significant environmental risk; LC50 concentrations for two species of freshwater fish were determined to be greater than 300 mg/l. Potassium hydroxide dissociates into ionic potassium and hydroxide in aqueous solution. The compound exhibited an LC50 of 80 mg/l for one species of freshwater fish; the environmental risk is low at the expected effluent concentrations. Triethanolamine poses a low environmental risk; the LC50 for common shrimp was determined to be 100 mg/l.

3.11.3 Oxygentle

Oxygentle is an 8% hydrogen peroxide solution. Hydrogen peroxide degrades very quickly in the presence of organic matter, and will likely break down prior to discharge. LC50 concentrations for two species of freshwater fish and one species of marine fish were found to be greater than 27 mg/l.

3.12 Proposed Effluent Discharge Parameters

Table 3.12 summarizes the expected effluent quality and quantity, the basis of the expected values, the means of measuring the parameter values, and the quality targets specified in the draft permit.

Table 3.12. Estimated 24hr flow proportionate sampled effluent characterization, justification and guideline values.

	Basis of Limit Quantification	**Acute Limit (end of Pipe)**	**Chronic Limit (Edge of IDZ)**	**Proposed Discharge Limit**
Daily Flow (m^3)	Treatment Process Design Capacity	N/A	N/A	720
TSS (mg/L)	Pilot Plant Results			200
BOD_5 (mg/L)	Pilot Plant Results			200
pH	BC Water Quality Guidelines	6.0 - 9.0	6.0 - 9.0	6.0 - 9.0
Ammonia (mg/L)	BC Water Quality Guidelines	37	4.28	37
Nitrate (mg/L)	BC Water Quality Guidelines	N/A	3.7	5.0
Hydrogen Peroxide (mg/L)	Great Pacific		0.75	100
Enterococci (MPN/100mL)	Lowest Reportable Detection Limit (RDL) with turbid samples	N/A	N/A	100

3.13 Effluent Discharge Limit Rationale

3.13.1 Flow

The daily discharge limit is set to the lowest capacity component of the wastewater treatment process., which is the AOP feed pump. The AOP feed pump is programmed to operate in automatic mode at a maximum flow of 30 m^3/hr (720 m^3/d). In hand mode the AOP feed pump is capable of operating to 40 m^3/hr (960 m^3/d). If the AOP feed pump can not keep up to incoming demand, the wastewater storage tank will overflow to the bottom of the AOP recirculation tank, which is designed to accept flow volumes 2.8 times greater than the AOP feed pumps automatic flow capacity. All other wastewater treatment components have a design capacity greater than 1000 m^3/d.

A typical operating day ranges between 10 to 16 hours of water use, depending on whether one or two loads of fish are processed. During normal operations 25m^3/hr of flow are processed through the wastewater treatment facility and will be treated through the wastewater treatment process at a continuous flow rate between 6.0 – 11.1 L/s.

3.13.2 TSS

The potential impact of total suspended solids depends on several factors, including its buoyancy, particle size and degradability. The TSS associated with the effluent from BBPC is very fine (less than 0.5mm), mostly neutrally buoyant, and highly biodegradable. The fine TSS, suspended in fresh or brine water, tends to rise in the denser seawater. The particulate is dispersed rapidly due to tidal currents. The solids do not settle to the seabed in the vicinity of the outfall.

Pilot plant testing of the treatment system at BBPC has consistently been able to achieve TSS results less than 100 mg/l. However, it takes approximately 70% more chemicals to achieve less than 100 mg/l of TSS than it does to achieve less than 200 mg/l, making the sludge byproduct less desirable due to higher concentrations of polyacrylamides. The treatment process will be programmed to achieve the best balance between the TSS and chemical usage while keeping TSS below 200 mg/l. If commercial scale effluent TSS results are consistently lower than 200 mg/L and producing a sludge that is acceptable to sludge receivers after one year of operation BBPC will apply for a minor permit amendment to reduce the TSS discharge limit.

The hydraulic modeling study conducted by Great Pacific predicted that at worst-case dilution the TSS discharge of 200 mg/L will meet BCWQGs within the 15m IDZ, and be <2 mg/L at 45m from the outfall terminus, which is determined to be the maximum boundary to protect human health and the environment. The model also predicted that with a single port discharge configuration, BCWQGs for TSS are met 45m from the discharge terminus without treatment under the worst-case dilution scenario.

3.13.3 BOD

The five-day biological oxygen demand of the effluent from BBPC has always been as high as 2800 mg/l, and averaged about 1000 mg/l. This is high strength wastewater compared to domestic sewage. Although BOD5 is one of the most common parameters for characterizing wastewater, and is very useful for comparative purposes, a high oxygen demand wastewater has little impact when discharged to a marine environment with strong tidal currents. The primary concern with high BOD wastewater is eutrophication, or oxygen depletion, either in the water column or on the benthic habitat. Eutrophication is seldom a concern in tidal waters unless the exchange is very low. This is not the case at BBPC, where the transfer of oxygen due to currents, even at slack water, far exceeds the maximum possible oxygen demand of the most highly concentrated effluent expected from the plant.

Pilot plant testing of the treatment system being installed at BBPC has consistently been able to achieve BOD results less than 100 mg/l. However, it takes approximately 70% more chemicals to achieve less than 100 mg/l of BOD than it does to achieve less than 200 mg/l, making the sludge byproduct far less desirable due to higher concentrations of polyacrylamides. The treatment process will be programmed to achieve the best balance between the BOD and chemical usage while keeping BOD below 200 mg/l. If commercial scale effluent BOD results are consistently much lower than 200 mg/L and producing a sludge that is acceptable to sludge receivers after one year of operation BBPC will apply for a minor permit amendment to reduce the BOD discharge limit.

The hydraulic modeling study conducted by Great Pacific predicted that at worst-case dilution the BOD discharge of 200 mg/L will be <5 mg/L at the 45m from the outfall terminus, which is equivalent to the levels found in the natural environment. BCWQG do not have a limit for BOD. The BCMWR maximum value for BOD is 130 mg/L which is predicted to be achieved within the 15m IDZ.

3.13.4 pH

BC Water Quality Guidelines for pH in the marine environment propose a discharge limit in the range of 6.0 – 9.0, which is the limit recommended for BBPC. pH levels are automatically controlled and continuously monitored in the treatment process. The discharge pH level is to be controlled between 7.0 and 8.5.

3.13.5 Nitrate

Nitrogen in fish processing effluent is associated with tissues, excreta and bloodwater. Nitrogen in tissues and bloodwater is mainly bound in protein molecules. Nitrogen is also present in the form of ammonia in excreta and bloodwater. Under aerobic degradation conditions, ammonia will be converted to nitrite and then nitrate. Nitrate and protein bound nitrogen pose a very low toxicity risk to marine fish.

The hydraulic modeling study conducted by Great Pacific predicted that at worst-case dilution the nitrate discharge of 5 mg/L will meet BCWQGs within the 15m IDZ, and be equal to the receiving environment concentration at 45m from the outfall terminus, which is determined to be the maximum boundary to protect human health and the environment. The model also predicted that with a single port discharge configuration, BCWQGs for nitrate are met 45m from the discharge terminus without treatment under the worst-case dilution scenario.

3.13.6 Nitrite

Nitrite concentrations are low in fish processing blood water waste streams, and the BC Water Quality guidelines do not propose a limit for nitrite discharge to the marine environment. Therefore, Nitrite is not proposed as a testing parameter for BBPCs effluent discharge.

3.13.6 Ammonia

Ammonia is persistent in the protein-rich waste stream of fish processing plants. The toxicity of ammonia in seawater is a function of pH, temperature and salinity. At a pH of 8, a temperature of 10°C, and a salinity of 20 mg/l, the BC water quality guidelines define a concentration of 2.1 mg/l as the maximum 30-day average concentration (chronic), and 14 mg/l as the maximum intermittent concentration (acute). 2017 and 2018 lab data has determined BBPCs ammonia concentrations were 3.8mg/l avg, and 5.9mg/l max over that time period. Lower values were recorded on rainy days vs dry days due to dilution from inflow and infiltration.

The hydraulic modeling study conducted by Great Pacific predicted that at worst-case dilution the ammonia discharge of 10 mg/L will meet BCWQGs within the 15m IDZ, and be 0.2 mg/L at 45m from the outfall terminus, which is determined to be the maximum boundary to protect human health and the environment. Therefore, a discharge of 37 mg/L will be well below the BCWQG of 4.28 at the edge of IDZ. The model also predicted that with a single port discharge configuration, BCWQGs for ammonia are met 45m from the discharge terminus without treatment under the worst-case dilution scenario.

3.13.7 Hydrogen Peroxide

The below text is copied from Great Pacific Engineering & Environment, Brown's Bay Packing – Dilution Modelling Study, December 3, 2018

There are no published BC or Canadian water quality guidelines for hydrogen peroxide in marine waters. Therefore, a literature review was conducted to determine whether sufficient information was available to propose a receiving environment criterion that will adequately protect aquatic life outside the IDZ.

Hydrogen peroxide is a chemical compound consisting of two hydrogen atoms and two oxygen atoms (H2O2). It is utilized as a disinfectant in the aquaculture industry for fungal, bacterial, and parasitic infections on fish (FDA 2006; Burridge *et al* 2008).

Hydrogen peroxide is a naturally occurring chemical, produced by biochemical and photochemical processes. In marine waters, it is found in concentrations of 0.001 – 0.0136 mg/L at the surface (FDA 2006; Shepard *et al* 2015). Hydrogen peroxide decomposes to form water and oxygen, thus is indicative of a chemical compound that is unable to bioaccumulate (Shepard *et al* 2015).

Hydrogen peroxide in elevated concentrations can have deleterious effects on marine biological systems (Wong *et al* 2002). In the marine environment, nine species of marine phytoplankton have been identified to decompose hydrogen peroxide (Wong *et al* 2002). The degradation rate of naturally occurring hydrogen peroxide in seawater varies widely from 0.00034 to 0.017 mg/L per hour (FDA 2006). Rate of degradation does not appear to be concentration dependent (Lyons *et al* 2014). However, toxicity of hydrogen peroxide to marine organisms is concentration dependent.

There is limited toxicity exposure data that specifically meets the hydrogen peroxide 96-h LC50 or 96-h LD50 (median lethal concentration or median lethal dosage) requirements (EC 2000; EPA n.d.).

Most studies have tested the acute toxicity for sea lice or aquaculture fish (e.g., rainbow trout) using high concentrations over short exposure times (e.g. 30 min to 1 h) (Rach 1997; FDA 2006; Burridge *et al* 2014). Hydrogen peroxide exposure in the aquatic environment predominately occurs from aquaculture (e.g., hatcheries and fish farms), thus exposing non-targeted species (e.g., zooplankton, crustaceans, etc.) (Lyons *et al* 2014; Hansen *et al* 2017).

Zooplankton provides a crucial role in the marine food web, providing an important transfer of energy between primary producers and fish. Zooplankton in the receiving environment will be exposed to lower concentrations through dilution but longer exposure times (Hansen *et al* 2017).

A recent study in Norway, investigated the toxicity of hydrogen peroxide over longer term (96-h) exposure. The copepod *Calanus finmarchicus*, an abundant zooplankton species in Norway, was used to determine the sub-lethal concentration value of hydrogen peroxide (Hensen *et al* 2017). Hansen *et al* (2017) determined that the sub-lethal concentration value was 0.75 mg/L. *C. finmarchicus* compared to other marine species is a much more sensitive species to hydrogen peroxide (Hansen *et al* 2017). Therefore, the *C. finmarchicus* no effects concentration (NOEC) of 0.75 mg/L is an applicable value for marine zooplankton, which play a crucial role in the marine food web.

Hansen *et al* (2017) recommended additional studies of hydrogen peroxide should occur on different life stages, and therefore more restrictive NOEC may be recommended in the future following pending studies.

The hydraulic modeling study conducted by Great Pacific predicted that at worst-case dilution the Hydrogen peroxide discharge of 100 mg/L will meet the proposed limit of 0.75 mg/L at IDZ within the 15m IDZ, and 0.01 mg/L at the 45m from the outfall terminus, which is determined to be the maximum boundary to protect human health and the environment.

3.13.8 Enterococci

Enterococci bacteria is highly abundant in the fish processing wastewater streams. Due to its almost guaranteed presence it has been selected as the indicator of choice to prove disinfection is being achieved. The influent enterococci at BBPC in 2017 and 2018 was as high as 160,000 MPN/100ml, and averaged 60,575 MPN/100ml.

The lowest reportable detection limit for enterococci in highly turbid effluent is 100 MPN/100ml. Analysis results <100 MPN/100ml of enterococci of BBPC effluent is indicative of an effective disinfection process.

The hydraulic modeling study conducted by Great Pacific predicted that at worst-case dilution the enterococci discharge of 100 MPN/100ml will meet BCWQGs within the 15m IDZ, and <1 MPN/100ml at the 45m from the outfall terminus, which is determined to be the maximum boundary to protect human health and the environment. The model also predicted that with a single port discharge configuration BCWQGs for secondary contact of enterococci are met 45m from the discharge terminus without disinfection or treatment.

3.14 Effluent Outfall Design

The facility's outfall location is illustrated in Figure 3.14. The outfall originates from the wastewater treatment system, located on DL1664, runs along the northwest side of the property, through DL1655, and terminates in the bay between the private dock, owned by Brown's Bay Resort, and the floating breakwater. The outfall is constructed of 8" HDPE pipe with concrete collars, and terminates approximately 100m from shore on a bearing of 142° from the west corner of DL1664 at a depth of 28m (Canadian Hydrographic Service Chart datum).

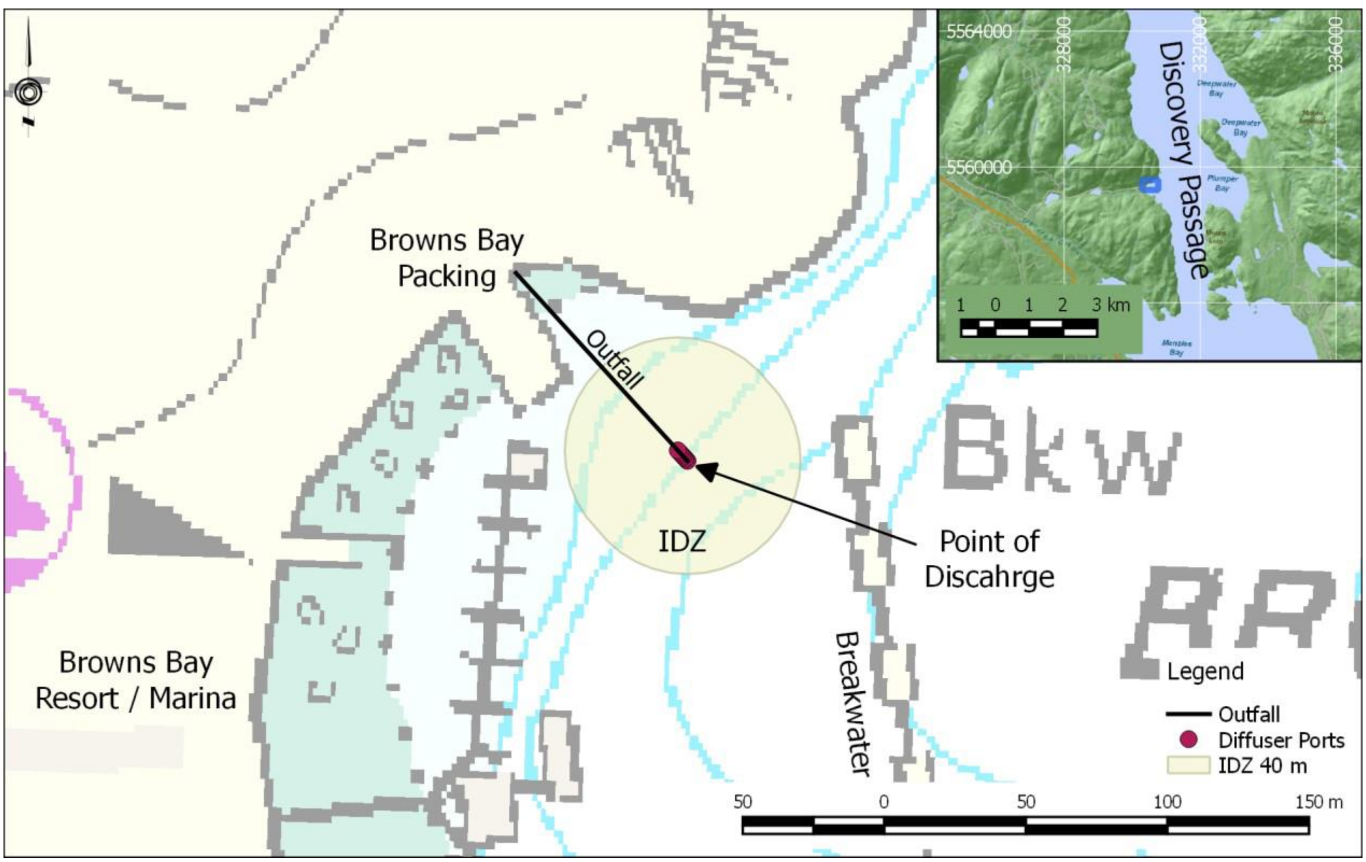


Figure 3.14 Location of facility outfall and Maximum Extent of Initial Dilution Zone for Current Multi Port Discharge

Great Pacific Engineering & Environment conducted two separate modelling scenarios to determine the most effective diffuser configuration pattern for the existing outfall;

- An open, plain ended pipe (i.e. no diffuser): The discharge is located at the following coordinates: 50°09.774'N 125°22.364'W, at a depth of 22 m. Presently the blind flange at the terminus of the outfall is not in place so the outfall is operating in this configuration.
- A six-port diffuser: The outfall was constructed with five 50 mm (2" diameter) ports spaced 1 m apart. A sixth port could be installed on the terminus blind flange. The outfall would operate in this configuration if the blind flange (with a 6th port) was re-installed.

The dilution from the single port diffuser is predicted to be greater than 1,240:1 under all scenarios modelled, and greater than 810:1 for the multi-port diffuser.

The single port is predicted to performs better than the multi-port diffuser under certain conditions. This is due to inadequate port spacing which will cause the plumes for each port to merge (begin diluting into each other) relatively quick, reducing the ability of the effluent plume to dilute. Increasing the spacing of the ports would result in better performance from a multi-port diffuser.

To achieve the best dispersion BBPC outfall will be configured as a single port discharge. The 5 existing dispersion ports on the outfall will be sealed to prevent future discharge.

3.15 Process Residual Disposal and Reuse Plan

3.15.1 Offal

Offal from the evisceration process is combined with screenings from the wastewater treatment process, and shipped by tanker trailer to West Coast Reduction Ltd. where it is converted into value added products. Approximately 5 m^3 of the incoming fresh water leaves the plant via this route on processing days.

3.15.2 Sludge

The froth (solids) from the DAF treatment process will be stored in a sludge storage tank, and shipped by tanker trailer to a compost facility or West Coast Reduction where it is converted into a value-added product.

3.16 Best Management Practices

3.16.1. Statutory Requirements

The Canadian Food Inspection Agency is the federal body that sets the standards to which fish processing plants must adhere to protect the health of consumers. The CFIA has developed the Quality Management Program, "a fish inspection and control system that includes procedures, inspections and records, for the purpose of verifying and documenting the processing of fish and the safety and quality of fish processed in and exported from Canada" (CFIA, 2011). All federally registered fish processing plants, including Brown's Bay Packing Company, are required to adhere to the QMP under the Fish Inspection Regulations. Other legislation governing the processing operations includes the *Fish Inspection Act, Food and Drugs Act, Food and Drug/* Regulations, Consumer Packaging and Labeling Act,* and *Consumer Packaging and Labeling Regulations.*

Wastewater discharge from the plant is regulated by the *Waste Discharge Regulation (Environmental Management Act)*. In this Regulation, fish processing is defined as a "prescribed industry"; it is included in Schedule 2 of the Regulation, and can be considered a medium risk activity. Discharge authorization is required if a Code of Practice has not been developed.

3.16.2 BBPC Water Management Policies

Sea water is used for preparing slush totes. The intake is located under the wharf, and the raw sea water is filtered and irradiated with UV prior to use. Monitoring is conducted daily. The UV system is equipped with an intensity monitor as well as lamp indicators. The bag filters are installed with pressure gauges to indicate fouling, but are changed monthly regardless of the pressure readings.

Fresh water is used in the evisceration plant, for cleaning operations, and in the employee areas (washrooms and lunchroom). The water is supplied by Brown's Bay Resort, who maintains a contract with a certified Water Systems Operator. At the point of supply to the facility, the water is further filtered, chlorinated as required to maintain a residual of at least 0.05ppm, and irradiated with UV. Monitoring is conducted daily. The UV system is equipped with an intensity monitor as well as lamp indicators. The bag filters are installed with pressure gauges to indicate fouling, but are changed monthly regardless of the pressure readings.

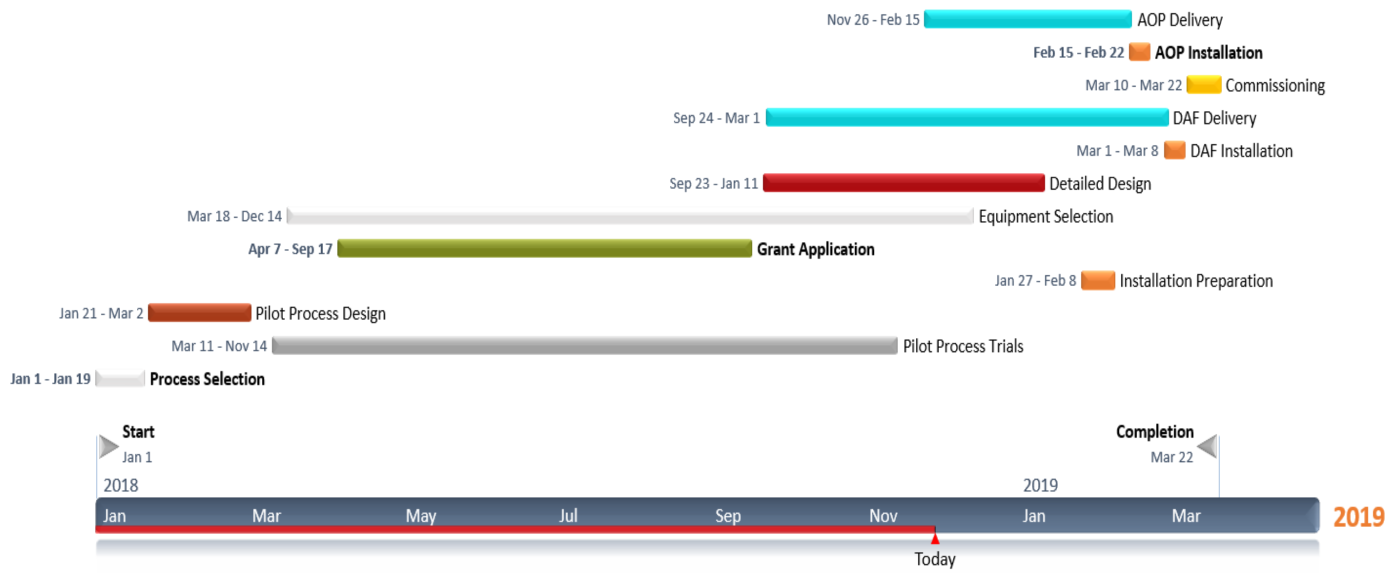
The wastewater effluent system is monitored daily. Visual inspections of the equipment are conducted throughout the day. The control system incorporates a graphical display, at the treatment facility located in an area routinely traversed by maintenance staff, which is also viewed throughout the day; alarms are indicated by a flashing icon on the screen and an audible siren. Setpoints for ORP, TSS, pH, and peroxide will constantly be monitored and automatically adjusted.

3.16.3 Staff Training, Operator Education and Monitoring Systems

BBPC maintains a highly experienced and competent full-time maintenance team consisting of four individuals including an electrician, a ticketed millwright, a millwright apprentice, and a 15-year specialist in processing facilities maintenance. The onsite shop and well-trained staff enable rapid and quality fabrication, and the warehouse and shop shelves are well stocked with parts and spares. The maintenance team performs daily monitoring of the influent sea and fresh water systems, as well as the effluent wastewater system.

In addition to the maintenance staff, BBPC contracts a certified Professional Wastewater Treatment Operator, who hold the following EOCP certifications; Municipal Wastewater Treatment level IV, Industrial Wastewater Treatment Level II, Wastewater Collections Level IV, and Water Treatment Level I, as well as Wastewater Treatment Level I through the Certification Commission of Environmental Professionals, to oversee system operation, conduct effluent sampling and prepare reports as required by the permit. The operator also provides varied consultation including permit compliance, process design assistance, troubleshooting, and repairs.

3.17 Treatment Works Construction and Commissioning Schedule



3.18 Treatment Works Engineer Sign-off

Refer to Engineer sign off attached as appendix F.

4. Environmental Impact Assessment

4.1 Receptors at Risk

The below text and tables are copied from Mainstream Biological Consulting, Brown's Bay Packing Ltd Effluent Outfall Amendment Receiving Environment Assessment Update, November 29, 2018, Appendix C.

The results of a review of online databases of potential biological receptors present in the environment surrounding Brown's Bay Packing Company are summarized in this section.

4.1.1 Marine Receptors

The outfall pipe serving the Brown's Bay Packing Company fish processing plant discharges effluent into Brown Bay via the pipe terminus located approximately 100 m southeast of the facility complex at a depth of 25 m below the low water mark (Adamsson, 2013). The BC Coastal Resource Information Management System (CRIMS) classifies this marine environment as possessing hard substrate with low exposure that is subject to high currents (> 3 kts). The ocean floor within Brown Bay has a slope of between 5% and 20% with depths ranging up to 200 m and temperature range of between 9°C and 15°C. Brown Bay receives freshwater flow from Hunt Creek located on the western edge of the bay which results in brackish water typical of estuarine habitats with mesohaline salinity levels ranging between 15ppt to 18ppt. Salinity measurements at the outfall and sampling stations taken in 2010 showed little variation with values ranging from 29.9 ppt at the outfall to 31.1 ppt at the four sampling locations (MBC, 2011). Levels of salinity ranged between 30.8 ppt to 34.3 ppt in measurements taken at the outfall and seven sampling stations in 2018 (MBC, 2018a). These results indicate that the effect of the freshwater input on the environment in the bay is no longer detectable by the outfall and monitoring station.

The BC CRIMS also reports that water becomes stratified in the deeper pelagic sections of the bay (CRIMS, 2018). Water quality measurements conducted in 2010 and 2018 found no indication of stratification at the outfall or surrounding monitoring stations (MBC, 2011, 2018a).

The intertidal zone found in Brown Bay, including the fish processing plant, consists of a narrow (<30 m wide) sand and gravel beach that has a long oil residency index (years). This is due to the protected nature of the bay from the surrounding terrain topography and geographic orientation of the bay. Sediment in the intertidal zone consists of boulder, cobble and pebble with sand and gravel substrate. CRIMS characterizes the backshore bioband with continuous barnacle, patchy *fucus* and *Ulva spp*. and no *verrucaria* present (CRIMS, 2018). Previous scuba surveys have characterized the seabed along the path of the outfall to consist of boulders from the shoreline to the outfall terminus at a depth of 25 m and 100 m from low low water. These surveys characterized the intertidal zone up to a distance of approximately 50 m from the shore as being gently sloped with pockets of sand and fine gravel within the gravel and cobble substrate. Beyond 50 m from shore the seabed steeply slopes to the outfall discharge point with gravel becoming the dominant substrate at greater depths (Adamsson, 2013).

An online search of biological resources potentially present within the marine environment adjacent to the Brown's Bay Packing Company facility showed that the bay is of relatively low importance for marine mammals including gray whales, humpback whales and Pacific white-sided dolphin. Brown Bay is classified as of minor importance for killer whale populations. The area is ranked as of high importance for the recreational finfish fishery with McMullen Point and south identified as a chinook salmon fishery of minor importance. The rockfish recreational fishery zone mapped within Brown Bay is ranked as of very high importance (CRIMS, 2018). Brown Bay lies within DFO Area 13 but outside of any designated Rockfish Conservation Areas (DFO, 2018). Two quillback rockfish *Sebastes maliger* were identified during the 2010 eelgrass survey in Brown Bay. This species of fish is designated by COSEWIC as threatened due to late maturation and slow growth combined with intensive fishing due to the preferred habitat of shallow inshore waters (COSEWIC, 2009).

A search of the BC Species and Ecosystem Explorer database was conducted for red, blue and SARA listed species that could potentially be found in Brown Bay intertidal, subtidal and marine environments (BC, 2018). Table 4.1.1 summarizes the results of this search. Federally listed SARA species potentially present within the receiving environment includes Northern Abalone *Haliotis kamtschatkana.* Populations of this marine snail have been subject to a decline of over 80% since 1978. The species is usually found on rocks in near-shore, exposed or semi-exposed areas of moderate water exchange. Typically adults are found at depths of less than 10 m but may reside in up to 100 m of water (DFO, 2018). No individuals of this species have been reported in Brown Bay during previous site surveys.

Table 4.1.1: Species at risk potentially present near or within the Brown's Bay Packing Company marine receiving environment. List created for intertidal, subtidal, sheltered and pelagic waters in the CWH biogeoclimatic zone in Strathcona Regional District, Campbell River Forest District on Vancouver Island.

Scientific Name	English Name	Conservation Status		
		BC List	COSEWIC	SARA
Ardea herodias fannini	Great Blue Heron, *fannini* subspecies	Blue	SC (2008)	1-SC (2010)
Brachyramphus marmoratus	Marbled Murrelet	Blue	T (2012)	1-T (2003)
Eumetopias jubatus	Steller Sea Lion	Blue	SC (2013)	1-SC (2005)
Falco peregrinus pealei	Peregrine Falcon, *pealei* subspecies	Blue	SC (2017)	1-SC (2003)
Haliotis kamtschatkana	Northern Abalone	Red	E (2009)	1-E
Ptychoramphus aleuticus	Cassin's Auklet	Red	SC (2014)	

No mapped occurrences of SARA listed species were identified within 5 km of Brown's Bay Packing Company fish processing plant during the desktop search. A search of the Conservation Data Center online database showed no mapped polygons within 5 km of the site. It should be noted that the absence of reports of sensitive species does not mean they could not be present within the habitat surrounding the hatchery, but that they may not have been previously identified.

Great Blue Heron are reported to frequent habitat types found around Brown Bay including bays and occasionally coastal cliffs with nests commonly created high in trees in swamps and forested sites, close to foraging areas (CDC, 1996). This species of bird is noted to be very sensitive to human disturbance (CDC, 1998). The level of human development and activity present in Brown Bay is likely to be of a level that would deter a Great Blue Heron colony from establishing in this location.

Marbled murrelet is a sea bird that nests in large stands of old growth forest, especially large Sitka spruce and western hemlock (CDC, 2013). Two areas of older growth ecosystems (559m southwest of processing plant and 676 m north of plant) are mapped by the Sensitive Ecosystem Inventory (SEI) online database (SEI, 2004). These areas are characterized as conifer-dominated and generally more than 100 years old and could potentially offer breeding habitat for marbled murrelet.

Steller sea lion are reported to frequent coastal waters near shore and to congregate at nearshore rafting sites. Commonly used terrestrial habitat includes remote beach or island areas that are difficult to access by humans or other predators. Exposed rocks, reefs, jetties and breakwaters are often used as haulout locations (CDC, 2011). No steller sea lion observations were recorded during any of the surveys conducted between 2010 and 2018. This may be the result of the high level of human activity within Brown Bay serving to deter steller sea lion presence.

Peale's peregrine falcon typically nests on the ledges of rocky island cliffs and occasionally on mainland headland cliffs, usually near seabird colonies (CDC, 1997). Cliff habitat is present around the northern rim of Brown Bay, however no seabird colonies have been recorded in this area during site surveys between 2010 and 2018 and this part of the coastline is not classified as an Important Bird Area (IBA Canada, 2018). As this sub-species of peregrine falcon depends on seabird colonies as the major source of food, the lack of a seabird colony in the area indicates that this species is not likely to be present at Brown Bay.

Northern abalone habitat is predominantly kelp beds along outer well-exposed coasts, typically within low intertidal zones of 10 m depth up to 100 m depth. Populations have been recorded in fairly sheltered bays but highest densities are reported in areas with the highest wave exposure (CDC, 2007). Brown Bay is generally sheltered with low exposure with no kelp beds recorded during previous site surveys. The northern portion of the bay may offer more exposed habitat for this marine snail.

Cassin's auklet is a seabird that burrows nests in the ground or under rock on offshore islands in areas with low vegetation (CDC, 1995). A small rocky island is located approximately 500 m northeast of the Brown's Bay Packing Facility that could potentially offer nesting habitat. The island is situated within 17 m of the shore of Vancouver Island and within 72 m of a residential dwelling. One of the major threats to this species is predation by rats and raccoons (CDC, 2018). The proximity of the potential habitat to the shore of Vancouver Island and a residential property could signify the increased likelihood of the presence of predators able to access the island which would act to reduce the viability of this location as potential nesting habitat.

4.1.2 Coastal Receptors

A search of the Sensitive Ecosystem Inventory (SEI) online database revealed that a number of sensitive ecosystems are mapped within 1 km of the fish processing plant. The coastline located immediately to the northeast of the facility is classified as a coastal bluff ecosystem with cliffs present. This type of ecosystem is described as low-lying, wind-swept rocky shorelines and steep coastal cliffs that are influenced by proximity to the ocean. Shallow soils are often present as soil pockets in rock cracks or crevices, or are absent altogether. Vegetation consists of salt-tolerant communities of mosses and lichens, grasses and herbs and occasional low shrubs. Specialized habitats within these sites, including vernal pools, crevices and seepage areas support numerous rare plants and animal species (SEI, 2004). This ecosystem polygon extends to within 5 m of the fish processing plant.

The processing plant is located on an area of shore classified as non-vegetated, urban exposed land (iMapBC, 2018). The facility lies within previously developed land on Sayward District Lots 1655, 1664, 1692 and 1693 (Property ID 13923340, 13553350, 90027141 and 90027142 respectively). A log sort was previously operated at Brown Bay until the 1950s when a salmon fishing lodge was established (Brown's Bay Resort, nd).

Brown Bay is not categorized as an Important Bird Area and none are located within 5 km of the bay (IBA Canada, 2018). A bald eagle nest (BAEA-110-546) has been identified and mapped 237 m southwest of the facility. The data was last recorded for this nest in June 1996 (WiTS, 2018). Two further observations of bald eagle nests have been mapped 133 m and 251 m north of the processing plant (iMapBC, 2018).

A search of the BC Species and Ecosystem Explorer database was conducted for red, blue and SARA listed species that could potentially be found in the coastal bluff environment adjacent to the Brown's Bay Packing Company plant. Table 4.1.2 summarizes the results of this search.

Table 4.1.2: Species at risk potentially present near or within the Brown's Bay Packing Company coastal receiving environment. List created for cliffs, coastal bluffs, rock / sparsely vegetated rock habitat in the CWH biogeoclimatic zone in Strathcona Regional District, Campbell River Forest District on Vancouver Island.

Scientific Name	English Name	Conservation Status		
		BC List	COSEWIC	SARA
Balsamorhiza deltoidea	deltoid balsamroot	Red	E (2009)	1-E (2003)
Brachyramphus marmoratus	Marbled Murrelet	Blue	T (2012)	1-T (2003)
Cypseloides niger	Black Swift	Blue	E (2015)	
Falco peregrinus pealei	Peregrine Falcon, *pealei* subspecies	Blue	SC (2017)	1-SC (2003)
Gulo gulo vancouverensis	Wolverine, *vancouverensis* subspecies	Red	SC (2014)	1-SC (2018)
Ptychoramphus aleuticus	Cassin's Auklet	Red	SC (2014)	

No mapped occurrences of SARA listed species were identified within 5 km of Brown's Bay Packing Company fish processing plant during the desktop search. A search of the Conservation Data Center online database showed no mapped polygons within 5 km of the site. As noted with other biological receptors, the absence of reported nests or sensitive species does not mean they could not be present within the habitat surrounding the hatchery, but that they may not have been previously identified.

The potential for habitat to be present around Brown Bay and surrounding areas for marbled murrelet, Peale's peregrine falcon and Cassin's auklet is discussed in Section 3.3.1 of appendix C.

The perennial vascular plant, deltoid balsamroot is highly associated with Garry oak ecosystems. An identified Campbell River population grows outside of the Garry oak range. This population is located on flat marine gravel and sand terrace, a few metres above tidewater with excellent drainage and full sun exposure (CDC, 2018c). The highest threat to this species is habitat destruction (CDC, 2009). The shore above the high tide mark around Brown Bay has been subjected to significant levels of human development historically that would likely preclude the continued presence of this species in the area.

The black swift nests on sea cliffs and in sea caves in dark inaccessible sites offering unobstructed flight paths (CDC, 1995). The species forages for flying insects over forest and open areas. Black swift have a very low reproductive rate and very specific nesting habitat requirements (CDC, 2015). Sea cliffs are present along the northern rim of Brown Bay and therefore could present potential nesting habitat for this species.

The *vancouverensis* subspecies of wolverine reported to be present on Vancouver Island frequents habitat found within 1 km of Brown Bay including conifer forest and sparsely vegetated rock cliff areas. It is presumed extirpated within the Campbell River Forest District (CDC, 2018d). It is now believed to be confined to the inaccessible areas of the central mountain ranges and west coast of Vancouver Island and is unlikely to be present in the vicinity of Brown Bay (CDC, 2018e).

4.2 Spatial and Temporal Boundaries

Meteorology data from Chatam Point has been used to approximate the conditions at Brown's Bay. Chatam Point is located 18 km north of Brown's Bay in the southern reaches of Johnstone Strait.

Average daily maximum temperatures range from 4.6°C in January to 19.8°C in July. Average daily minimum temperatures range from 1.5°C in January to 12°C in July. The extreme maximum temperature recorded was 33.3°C (12Jul1961); the extreme minimum was -15°C (28Dec1968).

Total annual precipitation is 2274mm, 2201mm of which is in the form of rainfall. The extreme daily rainfall of 122mm was recorded on 17Nov1995. The extreme daily snowfall of 35.3cm was recorded on 19Dec1964. Average snow depth in

December and January is 1cm, and is 0cm during other months. The extreme snow depth of 74cm was recorded on 14Jan1969.

In the summer months, average wind speed and direction are westerly at 18km/hr. During the winter months, average wind speed and direction are southeasterly at 13km/hr. The extreme wind speed of 108 km/hr (easterly) was recorded on 01Dec1988.

Due to the nature and location of the discharge, the effect of these meteorological phenomena will be negligible on the transport of the facility wastewater in the environment.

4.3 3-Dimensional Water Quality Modelling

Refer to Great Pacific Engineering & Environment, Brown's Bay Packing – Dilution Modelling Study, March 30, 2018

4.4 Potential Impacts

The below text is copied from Mainstream Biological Consulting, Brown's Bay Packing Ltd Effluent Outfall Amendment Receiving Environment Assessment Update, November 29, 2018, Appendix C

The inputs potentially present in the facility effluent have been identified and characterized (Adamsson, 2013) to include:

• Septic tank effluent

• Fish processing effluent potentially including:

- Cleaning and disinfection agents,
- Chlorinated water,
- Wastewater additives (hydrogen peroxide; nitric acid, sodium hydroxide)

Concentrations of these inputs could potentially contaminate the water column in the receiving environment or accumulate in harmful volumes on surrounding seabed substrate. Ingestion of contaminated material could potentially lead to bioaccumulation of deleterious substances through interlinked marine and coastal food webs resulting in harmful concentrations in secondary consumers. Exposure of marine organisms to harmful concentrations of effluent products over time could lead to damaging bioconcentrations in marine life.

4.5 Site Model – Contaminants to Receptors

Receptor exposure to contaminants is only probable within the 10m radius of the outfall point of discharge. Due to strong tidal currents at BBPC all contaminants are determined to be within BC water Quality Guidelines beyond this point, as determine by the hydraulic modelling study conducted by Great Pacific Engineering & Environment, November 2018.

4.6 Initial Dilution Zone

The below text is copied from Great Pacific Engineering & Environment, Brown's Bay Packing – Dilution Model Data Summary, December 3, 2018, Appendix D

The IDZ is based on the criteria specified in the Ministry of Environment's "*Interim Technical Guidance 11, Development and use of Initial Dilution Zones in Effluent Discharge Authorizations.:" (*MECCS, 2018)

Relevant guidance for the IDZ includes:

- the IDZ should not extend closer to shore than mean low water;
- an IDZ should be as small as possible to minimize the extent of the receiving environment potentially exposed to chronic toxicity levels;
- an IDZ should not adversely affect sensitive aquatic habitats;

- an IDZ should avoid highly-frequented recreational water use areas (e.g., public beach);

Based on the site geometry constraints, the maximum probable extent of IDZ boundaries for the discharges are shown in Figure 4.6 for a single port diffuser. The nearest sensitive habitat is understood to be an eelgrass bed located in shallow water on the north side of the processing plant (Aquarius Engineering, 2011). The eelgrass bed is located beyond these IDZ boundaries depicted in Figure 4.6.

For all scenarios modelled, a dilution greater than 280:1 is predicted within 15 m of the point of discharge. An initial dilution zone radius of 15 m is recommended to protect the receiving environment during normal operating conditions.

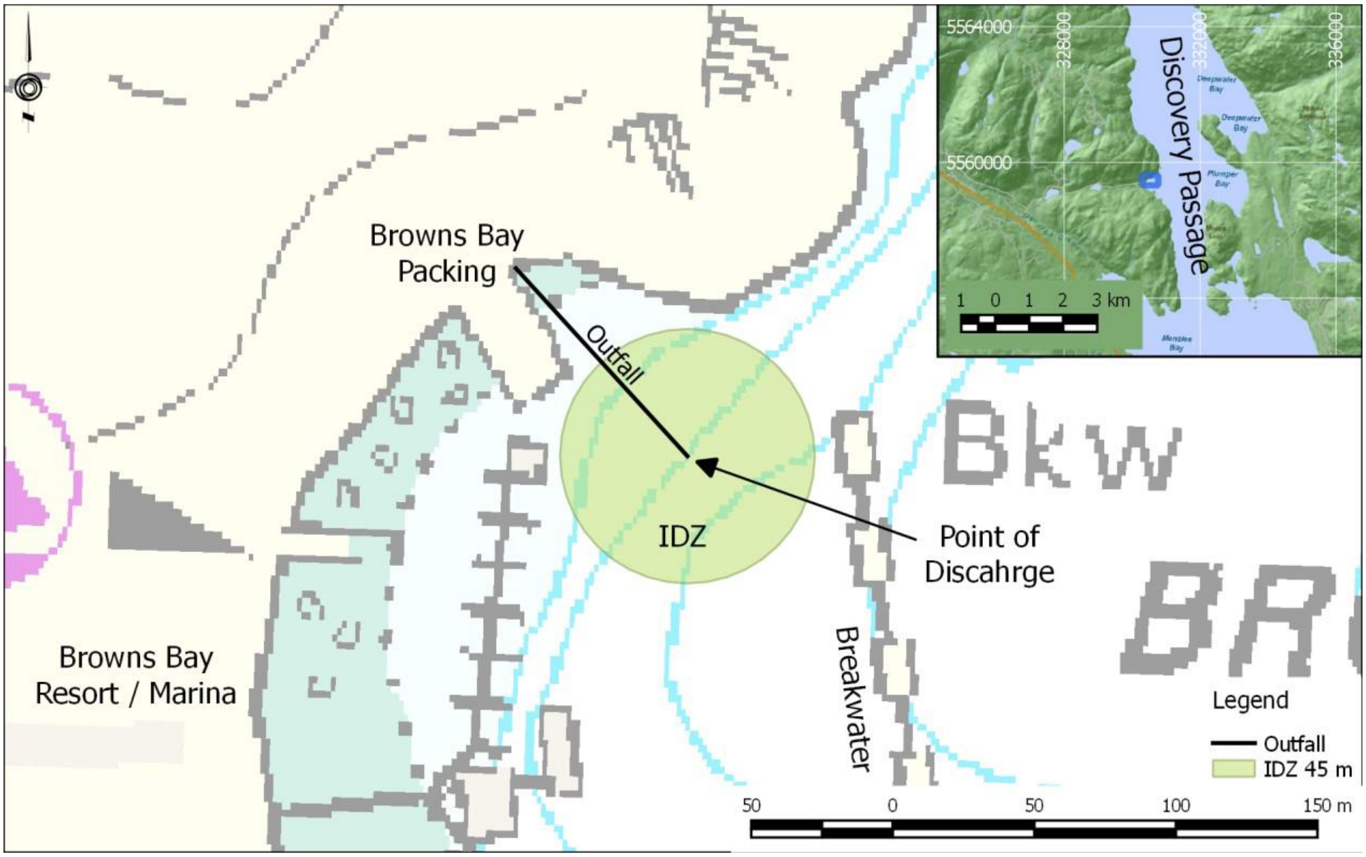


Figure 4.6 Outfall Location and maximum extent of Initial Dilution Zone for Single Port Discharge

4.7 Predicted Changes Over Existing Receiving Environment

The below text and table is copied from Great Pacific Engineering & Environment, Brown's Bay Packing – Dilution Modelling Study, March 30, 2018, Appendix D.

Results of the modelling exercise are provided in Table 4 for the single port diffuser and Table 5 for the multi-port diffuser. Good dilution is predicted within a relatively short distance from either discharge configuration. The worst-case dilution predictions are highlighted in yellow.

The dilution from the single port diffuser is predicted to be greater than 1,240:1 under all scenarios modelled, and greater than 810:1 for the multi-port diffuser. The water column is weakly stratified; therefore, the results for both diffuser configurations show a potential surfacing of the effluent plume under various conditions.

Interestingly, the single port is predicted to performs better than the multi-port diffuser under certain conditions. This is due to inadequate port spacing which will cause the plumes for each port to merge (begin diluting into each other) relatively quick, reducing the ability of the effluent plume to dilute. Increasing the spacing of the ports would result in better performance from a multi-port diffuser.

Table 4 Model Results – Single Port Diffuser

Scenario	Diffuser Configuration	Season	Current Speed	Dilution @ 45 m (#:1)	Trapping Depth
1	Open ended pipe	Summer	Min	1270	Surface
2			Mean	1810	Surface
3			Max	1240	Surface
4		Winter	Min	1270	Surface
5			Mean	1730	12.21
6			Max	1240	13.7

Table 5 Model Results – Multi Port Diffuser

Scenario	Diffuser Configuration	Season	Current Speed	Dilution @ 40 m (#:1)	Trapping Depth
7	6 x 0.05 m diameter ports	Summer	Min	820	Surface
8			Mean	1230	Surface
9			Max	1020	Surface
10		Winter	Min	810	Surface
11			Mean	1190	12.21
12			Max	1030	14.07

4.8 Prediction of Water Quality Guideline Exceedances

With the exception of Enterococci during bypass/failure conditions, the results of the modelling suggested that applicable water quality guidelines will be achieved at the boundary of the proposed IDZ for all proposed parameters under both normal treatment plant operation, and during bypass/treatment plant failure conditions with the most highly concentrated influent characteristics at BBPC.

4.9 Data Gap Analysis

The below text and tables are copied from Mainstream Biological Consulting, Brown's Bay Packing Ltd Effluent Outfall Amendment Receiving Environment Assessment Update, November 29, 2018, Appendix C.

4.9.1 Benthic habitat community characterization

The presence and abundance of marine species and substrate types was last completed in September 2010. Benthic grab sampling in September 2018 was unsuccessful due to the lack of fine substrate available for collection and testing. It is therefore recommended that an underwater video survey (diver or Remotely Operated Vehicle (ROV)) be conducted to catalogue the substrate types and marine life present in the benthic environment surrounding the Brown's Bay Packing Company outfall. This survey would allow evaluation of any visual indicators of pollution from the outfall to the surrounding environment. Additionally, video footage would also enable an assessment of the type and abundance of marine species present around the outfall including federally or provincially protected species potentially present such as quillback rockfish and northern abalone. If the scope of the survey were extended to include footage of the three other outfalls in Brown Bay, this would allow comparison of the benthic condition of other emission source environments with that of Brown's Bay Packing Company.

4.9.2 Water quality characterization – Other outfalls

Water quality sampling data is currently available for Brown's Bay Packing Company in isolation. To adequately quantify the level of impact of this emission source to the Brown Bay receiving environment, other sources must also be characterized. The three other outfalls known to discharge to Brown Bay, including the marina, require a comparable water quality sampling regime to be conducted alongside that currently in place for Brown's Bay Packing Company. This would allow side by side comparison of each outfall's contribution to the receiving environment and also provide an overall total impact received by Brown Bay.

4.9.3 Water quality characterization – Chlorine

Previous technical assessments have identified the discharge of chlorinated water to be the greatest risk to the receiving environment (Adamsson, 2013). Water quality guidelines for marine life are currently in place for chlorine with published limits for continuous exposure, intermittent exposure and controlled intermittent exposure (BC MoE, 2018). It is recommended that future water quality sampling includes testing for this parameter to ensure that the greatest risk to the marine environment is captured and monitored. Note that this test is very challenging, due to the short hold time for samples (15 min). testing should be done in *situ* to get accurate results.

4.10 Potential for Bioaccumulation or Bioconcentration of Contaminants

The below text is copied from Mainstream Biological Consulting, Brown's Bay Packing Ltd Effluent Outfall Amendment Receiving Environment Assessment Update, November 29, 2018, Appendix C.

Bioaccumulation is a potential pathway for a pollutant to enter a food chain. It refers to the accumulation of contaminants in biological tissues from sources such as food, water and suspended sediment (ScienceDirect, 2018). The lack of sediment identified at the outfall and surrounding sampling stations combined with the visible lack of accumulated material in drop camera imagery, indicates that any organic matter emitted from the outfall pipe is rapidly and effectively dispersed by high current flow. The results of *in situ* water quality monitoring at different times of the year indicate that the water column is consistently well mixed, with no stratification detected at the outfall or any other monitoring station. Slightly elevated TSS measurements recorded within 3 m of the outfall terminus during 2018 BAP monitoring that could indicate the presence of a plume were either rapidly dispersed within 10 m or below reference levels.. The rapid dispersal of organic matter around the pipe outfall removes a potential food source from marine food webs thus minimizing a potential pathway for bioaccumulation to occur.

Purple sea urchins *Strongylocentrotus purpuratus* were visible in the immediate vicinity of the outfall terminus in drop camera imagery captured during the eelgrass survey conducted in September 2018 and during the BAP survey in 2018 (Photo 8).

Sea urchins primarily feed on kelp and algae but will also consume animal matter. These echinoderms form the prey of sea otters, sea stars and fish (Harbo, 1999). Two sunflower stars *Pycnopodia helianthoides* were identified during the eelgrass survey conducted in 2010 but none were observed in 2018. A single Oregon Triton snail, *Fusitriton oregonensis,* was identified in a grab sample collected during the benthic survey in September 2018. These organisms are also known to occasionally prey on sea urchins (Harbo, 1999). Fish species observed in the vicinity of the outfall pipe during the 2010 survey include spiny dogfish, quillback rockfish and Blackeye goby (MBC, 2011). None of these species are known to prey on sea urchins (Lamb et al, 2010). Sea otter populations are not found along this part of the coast, being largely confined to the western coastline of Vancouver Island (VI-Wilds, nd).

The abundant presence of sea urchins in the vicinity of the outfall terminus gives an additional indication of water quality in the area as these organisms are known to show stress when exposed to pollution (Monterey Bay Aquarium, 2018).

The objective of the benthic habitat community survey conducted in September 2018 was to characterize the composition of sediment in Brown Bay at the outfall terminus and associated sampling stations. Insufficient quantities of substrate were collected during this survey indicating that the seabed at the outfall and sampling stations is "hard" with minimal fine sediments present. Images obtained using a drop camera during the 2018 eelgrass survey shows gravel and sand over bedrock present (Photos 1 and 2). Coarse sediment such as sandy gravel, cobbles and boulders are typically found where bottom currents are strong (NGU, 2016). This observation is corroborated by the CRIMS classification of Brown Bay environment being subject to high currents greater than three knots (CRIMS, 2018). Effluent discharged from the outfall pipe would be subject to significant dispersion from the high currents present in Brown Bay as indicated by the dilution of nutrients and bacteria recorded between 3 m and 10 m downstream (Tables 8, 9 and 10). Such currents would also potentially act to minimize the accumulation of contaminants from the effluent on substrate in the vicinity of the outfall. The results of water quality sampling, combined with the visually identified species composition and benthic conditions at the outfall and surrounding environment, indicates that the potential for bioaccumulation as a result of effluent discharge from Brown's Bay Packing Company is low.

The combined results of water quality sampling conducted between 2010 and 2018 show that no measurable parameters have approached the BC Water Quality Guidelines for the protection of marine life and recreational use or the BC Water Quality Criteria for Microbiological Indicators for aquatic shellfish harvesting. These results indicate that the discharge of effluent from Brown's Bay Packing Company fish processing plant has not induced measurable change within the receiving environment that would result in environmental impacts from bioconcentration of chemicals in the water column.

4.11 Prediction of Changes in Aquatic Resources

The below text is copied from Mainstream Biological Consulting, Brown's Bay Packing Ltd Effluent Outfall Amendment Receiving Environment Assessment Update, November 29, 2018, Appendix C.

Eelgrass surveys have been completed in Brown Bay in 2010 and 2018. Seagrass ecosystems are ranked as among the most diverse and productive ecosystems in the world. Eelgrass forms an essential part of seagrass ecosystems by acting as a primary producer and providing valuable cover and a food source for marine life (Gibsons, nd). Mapping of eelgrass presence in the vicinity of the Brown's Bay Packing Company effluent outfall pipe is a useful means of determining the ecological health of the receiving environment.

The eelgrass survey completed in August 2010 identified a 26 m2 bed located approximately 5 m off-shore immediately north of the Brown's Bay Packing complex. The report noted that the condition of this bed had been noted to be deteriorating during previous surveys, however no data is available from the 2006 or other previous assessments. The 2010 report also noted that this bed "is exposed to several potential stressors, including the persistent boat traffic associated with plant operation and the marina adjacent to the plant. It is probable that the ongoing wave action associated with the boat traffic would have more impact on the eel grass bed than the release of effluent from the plant", (MBC, 2011).

No evidence of any eelgrass growth was observed during the eelgrass survey completed in September 2018. The absence of the mapped bed may be due to ongoing deterioration as a result of the potential stressors previously mentioned. This would indicate an overall reduction in the condition of aquatic resources within Brown Bay. The absence of eelgrass may also be attributed to other factors. Eelgrass is a perennial flowering plant subject to winter die-off and spring/summer re-growth (Gibsons, nd). Abundance of this plant may therefore vary seasonally. The 2018 survey was completed in late September 2018 (September 21) and may have coincided with seasonal die-off of this plant. Physical and chemical disturbance, nutrient availability and turbidity and salinity are also known to affect eelgrass abundance (Gibsons, nd).

Levels of total ammonia nitrogen have been monitored in Brown Bay since 2010. Levels of this nutrient lowered in 2016 and 2017 from the baseline level measured in 2010 but spiked above the baseline in samples collected during BAP certification in March and June 2018 before decreasing again. Orthophosphate levels monitored since 2016 have shown little variation in concentration. Insufficient data is currently available to confidently identify the causal factors for the absence of an eelgrass bed in 2018 and further investigation could be conducted to assist in determining the ecological health of this productive marine habitat.

4.12 Acute and Chronic Toxicity Evaluation

The below text is copied from Mainstream Biological Consulting, Brown's Bay Packing Ltd Effluent Outfall Amendment Receiving Environment Assessment Update, November 29, 2018, Appendix C.

The environmental monitoring program implemented between 2010 and 2018 has been constructed to provide indication of the likelihood of the potential environmental impacts occurring in the Brown Bay receiving environment. The monitoring program has provided the following indicators of environmental condition at various locations relative to the outfall location in the receiving environment:

- Water quality grab samples including:
  - Nutrient concentrations,
  - Microbiological concentrations,
  - Total oil and grease concentrations,
  - Biochemical oxygen demand and,
  - Total suspended solids
- Water column environmental measurements including:
  - Dissolved oxygen,
  - Salinity,
  - Temperature and,
  - pH
- Benthic habitat community characterization

4.12.1 Acute Toxicity Evaluation

Provincial approved water quality guidelines to protect marine life, recreational use and aquatic life (shellfish harvesting) are in place for short term exposure to ammonia nitrogen, nitrate and nitrite, pH, TSS and enterococci (BC MoE, 2017).

Instantaneous maximum concentrations of total ammonia recorded during the monitoring period ranged from 0.022 mg/L (outfall, January 2017) to 0.71 mg/L (3 m upstream of outfall, March 2018). Total ammonia measured in collected samples did not approach the BCAWQG short term maximum of 23 mg/L to 79 mg/L which is dependent on pH, temperature and salinity.

Nitrate was tested in samples collected during the 2018 REMP. No samples had concentrations approaching the short term maximum of 10 mg/L specified for the protection of recreational users. One sample taken at the outfall terminus measured 14.7 mg/L but this was suspected to be a contaminated sample, as the original sample and all other samples collected were significantly lower (MBC, 2018a).

All samples collected during the 2018 REMP that were tested for nitrite were below reportable detection limits and therefore within provincial water quality guidelines for recreational water use (MBC, 2018a).

TSS levels were below reportable detection limits in samples collected in 2010 (MBC, 2011). TSS levels ranged between less than 4.0 mg/L (3 m upstream and 10 m downstream of the outfall) to a maximum of 16.5 mg/l at the outfall during the 2016 to 2018 surveys (Maxxam 2016a, 2016b, 2017a and 2017b)(MBC 2018a, 2018b, 2018c and 2018d). No samples exceeded the BCAWQG of a 25 mg/L change from background levels.

Enterococci levels did not exceed 16.0 CFU/100mL (August 14, 2018, bottom sample 100m west of outfall) over the monitoring period and therefore did not approach the single sample maximum concentration of 70 CFU/100mL specified in the BCRWQG (MBC, 2011 and 2018a, 2018b, 2018c, 2018d). No tests for enterococci were conducted in samples taken in 2016 or 2017.

Fecal coliform counts in samples collected during the 2010 REA survey were detected at all sampling stations with the exception of the reference station. Highest concentrations (9 CFU/100mL) were recorded at the EDZ 100 m east and south of the outfall. No single sample exceeded the BCWQCMI of 14 CFU/mL over the monitoring period.

Measured pH levels recorded during depth profiling ranged between 7.46 and 7.9 fell within the BCAWQG range for marine water of 7.0 – 8.7 (MBC, 2011 and 2018a).

BOD-5 levels remained below RDL in all samples collected in 2010, 2016, 2017 and 2018 (MBC 2011, 2018b, 2018c and 2018d) (Maxxam 2016a, 2016b, 2017a and 2017b). These results indicate a low polluting capacity of the fish processing plant due to undetectable oxygen depletion that would be expected during the decomposition of organic matter by micro-organisms. No water quality guidelines currently exist for this parameter.

4.12.2 Chronic Toxicity Evaluation

Water quality grab sampling conducted as part of the 2018 REMP assessed the exposure of the receiving environment to chronic levels of nutrients and microbiological bacteria. The collected samples were tested for concentrations of total nitrogen, total ammonia, nitrate-N and nitrite-N. Testing for concentrations of enterococci was also carried out (MBC, 2018a).

The report concluded that effluent from the Brown's Bay processing facility has not caused measurably elevated Enterococci counts or nitrogen concentration in the receiving environment compared to background levels (MBC, 2018a).

The results of testing for water quality parameters in Brown Bay indicate the following points:

• Slightly elevated instantaneous maximum concentrations of measured parameters have been recorded at the outfall terminus but these concentrations have fallen well within provincial short-term maximum guideline values for the protection of marine life, recreational use and aquaculture shellfish harvesting

• Concentrations of measured parameters are subject to rapid dilution within the water column from the current and tidal flows prevalent within Brown Bay with significant dissipation noted between 3 m and 10 m downstream of the outfall terminus.

• No harmful effects are apparent in the Brown Bay receiving environment from long term exposure to nutrient or bacterial loads discharged in the Brown's Bay Packing Company effluent.

4.13 Risk Assessment Matrix

The below text and tables are copied from Mainstream Biological Consulting, Brown's Bay Packing Ltd Effluent Outfall Amendment Receiving Environment Assessment Update, November 29, 2018, Appendix C.

Table 13 presents a summary of potential impacts to biological receptors identified during the desktop review and site assessments as a result of the discharge of effluent from the Brown's Bay Packing Company outfall pipe. The potential effects of these impacts have been evaluated in relation to the condition and operation of the effluent pipe as documented in water quality surveys conducted between 2010 and 2018. The significance of each potential impact has been determined based on factors including existing environmental conditions, impact magnitude and geographical extent.

Table 13: Summary of potential impacts to biological receptors as a result of effluent discharge to Brown Bay from Brown's Bay Packing Company fish processing plant.

Potential Impact	Impacted Receptor	Mode of Impact	Mitigation Factors	Risk Assessment
Enhanced nutrients and bacteria in effluent receiving environment altering the natural marine environment	Aquatic resources – water quality Biological receptors – marine organisms Biological receptors – recreational users	Bacteria and dissolved nutrients in effluent discharge	High current present in Brown Bay Rapid dilution rate recorded in vicinity of outfall Effluent subject to stringent wastewater treatment protocols prior to discharge	**Low risk:** Water quality testing results show consistent compliance with all relevant provincial water quality guidelines and criteria for acute and chronic exposure to nutrients and bacteria.
Reduction of water quality	Aquatic resources – water quality	Introduction of material from effluent discharge	High current present in Brown Bay Rapid dilution rate recorded in vicinity of outfall Effluent subject to stringent wastewater treatment protocols prior to discharge	**Low risk:** Insignificant variation in orthophosphate levels measured between sites and sampling dates. Biochemical Oxygen Demand levels below reportable detection limits throughout sampling period. pH levels consistently within BCAWQG values over reporting period.
Food source attraction altering natural wildlife behaviours leading to bioaccumulation	Biological receptors – marine food webs Biological receptors – recreational users (fishermen)	Organic matter attracting primary consumers to outfall Predation of primary consumers leading to bioaccumulation of harmful substances in secondary consumers	High current present in Brown Bay preventing settling of solid wastes Rapid dilution rate recorded in vicinity of outfall reducing availability of waste product Effluent subject to stringent wastewater treatment protocols prior to discharge including screening Brown Bay classified as low importance and low abundance for higher trophic level marine mammals Low abundance of secondary consumers identified around outfall	**Low risk:** Effluent screening procedures combined with high current and dilution rates present in receiving environment reduces availability of potential food sources for primary consumers
Chronic exposure to toxic substances	Biological receptors – marine organisms	Long term exposure to chemicals in effluent resulting in bioconcentration to toxic levels in marine organisms	High current present in Brown Bay Rapid dilution rate recorded in vicinity of outfall Effluent subject to stringent wastewater treatment protocols prior to discharge	**Low risk:** Water quality testing results show consistent compliance with all relevant provincial water quality guidelines and criteria for acute and chronic exposure to nutrients and bacteria.
Cumulative effect of stressors present in Brown Bay	Biological receptors – marine organisms Biological receptors – recreational users Aquatic resources – water quality	Boat traffic wake / wave action Physical disturbance from boat movement Leaching / spills of harmful material to water from boats Cumulative impact of other outfalls in Brown Bay	High current present in Brown Bay causing rapid dilution of effluent No wake zone inside marina breakwater	**Probable low to moderate risk:** Water quality testing results show consistent compliance with BCAWQG. Water quality testing required from other emission sources within receiving environment to adequately quantify level of impact from Brown's Bay Packing Company

4.14 Cumulative Effects of Effluent Combined with Other Sources

The below text is copied from Mainstream Biological Consulting, Brown's Bay Packing Ltd Effluent Outfall Amendment Receiving Environment Assessment Update, November 29, 2018, Appendix C.

The area around the outfall is subject to frequent boat traffic and associated wave action. Additionally, Brown Bay hosts a floating restaurant, RV park and marina as well as a number of private dwellings. The presence of a marina and the associated boat traffic is likely to have an environmental impact on water quality from compound deposits from vessels including zinc and copper. Frequent movement of motorized vessels may disturb marine life and products including detergents, paints, batteries and hydrocarbon based oils and fuels used to run boats may leach into the water causing harmful effects on biological receptors (EPonline, 2017). Three other outfall stations are mapped within Brown Bay (MBC, 2010). Any environmental impacts to biological receptors in Brown Bay are subject to these factors in addition to exposure to effluent emitted from the packing plant outfall. In order to correctly quantify the overall impact of the processing plant effluent, the characteristics of the other stations are required to properly assess the volume and type of emissions currently discharged into the receiving environment in Brown Bay.

5. Monitoring Plans

5.1 Discharge Monitoring

5.1.1 Flow Measurement

By March 30, 2019, the permittee will install and maintain a flow measuring device suitable to the Director and record once per day the effluent volumes discharged over a 24-hour period for each of the two waste streams (sewage effluent stream and process wastewater streams) prior to the streams combining and discharging.

In addition, the permittee will install and maintain suitable flow measuring devices to monitor and record continuously the temperature and peroxide of the processing effluent (downstream of the authorized treatment works, above the high tide level but before the domestic sewage tie-in point).

5.1.2 Discharge Composite Sampling of Effluent

A suitable sampling facility is installed and a composite sample of the processing wastewater effluent will be obtained prior to discharge once every month. The Permittee will collect composite samples consisting of no less than seven discrete samples collected hourly over an eight-hour period and mixed to form a single sample. Alternatively, the Permittee may use a flow proportional continuous sampler which is acceptable to the Director. The Permittee will take due care in sampling, storing and transporting the samples to control temperature and avoid contamination, breakage, and any other factor of influence that may compromise the integrity of the samples.

5.2 Continuous Process Monitoring

The wastewater effluent system will be monitored daily. Visual inspections of the equipment will be conducted throughout each operating day. The control system will incorporate a graphical display, at the treatment facility located in an area routinely traversed by maintenance staff, which will also be viewed throughout the day; alarms will be indicated by a flashing icon on the screen and an audible siren. Setpoints for ORP, TSS, pH, and peroxide will be constantly monitored and automatically adjusted.

5.3 Receiving Environment Monitoring Plan

5.3.1 Receiving Environment Monitoring

Monitoring will be conducted between June 1st and September 30th. To allow for comparison to applicable Water Quality Guidelines (WQGs), each bout of receiving environment monitoring will include eight rounds of samples, taken weekly, collected within 60 consecutive days (at each of six sites specified in section 5.3.2). Sampling will be conducted to ensure that at least one round of sampling occurs:

(a) During a period that includes operation of at least 80% peak plant production, and
(b) During the period of highest recreational use of the surrounding, impacted waters.

All sampling will be undertaken during periods when the plant is operating and discharging effluent. Each bout of sampling will be scheduled such that at least one round off sampling occurs during each phase of tidal cycle. Based on a review of at least 3 years of annual monitoring, the frequency of sampling may be reduced subject to approval by the Director.

For quality control, a field blank will be collected during each sampling session and duplicates will be collected for a minimum of 10% of the samples collected. A monitoring report will be submitted to the Regional Manager, Environmental Protection annually, by December 31 of the calendar year following sampling.

5.3.2 Receiving Environment Grab Sampling & Depth Profile Sites and Replicates

The six sites will be located as follows:

(a) site 1, outfall terminus: 50 09.78467N 125 22.37344W,
(b) site 2, 15m North: 50 09.791N 125 22.367W,
(c) site 3, 45m North: 50 09.803N 125 22.351W,
(d) site 4, 15m South: 50 09.778N 125 22.381W
(e) site 5, 45m South: 50 09.764N 125 22.394W
(f) site 6, 15m East: 50 09.779N 125 22.364W,
(g) site 7, 45m East: 50 09.770N 125 22.343W, and
(h) site 8, reference (1700m N of outfall terminus): 50 10.665N 125 22.740W.

5.3.3 Receiving Environment Profile Monitoring Depths

To identify the location of the plume, water column profile data will be collected prior to collection of each set of grab samples at the sites specified by Section 5.3.2, at the following depths:

(a) at one metre depth,
(b) every two metres to one metre from the bottom and,
(c) One metre from bottom.

5.3.4 Receiving Environment Grab Sampling Depths

Receiving environment grab sampling at sites specified in Section 5.3.2 will be conducted at the following depths:

(a) surface (0.5 metre depth),

(b) if located, at the depth of the plume or, if plume cannot be located, at 6 m depth, and
(c) one m from the bottom.

5.3.5 Field Measurements for Depth Profiling

At sites specified in Section 5.3.2 and depths specified in Section 5.3.3, profile measurements of the following will be obtained prior to grab sampling:

(a) Temperature,
(b) Dissolved Oxygen (% and mg/L),
(c) pH,
(d) Specific Conductivity (µS/cm) and,
(e) Salinity

This data will be uploaded to EMS by the analyzing laboratory following analysis and submitted to the province annually.

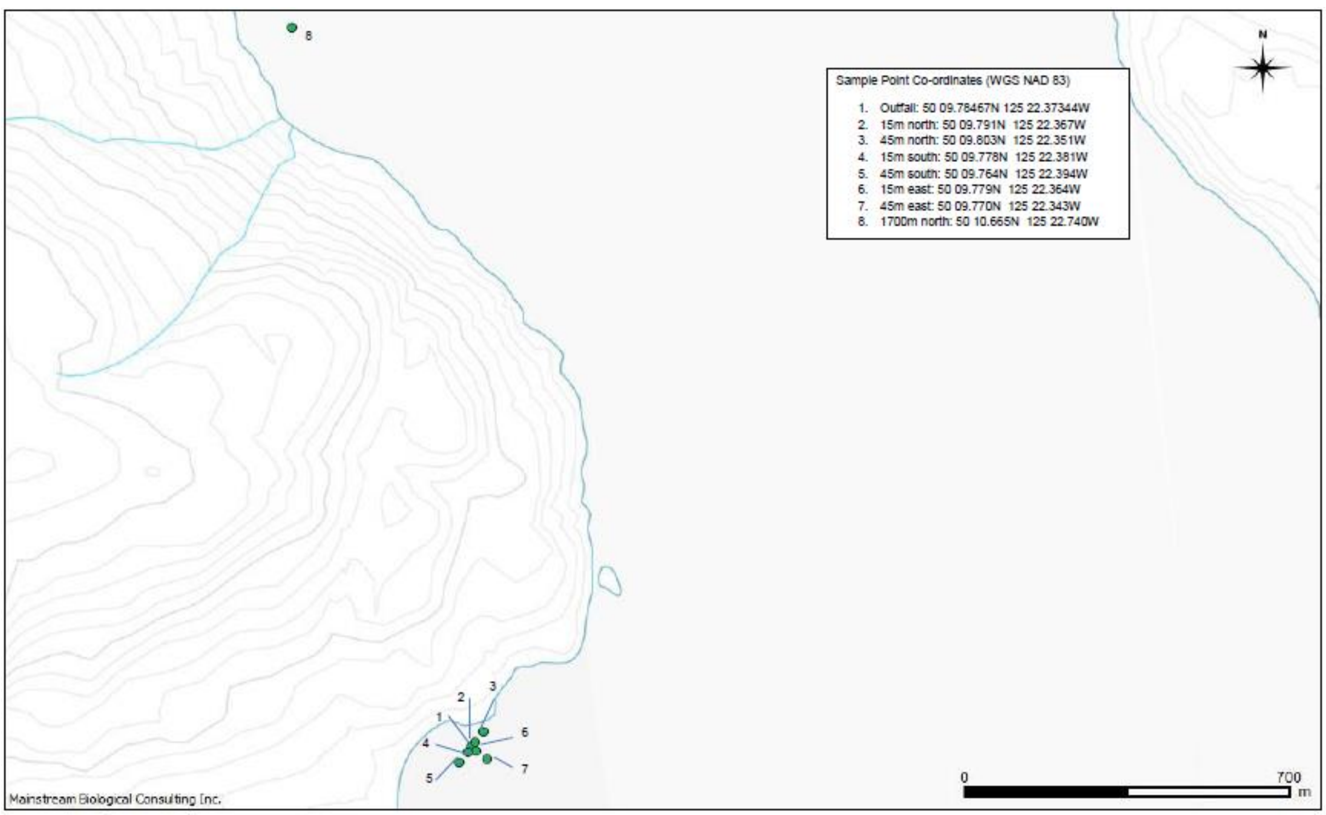
5.3.6 Analyses for Receiving Environment Monitoring

Analyses of the following parameters of receiving environment grab samples will be obtained:

(a) Ammonia and,
(b) Nitrate

This data will be uploaded to EMS by the analyzing laboratory following analysis and submitted to the province annually.

5.3.7 Sampling Locations Map



5.4 Data Assessment and Reporting Plan

5.4.1 Annual Report and Evaluation

The permittee will, within six months of the collection of the last set of receiving environment sampling during the term of this authorization, prepare and submit to the Director an Annual Report that is satisfactory to the Director and includes, but is not limited to, the following:

(a) The Annual Report must review and interpret the measurements for effluent volume and quality and receiving environment monitoring data for the preceding calendar year, and provide a graphical analysis, with suitable interpretation by a qualified professional, of any trends in monitoring results.
(b) The Annual Report will include an evaluation of the performance of the treatment works and identify any necessary changes. The Annual Report will include an implementation schedule for any alterations to the treatment and disposal works.

Results of the Effluent Monitoring and Receiving Environment Monitoring programs will be reported in accordance with the applicable sections of the most recent edition of "Technical Guidance 4, Environmental Management Act Authorizations, Annual Reporting Under the Environmental Management Act, A Guide for Mines in British Columbia" or by suitable alternative procedures as approved by the Director, written and signed off by a qualified professional.

5.4.2 Non-compliance Reporting

If the permittee fails to comply with any of the requirements of this authorization, the permittee will, within 30 days of such non-compliance, submit to the Director a written report that is satisfactory to the Director and includes, but is not necessarily limited to, the following:

(a) all relevant test results obtained by the permittee related to the non-compliance,
(b) an explanation of the most probable cause(s) of the non-compliance, and
(c) a description of remedial action planned and/or taken by the permittee to prevent similar non-compliance(s) in the future.

The permittee will submit all non-compliance reporting required to be submitted under this section by email to the Ministry's Non-Compliance Reporting Submission Mailbox at EnvironmentalCompliance@gov.bc.ca.

5.4.3 Spill Reporting

The permittee will immediately report all spills to the environment (as defined in the Spill Reporting Regulation) in accordance with the Spill Reporting Regulation, which among other things, requires notification to the Provincial Emergency Program at 1-800-663-3456.

5.5 Quality Control and Quality Assurance

5.5.1 Sampling and Lab Analysis QA/QC

Sampling will be carried out in accordance with the procedures described in the most recent edition of the "British Columbia Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples", or by suitable alternative procedures as authorized by the Director.

Analyses will be carried out in accordance with procedures described in the most recent edition of the "British Columbia Laboratory Methods Manual for the Analysis of Water, Wastewater, Sediment, Biological Materials and Discrete Ambient Air", or by suitable alternative procedures as authorized by the Director.

All data of analyses required to be submitted by the permit will be conducted by a laboratory acceptable to the Director. At the request of the Director, BBPC will provide the laboratory quality assurance data, associated field blanks and duplicate analysis results along with the submission of the data required by the effluent and receiving environment monitoring protocol.

6. Domestic Sewage

6.1 Domestic Sewage System

Domestic sewage from the processing plant washroom facilities is diverted to a 23m^3 polyethylene white water treatment system located under the administration and workshop building.

Design guidelines from the *Sewerage System Standard Practices Manual* (BCOSSA, 2007) estimate the daily flow from cafeteria, shower and toilet use to be 75L per employee. Based on the entire staff of 50 employees, estimated maximum daily flows on a processing day are 3.75 m^3 (BCOSSA, 2007), the residence time of the wastewater in the system is over 6 days, which will produce better than typical septic tank effluent.

The domestic sewage effluent is discharged through the same marine outfall as the process wastewater. The two lines are connected in the intertidal zone. The outfall is constructed of 8" HDPE pipe with concrete anchors, and terminates in four 2" diffuser ports. It is 100m long and the terminus is 26m deep at low tide. Sludge is removed from the tank as required and disposed of at the Norm Wood Environmental Centre in Campbell River.

6.2 Summary of Domestic Sewage Quality and Quantity

Table 6.2. Estimated effluent characterization, justification and guideline values.

	Basis of Expected Value	Expected Value [Quantification Method]	Discharge Limit
Daily Flow (m^3)	SSSPM	2.3 avg (3.4 max) [Batch dose with counter]	<10
TSS (mg/L)	SSSPM	45 avg (75 max) [Certified Lab 2017 an 2018]	N/A
BOD_5 (mg/L)	SSSPM	32 avg (34 max) [Certified Lab 2017 and 2018]	N/A
Fecal Coliform (MPN/100mL)	SSSPM	10^4 [Certified Lab]	N/A

6.3 Domestic Sewage Monitoring Plan

The BC Municipal Wastewater Regulation does not stipulate effluent quality maxima for discharges to marine waters of less than $10m^3$/day (although septic tanks are required, and design requirements are outlined). At BBPC the high currents in the area will greatly mitigate any potential impact of the discharge of black water.

BBPC will monitor daily flow rates from their domestic wastewater treatment system. If daily average flows exceed $10m^3$/day, effluent monitoring as per BC Water Quality Guidelines will commence.

Appendix A

Existing BBPC Effluent discharge Permit, PE-8124

BRITISH COLUMBIA
The Best Place on Earth

April 16, 2010

Tracking Number: 101038
Authorization Number: 8124

J.W. Timber Co. Ltd.
2705 Island Highway N
Campbell River, BC V9W 2H4

Dear J.W. Timber Co. Ltd.:

Re: Your application for a Permit Transfer under the Environmental Management Act

In response to your letter dated June 1, 1998, and pursuant to Section 17 of the Environmental Management Act, the Director hereby consents to the transfer of Permit PE-8124 from J.W. Timber Co. Ltd. to Brown's Bay Packing Company Ltd.

Furthermore, pursuant to Section 16 of the Environmental Management Act, Permit PE-8124 is hereby amended to reflect the name change from J.W. Timber Co. Ltd. to Brown's Bay Packing Company Ltd. A copy of the permit is enclosed for your records. Please note that although a revised permit has not been produced at this time, a copy of this letter is being placed on the permit file, as an addendum to the permit, to reflect the change in the name of the permit holder. Brown's Bay Packing Company Ltd. is now the permittee with all inherent rights and responsibilities. Your attention is respectfully directed to the conditions of the permit. An annual fee for the permit will be determined in accordance with the Permit Fee Regulation

This permit does not authorize entry upon, crossing over, or use for any purpose of private or Crown lands or works, unless and except as authorized by the owner of such lands or works. The responsibility for obtaining such authority rests with the permittee. This permit is issued pursuant to the provisions of the Environmental Management Act to ensure compliance with Section 120(3) of that statute, which makes it an offence to discharge waste, from a prescribed industry or activity, without proper authorization. It is also the responsibility of the permittee to ensure that all activities conducted under this authorization are carried out with regard to the rights of third parties, and comply with other applicable legislation that may be in force.

This decision may be appealed to the Environmental Appeal Board in accordance with Part 8 of the Environmental Management Act. An appeal must be delivered within 30 days from the date that notice of this decision is given. For further information, please contact the Environmental Appeal Board at (250) 387-3464.

Administration of this permit will be carried out by staff from the regional office. Plans, data and reports pertinent to the permit are to be submitted to the Regional Manager, Environmental Protection, at 2080A Labieux Road, Nanaimo, BC V9T 6J9.

Yours truly,

Blake W. Medlar
for Director, Environmental Management Act
Vancouver Island Region

CC: Environment Canada

ENCL: Authorization Document

Province of
British Columbia

Ministry of
Environment
[redacted]

Vancouver Island Region 1
Regional Headquarters
2569 Kenworth Road
Nanaimo
British Columbia
V9T 4P7
Phone: (604) 758-3951

FEB 16 1989

REGISTERED MAIL

File: PE-8124

J. W. Timber Co. Ltd.
906 Island Highway
Campbell River, British Columbia
V9W 2C3

Gentlemen:

LETTER OF TRANSMITTAL

Enclosed is a copy of Permit No. PE-8124, issued under the provisions of the Waste Management Act, in the name of J. W. Timber Co. Ltd. Your attention is respectfully directed to the terms and conditions outlined in the Permit. An annual fee for Permit No. PE-8124 will be determined on the basis of your industrial code and capacity in accordance with the Waste Management Permit Fees Regulation.

The administration of this Permit will be carried out by staff from our Regional Office located at 2569 Kenworth Road, Nanaimo, British Columbia, V9T 4P7 (telephone 758-3951). Plans, data and reports pertinent to the Permit are to be submitted to the Regional Waste Manager at this address.

You will note that values have been expressed in the International System of Units (SI). These units are to be used in submitting monitoring results and any other information in connection with this Permit.

This Permit does not authorize entry upon, crossing over, or use for any purpose of private or Crown lands or works, unless and except as authorized by the owner of such lands or works. The responsibility for obtaining such authority shall rest with the Permittee.

Yours very truly,

G. E. Oldham

G. E. Oldham, P. Eng.
Regional Waste Manager

MINISTRY OF ENVIRONMENT

PERMIT

Under the Provisions of the Waste Management Act

J. W. TIMBER CO. LTD.
906 Island Highway
Campbell River, British Columbia
V9W 2C3

is hereby authorized to discharge effluent
from a fish processing plant
located at Brown Bay, British Columbia
to Brown Bay.

This permit has been issued under the terms and
conditions prescribed in the attached Appendices
01, A-1, B-1, and C-1

Regional Waste Manager
Permit No. PE-8124

Date issued: FEB 16 1989
Date amended: ____________

ENV 2093

MINISTRY OF ENVIRONMENT

WASTE MANAGEMENT BRANCH

APPENDIX 01

to Permit No. PE-8124

(Effluent)

(a) The discharge of effluent to which this appendix is applicable is from a fish processing plant as shown on the attached Appendix A-1.

(b) The maximum rate at which effluent may be discharged is 28 m^3/d.

(c) The characteristics of the effluent shall be equivalent to or better than fine screened fish processing effluent plus typical septic tank effluent.

(d) The works authorized are coarse screen floor drains, sump, and Rotostrainer (0.5 mm apertures) for the process wastewater, two septic tanks (2.1 m^3 and 2.9 m^3, respectively) for the domestic sewage, a common outfall terminating 30 m from and 15 m below mean low water, and related appurtenances approximately located as shown on the attached Appendix A-1.

(e) The location of the facilities from which the effluent originates and to which this appendix is appurtenant is that parcel or tract of land situated on Lot 1150 at Brown Bay, Sayward District and all that parcel or tract of land situated at Brown Bay, Sayward District, containing 0.500 ha more or less, Ministry of Lands File No. 1403960 and all that parcel or tract of land (water) situated at Brown Bay, Sayward District being a pier under Crown File No. 1404327.

(f) The location of the point of discharge and to which this appendix is appurtenant is Brown Bay.

(g) Those works authorized must be completed and in operation when discharge commences.

Date issued: FEB 1 6 1989

Date amended: ______

Regional Waste Manager

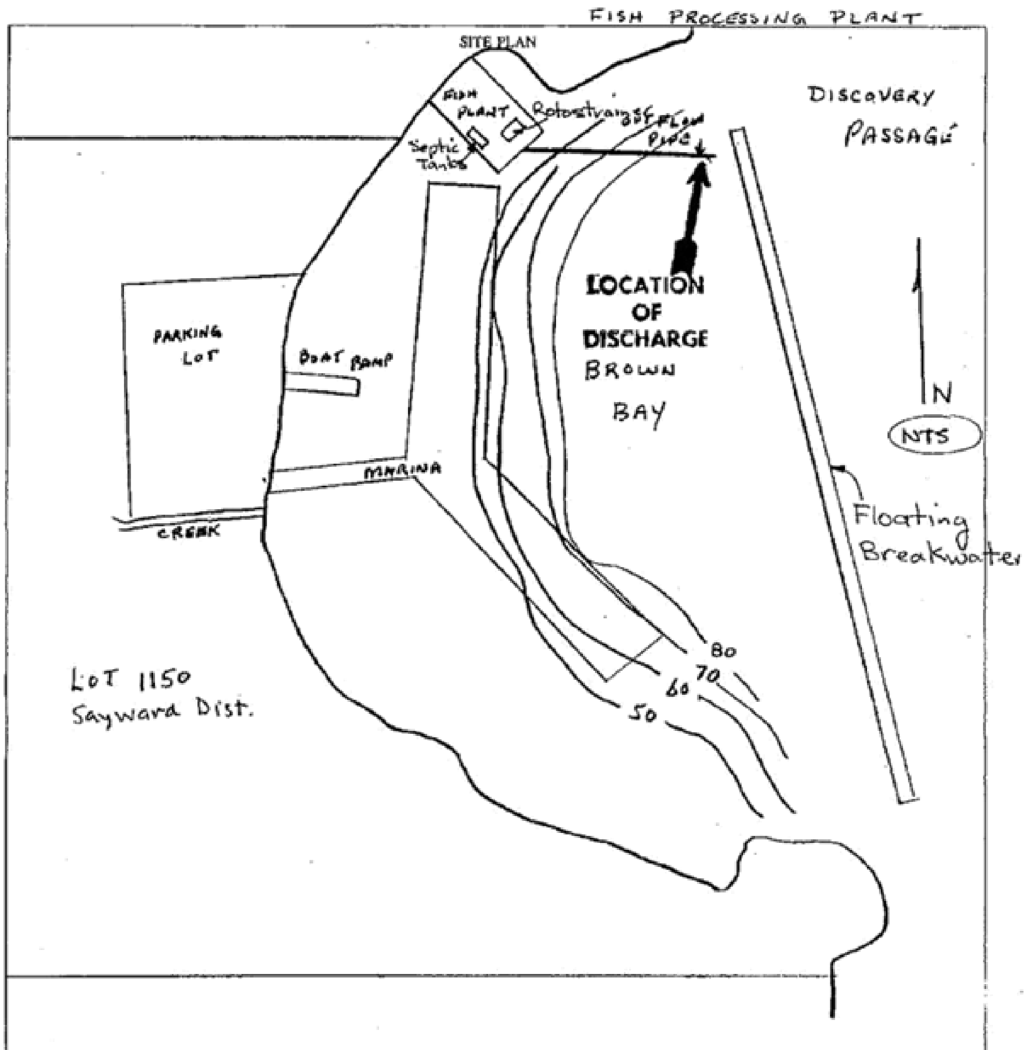
ENV. 2096 wa2

Province of British Columbia

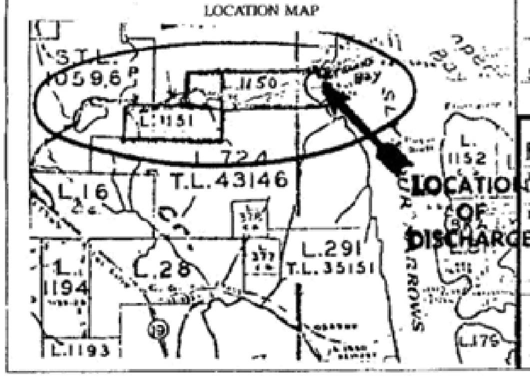
Ministry of Environment

WASTE MANAGEMENT BRANCH

SITE PLAN



LOCATION MAP



J. W. TIMBER CO. LTD.
(Name of applicant)

SEPT 2/88 (Date)

(Signature of applicant(s) or agent)

(FOR OFFICE USE ONLY)

FEB 1 6 1989 — Date Issued

Regional Waste Manager

Date Amended

Appendix A-1 to Permit No. PE-8124

Approval No.

ENV 1987

MINISTRY OF ENVIRONMENT
WASTE MANAGEMENT BRANCH

APPENDIX B-1

to Permit No. PE-8124

A. MAINTENANCE OF WORKS

The Permittee shall inspect the pollution control works regularly and maintain them in good working order. Notify the Regional Waste Manager of any malfunction of these works.

B. BYPASSES

The discharge of effluent which has bypassed the authorized works is prohibited unless the approval of the Director or the Regional Waste Manager is obtained and confirmed in writing.

C. PROCESS MODIFICATIONS

The Permittee shall notify the Regional Waste Manager prior to implementing changes to any process that may affect the quality and/or quantity of the discharge.

D. POSTING OF OUTFALL

The Permittee shall erect a sign along the alignment of the outfall above high water mark. The sign shall identify the nature of the works. The wording and size of the sign shall be approved by the Regional Waste Manager.

E. SEPTIC TANK SLUDGE AND SCUM REMOVAL

Sludge and scum shall be removed from the septic tanks annually, or at other frequencies as the Regional Waste Manager may allow, for disposal at a suitable site. The disposal arrangements are subject to the approval of the Regional Waste Manager. Records of sludge and scum removal should be maintained for inspection.

F. EFFLUENT UPGRADING

Based on receiving environment monitoring data and/or other information obtained in connection with this discharge, the Permittee may be required to provide additional treatment facilities.

Date issued: FEB 16 1989

Date amended: ______

Regional Waste Manager

MINISTRY OF ENVIRONMENT
WASTE MANAGEMENT BRANCH

APPENDIX C-1

to Permit No. PE-8124

A. FLOW MEASUREMENT

Periodic measurements of the effluent volume discharged over specified 24-hour periods may be required by the Regional Waste Manager. Suitable provisions should therefore be incorporated into the works to accommodate this requirement. If approved by the Regional Waste Manager, water consumption records may be acceptable in lieu of actual discharge measurements.

Date issued: FEB 16 1989

Date amended: __________

Regional Waste Manager

Appendix B

Treatment and Processing Plant Chemical MSDSs

Appendix B.1 Hydrogen Peroxide 50%

Appendix B.2 Hydrochloric Acid 35%

Appendix B.3 Sodium Hydroxide 50%

Appendix B.4 Savall

Appendix B.5 Roughrider II

Appendix B.6 Oxygentle

Appendix C

Brown’s Bay Packing Ltd Effluent Outfall Assessment Receiving Environment Assessment Update, Mainstream Biological Consulting, November 29, 2018

Appendix D

Brown’s Bay Packing Company Dilution Model Data Summary, Great Pacific Engineering & Environment, November 30, 2018

Appendix E

Brown’s Bay Packing Treatment Process Upgrades Equipment Specifications

Appendix F

Brown's Bay Packing Treatment Process Engineer Sign Off

Appendix G

Brown’s Bay Packing Technical Assessment, May 2013