Registration Document

for

The Johnson Lake Hatchery Project

Charlotte County
Province of New Brunswick

December 11, 2018

Prepared for:
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SIMCorp File # SW2018-138

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December 11, 2018

SIMCorp File #SW2018-138

Ms. Rachelle Voisine
Project Manager
Environmental Assessment Section
PO Box 6000
Fredericton, NB E5B 5H1

Dear Ms. Voisine:

RE: Project Registration: Johnson Lake Hatchery Project

Sweeney International Management Corporation (Simcorp) was retained by Kelly Cove Salmon Limited (KCS), a Division of Cooke Aquaculture Incorporated (CAI), to submit a Registration Document for the Johnson Lake Hatchery Project (the Project) as required by Section 5(1) of the EIA Regulation.

Historically, the existing Johnson Lake Hatchery (JLH) has been used as an egg incubation and first feeding facility and currently the facility uses a basic recirculation aquaculture system (RAS) that was installed to maintain discharge requirements and allow for a future expansion.

The proposed Project would see the existing facility expand to include a fry and large parr or 'pre-smolt' facility constructed on a portion of pre-worked land adjacent to the existing facility and on the same Parcel Identification Number (PID). With the installation and use of low water exchange state-of-the-art RAS technology, the expansion would not require any additional water requirements and would maintain environmental compliance as prescribed in the current Approval to Operate (I-8800).

The proposed Project would allow CAI to diversify and segregate its early rearing operations, increase efficiency and, decrease costs that are associated with delayed hatching and first feeding operations due to the limited fresh water resources that are being used for smolt rearing.

Once you have had the opportunity to review the attached Registration Document, please do not hesitate to contact us to address any questions/concerns you may have.

Sincerely,

David Hyslop, BSc., P.Eng.
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LIST OF ACRONYMS

DFO	Department of Fisheries and Oceans
EIA	Environmental Impact Assessment
NBDAAF	New Brunswick Department of Agriculture, Aquaculture and Fisheries
NBDELG	New Brunswick Department of Environment and Local Government
RAS	Recirculating Aquaculture System
PBS	Performance Based Standards
PID	Parcel Identifier
TSS	Total Suspended Solids
WTS	Wastewater Treatment System
SOCI	Species of Conservation Interest
EC	Environment Canada
NB DNR	New Brunswick Department of Natural Resources
NB DERD	New Brunswick Department of Energy and Resource Development
SARA	Species at Risk Act
NB SAR	New Brunswick Species at Risk
COSEWIC	Committee on the Status of Endangered Wild in Canada
ACCDC	Atlantic Canada Conservation Data Centre
S-Rank	Subnational Rank
KCS	Kelly Cove Salmon Ltd.
CAI	Cooke Aquaculture Inc.
WSSA	Water Supply Source Assessment
WAWA	Watercourse and Wetland Alteration
JLH	Johnson Lake Hatchery
VEC	Valued Environmental Component
FCR	Feed Conversion Ratio
WMP	Waste Management Plan
ICP	Integrated Contingency Plan

1.0 THE PROPONENT

Cooke Aquaculture Inc. (CAI) is a vertically-integrated aquaculture corporation based in Blacks Harbour, New Brunswick, Canada with salmon farming operations in Atlantic Canada, the United States, Chile and Scotland. The Cooke family's group of companies began with Cooke Aquaculture, which was established in 1985 as Kelly Cove Salmon (KCS) by Gifford, Michael and Glenn Cooke. Through KCS, CAI operates several land-based salmon hatcheries in Charlotte County, NB. CAI plans to expand an existing Johnson Lake hatchery (JLH) located in Pennfield, NB, previously owned by Johnson Lake Fisheries Ltd. This hatchery will utilize a state-of-the-art low water exchange system for the rearing of salmon fry and large parr or 'pre-smolt'.

1.2 Proponent and Consultant Information

Contact Information for the Proponent and consultants are as follows:

Proponent
Kelly Cove Salmon Ltd. a Division of
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2.0 THE UNDERTAKING

2.1 Name of Undertaking

Johnson Lake Hatchery Project (the Project).

2.2 Project Overview

Kelly Cove Salmon Limited (KCS) has purchased the Johnson Lake Fisheries Inc. hatchery at Johnson Lake, Pennfield, NB. KCS has been operating the hatchery since July 2018, and has plans to build a near zero water change, state-of-the-art Recirculating Aquaculture System (RAS), at the existing facility along with a new building (and associated infrastructure) to house new fry and large parr (or 'pre-smolt') systems.

The existing hatchery has been operated since 2001 and historically produces fry of up to 5 grams. The current Egg Incubation system operates by flow-through (single water pass), with an option to capture and re-use a portion of the water in the First Feed system. The existing First Feed system operates at 90% recirculation resulting in the use of 1200 liters of new water per kilogram of feed fed. The proposed upgrade using new RAS technology would operate at 99% recirculation and reduce the water requirements to 350 liters of new water per kilogram of feed fed.

As part of the expansion, salmon fry will be stocked less than 5 grams and will remain in the fry system until they reach 16 grams, at which point they will be transferred to a new parr system where they will remain until they are 60 grams. The proposed fry and parr systems will have the capacity to maintain a biomass of 43 MT and 240 MT respectively, using state-of-the-art technology that will vastly reduce water requirements while maintaining optimal water quality for rearing salmon.

2.3 Purpose/Need/Rationale for the Undertaking

The rationale for the Project is the need for CAI to manage a 5-year growth plan that would see the Company's harvest from its east coast marine farms rise to 65,000 tonnes annually. To achieve this objective, CAI is looking to increase the average smolt size and implement a managed sustainable increase in numbers. With the need to increase annual production there is the requirement to increase the freshwater capacity and production which can only be achieved by increasing the Company's physical capacity through the development of new and additional facilities.

To increase the average smolt size, CAI's future plans involve establishing new large 'post-smolt' units situated close to saltwater access for improved shipping and logistics. These new purpose-built units will use the very latest in RAS technology which requires low volumes of new water, very large tanks and intensive effluent treatment (including denitrification, phosphorus capture and sludge handling). The economies of scale of large tanks and high biomass is seen as the best solution for a large increase in freshwater tank volume required to raise smolts to a 300g+ size. These units will be supplied by large numbers of vaccinated large parr or 'pre-smolt'.

By re-developing the recently acquired JLH facility to a new state-of-the-art RAS facility, the company will be able to diversify and segregate its early rearing operations more effectively and make better use of the genetic improvement afforded by the Oak Bay Hatchery brood-stock genetics program. Freshwater capacity is currently limited, which makes it very difficult to take advantage of early egg production since most of the available space is occupied by smolts, at a time when a proportion of that volume is needed for the newly hatched young fry from the subsequent generation. Thus, there is less capacity to take advantage of advanced and delayed eggs and effectively spread-out production.

The revitalized Johnson Lake facility will have the space to accommodate earlier fry allow the Company to produce larger fry and parr. These can then be used as either S_0 smolts and/or over-wintered in some of our existing cold flow-through units to help increase the average size of spring smolts at these farms. Delaying hatching and first feeding until smolts have been shipped to free up freshwater resources is a competitive disadvantage in terms of efficiencies and costs.

Improved large parr production from the proposed Johnson Lake Project is seen as the first step to populate the new, large-scale, land-based smolt and post-smolt production facility proposed for development in New Brunswick and Nova Scotia. This unit will supply the fish required to grow 300g+ smolt for spring stocking and 900g fish for the fall. In turn, the grow-out period in these post-smolt units will significantly shorten the time fish spend in sea cages before harvest and, allow the company to achieve its harvest production targets. This reduced time in saltwater will also allow a much easier way to manage biological and environmental challenges like sea lice, severe environmental conditions, and disease.

More specifically, the objectives of the Project will include:

1. Making new, additional freshwater space available to bridge the gap between hatching of each new year class and spring smolt transfer of the previous generation.

2. Growing larger sized juveniles for both S_1 and S_0 production leading to better survival, improved biological control and ultimately reduce the time market fish spend in sea cages.

3. Serving as a primary source of large vaccinated parr for the proposed new off-site large smolt / post smolt production units.

4. Production during the first phase will focus primarily on multiple batches of eggs to produce fry, large parr and spring smolt. The spring smolt will bridge a short-term lack in numbers required for our current saltwater stocking plans. Once the proposed "big" smolt units come on-line in the second phase of the freshwater component of our 5-year plan, JLH's primary focus will be geared to supplying the stock for these new units as well as providing capacity for more efficient use of the company's egg and genetics program.

2.4 Project Location

The Johnson Lake Hatchery (JLH) is located on the extension of the Jack Road, Pennfield, Charlotte County, 3 km northeast of Pennfield, NB (Figure 1 and L-1: Appendix B). The JLH is bordered by Johnson Lake to the north and partially forested land on the other three sides. The JLH has been operated by Kelly Cove Salmon Ltd. since July of 2018. The current hatchery is located on PID 15162282 which is accessed from a road through PID 01277107. There is an existing dwelling on the KCS owned land (PID 15197015) adjacent to the exiting hatchery (L-2: Appendix B). Project location details are summarized in Table 1 and further discussed in Section 2.5.1.

Table 1 Property Location Information

Site Name	Johnson Lake Hatchery
Civic Address	Jack Road Extension
PID(s)	15162282, 15197015, 01227107
Community	Pennfield, NB
County	Charlotte County
1:50 000 Topographic Map #	21G02 Edition 3
Grid Reference	45°12'19.36"N, 67°43'7.32"W 45.13871m N, -66.7187m W (Zone 19T)

2.5 Siting Considerations

The existing Johnson Lake Hatchery was owned and operated by Johnson Lake Fisheries Inc. The original EIA was submitted by Johnson Lake Fisheries Ltd. to the NB Department of the Environment

in March 1, 2000 and the Minister's Determination with Conditions of Approval was granted on February 26, 2001. The facility is currently operating under most recent Approval to Operate (ATO) for the facility is I-8800 which is valid until July 31, 2019 (Appendix A).

There are limited opportunities for new freshwater facilities in Atlantic Canada and particularly New Brunswick. CAI has worked with the owners of JLH in a contract-rearing arrangement for approximately 15 years and through this relationship are aware of the existing facility's potential. The current hatchery has a suitable and reliable groundwater source and a good track record of regulatory compliance (Appendix G) and the absence of serious disease issues.

Upon further assessment of the existing approvals and available resources it was determined that the existing JLH site would have the capacity to accommodate the size and dimensions to meet CAI objectives as described in Section 2.3. Additionally, the initial design of the facility showed there was no need to increase the amount of current water needed for the new project and, that with the new technology available for low water use RAS, waste water and sludge treatment, KCS is confident that environmental compliance will be met as prescribed in the current Approval to Operate (I-8800).

The JLH facility has previously gone through an EIA and had approval to increase production from its current output. JLH has already been set up to receive and hatch eggs and its first feeding unit has produced significant numbers of good quality of 2-3 gram fry. The large piece of property associated with the JLH is in a central area for CAI operational resources and when the owners made CAI aware of their intention to sell and go into retirement, CAI took the opportunity to purchase the facility and surrounding land (Figure 3 and L-2: Appendix B).

Construction of the new building would be relatively straightforward on the existing site. The proposed location for the new infrastructure has been previously cleared, grubbed and infilled for when the previous owner was approved for an expansion. The Project can easily be managed by local resources and would not interfere with the running of the existing hatchery.

This proposed location for the Project is seen as a unique opportunity for CAI as they do not currently have any assets available within NB suitable to do a project of this nature.

Figure 1 Project Location

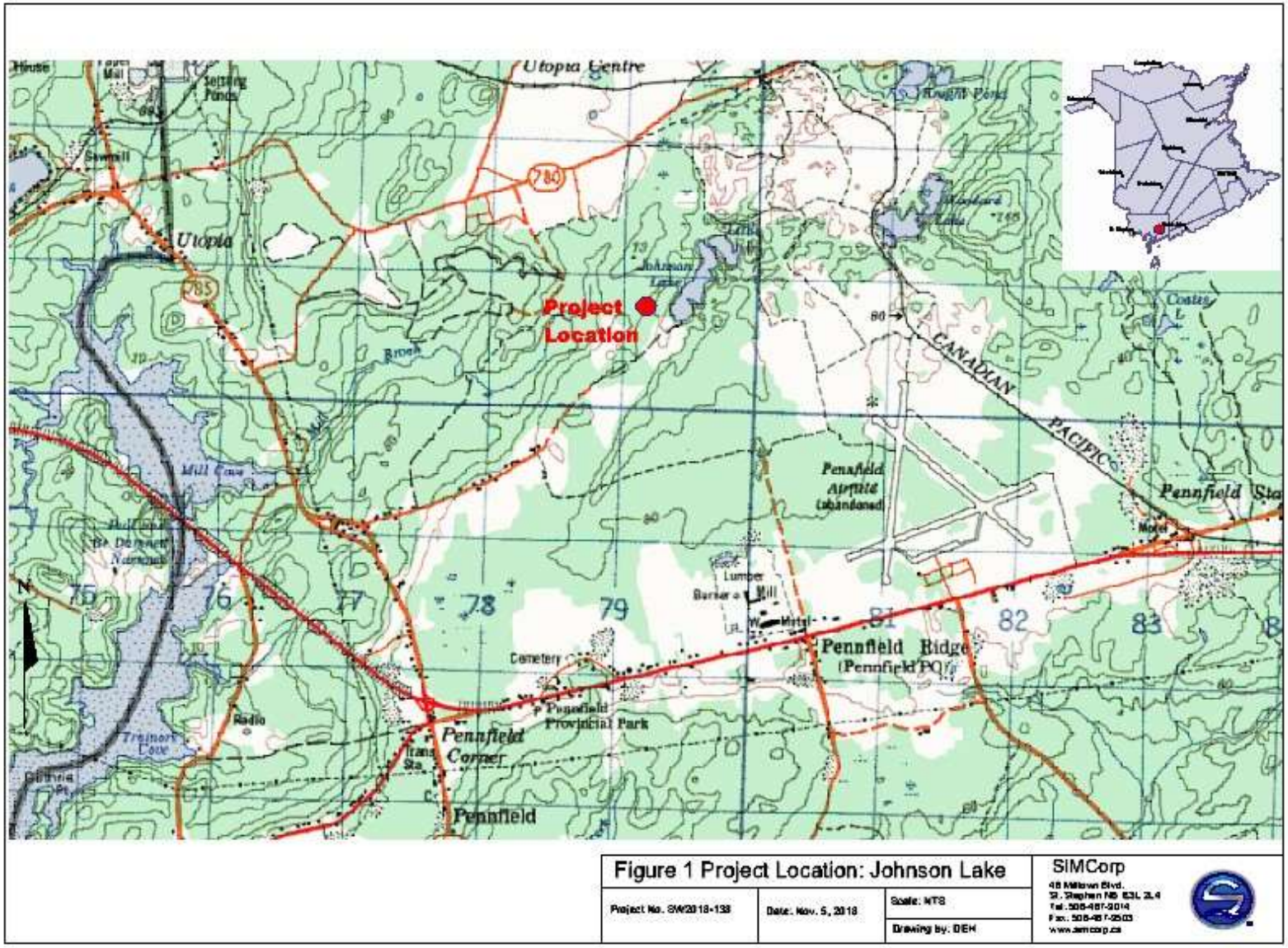
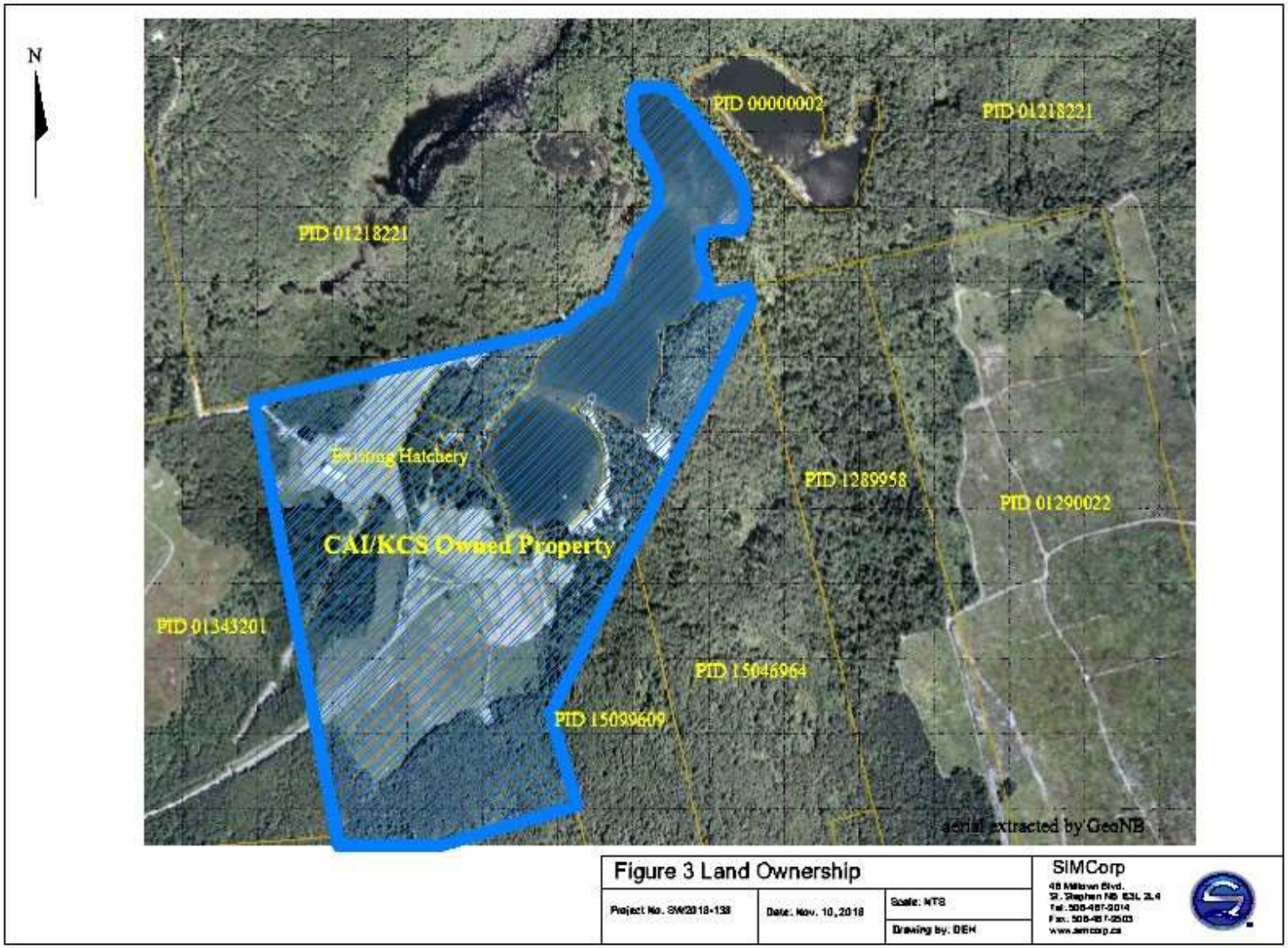


Figure 2 Aerial View of Johnson Lake Facility

Figure 3 Land Ownership



2.5 Johnson Lake Facility-Existing

2.5.1 Existing Facility Description

As discussed in Section 2.4 and summarized in Table 1, the existing hatchery, and proposed location for the new building for fry and parr/pre-smolt, is located on PID 15162282. There are two controlled access points prior to accessing the current JLH. There is an existing right-of-way at the end of Jack Road, with a controlled access point (gated) across PID 01343201 (owned by others) to PID 01227107 (CAI owned property) which accesses a second controlled access point (gated with biosecurity building) to the existing JLH and proposed Project (located on PID 15162282). This is illustrated on Drawing L-2 in Appendix B.

The existing facility includes a fabric building 12.20m [40'-0"] wide by 35.05 m [115'-0"] long (Figure 4). The fabric building houses egg incubation racks and rearing tanks. The treatment system for the existing rearing tanks is housed in a separate building behind the fabric building and an unused steel wall tank. The unused steel wall tank is 12.0m [40'-0"] diameter x 1.45m [4'-9"] walls and doesn't have a bottom. The tank has the proper drainage pipe install, but no supply. On the front of the fabric building is a small enclosure housing the electrical supply for the facility. The existing Project area, infrastructure, and topography is illustrated on drawing L-3 Plan in Appendix B.

Figure 4 Existing JLH Facility (Front View)

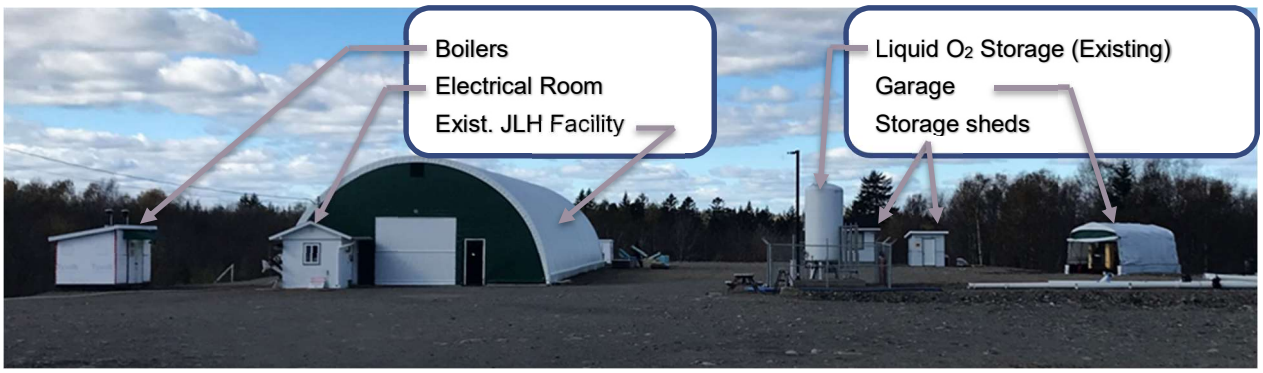


Figure 5 Existing Steel Tank (Rear of JLH Building)

2.5.2 Egg Incubation

There are currently (4) Alvestad CompHatch racks on site. Historically, each rack required 5.3 m^3/h [23.3 gpm] of water, totalling 21.2 m^3/h [93.3 gpm] for all four. Currently this water is single pass, flow through, with the option to re-use some or all of the water in the first feeding RAS. If the water is not re-used, it is discharged to the settlement ponds.

No feed is fed to the fish while they are in this system, and there is no temperature control for the racks.

2.5.3 First Feeding RAS

The existing First Feeding system on site, originally a flow through system, was upgraded by the previous owners to create a basic recirculation aquaculture system (RAS). This was done to maintain compliance with DELG discharge requirements and to allow for future expansion. Following the upgrade, the system requires approximately 1600 L of new water per kilogram of feed fed to maintain optimal water quality. In this system, the limiting parameter is ammonia. The new water is added to maintain ammonia concentrations at or below 3.5 mg/L, while feeding 1.5-million 3.5 g fish up to 200 kg/day. During this peak feeding period, the system requires 13.6 m^3/hr [60 gpm] of new water.

In addition to this system's water requirements, the two drum filters that are used in the recirculation loop require backwash water which is estimated to be 3.6 m^3/h [16 gpm] at peak biomass. This brings the total First Feeding water requirements to 17.2 m3/h [76 gpm].

The existing system is illustrated in drawings D-A1 (Plan View) and D-A2 (Elevation and Section), in Appendix B. The system has a recirculating water flow rate of approximately 174 m^3/hr [766 gpm],

giving a retention time of approximately 50 minutes. The process, illustrated in the block flow in Figure 7, includes: primary solids removal, ammonia conversion, secondary solids removal, gas balancing, and oxygenation. While these are the components of modern RAS, which require 350 L per kilogram of feed fed, the existing components do not have the capacity for such low water exchange. The system could be optimized by upgrading some of the system components. Some benefits of optimizing the system include: improved water quality, decreased new water demand and reduced ammonia discharge.

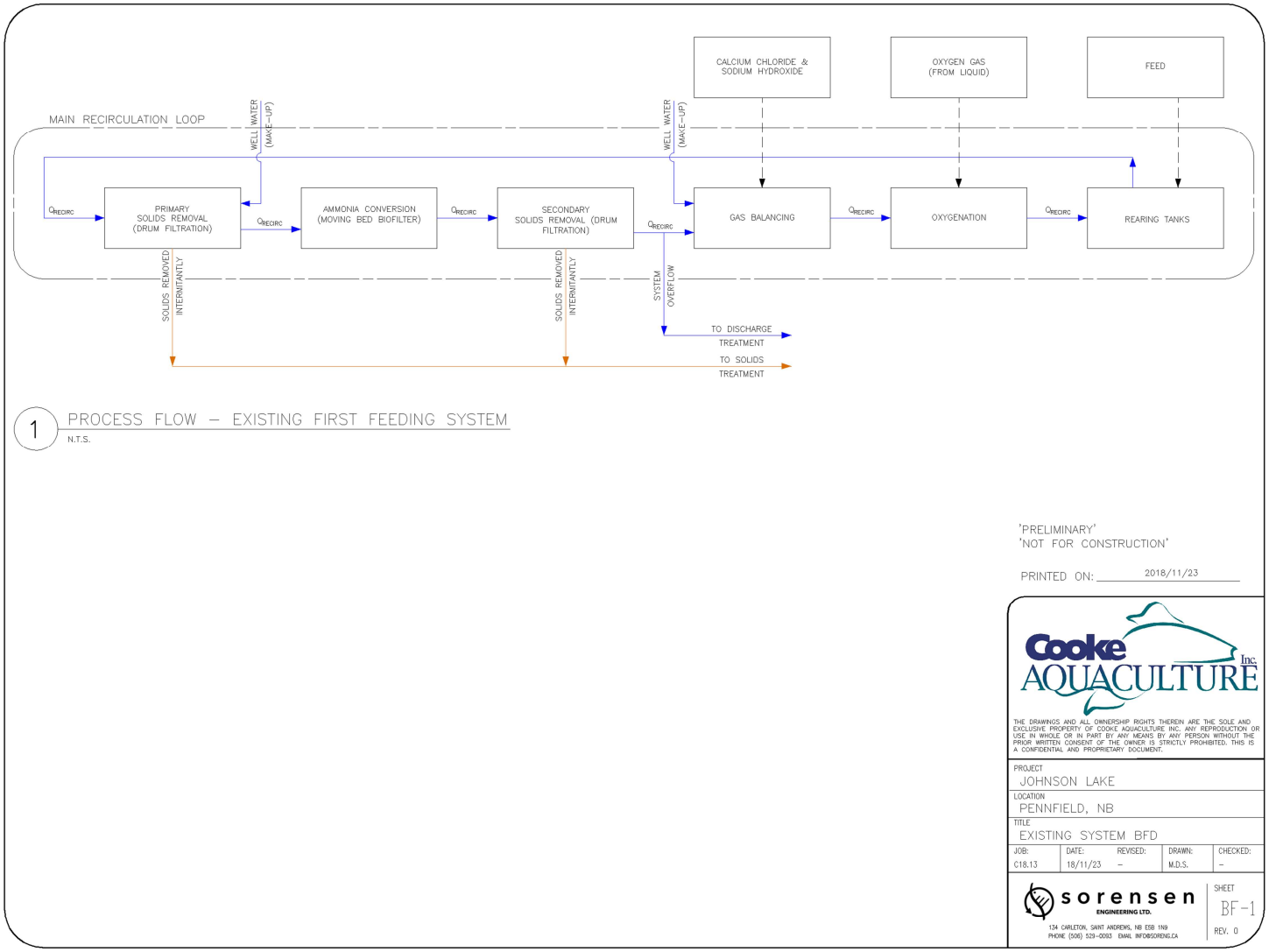
The following is a description of each component in the existing RAS with a schematic of the process flow illustrated in drawing PF-A1 in Appendix B:

There are fourteen (14) existing **Culture tanks** in the system (Figure 6). Historically, twelve (12) tanks have been used for rearing fish, leaving two (2) available for grading and shipping. The rearing tanks are 3.66 m [12'-0"] in diameter and are 1.14 m [3'-9"] deep, resulting in 12.0 m^3/tank or 144 m^3 of potential rearing space in 12 tanks or 168 m^3 for 14 tanks.

Figure 6 Existing First Feed Tanks

Primary Solids Removal is achieved through drum filtration with a PR Aqua rotary drum filter (model 48720 with 54 µm filter panels and a capacity of approximately 492 m^3/hr [2,166 gpm]. Water, gravity flows from the rearing tanks to the drum filter, which is automated, based on a pre-defined pressure drop across the filter. The waste stream of captured solids generated, currently flows to the solids holding tanks, which are pumped out as required and disposed of in an approved landfill.

Figure 7 Existing System Block Flow Diagram (BF-1)



Ammonia conversion is achieved using a moving bed biofilter in which plastic media, agitated by aeration, provides surface area for bacteria growth. The bacteria convert ammonia produced from the fish to nitrite and then nitrate, which is a significantly less toxic form of dissolved nitrogen. The existing biofilter is 1.83 m (6'0" ft) in diameter and approximately 6.1 m (20'0" ft) deep, resulting in a volume of 16 m^3. A water level is maintained of approximately 0.60 m (2'0" ft) from the top of the biofilter resulting in a working volume of 14.4 m^3. The biofilter currently contains 12.5 m^3 of plastic media (86% fill ratio).

Secondary Solids Removal is a polishing step after the moving bed biofilter to capture bio-floc generated during ammonia conversion using a rotary drum filter. The drum filter is a Hydrotech 803 with 60 um filter panels and capacity of 180 m^3/hr [792 gpm].

Gas Balancing is achieved using a cross current, low head degasser. Recirculated water is pumped on top of a perforated plate through which water falls in droplets through a void space. A large volume of air is continually blown through this void space, allowing gas pressures such as oxygen, carbon dioxide, and nitrogen to equilibrate.

Oxygenation ensures there is sufficient oxygen in the stream to maintain oxygen saturation in the rearing tanks. Oxygenation is accomplished using a low head oxygenator which operates like gas balancing but uses pure oxygen instead of air in the void space in order to super-saturate the water with oxygen.

A schematic of the process flow is illustrated in Figure 7 (BF-1).

2.5.4 Effluent Treatment

The effluent leaves the existing First Feeding system after the primary solids are removed (PR Aqua 4872 drum filter). This discharge then combines with that from the egg incubation system and both discharges to the settling ponds. The settling ponds consists of three artificial ponds: initial, secondary and tertiary (Photo 8, Appendix C).

The solids that are removed by the drum filters in the recirculation loop flow to a 3.79m^3 (1000gal) on-site holding tank and the top water in this tank flows to the settling ponds. The settled solids are periodically emptied and appropriately disposed of.

The initial settling pond is approximately 6.1 (20 ft) wide by 0.46 m (1.5 ft) deep for an estimated volume of 17 m^3. The second pond is approximately 5.3 m (17.5 ft) wide by 12.2 m (40 ft) long and 0.61 (2 ft) deep for an estimated volume of 39.6 m^3. The final pond measures approximately 18.3 m (60 ft) wide by 18.3 m (60 ft) long by 1.1 m (3.5 ft) deep for an estimated volume of 356.8 m^3.
The total estimated volume of the ponds is 413 m^3 (110,000 gal) which currently provides a retention time of 9.3 hours when both egg incubation and first feeding systems are operating at peak capacity.

2.5.5 Liquid Oxygen

The existing First Feeding system has been the only system which has required oxygen input. When the First Feeding system is feeding 200 kg of feed per day, the oxygen demand was 3.3 kg of oxygen per hour (80 kg_{02}/day).

The existing bulk liquid oxygen tank (Figure 8) has the storage capacity of 2000 Nm^3 or 2858 kg of liquid oxygen. With the existing first feeding system at peak biomass, the storage tank has the capacity to last approximately 35.7 days.

Figure 8 Liquid Oxygen Storage Tank

2.5.6 Electrical Entrance

The installed electrical entrance supplying the facility is 300A, single phase, at 208 V.

2.5.7 Production Schedule

Currently, eggs are stocked to the existing facility twice a year, typically in December and April or May. For each batch, approximately 500,000 green eggs are stocked into each of four racks, totalling 2-million green eggs. From this, approximately 1.6-million (80%) survive for transfer to first feeding. The First Feeding system then rears the fish to 3 grams, producing approximately 1.5-million, or 5 MT, per batch. Once the fish reach 3 grams they are currently transferred to another site for further rearing. This is illustrated in the Figure 9 (PS-1) and summarized in Table 2.

Figure 9 Existing Production Schedule

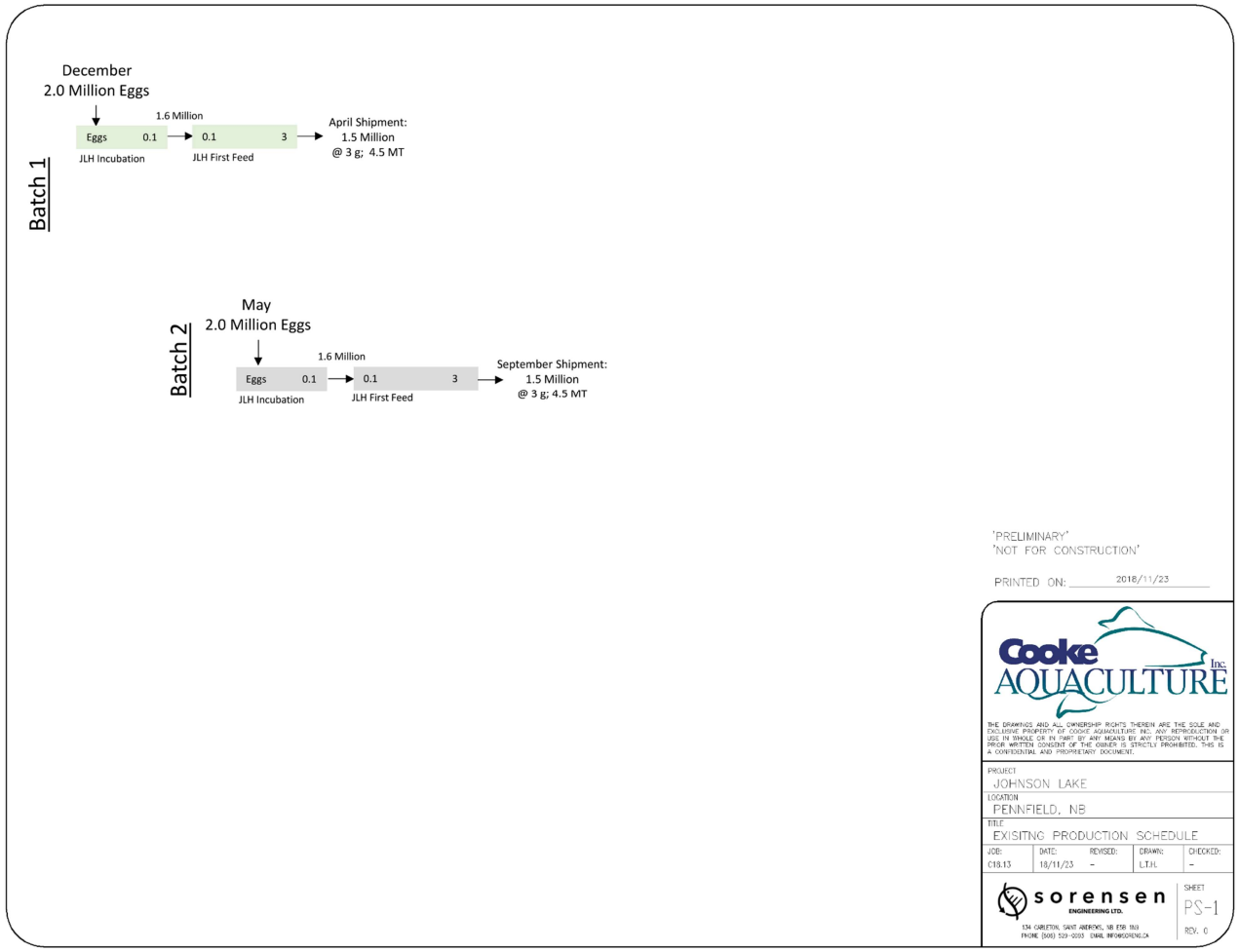


Table 2 Existing Production Summary – First Feeding

Batch	Stage	Quantity	Size	Bio-Mass
1	Fry	1.5-million	3.5 g	5.25 MT
2	Fry	1.5-million	3.5 g	5.25 MT

2.5.8 Water Budget

The site is currently permitted (ATO I-8800) to use a maximum of 152 m^3/hr [669 gpm], 54.5 m^3/hr [240 gpm] from Well 1 (Production Well 1) located adjacent the existing facility and the balance, 97.5 m^3/hr [419 gpm], from the Mill Brook. Well 2 is an emergency well, adjacent to Well 1, that is permitted for use as a back-up supply. Abstraction from the emergency well (Well 2) cannot exceed 19 m^3/hr [84 gpm] as set out in the current ATO. Wells 3 and 5 are not currently used and well 4 is used a supply for the residence on PID 15197015. Monitoring equipment will be installed in each well, to monitor the aquifer response to water withdrawal from Well 1 and/or 2. The water budget is summarized in Table 3 and the well locations are illustrated on drawing L-2 in Appendix B.

Table 3 Existing Water Budget

WATER SOURCE	WATER QUANTITY PERMITTED	WATER DEMANDS
PRODUCTION WELL 1 (PW1)	54.5 m^3/hr [240 gpm]	
MILL BROOK	97.5 m^3/hr [429 gpm]	
EMERGENCY WELL (SHORT-TERM, TEMPORARY USE)	19.0 m^3/hr [84 gpm]	
EGG INCUBATION		30.8 m^3/hr [136 gpm]
FIRST FEEDING		17.2 m^3/hr [76 gpm]
TOTALS (WITHOUT EMERGENCY WELL)	152 m^3/hr [669 gpm]	48 m^3/hr [212 gpm]

2.6 Proposed Changes to Existing Facility (Egg Incubation and First Feeding)

2.6.1 Egg Incubation

There will be four additional Alvestad CompHatch units added to the existing egg incubation system. The optional re-use of water in the First Feeding system will not be used in order to promote good bio-security (D-A3: Appendix B). A new recirculation system will be installed on all eight CompHatch

units to enable efficient temperature control. This recirculation system would only be used when temperature control is operating.

The new recirculation system will include drum filtration with 60 µm filter panels and gas balancing on the recirculated water to maintain optimal water quality for hatching. Temperature control equipment will be installed so there will be an option to manage time of hatch and first feed more effectively. UV irradiation will be used to disinfect new water to the egg system to promote good bio-security.

2.6.2 First Feeding

The existing system must be upgraded to reduce its new water requirements and to further accommodate expansion of the site and increase the phosphorous concentration of the discharge while reducing the volumetric flow, optimizing the efficiency of chemical treatment on the discharge. Historically, only 12 of the 14 tanks were used for fish rearing, as two were used for grading and shipping. The upgrade will include a grader tank so all previous existing 14 tanks will be available for fish rearing. The flow diagram for the proposed upgrade of the First Feeding system is illustrated on PF-A2, Appendix B.

The following proposed upgrades to the First Feeding system are:

Biofilter Upgrade
Upgrading the existing bio-filter will significantly reduce the water requirements of the facility. A second bio-filter will be constructed and plumbed in parallel to the existing filter. The new bio-filter will be a rectangular horizontal moving bed bio-filter, as opposed to the existing chamber which is a vertical cylinder. The proposed bio-filter will have the added advantage of efficiently stripping carbon dioxide, reducing its concentration in the system.

Grader Tank
The existing steel tank located outside between the rearing tanks and water treatment system (Figure 5) has walls and plumbing to the RAS but does not have a finished floor. A new floor will be poured, and epoxy coated, and the tank will then be used for grading and staging batches for transfer to the new fry system. The use of this tank for grading will resulting in no increased feed usage or will require no new water requirements.

Structural Upgrade
The existing hatchery building, which covers the rearing tanks, will be extended to cover both the grader tank and the water treatment system. Additionally, an entry room will be constructed at construction-east end for a bio-security room and lavatory. These structural changes are illustrated on drawing D-A1 in Appendix B.

2.6.3 Production Schedule

The proposed production schedule includes stocking eggs into the renovated facility three times a year, typically in November, February and May. For each batch, 262,500 green eggs will be stocked into each of eight racks, totalling 2.1-million green eggs. From this, approximately 1.68-million (80%) will survive for transfer to the First Feeding system. The First Feeding system will then rear the fish to 3 grams, producing approximately 1.6-million, or 4.8 MT of bio-mass, per batch. Once the fish reach 3 grams they will be transferred to the Parr System in the proposed new facility on site. This is illustrated in Figure 10 (PS-2) and is summarized in Table 4.

Table 4 Proposed Production Summary – First Feed

Batch	Stage	Quantity	Size	Bio-Mass
1	Fry	1.6-million	3.5 g	5.6 MT
2	Fry	1.6-million	3.5 g	5.6 MT
3	Fry	1.6-million	3.5 g	5.6 MT

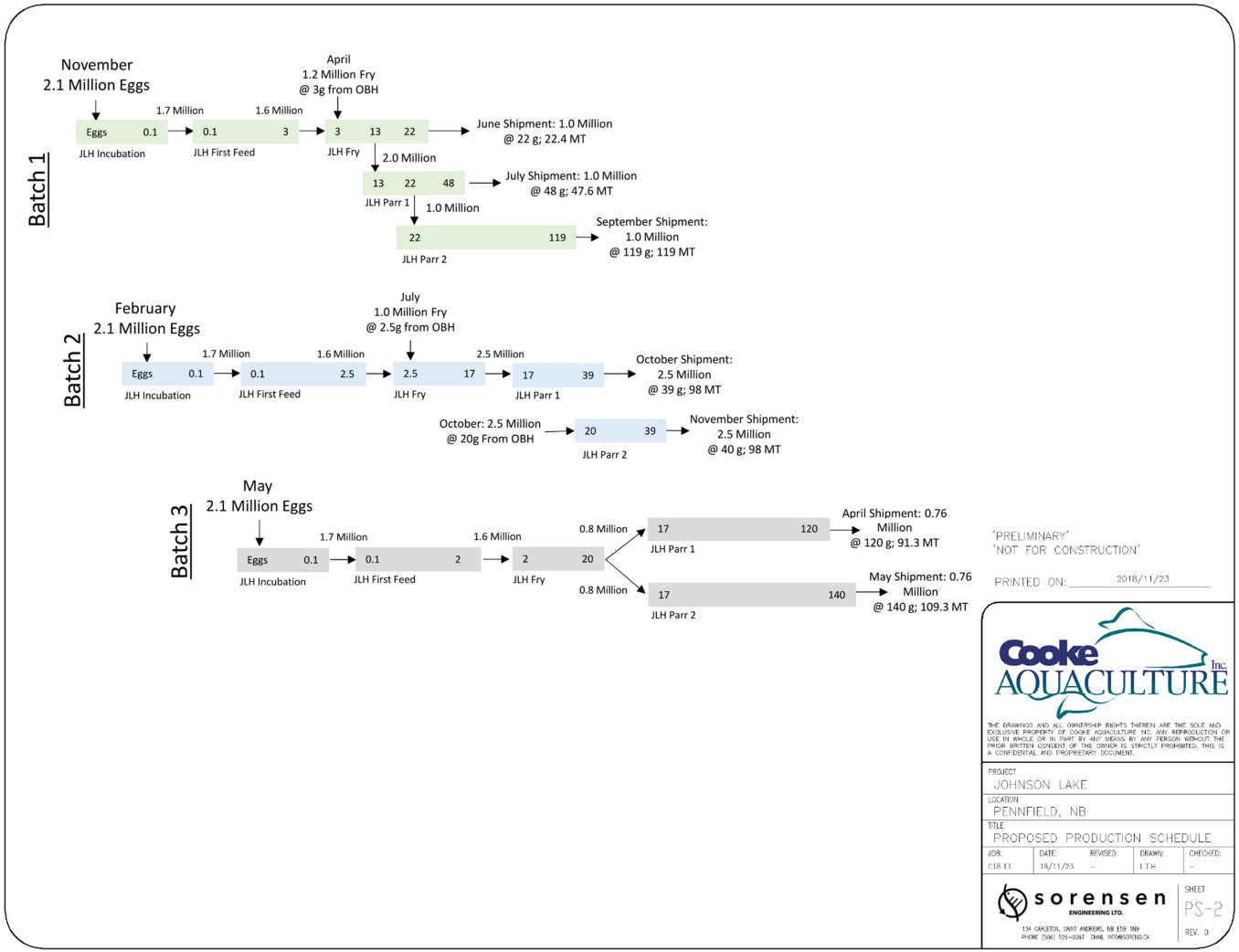
2.6.4 Water Budget

The water sources outlined in the existing water budget (Section 2.5.1.8) will remain the same. The maximum water consumption of the Egg Incubation will only increase slightly to 32 m^3/hr up from 30.8 m^3/hr. The peak water consumption of the First Feeding system will be reduced to 6.9 m^3/hr, from 17.2 m^3/hr, reducing the facility's peak water consumption from 48 m^3/hr to 38.9 m^3/hr (Table 5).

Table 5 Proposed Water Budget

WATER SOURCE	WATER QUANTITY PERMITTED	WATER DEMANDS
PRODUCTION WELL 1 (PW1)	54.5 m^3/hr [240 gpm]	
MILL BROOK	97.5 m^3/hr [429 gpm]	
EMERGENCY WELL (SHORT-TERM, TEMPORARY USE)	19.0 m^3/hr [84 gpm]	
EGG INCUBATION		32.0 m^3/hr [140.8 gpm]
FIRST FEEDING		6.9 m^3/hr [30.4 gpm]
TOTALS (WITHOUT EMERGENCY WELL)	152 m^3/hr [669 gpm]	38.9 m^3/hr [171.2 gpm]

Figure 10 Proposed Production Schedule



2.7 Proposed Change to Existing Facility (New Fry and Parr Facility)

Various water treatment technologies have been implemented in land-based aquaculture over the past several decades. This has taken the industry from flow-through facilities to modern recirculating aquaculture systems (RAS); reducing the new water required per kilogram of feed offered from greater than 10,000 L to 350 L. Additionally, advanced water treatment technologies have been implemented on the discharge of modern RAS to further reduce environmental impacts. This includes chemical coagulation and flocculation which effectively remove dissolved phosphorus and nutrients bound in solid particles.

Since the 1980's, KCS has owned and operated land-based aquaculture facilities which contain the full range of development from flow through to modern RAS. KCS has continually adopted and implemented new technologies. Recently, more advanced technologies have been developed, reducing the water requirements of modern RAS even further. These technologies have led to low-water exchange RAS, which require 50 L of new water per kilogram feed. This is accomplished by adding secondary and tertiary treatment to modern RAS. KCS has extensively reviewed the low water exchange technologies available from several global RAS suppliers and, has seen that they have been successfully implemented in several projects across the world where fish production was limited by freshwater availability (i.e., Faroe Islands, Norway and, Australia).

The proposed new Project at the existing Johnson Lake facility will include three new low-water exchange RAS units: a new fry system and two new parr systems. Each RAS will utilize the most recent technology available, including secondary and tertiary treatment. The secondary treatment, denitrification, reduces the water requirement of modern RAS to approximately 30%. The tertiary treatment, phosphorous control, further reduces the water requirement to approximately 15% of modern RAS.

2.7.1 Modern Recirculating Aquaculture Systems (RAS)

The modern RAS, as seen in Figure 11 (also BF-2: Appendix B), includes primary solids removal, ammonia conversion (metabolic by-product removal), ozone treatment, gas balancing, and oxygen transfer. This is the most common form of RAS and can be found through-out the aquaculture industry. Typically, this type of RAS requires 350 L or more of new water for every kilogram of feed offered to the fish. In these systems, the new water is added to dilute the concentration of nitrate, which typically reaches concentrations of up to 100 mg/L. Following is a description of each component:

Primary Solids removal in the RAS systems will be done by drum filters with 60 µm screen openings. The drum filters will be automated based on a pre-defined pressure drop across the filter. The waste stream of captured solids that is generated, will flow to the Denitrification Loop.

Ammonia-nitrogen, excreted by the salmon, will be converted to nitrate through nitrification in static biofilters. The static biofilters will also capture fine solids, which pass through drum filtration. Periodically, the static filters will be back-washed, sending the captured solids to solids treatment.

Ozone will be continuously dosed, based on feed rate, to control the accumulation of dissolved constituents and fine solids and to maintain water clarity.

Gas balancing will be attained by cross-flow aeration of the recirculating flow. This energy efficient process will ensure gases such as carbon dioxide, oxygen and nitrogen are returned to their natural saturated concentrations.

Oxygenation will be completed as the recirculated water travels back to the rearing tanks, ensuring there is sufficient oxygen in the stream to maintain oxygen saturation in the rearing tanks. Oxygenation will be accomplished using oxygen cones, which will operate at a pressure less than 1 bar.

2.7.2 Secondary Treatment

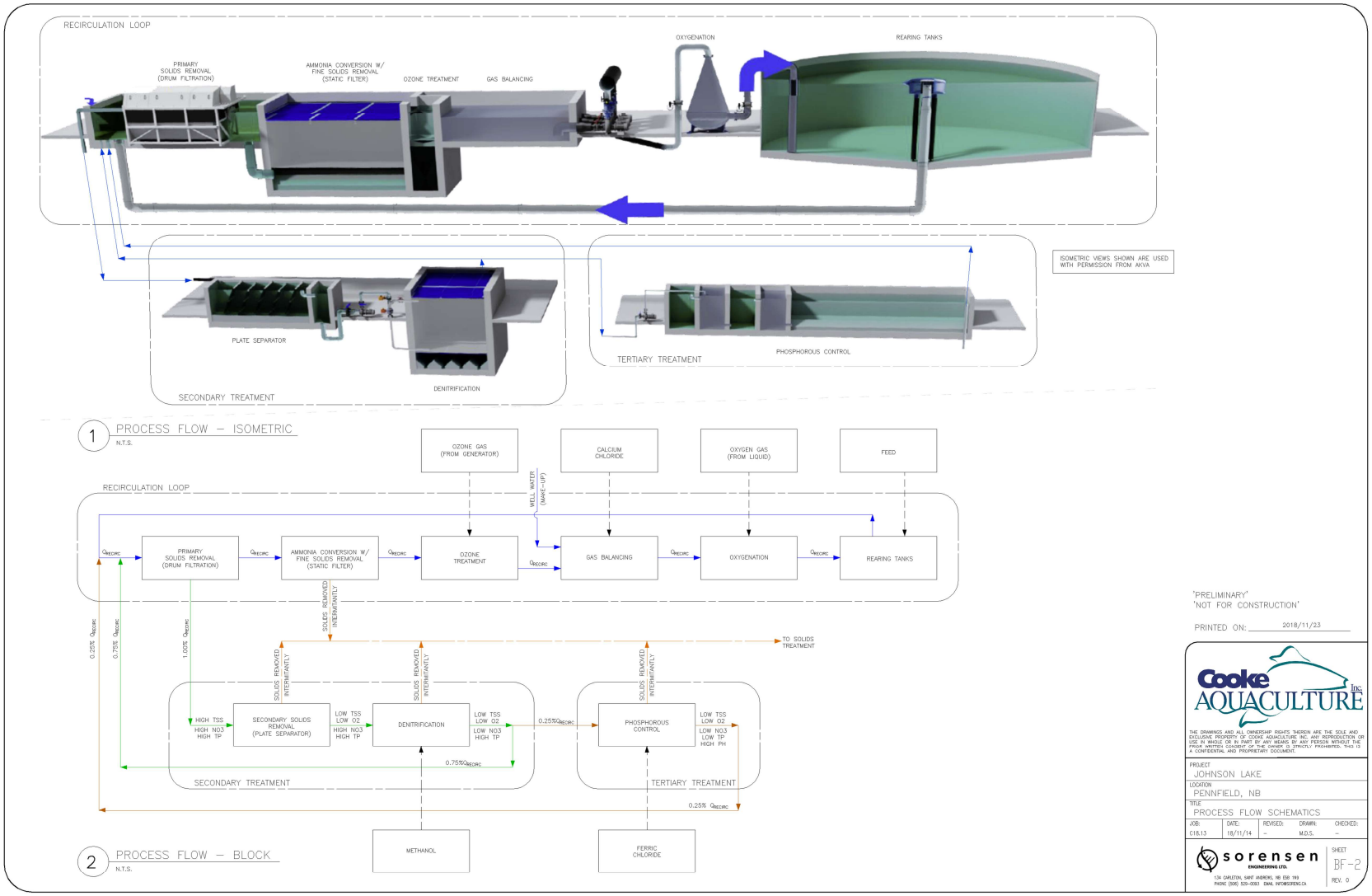
Secondary treatment, as shown in Figure 11 (also BF-2: Appendix B), will be included with the new RAS to be constructed on site. The added treatment addresses the modern RAS nitrate dilution requirement. The secondary treatment reduces the required new water to 100 L for every kilogram of feed offered to the fish. With this added level of treatment, the nitrate concentration is maintained at 150 mg/L. However, the reduced new water causes phosphorous to accumulate, increasing the concentration in the rearing tank water up to 30 mg/L. Phosphorous then becomes the limiting dilution demand.

The following is a description of each component:

The stream to secondary treatment is the backwash generated by drum filtration (primary solids removal), a **Plate Separator** is included in secondary treatment to reduce the total suspended solids (TSS) concentration and reduce the oxygen levels in the side stream to enable denitrification. Solids are intermittently removed from the plate separator and sent to solids treatment for dewatering.

Denitrification is a biological process which occurs at low oxygen levels. Naturally occurring bacteria, when exposed to water with low oxygen will resort to stripping the oxygen contained in nitrate (NO_3) for metabolic processes and produce nitrogen gas as a by-product. The bacteria require a carbon source (methanol) for efficient denitrification. This nitrogen will then be off-gassed

Figure 11 Process Flow Schematics



as part of gas balancing once the side stream returns to the main recirculation loop. Solids from the denitrification chamber are removed intermittently and sent to solids treatment for dewatering.

2.7.3 Tertiary Treatment

Tertiary treatment, as seen in Figure 11 (also BF-2: Appendix B), is a system that will be included in the new RAS systems. A portion of the discharge from secondary treatment will pass through tertiary treatment. The tertiary treatment will address the secondary treatment's phosphorous dilution requirement. This reduces the required new water to 50 L for every kilogram of feed offered to the fish. With this added level of treatment, the nitrate concentration is maintained at or below 150 mg/L and the phosphorous concentration is maintained at or below 30 mg/L.

The following is a description of each component:

pH adjustment using sodium hydroxide is required to bring the pH of the tertiary treatment side stream to a pH of 9.

Chemical precipitation of phosphorus is achieved through the addition of a multivalent metal salt, ferric chloride. The reaction is more efficient at higher pH, hence the necessary pH adjustment prior to injection of the ferric chloride. Precipitated phosphorus is removed intermittently and sent to solids treatment for dewatering.

A small amount of intermittent discharge from tertiary treatment that is low in phosphorus, nitrate, TSS, and oxygen and pH of less than 9 may be sent to discharge treatment prior to discharge.

2.7.4 Fry System

The Fry System will contain six (6) 140 m^3 production tanks (10 m diameter by 2.0 m tall; 1.8 m working depth) for a total working volume of 840 m^3. The system will be designed to operate up to a stocking density of 50 kg/m^3, resulting in a holding capacity of 42 MT. The treatment system will be designed for feeding up to 2.5% BW/day, or a peak of 1,000 kg_{FEED}/day.

The system will operate with a varying tank retention time down to 30 minutes (2 turnovers per hour). A drum filter with maximum 60 µm mesh screens will serve as primary solids removal followed by a biofilter, which will use media to maintain a TAN concentration of less than 2.0 mg/L at peak biomass. Degassing will be sufficient to maintain a CO_2 concentration of the tank discharge equal to or less than 15 mg/L at peak biomass. Denitrification technology will be used to maintain nitrate levels at or below 150 mg/L.

A side stream will be utilized to dose at least 12 g of ozone (O_3) per kg of feed offered, to maintain water clarity. The ozone will be generated on site at up to 13wt%. The ozone demand will ensure

no residual leaves the contactor and there will be monitoring in place for verification. Any off gas will be vented outside the building. Air monitoring equipment will be in place adjacent ozone generators, ozone distribution systems and contactors to pre-emptively alert staff to elevated ozone levels and to deactivate the ozone generators.

A process flow schematic (PF-B1) is included in Appendix B for more detail on the proposed system.

2.7.5 Parr Systems

Two Parr Systems will contain eight (8) 212 m^3 production tanks each (10 m diameter by 3.0 m tall; 2.5 m working depth) for a total working volume of 1,696 m^3 per system. The systems will be designed to operate up to a stocking density of 70 kg/m^3, resulting in a holding capacity of 119 MT per system. The treatment system will be designed for feeding up to 1.15% BW/day, or a peak of 1,400 kg_{FEED}/day per system.

The system will operate with a varying tank retention time down to 30 minutes (2 turnovers per hour). A drum filter with maximum 60 µm mesh screens will serve as primary solids removal followed by a biofilter, which will use media to maintain a TAN concentration of less than 2.0 mg/L at peak biomass. Degassing will be sufficient to maintain a CO2 concentration of the tank discharge equal to or less than 15 mg/L at peak biomass. Denitrification technology will be used to maintain nitrate levels at or below 150 mg/L.

A side-stream will be utilized to dose ozone similar to that described in the Fry System above.

A process flow schematic (PF-C1) is included in Appendix B for more details on the proposed system.

2.7.6 Construction Details

Construction details/building plans are included in Appendix B (DB-1, DB-2 and, DB-3). Construction will not commence until after approval for the Project is made by the Minister and all permitting and regulatory requirements are met. KCS is targeting for the first smolt to leave the facility in May of 2020 from fish stocked in late 2019.

2.7.7 Proposed Production Schedule

The new Fry and Parr facility will produce three batches of fish per year is described below and illustrated in Figure 10 (PS-2). The Production Schedule presented is a steady state production schedule which will not be implemented the first year of operation. Rather, production from the facility will be staged as KCS various operations in Atlantic Canada adjust to the change in production.

The following description of the proposed production schedule is summarized in Table 6. All fish sizes are estimated as, fish growth is dependent on a variety of factors and, movements of fish may be earlier or later than described depending on weather conditions, other KCS hatchery availability and, time-lines, etc.

Batch 1
In April, the first batch of fish stocked to the Fry System will come from 2 sources: 1.6-million from the First Feed system on site and 1.2-million from Oak Bay Hatchery. The 2.8-million fish will be reared to approximately 13 g, then 2-million will be transferred to Parr System 1. The remaining 1-million fish will continue rearing in the Fry System until June when they reach 22 g. Then, the 22.4 MT will be transferred to another KCS hatchery for further rearing prior to transfer to sea.

The 2-million fish transferred to Parr System 1 will be reared to 22 g, then 1-million will be transferred to Parr System 2. The remaining 1-million fish in Parr System 1 will be reared to 48 g, totalling 47.6 MT. Then, they will be transferred to another KCS hatchery in July, for further rearing prior to transfer to sea.

The 1-milion fish transferred to Parr System 2 will be reared to 119 g, totalling 119 MT, then will be transferred to sea in September.

Batch 2
In July, the second batch of fish stocked to the Fry System will come from 2 sources: 1.6-million from the First Feed system on site and 1.0-million from the Oak Bay Hatchery. The 2.6-million fish will be reared to 17 g, then will be transferred to Parr System 1.

In Parr System 1, the fish will be reared to 39 g, or 98 MT, then 2.5-million fish will be transferred to another KCS hatchery for further rearing prior to transfer to sea.

In October 2.5-million fish at 20 g will be transferred from Oak Bay Hatchery (or another clean fry source in the KCS group) to Parr System 2. The fish will then be reared to 39 g, or 98 MT, then will be transferred to another KCS hatchery before transfer to sea.

Batch 3
In October, the third batch of fish stocked to the Fry System, at 2 g, will come from the First Feeding system on site. The fish will be reared to 20 g, then will be split into Parr Systems 1 and 2. In the Parr Systems, the fish will be reared to 120 to 140 g then transferred to sea. This will produce approximately 200MT.

Table 6 Proposed Production Summary - New Facility

Batch	Stage	Quantity	Size	Bio-Mass
1	S_0 Parr	2-million	22 – 48 g	70 MT
	S_0 Smolt	1-million	119 g	119 MT
2	Parr	5-million	40 g	196 MT
3	S_1 Smolt	1.5-million	120 – 140 g	201 MT

2.7.8 Water Budget

The water sources outlined in the existing water budget (Section 2.5.1.8) will remain the same. The combined water consumption of the Egg Incubation and First Feed will decrease by approximately 10 m^3/hr. Using the low water exchange technology will limit the new water requirement of the new facility to a combined total of 7.9 m^3/hr (Table 7).

Table 7 Water Budget - Upgraded Facility

WATER SOURCE	WATER QUANTITY PERMITTED	WATER DEMANDS
PRODUCTION WELL 1 (PW1)	54.5 m3/hr [240 gpm]	
MILL BROOK	97.5 m3/hr [429 gpm]	
EMERGENCY WELL (SHORT-TERM, TEMPORARY USE)	19.0 m3/hr [84 gpm]	
FRY SYSTEM		2.1 m^3/hr [9.2 gpm]
PARR SYSTEM 1		2.9 m^3/hr [12.8 gpm]
PARR SYSTEM 2		2.9 m^3/hr [12.8 gpm]
	152 m3/hr [669 gpm]	7.9 m^3/hr [34.8 gpm]

2.8 Proposed Change to Existing Facility (New Effluent Treatment and Sludge De-watering)

The new effluent building will house both effluent treatment and solids dewatering. The building will have a concrete foundation with a wooden structure, metal clad exterior and have Trusscore or equivalent liner on the interior. The building plan is included in Appendix B (D-C1).

2.8.1 Effluent Treatment

The effluent treatment facility will contain two distinct treatment systems: solids treatment and discharge treatment. These two streams will have independent buffer tanks and chemical injection system and will include all discharge streams from the First Feeding, Fry, and Parr Systems. The block flow diagram is shown in Figure 12 and a detailed process flow schematic can be found in Appendix B (PF-E1).

Solids treatment, as its name suggests, targets solids removal through chemical coagulation and flocculation. Solids that are removed from the recirculation systems are combined in a buffer tank. A transfer pump will intermittently pump the slurry from this tank through a flocculator, designed to promote mixing of chemicals with the water to be treated. The slurry will enter radial flow separators (RFS) which use a low up-flow velocity to promote gravity sedimentation in which solids are collected in the bottom of a cone and clarified water overflows the RFS. Solids are naturally compacted in a 60° cone and removed intermittently with a diaphragm pump to a solids holding tank. Clarified water gravity flows to combine with the overflows from each system to the discharge treatment system.

The Discharge Treatment system is similar to the solids treatment system; however, the target of this system is the precipitation of phosphorus. The water entering this system is low in total suspended solids (TSS) as it is directly from the recirculation loop itself and the clarified water after solids treatment. A transfer pump intermittently pumps the discharge water through a flocculator, designed to promote mixing of chemicals to maximize contact between the multivalent metal salt and phosphate compounds in the water. The chemical reaction that occurs produces a precipitate of phosphate that is removed in radial clarifiers. Phosphorus concentrations less than 1 mg/L are attainable with this type of treatment (Neethling, 2013). Buckman's Creek Hatchery in Pennfield uses a similar treatment system and consistently achieves outfall phosphorus concentrations of less than 1 mg/L.

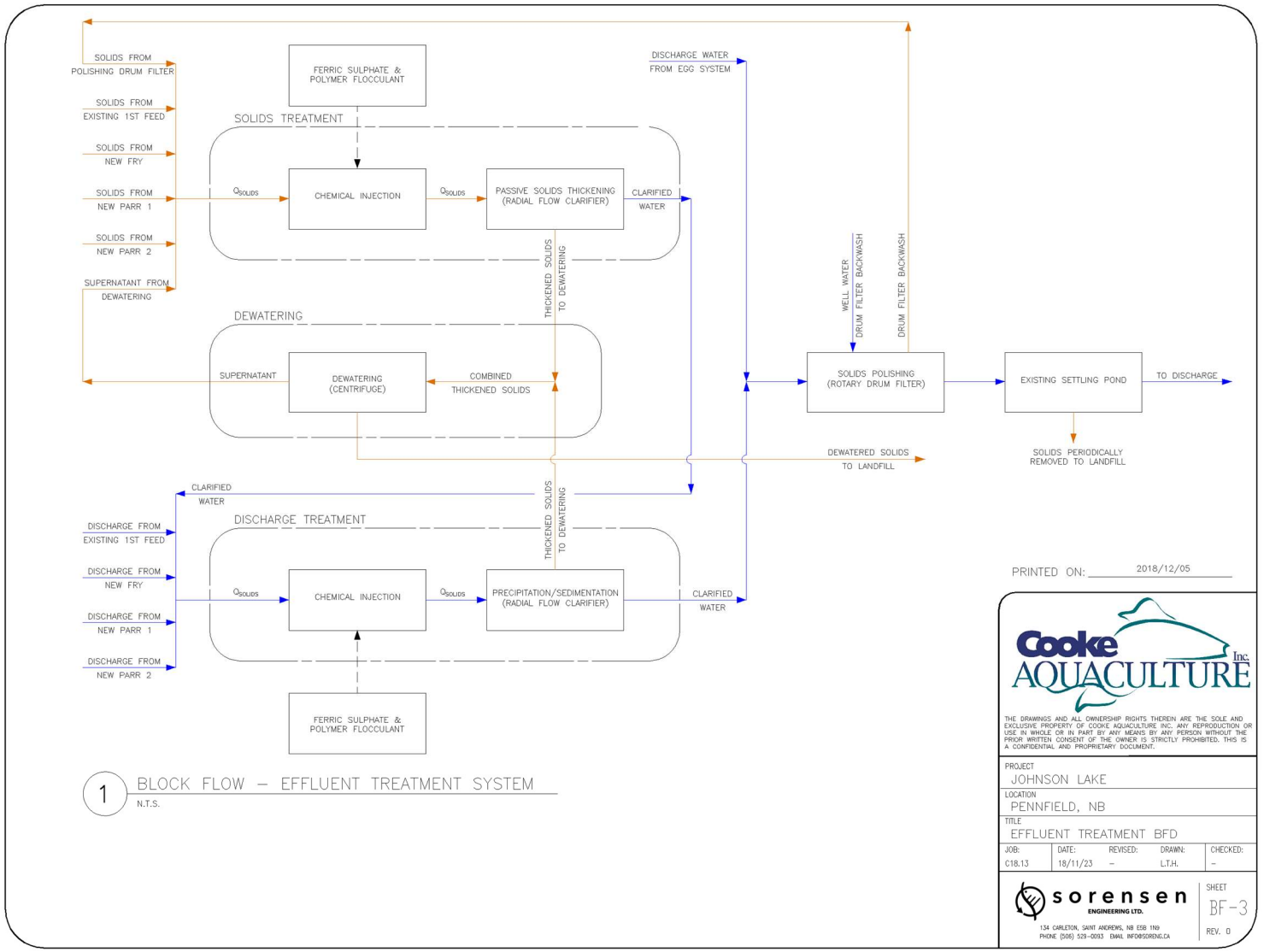
Treated water leaving the discharge treatment system joins with water discharged from the egg incubation system before passing through a drum filter with 60 µm filter panels. The filtered water is discharged to the existing settling pond before reaching the receiving water. Backwash (approximately 0.5 m^3/hr at peak) from this drum filter will be sent back through solids treatment. The maximum flow through the settling pond will be 47.1 m^3/hr, providing a retention time of 8.8 hours, slightly improved compared to the existing 9.3 hr retention time.

2.8.2 Sludge De-watering

Solids captured in the Radial Flow Separators in both the solids treatment and discharge treatment systems will be collected in a solids holding tank. This slurry, which will have a solids content of 3-5wt% solids will be pumped intermittently through two centrifuges designed to increase solids content to 25-30wt%. Leaving these centrifuges will be two streams: supernatant and dewatered solids.

The supernatant will be high in TSS and will return to the solids treatment system for re-treatment. The dewatered solids will be stored on site for a period before being sent to an approved composting or landfill site.

Figure 12 Process Flow - Effluent



2.8.3 Nutrient Discharge

Low water exchange RAS use less water per kilogram of feed, however, the amount of nutrients excreted by the fish remains the same. This means the discharge from each system is high in nutrients such as phosphorus and nitrogen, which needs to be effectively managed. The proposed effluent system, in conjunction with the secondary and tertiary treatment loops within the low-water exchange RAS will effectively reduce nutrient loading on the receiving water.

In early October, before the annual recharge period, the water flow rate of the receiving water was estimated to be 350 m^3/hr. This flow rate was taken as the conservative baseline for calculations of nutrient discharge. Based on this flow rate, using the thresholds and guidelines from Table 2.6 of the EMP (DELG, 2013), the following table (Table 8) was generated, summarizing maximum daily nutrient discharge parameters.

Table 8 Nutrient Discharge Threshold Summary

Parameter	**Threshold/Guideline * (mg/L)**	**Upstream Concentration (mg/L)**	**Maximum Daily Discharge (kg/day)**
Total Phosphorus (TP)	0.035 mg/L	0.010 mg/L	0.21 kg/day
Un-ionized Ammonia	0.019 mg/L	-	<0.16 kg/day
Nitrite (NO_3)	0.060 mg/L	Unknown	<0.5 kg/day
Nitrate (NO_3)	13.0 mg/L	Unknown	<109 kg/day

The flow schematics Figures 13 and 14 (FS-1 and FS-2) show the nutrient pathways for the first feeding system and proposed fry/smolt systems, respectively. The schematics show how the phosphorus and nitrogen are removed from the system and how much of each nutrient is retained by the fish, how much is sent to landfill with the solids, and how much is discharged to the receiving waters. The percentages shown are percentages of the nutrients initially present in the feed.

The RAS (existing and proposed) are pseudo-steady state systems in which equilibrium is reached for a given constant feeding rate. Any nutrients entering the system in the feed must be either retained by the fish or removed from the system through mechanical, biological, or chemical means. The fish retain 24% phosphorus and 23% of the nitrogen contained within the feed, the rest is excreted as particulate matter or dissolved nutrients.

2.8.3.1 First Feeding Nutrient Summary

The first feeding system is a conventional RAS and therefore relies on effluent treatment to reduce nutrient discharge (Figure 13). The nutrients leaving the first feeding system undergo chemical coagulation and flocculation to effectively remove solid particles in the stream along with the nutrients bound therein. 51.7% of the phosphorus in the feed and 21.2% of the nitrogen is removed in this treatment step.

Discharge treatment further reduces particulate concentration, but targets dissolved phosphorus by precipitating dissolved phosphate out of solution using a multivalent metal salt: ferric sulphate. Of the phosphorus that entered the system in the feed, 23.1% is removed in this step, the majority dissolved. A small number of solids are also removed which corresponds to some nitrogen removal.

The polishing drum filter removes 30% of the remaining solids which corresponds to 0.12% phosphorus and 0.06% nitrogen.

Overall, the fish retain 24% of the phosphorus and 23% of the nitrogen in the feed, almost 75% of the phosphorus in the feed is removed and sent to landfill, and only slightly more than 1% is discharged. The nitrogen present in the feed is largely discharged from the first feeding system with 23% retained by the fish, 22.36% captured and sent to landfill, and 54.64% discharged. The bulk of this nitrogen discharged is nitrate; the total ammonia nitrogen (TAN) in the system will be maintained at 3.2 mg/L or lower.

2.8.3.2 New Fry and Parr Systems Nutrient Pathway

The total feed to the First Feeding System is small (225 kg/day) in comparison to the peak on-site feed (2780 kg/day), the bulk of the nutrients discharged originates in the new low water exchange fry and parr systems. The low water exchange systems proposed integrate nutrient reduction within the recirculation system itself to allow for low water requirement.

As shown in Figure 14, secondary treatment effectively removes nitrogen from the system through denitrification in which 45.8% of the nitrogen in the feed is off-gassed. The remaining 31.2% of the feed nitrogen and 64.5% of the feed phosphorus is removed through a plate separator.
Tertiary treatment targets dissolved phosphorus, precipitating 11.5% of the feed phosphorus. This precipitate is combined with the solids collected in the plate separator and denitrification reactor and is sent to solids treatment. Solids treatment involves chemical coagulation and flocculation to effectively remove 65.44% of the feed phosphorus and 22.12% of the feed nitrogen.
Discharge treatment targets dissolved phosphorus in the water to be discharged and precipitates 10.08% of the feed phosphorus. The precipitation of phosphorus also removes some solids including 0.34% of the feed nitrogen
.
The clarified water pass through a polishing drum filter which removes 30% of the incoming particulate (the backwash from the drum filter is returned to solids treatment) and the treated water is

Figure 13 Nutrient Pathways - First Feed

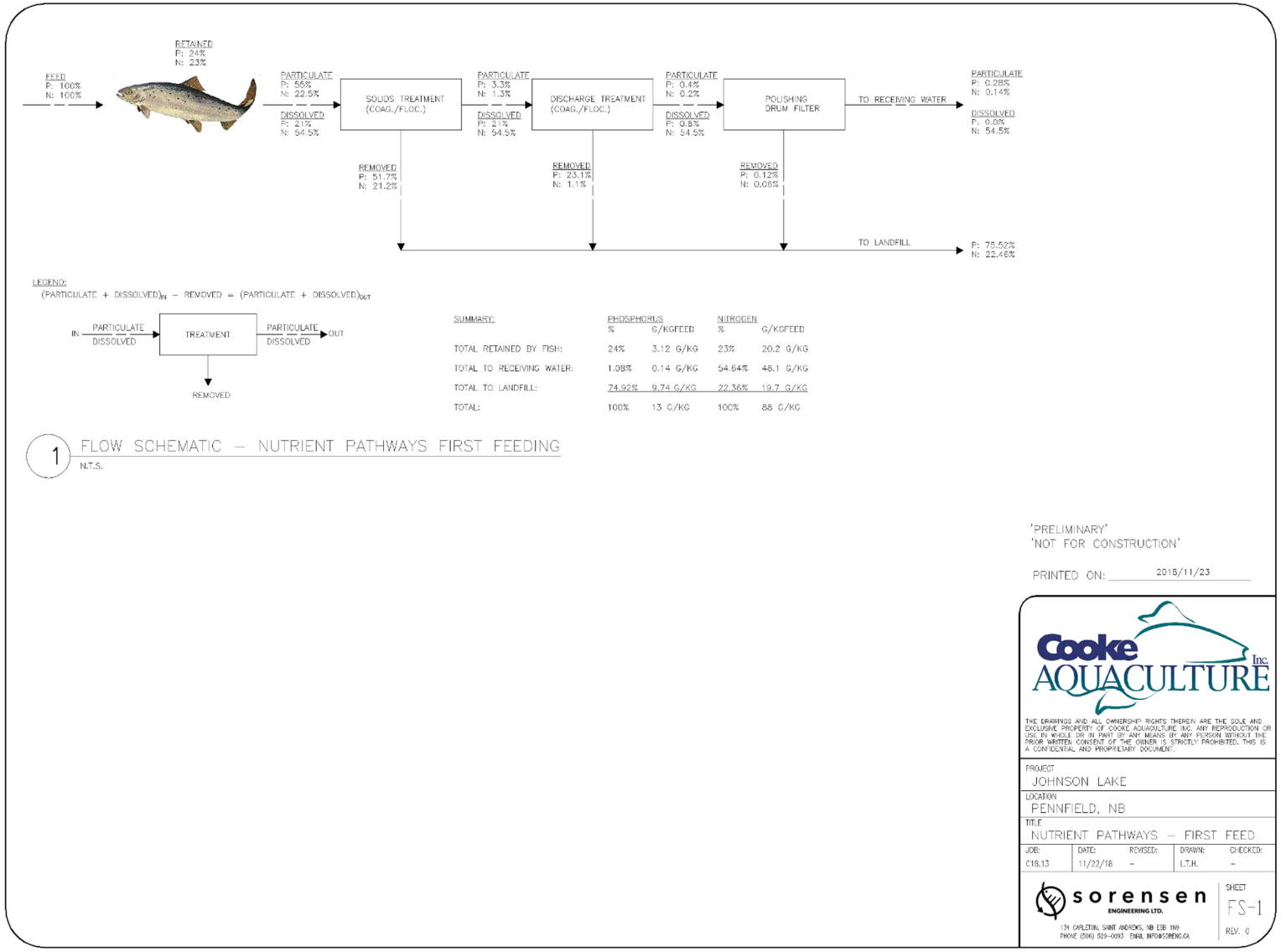
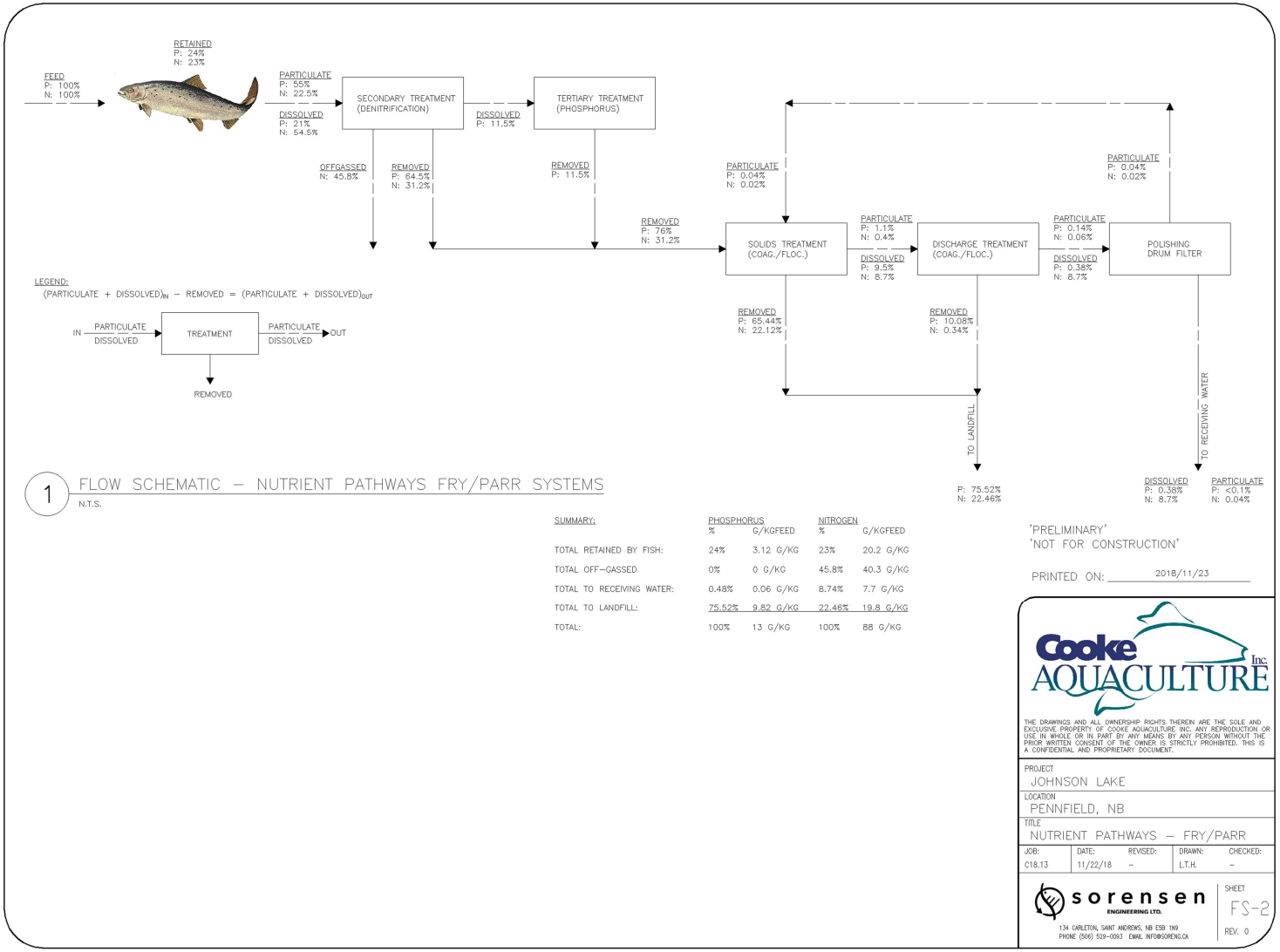


Figure 14 Nutrient Pathways - Fry/Parr



SUMMARY:	PHOSPHORUS %	PHOSPHORUS G/KGFEED	NITROGEN %	NITROGEN G/KGFEED
TOTAL RETAINED BY FISH:	24%	3.12 G/KG	23%	20.2 G/KG
TOTAL OFF-GASSED	0%	0 G/KG	45.8%	40.3 G/KG
TOTAL TO RECEIVING WATER:	0.48%	0.06 G/KG	8.74%	7.7 G/KG
TOTAL TO LANDFILL:	75.52%	9.82 G/KG	22.46%	19.8 G/KG
TOTAL:	100%	13 G/KG	100%	88 G/KG

'PRELIMINARY'
'NOT FOR CONSTRUCTION'

PRINTED ON: 2018/11/23

Cooke AQUACULTURE Inc.

PROJECT: JOHNSON LAKE
LOCATION: PENNFIELD, NB
TITLE: NUTRIENT PATHWAYS – FRY/PARR

JOB:	DATE:	REVISED:	DRAWN:	CHECKED:
C18.13	11/22/18	–	L.T.H.	–

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SHEET FS-2
REV. 0

sent to the existing settling pond and then to the receiving water. For this conservative calculation, any nutrient removal by the settling pond is not included and will serve as safety factor and will help to buffer inconsistent flows.

Overall, the fish retain 24% of the phosphorus and 23% of the nitrogen in the feed, 75.52% of the phosphorus in the feed is removed and sent to landfill, and less than 0.5% is discharged. The nitrogen present in the feed is largely off-gassed through denitrification with 23% retained by the fish, 45.8% is off-gassed, 22.46% is captured and sent to landfill, and 8.74% discharged. The bulk of this nitrogen discharged is nitrate; the total ammonia nitrogen (TAN) in the system will be maintained at 3.2 mg/L or lower.

2.8.3.3 Nutrient Discharge Calculation

The nutrient pathway flow schematics and calculations can be used to easily predict nutrient discharges from the facility for a given feed rate. Nutrients added in the form of feed to the First Feeding System and/or the new Fry and Parr Systems will be discharged according to the nutrient pathway summary depicted in Table 9.

Table 9 Nutrient Pathway Summary

System	First Feed System		Fry/Parr System	
Nutrient	Phosphorus	Nitrogen	Phosphorus	Nitrogen
Retained by fish	24%	23%	24%	23%
Off-Gassed	N/A	0%	N/A	45.8%
Removed to Landfill	74.92%	22.36%	75.52%	22.46%
Discharged to Receiving Water	1.08%	54.64%	0.48%	8.74%

Using these calculations and Table 10, which shows the predicted peak feed rates on a bi-weekly basis for the site, the predicted phosphorus and nitrogen discharge in kilograms per day can be calculated.

The peak nutrient discharge occurs in September and October with a maximum predicted discharge of 0.19 kg_{TP}/day for week 43-44 and 25.4 kg_{TN}/day for week 37-38, which corresponds to 24.8 kg_{NO3}/day and 3.9 kg_{UIA}/day. These maximums are below the Maximum Daily Discharge limits in Table 8.

2.8.5 New Water Storage Tank

A new water supply storage tank will be required for any short-term water requirements (i.e., for fish grading, etc.) and have a planned storage capacity of 200 m^3 of water. This tank will be installed adjacent to Well 1 and Well 2 (L-4: Appendix B) and be constructed with a concrete base and either glass-lined steel panels or fibreglass walls.

Table 10 Predicted Discharges

Starting Week		1	3	5	7	9	11	25	27	29	31	33	35	37	39	41	43	45	47	49	51
Peak Feed (kg/day)	First Feeding System	5	10	18	35	71	216	180	0	7	14	25	49	102	148	0	0	0	0	0	0
	Fry System	336	0	0	0	0	0	0	298	431	501	730	966	0	0	224	174	256	317	461	610
	Parr System 1	395	497	577	671	688	719	615	785	904	0	0	0	1264	1400	1400	1400	0	0	0	0
	Parr System 2	395	497	577	671	688	719	628	801	923	1107	1190	1400	1400	0	1264	1400	1400	1400	0	0
Predicted Phosphorus Discharge (kg/day)		0.07	0.06	0.07	0.09	0.10	0.12	0.10	0.12	0.14	0.10	0.12	0.15	0.18	0.11	0.18	0.19	0.10	0.11	0.03	0.04
Predicted Nitrogen Discharge (kg/day)		8.9	8.1	9.7	12.0	14.0	21.4	18.2	14.5	17.7	13.0	16.0	20.5	25.4	17.9	22.2	22.9	12.7	13.2	3.5	4.7
Unionized TAN Discharge (g/day)		1.0	1.0	1.3	1.7	2.3	4.7	3.9	1.6	2.0	1.6	2.0	2.8	3.9	3.6	2.5	2.5	1.4	1.5	0.4	0.5
Predicted Nitrate Discharge (kg/day)		8.7	8.0	9.6	11.8	13.6	20.8	17.6	14.3	17.4	12.8	15.7	20.1	24.8	17.4	21.9	22.5	12.5	13.0	3.5	4.6

2.8.6 Liquid Oxygen

The existing on-site liquid oxygen tank, which has a 2500 L capacity, is insufficient for the proposed Project requirements. This tank will be dismantled, removed and, replaced with a new liquid oxygen (O_2) storage facility (L-4: Appendix B) that will consist of 2 storage tanks, each having the capacity for 22,996 L of O_2 storage. This new installation will allow filling of the tanks from the outside of the proposed new bio-secure area, therefore access to the site will not be necessary. Assembly of the new liquid O_2 storage facility will be completed by Air Liquide.

2.8.7 Electrical Entrance Upgrade

A new 3-phase power supply will be brought to the site, supplying a new 1,600A entrance. A new pad-mounted transfer will be installed and will supply a central electrical distribution room for the site. A preliminary drawing of the building is included in Appendix B (ESK-1) and the proposed location is shown on L-4 (Appendix B). Additionally, two 800kW generators will be installed to supply emergency back-up power to the site. One generator will be required in the event of a power failure and the second unit will be a back-up.

The electrical generators will be supplied fuel from a 22,700 L storage tank. The storage tank will be double-wall steel construction. The tank will be placed in a weather proof enclosure with concrete foundation and knee walls with holding capacity for 100% of the tank volume, providing a third level of containment. Connection of the fuel system will be completed by a licensed contactor. There will be secured access to the fuel storage from outside the bio-secure area.

2.9 Operation and Maintenance

The Johnson Lake Hatchery is operated in compliance with the *Water Quality Regulation – Clean Environment Act* as well as adheres to any municipal bylaws, other provincial acts and regulations, and federal acts and regulations. As required in the current Approval to Operate I-8800, which is valid from August 1st, 2014 until July 31st, 2019 (Appendix A), the facility operates in accordance to the most recent version of *the Environmental Management Program for Land Based Finfish Aquaculture in New Brunswick* (2013) issued by the NBDELG.

Maintenance of the current facility is routinely carried out and mechanical repairs done as required. This practice will continue to be followed when the Project is completed.

2.10 Future Modifications, Extensions, or Abandonment

Future modifications, extensions or abandonment of the development are not anticipated at this time. Typically, it has been required in the terms and conditions of the Approval to Operate I-8800 for the Johnson Lake Hatchery that: “The Approval Holder shall apply in writing to the Director and

receive approval for an amendment of this Approval before making any changes, including fish species, to the currently Approved Facility" (Appendix A).

2.11 Accidents and Malfunctions

The Project and its components will be designed and implemented in accordance with applicable Acts, regulations, guidelines, codes and standards. Accidental events may occur whether they are related to activities described in the EIA or in the daily operations of the facility. Kelly Cove Salmon Ltd. has an Integrated Contingency Plan (ICP) (Appendix D) which includes an: Oil Spill Prevention Control and Countermeasures (SPCC) Plan; Hazardous Matter Spill Prevention Control and Cleanup Plan; and a Facility Emergency Response Plan.

2.12 Project Related Reports

Any Project related reports are referenced throughout the EIA Report and are attached in the Appendices A thru G.

3.0 DESCRIPTION OF EXISTING ENVIRONMENT

3.1 Atmospheric Environment

3.1.1 Weather and Climate

The Johnson Lake Hatchery is located in the Fundy Coast Ecoregion. This Ecoregion is strongly influenced by effects of the cool Bay of Fundy. Elsewhere, the mean temperature tends to decrease with increasing elevation. Precipitation in the Fundy Coast Ecoregion is high relative to other ecoregions, except in late summer (NBDNR, 2017).

Climate in the region is marked by warm, rainy summers and mild, snowy winters. The mean annual temperature is approximately 5°C. The mean summer temperature is 15°C and the mean winter temperature is -5°C.

Local temperature and precipitation data were obtained from the Pennfield meteorological station (45°06'00.00N, 66°44'00.00W) located approximately 3 km southwest of the Project site. For the period from 1981-2010, the mean annual temperature was 5.2°C, with a mean daily high of 10.4°C and a mean daily low of -0.1°C (EC 2015a). January and February were the coldest months (-7.1°C and -5.5°C, respectively), while the warmest months were July and August (15.6 °C and 15.6°C, respectively) (EC, 2018a).

From 1981-2010, mean annual snowfall was 192.0 cm and rainfall were 1,237.7 mm (EC, 2018a). Most snowfall is received in January and March (53.5 cm and 45.2 cm, respectively), while the rainiest months are May and November (130.2 mm and 132.2 mm, respectively) (EC, 2018a).

3.1.2 Air Quality

NBDELG monitors air quality at seven stations throughout the province. Measured parameters include ground-level ozone (O_3), particulate matter (PM2.5), and nitrogen dioxide (NO_2), and these values are used to calculate a score on the Air Quality Health Index (AQHI) (EC, 2018b). The AQHI is a scale from 1-10+, in which scores represent the following health risk categories: Low (1-3), Moderate (4-6), High (7-10), and Very High (10+). The closest AQHI monitoring stations are in Saint John and Fredericton, approximately 50 km east and 63 km northeast of the site respectively. The AQHI at this site is usually low (1-3) at all times of the year (EC, 2018b).

The nearest source of industrial emissions would be the Lake Utopia Paper (LUP) mill. LUP is owned and operated by JD Irving Limited, and is located approximately 4.5 km to the northwest of the proposed undertaking. LUP produces high quality corrugating medium for the North American and global markets, used in the production of packaging material. SCHEDULE A of LUP's current Approval to Operate (I-8900) indicates that there exists the potential for environmental impacts from the release of trace amounts of air contaminants from a variety of Mill Complex Emission Sources. LUP is currently approved by NBDELG to operate under the *Air Quality Regulation - Clean Air Act*, subject to the conditions described in their current Approval to Operate (I-8900). Wood-burning fireplaces and campfires contributing particulate matter and PAHs, and vehicle emissions contributing VOCs, are the primary sources of air emissions in the immediate vicinity of the Project.

3.1.3 Ambient Sound Quality

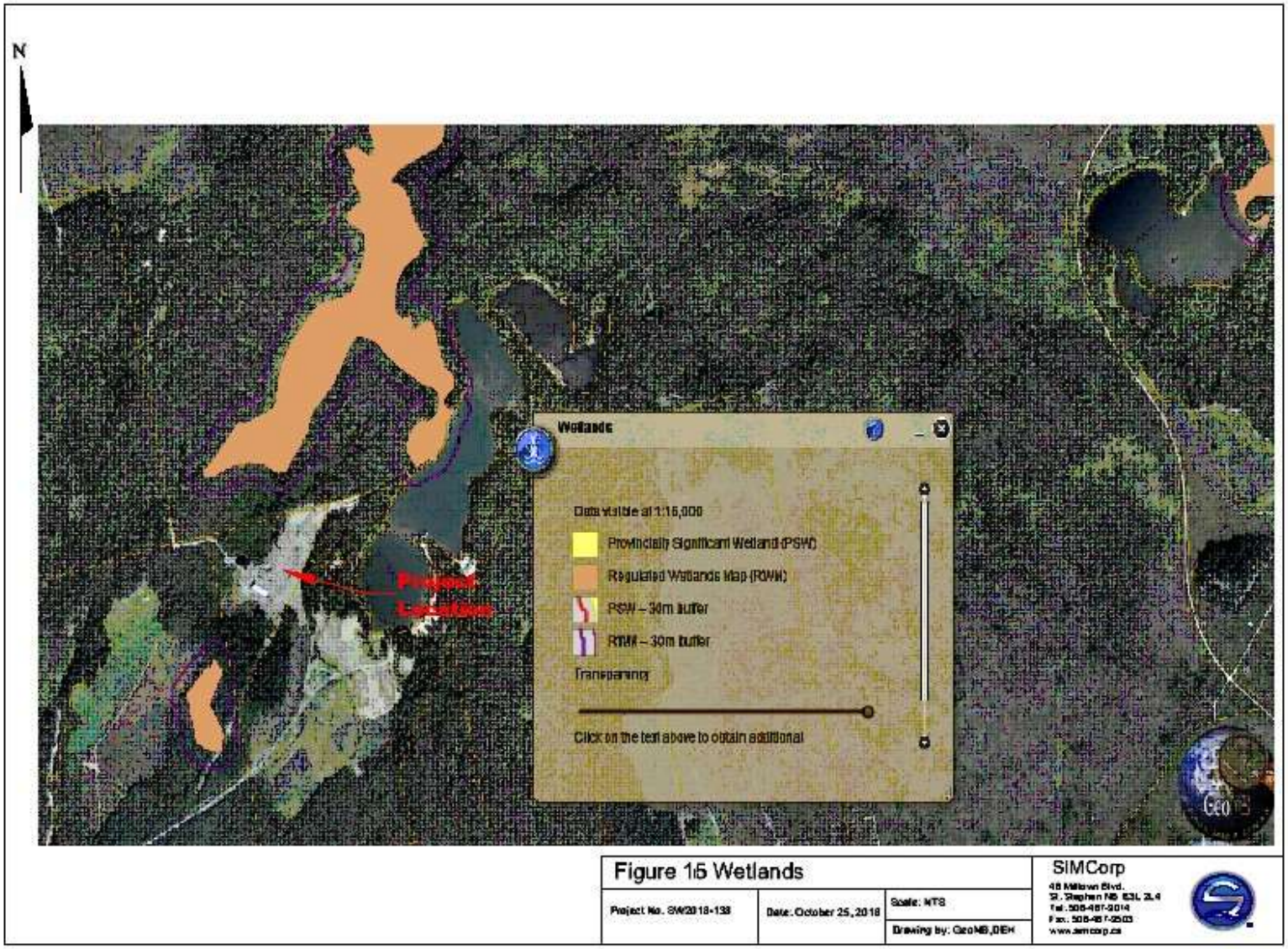
Any changes to ambient sound quality will be limited to construction activities which are anticipated to be short-term. Existing sound quality conditions in study area were not measured for this assessment.

3.2 Aquatic Environment

3.2.1 Wetlands

A review of the GeoNB Database indicates that there are no Provincially Significant Wetlands (PSW) on the Project site. The Regulated Wetlands Map shows two wetland areas that are regulated under the Watercourse and Wetland Alteration Program in the vicinity of the Project but, there will not be any activity involving the disturbance of soil or cutting of trees, in or within 30 meters of the wetland boundary (http://geonb.snb.ca/wetlands/) (Figure 15).

Figure 15 Wetlands



3.2.2 Watercourses/Surface Water

Mill Brook lies approximately 100 m northwest of the existing hatchery building and currently is used for a supplementary source of water for the hatchery (upstream) and further downstream as the location for the release of treated wastewater.

Water Withdrawal (Mill Brook)
The current Approval to Operate (ATO 8800, Appendix A) ***Terms and Conditions*** allows for surface water withdrawal from Mill Brook. Current water withdrawals are not to exceed that required to maintain historic aquatic habitat within the watercourse as outlined in the BMP's of the most current *Environmental Management Program for Land Based Finfish Aquaculture in New Brunswick.* See Section 2.5.8 and Table 3 (Existing Water Budget).

Wastewater (Mill Brook)
The current wastewater treatment system is described in Section 2.5.4 and includes drum filtration of discharge water followed by a three- section settling pond with raised beds to hold vegetation prior to discharge into Mill Brook (Appendix C – Photograph 8).

Mill Brook originates from a wetland and Johnson Lake which are spring fed. Mill Brook exits at the upper portion of the L'Etang inlet. Since 1971 the effluent from the Lake Utopia Mill has been released into the upper portion of the L'Etang north of the causeway on Route 1, which greatly reduced the quality of the water. By 1975 the upper portion of the L'Etang inlet was totally anoxic (LeBlanc, 1997). As of 1999, The large amounts of effluent secreted from the mill caused a reduction of various benthic species as well as a distinct odour of hydrogen sulfide (LeBlanc, 1997). To prevent this effluent from mixing with the seawater in the entire estuary, and to eliminate the hydrogen sulfide smell, a control dam was built in 1989 at the "Pull and be Damned Narrows" slightly south of the Route 1 highway (ECW, 1997 and Washburn and Gillis, 1992). This control structure was equipped with culverts to allow the impoundment to drain at low tide, but flap gates prevented an influx of seawater when tides are rising (Washburn and Gillis, 1996).

The current ATO I-8800 (Appendix A) stipulates that the Approval Holder shall ensure that the level of total phosphorous as measured 100 metres downstream from the point of discharge is in accordance with Table 2.6 of the most version of the *Environmental Management Program for Land Based Finfish Aquaculture in New Brunswick*. Schedule "B" of ATO I-8800 outlines the current monitoring and sample plan of the facility. Appendix G provides EMP results at the current facility.

3.2.3 Groundwater Resources

There are two wells in close proximity of the Johnson Lake Hatchery (Figure 1 and L-2: Appendix B), one is well labelled as Well 1 (production well) and a Well #2 (emergency well). The current ATO 8800 stipulates that water withdrawal from Well 1 cannot exceed 909 L/min (200 IGPM) and that Well 2 can only be used in an emergency backup situation with water withdrawals not to exceed 318

L/min (70 IGPM). Further, the terms and conditions of the ATO limits the maximum pumping rate for Well 1 (production well) and Well 2 (emergency well) to not exceed 909 L/min (200 IGPM).

Based on a production well evaluation (Well 1) performed by Craig Hydrogeologic in October 27, 2000, the specific capacity of Well 1 was estimated to be 20 IGPM per meter of drawdown. It was recommended that the allowable drawdown should be 10 meters, therefore a water source approval of 200 IGPM. Hydrogeologic information is further provided in Section 3.3.1.

As described in Section 2.5.8 (Water Budget) and L-2 (Appendix B) there are three other wells on CAI owned land in the vicinity of the Project area. Wells 3 and 5, which are not in use and Well 4, which is the water supply for a residence owned by CAI.

3.3 Terrestrial Environment

The description of the terrestrial environment considers topography/geology, and flora and fauna (including species at risk) habitat/populations within 500m of the Project site.

3.3.1 Topography/Geology/Hydrogeology

The overburden in the general area is an extensive gravel deposit with some sands. They are described as a deltaic deposit from 1 to 35 meters in thickness. The Pennfield depositional scarp is located south of the project area and marks the southern edge of the gravel deltaic deposit. According to the well logs in the area the gravels range from greater than 10.7 to 35.4 meters (greater than 35 to 116 feet) in thickness. The overburden is widely used as a groundwater water source in the local area and it is the gravel deposit that forms the local aquifer. The bedrock in the area is mapped as Late Neoproterozoic age granitoids which form a complex geology. Some of the wells in the data set penetrate a few meters into the granite beneath the gravel, however, these wells utilize the upper fractured regolith zone at the top of the granite to source water from the overlying gravels.

In the general area of the site the gravel aquifer has safe yields in the range of 20.5 to 681.9 L/min (4.5 to 150 igpm). Based on common knowledge of the area, the gravel aquifer has been successfully developed for private residential wells by several individuals over the area. Local well drillers with knowledge of the area confirmed the potential for water supply development in terms of private wells. The vast majority of residential wells sourcing water from the gravel aquifer do not have well screens, the water simply flows into the open end of the well casing.

The inferred shallow groundwater flow is towards Johnson Lake. Deeper groundwater flow is probably towards the south. Surface water drainage flows out of Johnson Lake north and west via Millbrook to the Magaguadavic River (Craig HydroGeoLogic Inc., 2018 – Pers Comm.).

A search of the NBDELG well log database for a 1600-meter radius around PID 15162282 yielded a total of 10 well logs. These well logs provide the following information relating to the gravel aquifer (Table 11). This search was carried out in November 11, 2018 by Craig Hydrogeologic Inc.

Table 11 Summary of hydrogeologic information*

Well Depth (feet)	Estimated Yield (igpm)	Depth to Bedrock (feet)	Casing Length (feet)
Average: 73.3	Average: 30.5	Average: 73.7	Average: 56.8
Median: 60	Median: 20	Median: 70	Median: 50.5
Minimum: 40	Minimum: 4.5	Minimum: 35	Minimum: 40
Maximum: 185	Maximum: 150	Maximum: 116	Maximum: 116

* derived from 1600-meter radius around PID 15162282 search of NBDELG well log database which yielded 10 well logs.

All the well logs summarized in Table 11 appear source water from the gravel aquifer. Three of the 10 wells are drilled into the top of the bedrock; however, such wells utilize the upper weathered zone of the bedrock granite to draw water from the overlying gravel aquifer. The gravel aquifer appears to be quite productive. The well with an estimated safe yield is 118 feet in depth, drilled two feed into the top of the granite with a six-inch casing. The estimated safe yield of 150 igpm is about how much water you can force up a six-inch casing with a normal water well rig using air lifting. The estimated safe yield of this well probably does not represent the upper productive limit for this aquifer if designed well screens are employed.

A 2000-meter radius location search around PID 15162282 of the NBDELG well chemistry database provided results from a total of eight wells located in the area for which groundwater chemistry data was available. The precise locations of the wells from which the ground water chemistry data was obtained are not available due to right to privacy considerations of the property owners. The analytical results for the samples are provided in Appendix E Table 2. In Table 2 any result that exceeds the Canadian Drinking Water Quality Guidelines (CDWQG) is bolded and colour shaded for ease of recognition. The groundwater chemistry data in Table 1 was collected and analyzed using the water analysis certificate provided to the homeowner by the well driller when the well is new. The water samples are usually collected by the homeowner shortly thereafter to provide confidence that they can use the water. Because of the well just being drilled, the well from which the water sample was collected typically has not had enough time or use for the water to clear sufficiently prior to the water sample being collected. The result of this is that the chemistry data in Table 2 may overestimate the long-term turbidity and some trace metal concentrations as most wells will clear naturally with use and time.

Out of the eight chemistry records available, two wells had an exceedance of the CDWQG for iron of 0.3 mg/L and one well exceeded the CDWQG concentration for manganese of 0.05 mg/L. The guidelines for iron and/or manganese are based on esthetic considerations, not health. Iron and/or manganese can cause staining of plumbing fixtures and laundry. Iron and/or manganese can usually be readily removed by commercial water softeners at the hardness observed in this water or by filters. The presence of Iron and/or manganese in the groundwater from this aquifer is not uncommon and is usually the result of natural conditions.

Out of the seven well chemistry records available, one well exceeded the CDWQG for lead of 10 µg/L with measured concentrations of 22 µg/L. Lead is known to occur naturally in groundwater in New Brunswick and other areas of Canada and the United States.

A total of four out of the eight chemistry records available had elevated turbidity present in the samples. The elevated levels of turbidity may be related to the relative newness of the wells and they may not have had sufficient time, or use, to clear naturally. The water samples in the database are provided from the water well testing certificates which are provided by the well drilled immediately after the well has been drilled. As a result, the clear majority of the analytical results come from new wells. Most new wells clear naturally with time and use. At levels more than 5 NTUs turbidity may become noticeable to consumers and therefore, objectionable. The turbidity may be the result of elevated concentrations of iron and or manganese or the presence of particulate in the water. In either case, turbidity can be treated by water softeners and/or particulate filters.

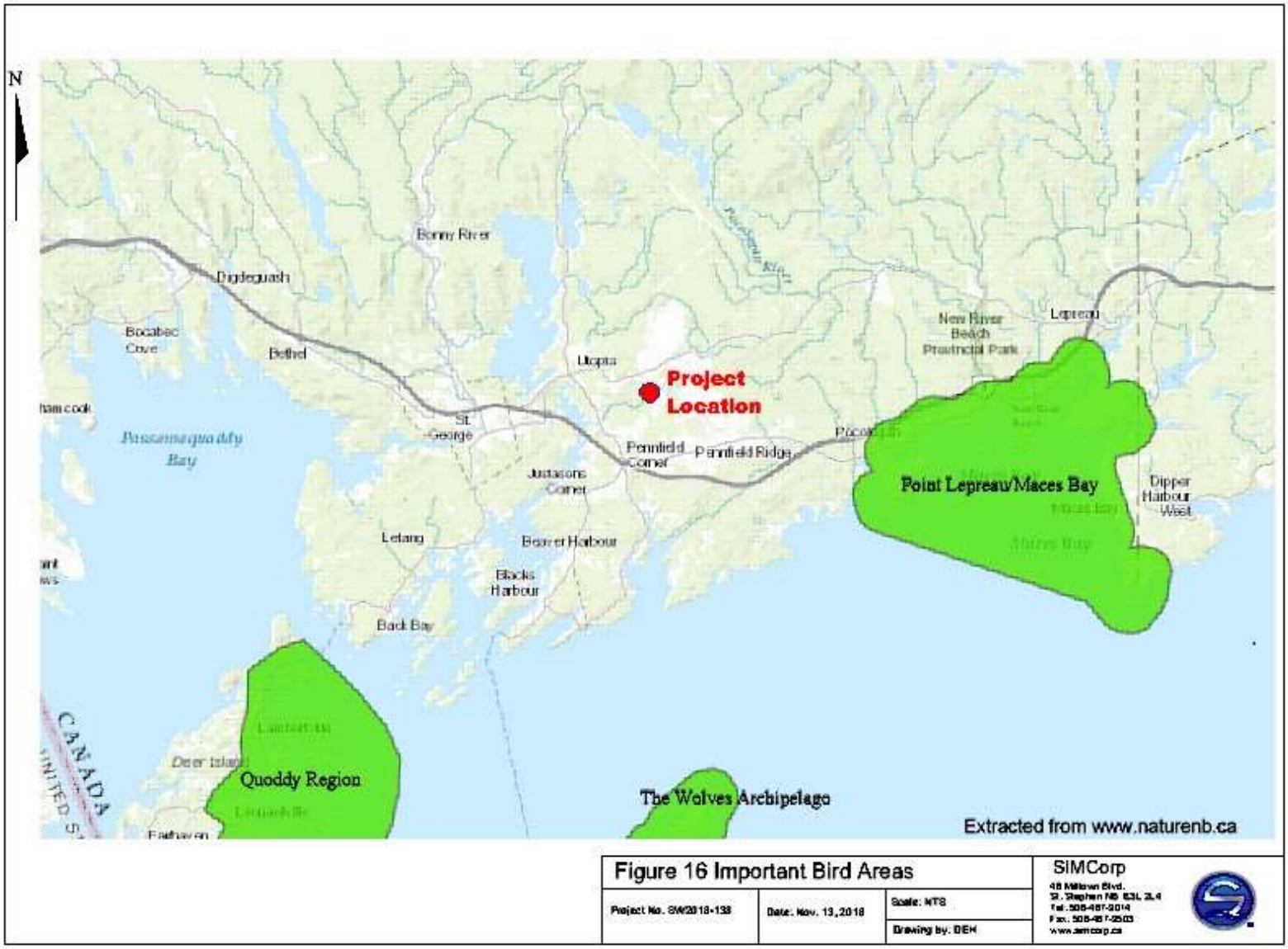
A total of nine sample results were available in the data set for E. coli analysis. Out of these results, no well had a detection of E. coli. A total of nine sample results were available for total coliform analysis and out of these nine results, two wells had a detection of total coliform. Total coliforms are natural soil bacteria and are commonly present in private well water systems, particularly associated with elevated turbidities. Such detections are usually easily treated by shock chlorination of the wells and associated plumbing systems.

3.3.2 Environmentally Significant Areas

Important Bird Areas

Important Bird Areas (IBAs) are discrete sites that support specific groups of birds: threatened birds, large groups of birds, and birds restricted by range or by habitat (https://www.ibacanada.org). The nearest IBA is Point Lepreau/Maces Bay Region IBA (NB020) and is located over 10 km to the southeast of the Project Site (Figure 16).

Figure 16 Important Bird Areas



Nature Preserves

Established in 1987, the Nature Trust of New Brunswick is a charitable land conservation organization that is responsible for conserving over 6000 acres (2400 hectares) in more than 40 beautiful and diverse nature preserves throughout the province. Table 12 identifies the Nature Preserves that are located in Southwest New Brunswick Fundy Region and their proximity to the proposed Project (http://www.naturetrust.nb.ca/wp/).

Table 12 Nature Preserves

Nature Preserve	Distance/Location from Project
Letang Islands	7.5 km SE
Belding Reef	29 km E
Connors Brothers at Pea Point	14 km SW
Dick's Island	21 km W
Navy Island Ann Leigh Williamson	27 km SW
New River Island	13 km E
Pagan Point	26 km SW
South Wolf Island	24 km S
Thompson Marsh	28 km E

Protected Natural Areas

According to the New Brunswick Department of Energy and Resource Development, Protected Natural Areas are sanctuaries that allow nature to exist with minimal human interference. They host a diversity of wildlife and plants across a range of forests, lakes, rivers, streams and wetlands. Forests in Protected Natural Areas are allowed to grow old and maintain primeval characteristics such as standing dead trees, or large decaying trunks on the forest floor. These are important to many wildlife species, ranging from butterflies to the American marten. Rich in biodiversity, Protected Natural Areas are linked to people and communities. They have cultural, spiritual and aesthetic value. They also provide benefits such as flood control, production of clean air and water, and assist in the maintenance of rare species (NB DERD, 2018a).

The nearest protected natural area is the Class 2 Protected Natural Area of Pocologan located approximately 7 km east of the Project site. Class 2 sites are less restrictive and allow low-impact recreational activities.

AC CDC Identified Areas

AC CDC GIS Scan identified the managed area of Utopia Wildlife Refuge and the Pennfield Ridge ESA (Appendix F) which are located approximately 5 km northwest and 2 km south of the Project site, respectively.

3.3.3 Vegetation

Forest Habitat

The Johnson Lake Hatchery is in the eastern part of the Fundy Coast Ecoregion. The cool, moist climate has led to a mainly coniferous forest cover. Winter temperatures are much colder in this region which is the reason that the coniferous community in the Fundy Coast Ecoregion is dominated by red spruce (an Appalachian species) together with balsam fir, black spruce, white spruce, and tamarack. Cedar is a predominant species on the limestone-derived soils around Saint John and in isolated places farther west. The tolerant hardwood assemblage of yellow birch, sugar maple, and beech that thrives elsewhere in southern New Brunswick is rare here. These heat-loving species prefer well drained soils and are ill adapted to the Bay of Fundy's damp, cool summer weather. They occur only at higher elevations on the warmest and most protected sites along ecoregion borders. The most common hardwoods are white birch, mountain ash, red maple, and some yellow birch. In the eastern part of the region, red maple and birches typically appear with balsam fir and red spruce, whereas in the western area, red maple and yellow birch occur with balsam fir and all three spruces (NBDNR, 2017).

The fog, abundant precipitation, and low soil temperatures in summer together have limited the frequency of regional wildfires. Fire-dependent species such as jack pine and white pine occur in only a few locales, and the intolerant hardwood community includes mountain ash and white birch. Because of the cool, damp summers, the forest understorey can support boreal-type species such as rock cranberry on dry sites and cloudberry in peatlands. Some coastal ravines and bogs also harbour noteworthy species of arctic flora, which represent disjunct vestiges of vegetation that prevailed early in the post-glacial period (see Chapter 3). In some locations, the vegetation here shows a sharp transition from predominantly coniferous coastal forests at lower elevations to mixed or deciduous forests over the warmer inland terrain. The occurrence of sugar maple and beech marks the transition to the Caledonia Uplands Ecoregion. Where the Fundy Coast Ecoregion borders the Mount Pleasant Ecodistrict of the Valley Lowlands Ecoregion, the boundary is less sharp, owing to a predominance of granitic bedrock and acidic soils. There, coniferous cover prevails in spite of the warmer climate (NBDNR, 2017).

Flora

AC CDC identifies that there are four species of concern within the Project area and they are listed in order of concern on Table 4.1 in Appendix F.

The area of proposed construction activities currently consists of imported fill material and there is an active salmon hatchery on the site. Vegetation on the proposed construction site consists primarily of intermittent patches of weeds and grasses (Appendix C – Photographs 3 and 4).

3.3.4 Wildlife and Wildlife Habitat

The immediate area of the Project area may provide suitable habitat for small mammals, including muskrat (*Ondatra zibethicus*), red fox (*Vulpes vulpes*), skunk (*Mephitis mephitis*), raccoon (*Procyon lotor)*, American mink (*Neovison vison*), squirrels (*Sciurus vulgaris*) and chipmunk (*Tamias striatus*) as well as others. The habitat in this area may also provide occasional foraging and migration pathways for other larger species such as white-tailed deer (*Odocoileus virginianus*), moose (*Alces alces*) and coyote (*Canis latrans*), etc.

During two site visits evidence of white-tailed deer (*Odocoileus virginianus*) was observed (scat and tracks) within the Project area. No other wildlife was observed at those visits. Given the limited availability of forest habitat and the level of development in the area there is limited potential for diverse wildlife habitat.

AC CDC identifies two rare and =/or endangered vertebrate animal (excluding birds) observations within their search area, one is the Eastern cougar, and the other is the Harbour Porpoise (Appendix F). Neither is likely to occur in the immediate area of the Project.

AC CDC (Appendix F) also identifies two rare/and or endangered species of butterflies that have been observed within AC CDC's prescribed project area; the Two-spotted Skipper (*Euphyes bimacula*) and the Aphrodite Fritillary (*Speyeria Aphrodite*). Both species have been given the general status ranking of "secure". Species that are ranked as secure are not believed to be At Risk, May Be At Risk, Sensitive, Extirpated, Extinct, Accidental or Exotic. These are generally species that are widespread and/or abundant. Although some Secure species may be declining, their level of decline is not felt to be a threat to their status in the province (NBDERD, 2018b).

3.3.5 Birds and Bird Habitat

AC CDC lists 14 rare and/or endangered birds within the AC CDC study area (Appendix E). These birds are listed in Table 13 along with the number of observations per taxon and the distance in kilometres from the study area centroid to the closest observation (+/- the precision, in km, of the record), Status (Provincial General Status (GS), International Union of Conservation of Nature (IUCN) status , Conservation of Endangered Wildlife in Canada (COSEWIC) status , Species at Risk Act (SARA) status), and habitat.

Table 13 Birds

Common name	Scientific name	Distance	Status	Habitat
Upland Sandpiper	*Bartramia longicauda*	1.4 +/- 0.0 km	Provincial GS Rank: Sensitive IUCN: Least concern	Abandoned rifle ranges, grasslands, blueberry fields.
Horned lark	Eremophila alpestris	2.0 +/- 7.0 km	Provincial GS Rank: may be at risk IUCN: Least concern	Open country, very short or no vegetation, including bare agricultural fields. Breed in short grassland, short-stature sage shrubland.
Northern Mockingbird	*Mimus polyglottos*	2.0 +/- 7.0 km	Provincial GS Rank: sensitive IUCN: Least concern	Favours areas with dense low shrubs and open ground, wither short grass or open soil. Also in second growth, woodland edges, farmland.
Brown Thrasher	*Toxostoma*	1.9 +/- 0.0 km	Provincial GS Rank: Sensitive IUCN: Least concern	Thickets, brush, shrubbery, thorn scrub. Breeds in areas of dense low growth, especially thickets around edges of deciduous or mixed woods, shrubby edges of swamps, or under growth in open pine woods.
Indigo bunting	*Passerina cyanea*	2.8 +/- 0.0 km	Provincial GS Rank: Secure IUCN: Least concern	15 spotted lake Utopia. For nesting favours roadsides, edges of woodlands, edges of railroads. Also, in clearings within deciduous woods, edges of swamps.

Canada Warbler	*Wilsonia canadensis*	2.6 +/- 0.0 km	Provincial GS Rank: At risk IUCN: Least concern COSEWIC: Threatened SARA: Threatened	10 spotted in Pocologan River. Proper nesting are Breeds in a range of deciduous and coniferous, usually wet forest types, all with a well-developed, dense shrub layer. Canada warbler nests are usually found on or near the ground on mossy logs or roots along stream banks or hammocks.
Vesper Sparrow	*Pooecetes gramineus*	1.9 +/- 0.0 km	Provincial GS Rank: May be at risk IUCN: Least concern	Meadows, fields, prairies, roadsides. Favours open grass fields. Commonly found in weed dominated roadsides, gravel pits, stubble fields. Often breeds in open areas with short, sparse grass and scattered shrubs, including old fields, pastures, weedy fencelines, and roadsides, hayfields, and native grasslands.
Killdeer	*Charadrius vociferus*	2.5 +/- 0.0 km	Provincial GS Rank: Sensitive IUCN: Least Concern	Fields, airports, lawns, river banks, mudflats, shores. Often found on open ground, such as pastures, plowed fields, large lawns, even at a great distance from water. Also, commonly found around water, on mudflats, lake shores, coastal estuaries.
Pine Siskin	*Carduelis Pinus*	2.8 +/- 0.0 km	Provincial GS Rank: Secure IUCN: Least concern	Breed in coniferous forests. Found in forest edges, and weedy fields

Barn Swallow	*Hirundo rustica*	2.3 +/- 2.0 km	Provincial GS Rank: sensitive IUCN: Least concern SARA: Threatened COSEWIC: Threatened	Nest in artificial structures, including barns and other out buildings and garages, houses, bridges, and road culverts. For foraging they prefer grassy fields, pastures, various kinds of agricultural crops, lake and river shorelines, farm yards, wetlands
Bobolink	*Dolichonyx oryzivorus*	3.1 +/- 0.0 km	Provincial GS Rank: Sensitive, IUCN: Least concern COSEWIC: Threatened SARA: Threatened	Grasslands habitats, including wet prairie, graminoid peatlands, and abandoned fields dominated by tall grasses, no till cropland, small-grain fields.
Turkey Vulture	*Cathartes aura*	2.6 +/- 2.0 km	Provincial GS Rank: Secure IUCN: Least concern	Widespread over open country, woods, deserts, foothills. Generally, avoids densely forested regions. Commonly breeds in farmlands, rangelands, forests, and low elevation mountains.
Willow Flycatcher	*Empidonax traillii*	2.3 +/- 2.0 km	Provincial GS Rank: Sensitive IUCN: Least concern	Bushes, willow thickets, brushy fields, upland copses. Breeds in thickets of deciduous trees and shrubs, especially willows, or along woodland edges. Often near streams or marshes.
Long Eared Owl	*Asio otus*	2.6 +/- 6.0 km	Provincial GS Rank: Undetermined IUCN: Least concern	Woodlands, conifer groves. Favoured habitat includes dense trees for nesting and roosting, open country for hunting. Inhabits forest with extensive meadows, generally avoids unbroken forest.

Site Observations

During two site visits it was noted that much of the original bird habitat (mature trees) had been disturbed beforehand through historical activities and initial earthworks completed in the proposed Project area.

Two Bald Eagles (*Haliaeetus leucocephalus*) where observed flying over the Project area. Bald Eagle's typically nest in forested areas, in tall, mature trees (often mature white pine in New Brunswick). No suitable Bald Eagle nesting habitat is located within the Project location; therefore, the proposed Project is not anticipated to adversely impact this species.

3.6 Archaeological and Cultural Features

The proposed area for the construction has been previously reworked and consists mainly of fill-material (Figure 2 and Photographs: Appendix C). The New Brunswick Archeological Services Branch has indicated that they do not have any concerns with the Project going forward based on the information provided to them which included a brief description of the proposed location of groundworks and an aerial photograph of the proposed location of the new building (Anne Hamilton - ASB, Pers. Comm.).

3.7 Socio-Economic Environment

3.7.1 Population and Labour Force

The Project is located at Jack Road Extension, Pennfield, Charlotte County, NB. Charlotte County is in southwestern New Brunswick and borders the state of Maine, which makes it the closest entry point to markets in New England and the eastern seaboard of the United States. Charlotte County is a rural area with six municipalities: the town of St. Stephen, the town of St. Andrews, the town of St. George, the village of Grand Manan, the village of Blacks Harbour, and the community of Campobello. The largest communities in Charlotte County include the town of St. Stephen (pop. 4,415), the village of Grand Manan (pop. 2,360), and the town of St. Andrews (pop. 1,786) (Census Profile, 2016 Census). The area immediately surrounding the Project site is sparsely populated.

Population statistics for Pennfield Parish Census Subdivision (includes the Project area), Charlotte County and New Brunswick are derived from the 2016 census are summarized in Table 14.

Table 14 Population in the Saint David Parish Census Subdivision and Charlotte County

Population Statistics	Pennfield Parish Census Subdivision	Charlotte County	New Brunswick
Population in 2016	2,170	25,428	747,101
Population in 2011	2,218	26,549	751,171
Population change from 2011-2016 (%)	-2.2	-4.2	-0.5
Total private dwellings in 2016	996	13,513	359,721
Land area (square km)	363.86	3,426.97	71,388.81
Population density per square kilometre	6	7.4	10.5

Source: http://www12.statcan.gc.ca (Census Profile - 2016)

The age distribution in the Pennfield Parish and Charlotte County reveals a median age of 46.7 years and 47.9 years respectively, which are both higher than the provincial median age of 45.7 years and the Canadian median age of 41.2 years (https://www12.statcan.gc.ca, Census Profile-2016 Census). An overview of age distribution for 2016 for Pennfield Parish, Charlotte County and the Province is outlined in Table 15 below.

Table 15 Age Distribution in the Saint David Parish Census Subdivision and Charlotte County

Age Statistics	Pennfield Parish Census Subdivision	Charlotte County	New Brunswick
0 - 14 years	340 (13.1%)	3,755 (14.8%)	110, 495
15 - 64 years	1,435 (65.4%)	16,260 (63.9%)	487,820
65+ years	395 (21.2%)	5,420 (21.3%)	148,785
Total Population	**2,170 (100%)**	**25,430 (100%)**	**747,105 (100%)**

Source: http://www12.statcan.gc.ca (Census Profile - 2016 Census)

The median total income for recipients in the Pennfield Parish and Charlotte County was $30,165 and $29,064 a year respectively, compared with the median income of $30,961 for New Brunswick (Census Profile, 2016 Census). The median income for the Pennfield Parish was lower than the Canadian median of $34,204. The median value of dwellings in the Pennfield Parish and Charlotte County and is $125,016 and $129,557 respectively. In comparison, the median value of dwellings in New Brunswick and in Canada was $150,010 and $341,556, respectively (http://www12.statcan.gc.ca, Census Canada-2016 Census) (Table 16).

Table 16 Median Dwelling Value and Individual Income

Jurisdictions	Median Dwelling Value	Median Individual Income in 2015 Among Recipients
Pennfield Census Subdivision	$125,016	$30,165
Charlotte County	$129,557	$29,064
Province of New Brunswick	$150,010	$30,961
Canada	$341,556	$34,204

Source: http://www12.statcan.gc.ca (Census Profile – 2016 Census)

Pennfield Parish falls within the region of Madawaska-Charlotte and the current unemployment rate in this region is 8.6% effective from June 10, 2018 to July 7, 2018 (https://www150.statcan.gc.ca). This can be compared to the other regions of New Brunswick such as the Fredericton-Moncton-Saint John Region having and unemployment rate of 6.2% and Restigouche-Albert Region having a rate of 11.3%. Canada has a unemployment rate of 5.8% as of May 2018 (https://www150.statcan.gc.ca).

A breakdown of the labour force within the Pennfield Parish, Charlotte County and New Brunswick is provided in Table 17. The highest proportion of workers in the Pennfield Parish are in the trades, transport and equipment operators and related occupations while in Charlotte County and the Province, the highest proportion of employed person are in the sales and service occupations category.

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3.7.2 Existing and Historic Land Use

The Johnson Lake Hatchery is a pre-existing hatchery owned by Johnson Lake Fisheries Inc. and now Kelly Cove Salmon Ltd. The Certificate of Determination to Proceed (Minister's Determination) for existing fish hatchery was issued on February 16, 2001 and has been operated by Johnson Lake Fisheries Inc. until KCS took it over at the end of July 2018. Land uses of the site prior to Ministerial Determination in 2001 (from 1970's until 1998) included five onsite serviced cottages and an 80-site campground. Some of the remnants/infrastructure and features of the campground remain on the property. Other observable land uses in the immediate area include some limited forestry, and blueberry farming operations (Figure 17).

In reference to the Ministerial Regulation for the Pennfield Planning area, the entire planning area is designated as a mixed-use zone which allows for a variety of permitted uses.

The closest aboriginal community is the Oromocto First Nation located along the approximately 82 km north of the Project site (Figure 13). The Peskotomuhkati Nation (Passamaquoddy Nation) has an office in St. Stephen NB located approximately 54 km east of the Project site. Consultations will be carried out with First Nations in accordance to the requirements for all registered projects and submitted to NBDELG.

Table 17 Labour Force by Industry in Saint David Parish, Charlotte County and New Brunswick

Total	Pennfield Parish	Charlotte County	New Brunswick
Total labour force population aged 15 years + (NOC-2016) All occupations	1,070	12,810	374,470
Management Occupations	75	1,125	34,015
Business Finance and Admin.	70	1,335	52,695
Natural and applied science and related occupations	45	525	20,705
Health Occupations	75	825	30,730
Occupations in education, law and social, community and gov. services	70	1,225	45,640
Occupations in art, culture, recreation and sport	0	105	6,610
Sales and service occupations	200	2,445	91,035
Trades Transport and equipment operators and related occupations	225	2,030	59,925
Natural resources, agriculture, and related production occupations	110	1,435	14,485
Occupations in manufacturing and utilities	205	1,480	18,620

Source: https://www12.statcan.gc.ca/census

Figure 17 Land Use

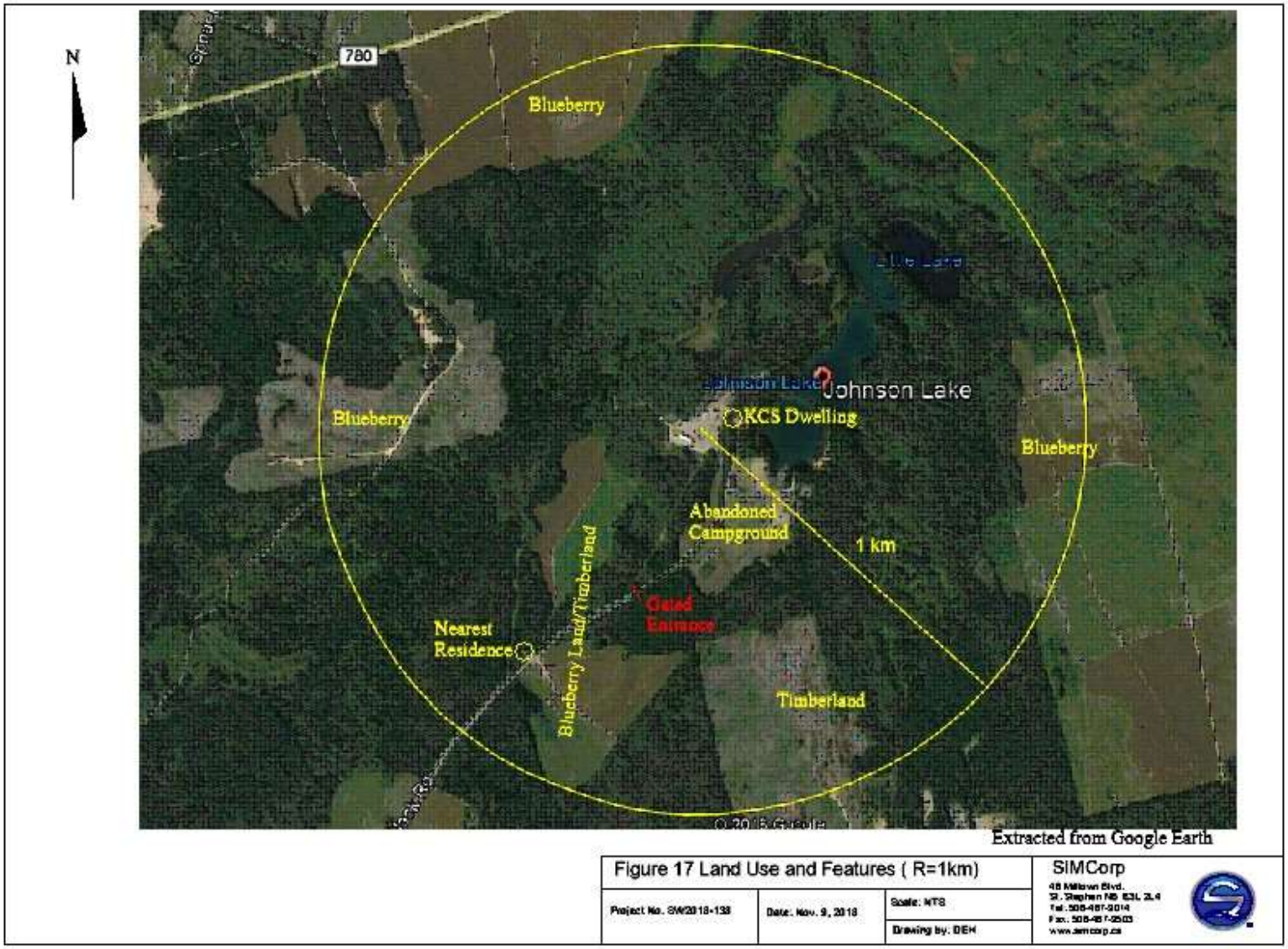
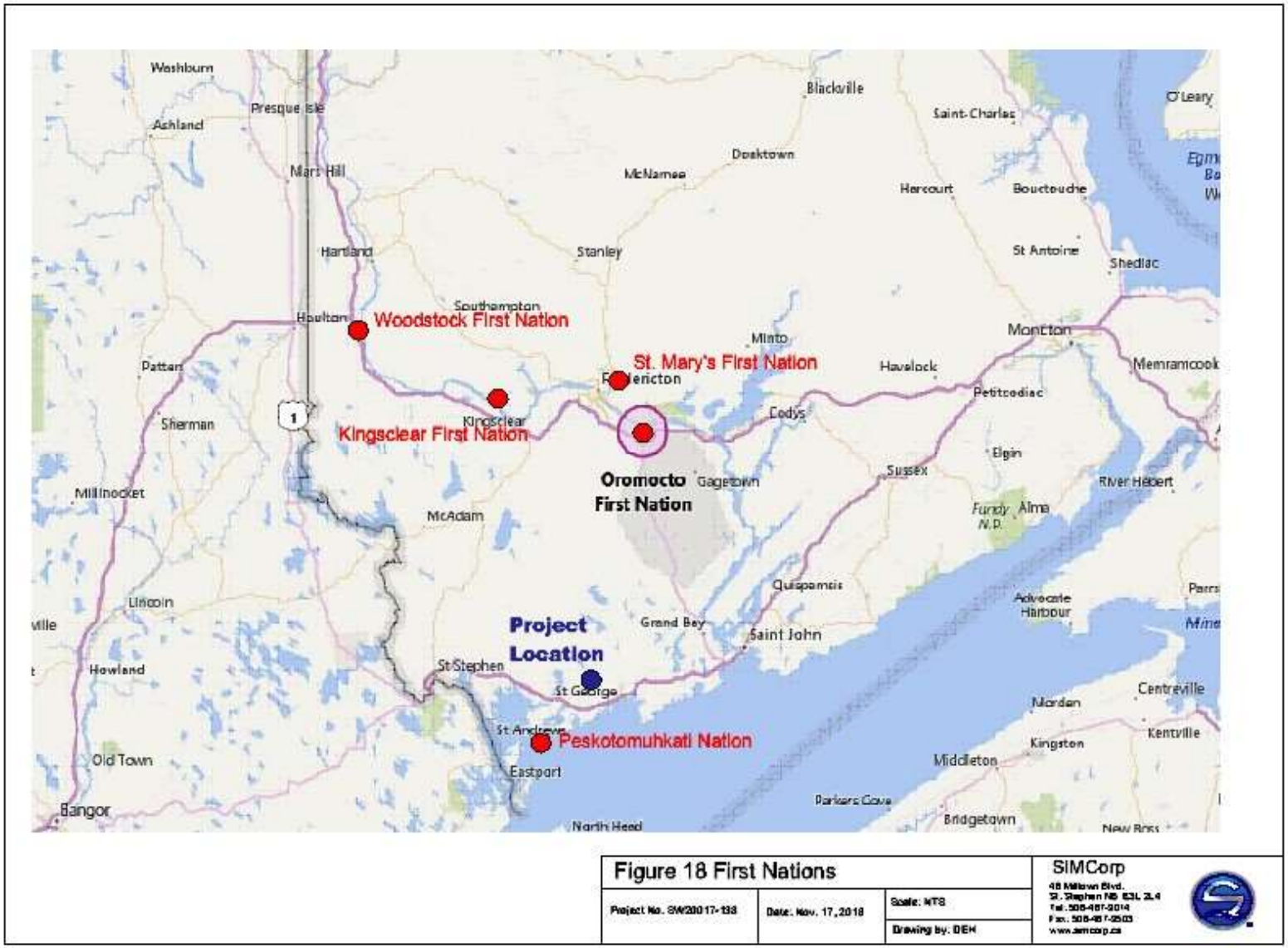


Figure 18 First Nations



3.7.3 Recreation and Tourism

Communities in the vicinity of the Project site include that of Pennfield, St. George and Blacks Harbour.

Pennfield (also referred to Pennfield corner) is a rural community located approximately 3 km south from the Project site. In October 2012 Pennfield had a major highway route change and the commercial area of the community was by-passed by the Route 1 Gateway Project, which extended from the Maine-USA border to Saint John New Brunswick. Many of the restaurants and gas stations remain on the commercial strip and are accessible from the new Route 1 Gateway Highway by off-ramps that access Route 175.

The Town St. George is located approximately 8 km southwest of the Project site has a population of 1517 (Statistics Canada, 2016). Major employers include aquaculture companies such as Cooke's Aquaculture Inc., Lake Utopia Paper mill (owned and operated by JDI) and various Provincial and Federal Government buildings.

Recreational activities in the immediate area of the proposed Project consist mainly of camping, hunting, fishing, boating, hiking, and ATV use.

3.7.4 Commercial, Recreational and Aboriginal Fisheries

Commercial Fisheries
The nearest aquaculture facility is the Buckman's Creek Hatchery which is owned by the Proponent and is located 3 km south in Pennfield Ridge. The Elmsville Hatchery also rears Atlantic salmon which are destined for Company owned aquaculture sites for grow-out.

Recreational Fisheries
It is unknown if any recreational fishery exists in the immediate area (i.e., Johnson Lake, Mill Brook) of the proposed project. The access road to the Hatchery has typically been gated and therefore access to the area has been restricted. (P.Turmel, NBDNR – Pers. Comm, October 2018).

Aboriginal Fisheries
The registration of the Project will require public consultations and will include communications with First Nations. Public consultations will allow First Nations to become familiar with the proposed Project and enable them to make comments or raise concerns (P. Turmel, NBDNR – Pers. Comm.).

4.0 ASSESSMENT OF POTENTIAL ENVIRONMENTAL IMPACTS

To adequately assess Valued Environmental Components (VECs), their temporal and spatial boundaries should be taken into consideration. Temporal bounds delineate period of time over which project-related impacts can be expected while spatial bounds delineate physical areas in which VEC's may be affected by Project activities.

The temporal bounds for the Project are the construction and operation of the facility and it's decommissioning and abandonment. Decommissioning and abandonment were not considered as it is an unknown factor that can't be quantified.

The spatial bounds for many of the Valued Environmental Components (VECs) is the immediate footprint of the Project but some my be bounded by areas outside of the Project footprint due to the down-gradient movement of water and air.

For this Project Valued Socio-Economic Components (VSCs) are extended to the communities that have stake in the construction and operation of the facility such as the community of Pennfield.

The assessment of potential environmental impacts was conducted using the following step by step process:

- description of Project activities;
- identification and description of the environmental components that will be affected;
- description of impacts (if any) between the environment and the Project;
- description of the mitigative measures;
- identification of any residual effects after mitigative measures are applied; and
- the determination of the importance of effects after mitigative measures are implemented.

4.1 Valued Environmental Components (VECs)/Valued Socio-Economic Components (VSCs)

Valued Environmental Components (VECs) typically represent major components or aspects of the physical and biological environment that may be altered by the Project and are recognized as important for ecological reasons. Valued Socio-Economic Components (VSCs) are components of the socio-economic environment that are important to an individual's well-being and quality of life. The VECs/VSCs were assessed based on their intrinsic value to the environment, heritage and culture, legislation, and on professional judgment.

In summary the following have been identified as VECs/VSCs for the Project:

- Topography and drainage
- Groundwater resources

- Surface water resources
- Wildlife and Habitat
- Migratory Birds
- Flora
- Species at Risk
- Local Economy

4.2 Project Activities

There are three main project activities/phases associated with the components within the EIA:

1. **Construction Phase**: includes site preparation/civil works activities and construction activities for the fry and parr/pre-smolt building and associated systems.
2. **Operation/Maintenance**: includes the day to day operations and maintenance of the completed facility.
3. **Accidents and Malfunctions**: includes any incidents that cause spills or leaks and any unplanned events that could occur during project activities.

The Johnson Lake Hatchery is expected to operate into the foreseeable future, so the decommissioning of the facility was not considered in this document. If the facility were to be decommissioned it would be subject to any applicable legislation or regulation of the day.

4.3 VECs/VSCs/Project Activity Interactions

Table 18 describes the potential project impacts, identifies possible pathways of concern and the rationale for the inclusion or exclusion as a VEC or VSC for the project activities of construction and operation of the facility. Mitigations associated with VECs/VSCs and project activities are further discussed in Section 5.

Table 18 Pathway Analysis – VECs and VSCs for Johnson Lake Hatchery Project

Environmental Resources	Environmental Components of Concern	Pathway of Concern		Identified Pathways	VEC/VSC Determination	Project Activity			Rationale
		Yes	No			Construction	Operation	Accidents/ Malfunctions	
Terrestrial Environment	Topography and Drainage	X		• excavation activities • accidents/malfunctions	Yes	X		X	Potential impacts related to excavation activities etc.
	Surficial and Bedrock Geology		X	None Identified	No				No pathway identified
Atmospheric Environment	Climate		X	None Identified	No				No pathway Identified
	Air Quality	X		• disturbance of material • equipment operation	No	X		X	Grubbing and clearing are minimal due to Project location and existing infrastructure.
	Ambient Noise	X		• equipment operation	No				Short -term increase in noise levels is limited to construction activities.
Biological Environment	Migratory Birds	X		• construction activities • accidents/malfunctions	Yes	X		X	Protected by regulation
	Wildlife and Habitat	X		• construction/operation activities • accidents/malfunctions	Yes	X	X	X	Protected by regulation
	Species at Risk	X		• construction activities • accidents/malfunctions	Yes	X		X	Protected by regulation
	Flora	X		• introduction of invasive species.	Yes	X			Potential impact from ground work activities.
Water Resources	Groundwater Resources	X		• accidental release of hazardous material.	Yes	X	X	X	Protected by regulation
	Surface Water Resources	X		• wastewater treatment and release. • accidents/malfunctions	Yes		X	X	Protected by regulation
	Protected areas	X		• accidents/malfunctions	No	X	X	X	Project activities are outside 30 m buffer for wetlands. No protected area near Project location.
	Local Economy	X		• increase in employment • local economic spin-offs	Yes	X	X		Benefits to local and provincial economy
	Land-use		X	None identified	No				Existing hatchery on the site
	Road Transportation	X		• increase in traffic	No	X	X		Increase in traffic for construction is short-term and little effect on local traffic expected during operation.
	Archeological Resources		X	None identified	No				Fill material existing on proposed Project location and site for new infrastructure was previously excavated.

5.0 SUMMARY OF PROPOSED MITIGATIONS

5.1 Methodology

In Section 4.0 VECs and VSCs for the Project were rationalized and identified for each environmental components of concern (Table ??). The next step is to determine the significance of potential effects prior to mitigative measures and then the significance of predicted residual effects after mitigative measures are imposed. The level of significance is typically assessed a numerical value based on the level of significance with 0=none, 1=insignificant, 2=significant, 3=unknown, and 4=positive and is determined based on professional judgement. The results of this methodology for each VEC/VSC are presented in the following sections.

During all phases of the Project there is a potential for accidents or malfunctions to occur. Kelly Cove Salmon Ltd. has a Waste Management Plan (WMP) and Integrated Contingency Plan (ICP) with includes an Oil Spill Prevention Control and Countermeasures (SPCC) Plan, Hazardous Matter Spill Prevention Control and Cleanup Plan and, Facility Emergency Response Plan (Appendix D). The effect of the potential impacts of accidents and other unplanned events prior to mitigation is unknown (=3) but, with adherence to the WMP and the various components of the ICP it is reduced to insignificant (=1).

5.2 Terrestrial Environment

Table 19 VEC-Topography and Drainage

Pathway	Significance Before Mitigation	Mitigation Measures	Significance of Residual Effects	Follow-Up Monitoring
• Excavation activities	2	As described	1	Not required
• Accidents/malfunctions	3	WMP, ICP	1	

Mitigations:

Scheduling activities to minimize potential impacts associated with erosion (i.e., avoid activities during intense storm events).

- Installation of effective erosion and sediment control measures before starting work to prevent sedimentation/siltation.

- Regular inspection and maintenance of erosion and sediment control measures and structures during construction activities.

- Repairs to erosion and sediment control measures and structures if damage occurs.
- Removal of non-biodegradable erosion and sediment control materials once construction is completed.
- Minimize ground disturbance to reduce the potential for erosion and sedimentation.
- Preserve natural vegetation on site as much as possible. Re-vegetate disturbed areas with species of plants native to the area or, if not available, insure plants used are not known to be invasive.

Residual Effects:

With these mitigation measures in place, the potential environmental residual effects of the excavation associated with construction activities during the Project are reduced from possibly significant (pre-mitigation) to insignificant.

5.3 Biological Environment

Table 20 VEC-Migratory Birds

Pathway	Significance Before Mitigation	Mitigation Measures	Significance of Residual Effects	Follow-Up Monitoring
• Construction activities	2	As described	1	Not required
• Accidents/malfunctions	3	WMP, ICP	1	

Mitigations:

- Comply with all applicable permits and approvals.
- Abide by any relevant timing constraints as identified by regulatory agencies.
- Implement dust prevention and abatement measures.
- Adhere to *Migratory Bird Convention Act* stipulations.
- Although clearing of trees is not required for new construction and human activity has been ongoing at the existing facility, if any ground nests are discovered then they will be reported.

- Select outdoor lighting to minimize glare and up-lighting, wherever possible, to avoid attracting birds.

Residual Effects:

With these mitigation measures in place the potential environmental residual effects on migratory birds at the proposed project area are reduced from possibly significant (pre-mitigation) to insignificant.

Table 21 VEC-Wildlife and Habitat

Pathway	Significance Before Mitigation	Mitigation Measures	Significance of Residual Effects	Follow-Up Monitoring
• Construction/operation activities	2	As described	1	Not required
• Accidents/malfunctions	3	WMP, ICP	1	

Mitigations:

- Comply with all applicable permits and approvals.
- Comply to NB *Fish and Wildlife Act.*
- Abide by any relevant timing constraints for wildlife as identified by regulatory agencies.
- Enforce speed limits for vehicles and limit vehicle movement.
- Construction equipment and vehicles to yield to wildlife.
- No on-site employees will harass wildlife.

Residual Effects:

With these mitigation measures in place the potential environmental residual effects on wildlife and habitat at the proposed project area are reduced from significant (pre-mitigation) to insignificant.

Table 22 VEC-Species at Risk

Pathway	Significance Before Mitigation	Mitigation Measures	Significance of Residual Effects	Follow-Up Monitoring
• Construction activities	2	As described	1	Not required
• Accidents/malfunctions	3	WMP, ICP	1	

Mitigations:

- Comply with all applicable permits and approvals.
- Comply to Federal and Provincial *Species at Risk Acts.*
- Abide by any relevant timing constraints as identified by regulatory agencies.

Residual Effects:

With these mitigation measures in place the potential environmental residual effects on Species at Risk at the proposed project area are reduced from significant (pre-mitigation) to insignificant.

Table 23 VEC-Flora

Pathway	Significance Before Mitigation	Mitigation Measures	Significance of Residual Effects	Follow-Up Monitoring
• Construction activities	2	As described	1	Not required
• Accidents/malfunctions	3	WMP, ICP	1	

Mitigations:

- Comply with all applicable permits and approvals.
- Comply to all relevant legislation or acts.
- If there is a need for re-vegetation in the general project area, then plants native to the area will be used. If seed mixes or herbaceous native species for the area are not available, plants used for re-vegetation will not be invasive.

- Measures to diminish the risk of introducing invasive species such as: cleaning and inspection of equipment prior to transport from elsewhere; and regularly inspecting equipment prior to, during and immediately following construction in areas found to support Purple Loosetrife, will be implemented.

Residual Effects:

With these mitigation measures in place the potential environmental residual effects associated with flora at the proposed project area are reduced from significant (pre-mitigation) to insignificant.

5.3 Water Resources

Table 24 VEC-Groundwater Resources

Pathway	Significance Before Mitigation	Mitigation Measures	Significance of Residual Effects	Follow-Up Monitoring
• Construction/operation Accidental release of hazardous materials	2	As described	1	Not required

Mitigations:

- Comply with all applicable permits and approvals.
- Comply to all relevant legislation or acts (*Canadian Environmental Protection Act, Transportation of Dangerous Goods Act, NB Clean Water Act, NB Clean Environment Act*).
- Contain all construction water and solids and recycle where possible.
- Use sedimentation and erosion control measures as described in mitigations associated with topography and drainage VEC.
- Conduct routine inspections to ensure accidental spill risks are minimized.
- Adhere to and implement KCS's WMP, ICP and its components as appropriate.

Residual Effects:

With these mitigation measures in place the potential environmental residual effects on ground water resources at the proposed project area are reduced from significant (pre-mitigation) to insignificant.

Table 25 VEC-Surface Water Resources

Pathway	Significance Before Mitigation	Mitigation Measures	Significance of Residual Effects	Follow-Up Monitoring
• Wastewater treatment and release.	2	As described	1	Required under ATO & EMP
• Accidents/malfunctions	3	WMP, ICP	1	

Mitigations:

- Comply with all applicable permits and Approval to Operate.
- Comply to all relevant legislation or acts (i.e. NB *Clean Water Act*, CEPA, NB *Clean Environment Act*, etc.).
- Maintain appropriate feed conversion ratios (FCRs) so that no access feed is released.
- Train staff on feeding techniques
- Maintain appropriate filter system
- Use only approved therapeutant products
- Allow proper dilution of therapeutants prior to discharge
- Follow Fish Health Management Plan (FHMP) and Best Aquaculture Practices (BAP)
- Adhere to Waste Management Plan (Appendix D)

Residual Effects:

With these mitigation measures in place the potential environmental residual effects on surface water resources at the proposed project area are reduced from significant (pre-mitigation) to insignificant.

5.4 Socio-economic Environment

Table 26 VSC- Local Economy

Pathway	Significance Before Mitigation	Mitigation Measures	Significance of Residual Effects	Follow-Up Monitoring
• Increase in employment	3	Hire Locally	4	Not required
• Increase in economic spin-offs	3	Hire Locally	4	

Mitigations:

Although the construction phase will create short-term employment for various trades (electricians, heavy machine operators, etc.), the operations of the new facility will have the need for up to 6 permanent year-round employees. Since the facility will utilize state-of-the-art low water exchange technology, some of the positions will require post secondary education, such as aquaculture technician or engineering technology. Positive economic spin-offs are anticipated as employees and company tend towards buying and hiring locally.

Residual Effects:

With these mitigation measures in place the potential environmental residual effects on employment and economic spin-offs associated with the proposed project would be positive.

6.0 PUBLIC CONSULTATION

Upon submission of this EIA Document a comprehensive public consultation strategy will be developed in consultation with NBDELG. At a minimum it will involve:

- Direct communications with elected officials (i.e. the MLA, MP, local mayors), local service districts, community groups, environmental groups, and other key stakeholder groups (companies, agencies, interest groups etc.) and First Nations as appropriate, enabling them to become familiar with the proposed project and ask questions and/or raise concerns.

- The provision of direct, written notification (letter, information flyer, etc.) about the project and its location to potentially affected area residents and landowners and individuals (to be determined in consultation with Sustainable Development, Planning and Impact Evaluation Branch).

- The Sustainable Development, Planning and Impact Evaluation Branch, Department of Environment and Local Government (DELG) shall place notice of the Registration on its web

site at http://www.gnb.ca/0009/0377/0002/0016-e.pdf and shall make the Registration Document (and any subsequent submissions in response to issues raised by the Technical Review Committee) available for public review at 20 McGloin Street, 2nd Floor, Fredericton, N.B.

- The provision of copies of the project registration document, (and any subsequent submissions in response to issues raised by the Technical Review Committee) available to any interested member of the public, stakeholder or First Nation and shall deposit a copy of this document along with any subsequent revision with the appropriate DELG regional office, where it will be available for public review.

And for all registered projects:

Within 60 days of project registration, a report documenting the above public involvement activities will be prepared and submitted to the Department of Environment and Local and this report will be made available for public review. The report will:

• describe the public involvement activities (dates and times of any meetings, copies of newspaper notices, flyers, letters etc.);

• identify key public and private stakeholders (local naturalist groups, industry representatives, politicians, etc.) and First Nations directly contacted;

• include copies of all correspondence received from and sent to stakeholders and the general public;

• describe (summarize) any issues or concerns received as a result of the public involvement program (names and affiliations of persons providing the comments will be included in the report, but personal information such as addresses, and telephone numbers will be omitted);

• indicate how these issues and concerns were (or will be) considered or addressed;

• describe any proposed future public consultation with respect to the undertaking (e.g. ongoing public liaison committees, etc.).

7.0 CONCLUSION

This Registration Document has been prepared on behalf of Kelly Cove Salmon Ltd. The environmental components and potential project effects were assessed and presented with appropriate mitigation measures to minimize and/or eliminate the potential effects. Based on these interactions, it can be concluded that, with the proper mitigations and appropriate follow up monitoring, that the residual effects of the project would be considered not significant for all VEC's. The Project will have a positive residual effect for the identified VSC (local economy) as local economic spin-offs associated with the construction and operation of the facility and an increase in gainful employment are anticipated.

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Appendix A

Approval to Operate I-8800

APPROVAL TO OPERATE

I-8800

Pursuant to paragraph 8(1) of the *Water Quality Regulation - Clean Environment Act,* this Approval to Operate is hereby issued to:

Johnson Lake Fisheries Inc.
for the operation of the
Johnson Lake Fish Hatchery

Description of Source:	**A tank based aquaculture facility consisting of a covered tank field for the culture of Atlantic salmon from egg to smolt size.**
Source Classification:	**Fees for Industrial Approvals Regulation - Clean Water Act** **Class 5**
Parcel Identifier:	**01227107**
Mailing Address:	**P.O. Box 280** **Pennfield, NB E5H 2M1**
Conditions of Approval:	**See attached Schedule (s)"A", "B" and "C" of this Approval**
Supersedes Approval:	**I-8555**
Valid From:	**August 01, 2014**
Valid To:	**July 31, 2019**

Recommended by: _____
Environment Division

Issued by: _____ July 30, 2014
for the Minister of Environment and Local Government Date

SCHEDULE "A"

A. DESCRIPTION AND LOCATION OF SOURCE

Johnson Lake Fisheries Inc. operate an aquaculture facility consisting of a tank based hatchery facility and grow-out tanks contained within a greenhouse near Johnson Lake, Charlotte County, for the purpose of culturing Atlantic salmon smolts. The facility utilizes flow through, 50% re-use and 90% recirculation technology at different stages of the rearing cycle. Effluent is treated to remove solids with rotary drum filters with particulate matter directed to a septic tank followed by flow into a three section settling pond with raised beds to hold vegetation prior to discharge to Mill Stream. The total water requirement for the facility will be 560 IGPM, supplied by two drilled wells and Mill Brook. The facility located adjacent to Johnson Lake and referenced by parcel identifier 01227107 is hereby approved subject to the following:

B. DEFINITIONS

1. **"after hours"** means the hours when the Department's offices are closed. These include statutory holidays, weekends, and the hours before 8:15 a.m. and after 4:30 p.m. from Monday to Friday.

2. **"Approval Holder"** means the person or persons to whom the Certificate of Approval has been issued and includes all persons responsible for the operation of the source.

3. "**Chemical**" means antibacterial and antibiotic agents, therapeutants, pesticides, herbicides, anesthetics, feed additives, hormones, veterinary biologics, biotechnology products, disinfectants, water treatment agents, fertilizers, paint products, organic solvents, anti-foulant products, petroleum products, liquid and gaseous fuels, sealants, lubricants, flocculants, and any other hazardous, toxic, or potentially harmful substance.

4. "**Department**" means the New Brunswick Department of Environment and Local Government.

5. **"Director"** means the Director of the Impact Management Branch of the Department and includes any person designated to act on the Director's behalf.

6. **"Facility"** means all property, real or personal, utilized in the operation or maintenance of the source.

7. **"Inspector"** means an Inspector designated under the *Clean Air Act*, the *Clean Environment Act*, or the *Clean Water Act.*

8. **"Minister"** means the Minister of Environment and Local Government and includes any person designated to act on the Minister's behalf.

9. **"Source"** means "source of contaminant" as defined in the Act.

10. **"watercourse"** means the full width and length, including the beds, banks, sides and shoreline, or any part of a river, creek, stream, spring, brook, lake, pond, reservoir, canal, ditch or other natural or artificial channel open to the atmosphere, the primary function of which is the conveyance or containment of water whether the flow be continuous or not.

C. EMERGENCY REPORTING

11. The Approval Holder**,** operator or any person in charge of the Facility shall **immediately** report to the New Brunswick Department of the Environment and Local Government where:

a) there has been, or is likely to be, an unauthorized release of solid, liquid or gaseous material including wastewater, petroleum or hazardous materials, to the environment;

b) there has been a violation of the *Air Quality Regulation*, the *Water Quality Regulation* or any Approval issued thereunder; or

c) a release of a contaminant or contaminants is of such magnitude or period that there is concern for the health or safety of the general public, or there could be significant harm to the environment.

During normal business hours, contact the:

Saint John Regional Office
(506) 658-2558

After hours, or in the event the Regional Office cannot be reached contact the:

Canadian Coast Guard
1-800-565-1633

All reports shall include:

a) a description of the source, including the name of the owner or operator;
b) the nature, extent, duration and environmental impact of the release;
c) the cause or suspected cause of the release; and
d) any remedial action taken or to be taken to prevent a recurrence of the release.

An Inspector will be contacted to return the call and provide direction, where required.

D. GENERAL INFORMATION

12. The Approval Holder shall operate the Facility in compliance with the *Water Quality Regulation-Clean Environment Act*.

13. This Certificate of Approval does not relieve the owner from complying with municipal bylaws, other provincial acts and regulations, or any federal acts and regulations.

14. Violation of any conditions of this Certificate of Approval constitutes a violation of the *Clean Environment Act*.

15. The Minister may revoke this Approval at any time and this Approval is automatically revoked by the issuing of a new Approval applying to the same source.

16. An Inspector, at any reasonable time, has the authority to inspect the Facility and carry out such duties as defined in the *Clean Air Act*, the *Clean Environment Act* or the *Clean Water Act*.

17. The terms and conditions of this Approval are severable. If any term or condition of this Approval is held invalid, is revoked or is modified, the remainder of this Approval shall not be affected.

E. TERMS AND CONDITIONS

GENERAL CONDITIONS

18. The Approval holder shall operate the facility in accordance with the most recent version of the *Environmental Management Program for Land-Based Finfish Aquaculture in New Brunswick* issued by the Department.

19. All water withdrawals, including those from ground, surface or pipeline sources shall be equipped with flow meters prior to November1st 2015.

20. Surface water withdrawal from the Mill Stream shall not exceed that required to maintain the historic aquatic habitat within the watercourse in which the water is withdrawn as outlined within the Best Management Practices section of the most recent version of the *Environmental Management Program for Land Based Finfish Aquaculture in New Brunswick.*

21. The Approval Holder shall ensure that the total water withdrawal from PW1 shall not exceed 909 litres per minute (200 IGPM) .

22. The use of on site experimental well (ExpW), located in close proximity to PW1 is not permitted but may be used as a backup ground water supply in emergency situations. In such circumstances the pumping rate shall not exceed 318 litres per minute (70 IGPM) and the approval holder shall contact the department within five days after commencement of pumping and shall notify the department when the use of the required emergency water supply has ceased.

23. The maximum pumping rate for the PW1 and the emergency back up well (ExpW) cannot exceed 909 (200 IPGM) litres per minute.

24. The development of additional water supplies for this Facility requires the approval of the Minister.

25. The Approval Holder shall ensure that a copy of the Approval, including all attached schedules is maintained onsite at all times. A copy of the Approval must also be posted in a prominent and accessible location.

26. The Approval Holder shall apply in writing to the Director and receive approval for an amendment of this Approval before making any changes, including fish species, to the currently Approved Facility.

27. The Approval Holder shall submit a written application to the Director for an Approval to Operate a **minimum of 60 days prior** to the expiration of this Approval.

28. The Approval Holder shall ***immediately*** notify the Minister in writing of any change in its name or address.

SOLID WASTE MANAGEMENT

29. The Approval Holder shall remove sludge from the septic and/or settling pond at least once per year and make arrangements for disposal in a manner which is acceptable to an inspector. Additional cleanout(s) may be required should any monitoring results indicate a failure to achieve the limits specified within this Approval.

WASTE MANAGEMENT PLAN

30. The Approval Holder shall ensure that all wastes generated throughout the operation and maintenance of the facility are managed and disposed of in accordance with the procedures and practices detailed in the Waste Management Plan in the attached SCHEDULE "C", or in a manner deemed acceptable by an Inspector, or as otherwise directed by the Department.

CHEMICAL STORAGE AND HANDLING

31. The Approval Holder shall ensure that all chemicals are stored in a manner such that any spill is contained and not released to the environment.

TESTING AND MONITORING

32. The Approval Holder shall conduct a water quality monitoring program in accordance Section 2.4, Table 2.5 and methodology in accordance with Appendix 1 and Table A1-2 within the most recent version of the *Environmental Management Program for Land Based Finfish Aquaculture in New Brunswick* issued by the Department and summarized in SCHEDULE "B".

DISCHARGE LIMITS

33. The Approval Holder shall ensure that the level of total phosphorus as measured 100 metres downstream from the point of discharge is in accordance with Table 2.6 of the most recent version of the *Environmental Management Program for Land Based Finfish Aquaculture in New Brunswick.*

REPORTING

34. The Approval Holder shall submit reports in accordance with Appendix 2 of the most recent version of the document titled *Environmental Management Program for Land-based Finfish Aquaculture in New Brunswick*, issued by the Department.

Prepared by: _____

Troy Lyons, M.Sc.
Aquaculture Approvals Officer, Industrial Processes

SCHEDULE "B"

MONITORING AND SAMPLING PLAN

Level 1

Station*	Parameters**	Analysis	Time Period	Frequency	Method
1-3	TP_L	Lab	June 1- Nov 15	Bi-monthly	Grab
	Temp and DO				Meter
5	Temp and DO	Self	Jan. 1-Dec. 31	Bi-monthly	Meter

Level 2

Station*	Parameters**	Analysis	Method
1-3	TP_L	Lab	Grab
	Temp and DO	Self	Meter
4	TP_L	Lab	Grab
5	Flow and Temp	Self	Meter

***Stations**

1. Mill stream - 10 metres upstream from the point of final effluent discharge.
2. Effluent - prior to outfall into Mill stream.
3. Mill stream - 100 metres downstream from the point of final effluent discharge.
4. Immediately prior to entry into settling pond
5. Well water

****Parameters**

TP_L - Total Phosphorus (low level) reported in milligrams per litre.
DO - Dissolved Oxygen (mg/litre)
Temp - Temperature (degrees Celsius)

SCHEDULE "C"

WASTE MANAGEMENT PLAN

1. The following Waste Management Plan was developed through consultation between the Department and the Approval Holder. This plan must be updated, and approved whenever operational practices require substantive and routine deviation from the procedures outlined herein.

Appendix B

Drawings/Schematics/Plans

L-1 Maps - Project Area
L-2 Maps - Property Area
L-3 Plan - Project Area (Existing)
L-4 Plan - Project Area (Proposed)

D-A1 Plan – System A
D-A2 Elevations and Section
D-A3 Details – Comphatch Deck

D-B1 Plan – Building
D-B2 Plan – Grading Deck
D-B3 Sections – Building
D-C1 Plan – Effluent Building
ESK-1 Plan – Generator and Electrical Rooms

PF-A1 – Process Flow Existing: First Feeding System
PF-A2 – Process Flow Upgraded: First Feeding System
PF-B1 – Process Flow: Fry
PF-C1 – Process Flow: PARR 1/PARR 2
PF-E1 – Process Flow: Effluent

BF-2 Process Flow Schematics

1 MAP – PENNFIELD
N.T.S.

2 MAP – NEW BRUNSWICK
N.T.S.

NOTES:

1. DETAILS 1 AND 2 MAPS FROM GEOGRATIS, GOVERNMENT OF CANADA.

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'NOT FOR CONSTRUCTION'

PRINTED ON: 2018/11/28

Cooke Inc. AQUACULTURE

PROJECT
JOHNSON LAKE HATCHERY

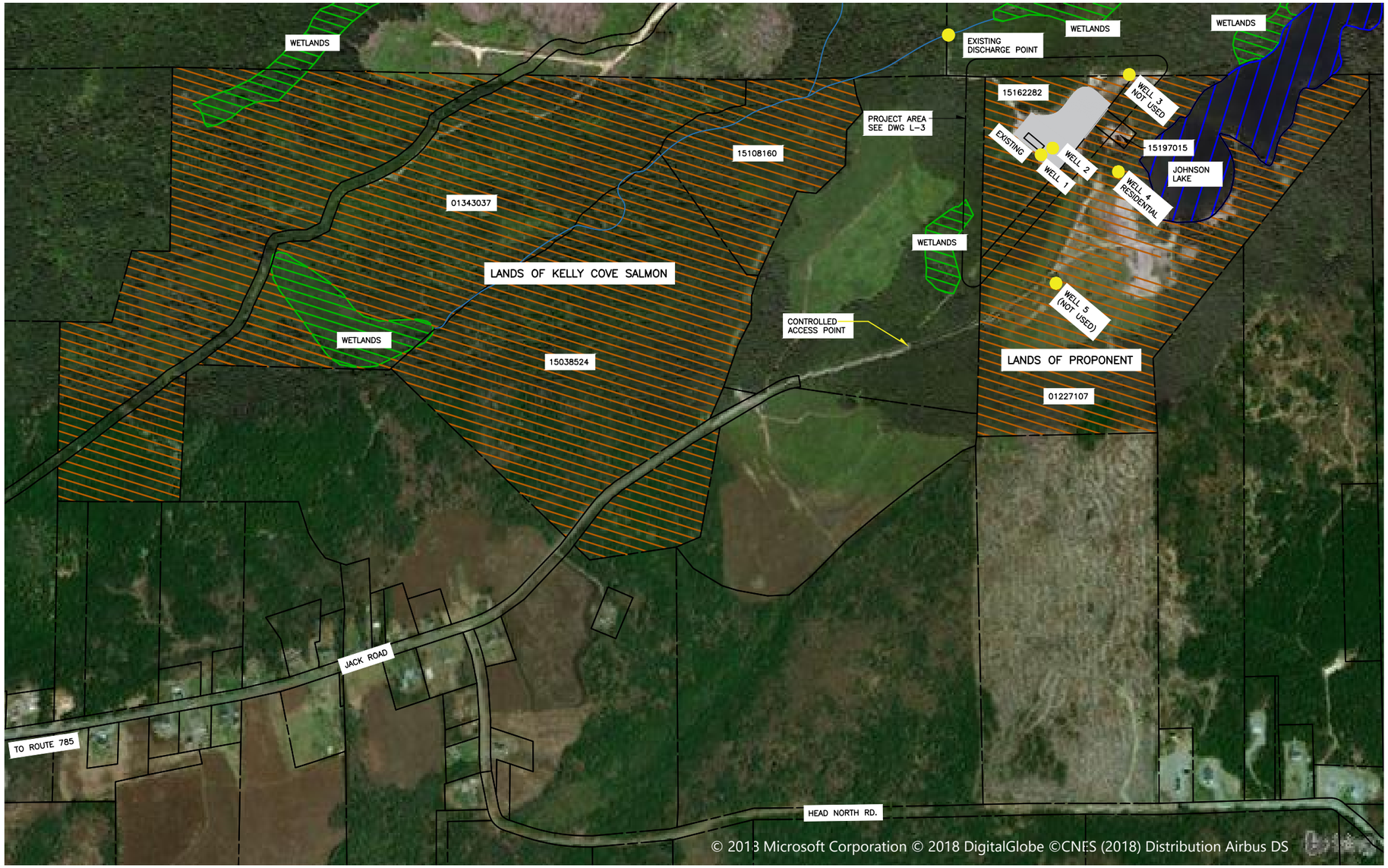
LOCATION
PENNFIELD, NB

TITLE
MAPS – PROJECT AREA

JOB:	DATE:	REVISED:	DRAWN:	CHECKED:
C18.13	18/11/20	–	M.D.S.	–

sorensen ENGINEERING LTD.
134 CARLETON, SAINT ANDREWS, NB E5B 1N9
PHONE (506) 529-0093 EMAIL INFO@SORENG.CA

SHEET
L-1
REV. 0



1 MAP – PROJECT AREA
N.T.S.

NOTES:

1. PROPERTY LINES FROM GEONB, PROVINCE OF NEW BRUNSWICK.
2. UNDERLAY MAP FROM BING MAPS.

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'NOT FOR CONSTRUCTION'

PRINTED ON: 2018/11/28

Cooke Inc. AQUACULTURE

PROJECT
NEW PARR UNIT

LOCATION
JOHNSONS LAKE, NB

TITLE
MAP – PROPERTY AREA

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C18.13	18/06/10	–	M.D.S.	–

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SHEET L-2
REV. 0

APPROX. LOCATION OF BROOK

166°29'50" 49.430

166°29'50" 50.560

76°14'20" 69.399

79°06'20" 78.960

10.058

10.058m WIDE EASEMENT
REF: PLAN No. 174029638

2050

PID 1343201
FREDERICK JOSEPH JACK
DOC. No. 92826
BK. 271 Pg. 412
REG: 1982-07-19

EDGE OF FILL

SETTLING POND

STORAGE AREA

STORAGE AREA

SHED

GARAGE

DUG OUT AREA

2.78 [9'-2"]

13.54 [44'-5"]

SHED

TANK

LIQUID OXYGEN

35.15 [115'-4"]

9.63 [31'-7"]

BUILDING 'A'

TOP OF BANK

STAIRS

WELLS 1&2

APPROX. LOCATION OF WATERLINE

UTILITY POLE

POH

WELL 3

WOODS ROAD

EDGE OF FILL

WOODS ROAD

UTILITY POLE

SHED

POH

GRAVEL

HOUSE

UTILITY POLE

COMMUNICATION TOWER

OFFICE ON WHEELS

UTILITY POLE

BIO-SECURITY BUILDING

GATE

UTILITY POLE

CHAIN LINK FENCE

GRAVEL PARKING

UTILITY POLE

WELL 4

FIELD

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'NOT FOR CONSTRUCTION'

PRINTED ON: 2018/12/05

Cooke Inc. AQUACULTURE

PROJECT
JOHNSON LAKE EXPANSION

LOCATION
PENNFIELD, NB

TITLE
PLAN – PROJECT AREA (EXIST.)

JOB:	DATE:	REVISED:	DRAWN:	CHECKED:
C18.13	18/11/16	-	B.A.W.B.	M.D.S.

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SHEET L-3 REV. 0

APPROX. LOCATION OF BROOK

166°29'50" 49.430

166°29'50" 50.560

2050

76°14'20" 69.399

79°06'20" 78.960

10.058

10.058m WIDE EASEMENT
REF: PLAN No. 174029638

WOODS ROAD

WELL 3

EDGE OF FILL

SETTLING POND

SHED

11.58 [38']

18.29 [60']

SEE DWG. D-C1

EFFLUENT

SHED

TANK

51.47 [168'-10"]

14.38 [47'-2"]

BUILDING 'A'
SEE DWG D-A1

TOP OF BANK

STAIRS

WELLS 1&2

GATE

GENERATORS,
FUEL & ELECT.

OXYGEN

WATER RESERVOIR

UNDER GROUND POWER

TRANSFORMER
PAD

48.77 [160']

97.54 [320']

BUILDING 'B'
SEE DWG D-B1

FISH LOADING

ENTRANCE

BIO-SECURITY BUILDING

PARKING

GATE

UTILITY POLE

POH

EDGE OF FILL

WOODS ROAD

UTILITY POLE

SHED

GRAVEL

HOUSE

UTILITY POLE

COMMUNICATION TOWER

WELL 4

PARKING

UTILITY POLE

FIELD

PID 1343201
FREDERICK JOSEPH JACK
DOC. No. 92826
BK. 271 Pg. 412
REG: 1982-07-19

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PRINTED ON: 2018/12/10

Cooke Inc. AQUACULTURE

PROJECT
JOHNSON LAKE EXPANSION

LOCATION
PENNFIELD, NB

TITLE
PLAN – PROJECT AREA (PROPOSED)

JOB:	DATE:	REVISED:	DRAWN:	CHECKED:
C18.13	18/11/16	–	B.A.W.B.	M.D.S.

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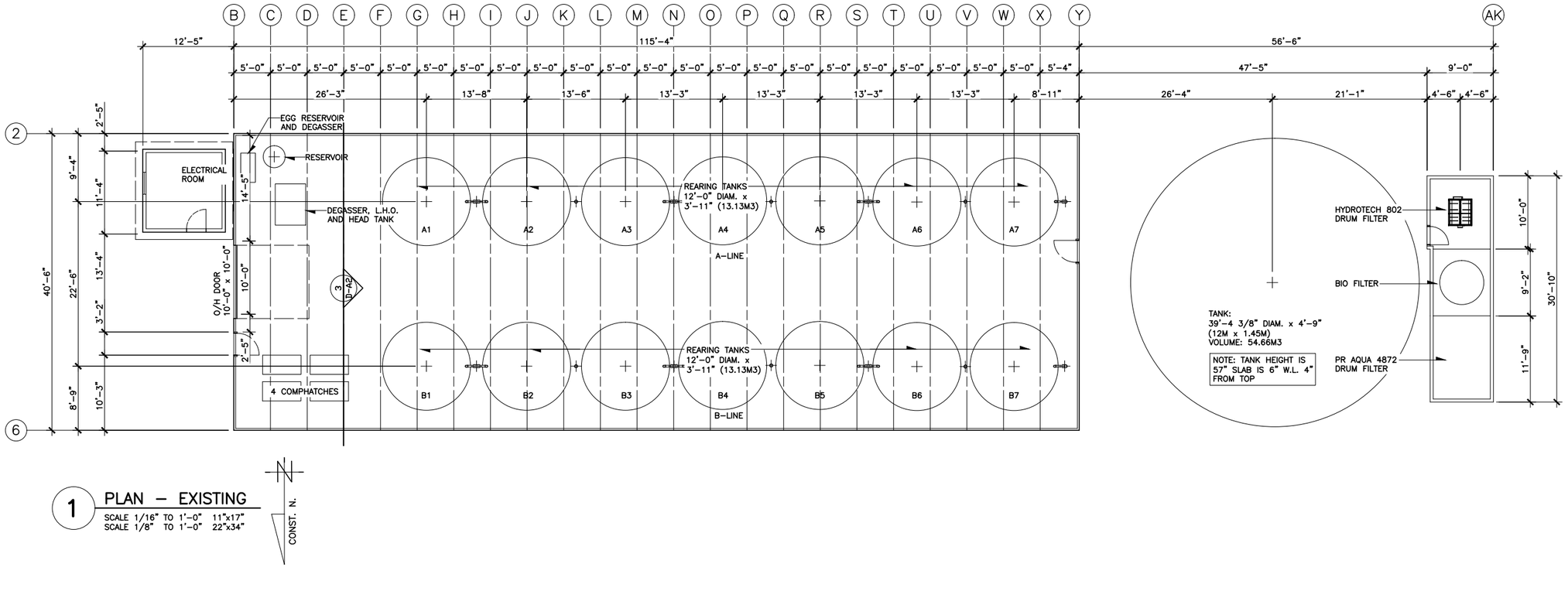
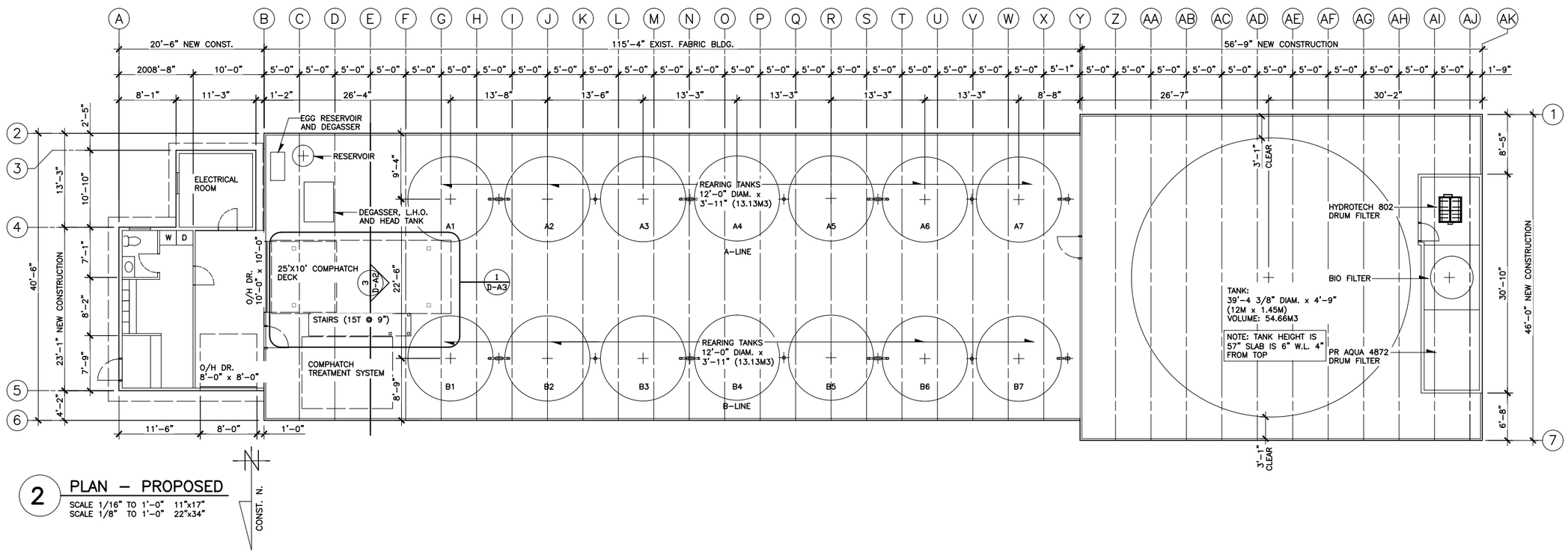
SHEET
L-4
REV. 0



1 PLAN – EXISTING

SCALE 1/16" TO 1'–0" 11"x17"
SCALE 1/8" TO 1'–0" 22"x34"



2 PLAN – PROPOSED

SCALE 1/16" TO 1'–0" 11"x17"
SCALE 1/8" TO 1'–0" 22"x34"

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'NOT FOR CONSTRUCTION'

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Cooke AQUACULTURE Inc.

PROJECT
JOHNSON LAKE EXPANSION

LOCATION
PENNFIELD, NB

TITLE
PLAN–SYSTEM A

JOB:	DATE:	REVISED:	DRAWN:	CHECKED:
C18.13	18/11/16	–	B.A.W.B.	M.D.S.

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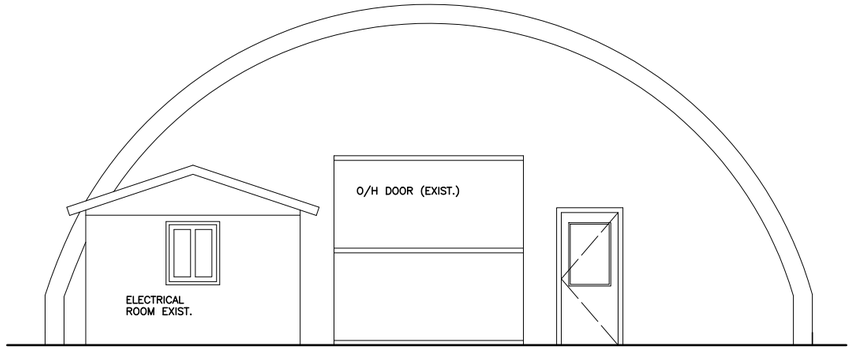
SHEET
D-A1

REV. 0



1 ELEVATION – EAST (EXIST.)

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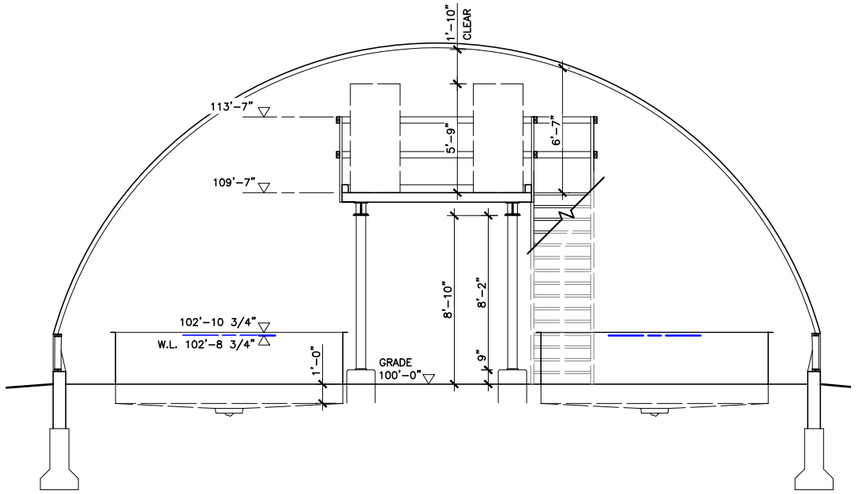
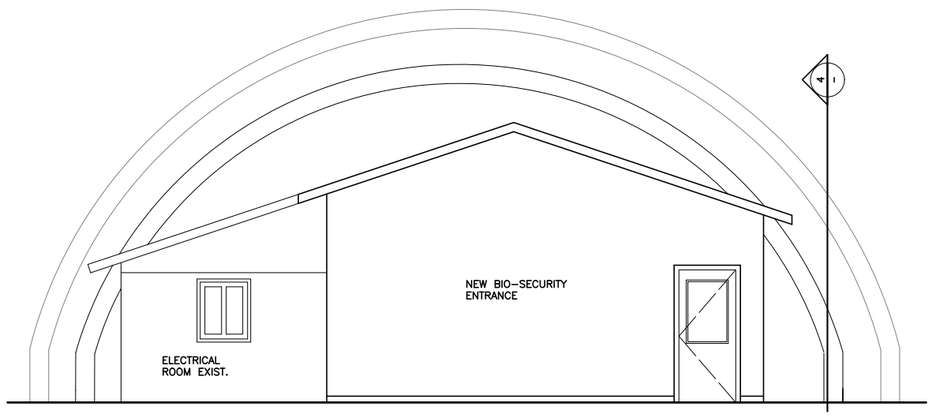
SCALE 1/4" TO 1'–0" 22"x34"



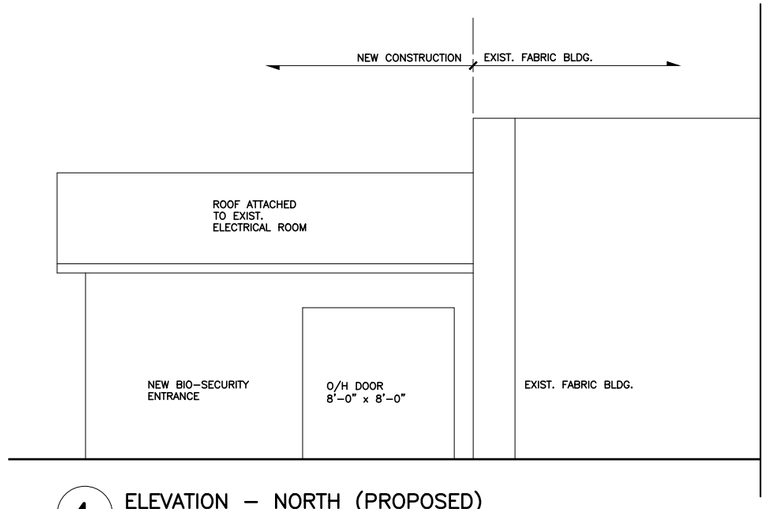
3 SECTION – EAST/WEST

SCALE 1/8" TO 1'–0" 11"x17"
SCALE 1/4" TO 1'–0" 22"x34"



2 ELEVATION – EAST (PROPOSED)

SCALE 1/8" TO 1'–0" 11"x17"
SCALE 1/4" TO 1'–0" 22"x34"



4 ELEVATION – NORTH (PROPOSED)

SCALE 1/8" TO 1'–0" 11"x17"
SCALE 1/4" TO 1'–0" 22"x34"

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Cooke AQUACULTURE Inc.

PROJECT
JOHNSON LAKE EXPANSION

LOCATION
PENNFIELD, NB

TITLE
ELEVATIONS AND SECTION

JOB:	DATE:	REVISED:	DRAWN:	CHECKED:
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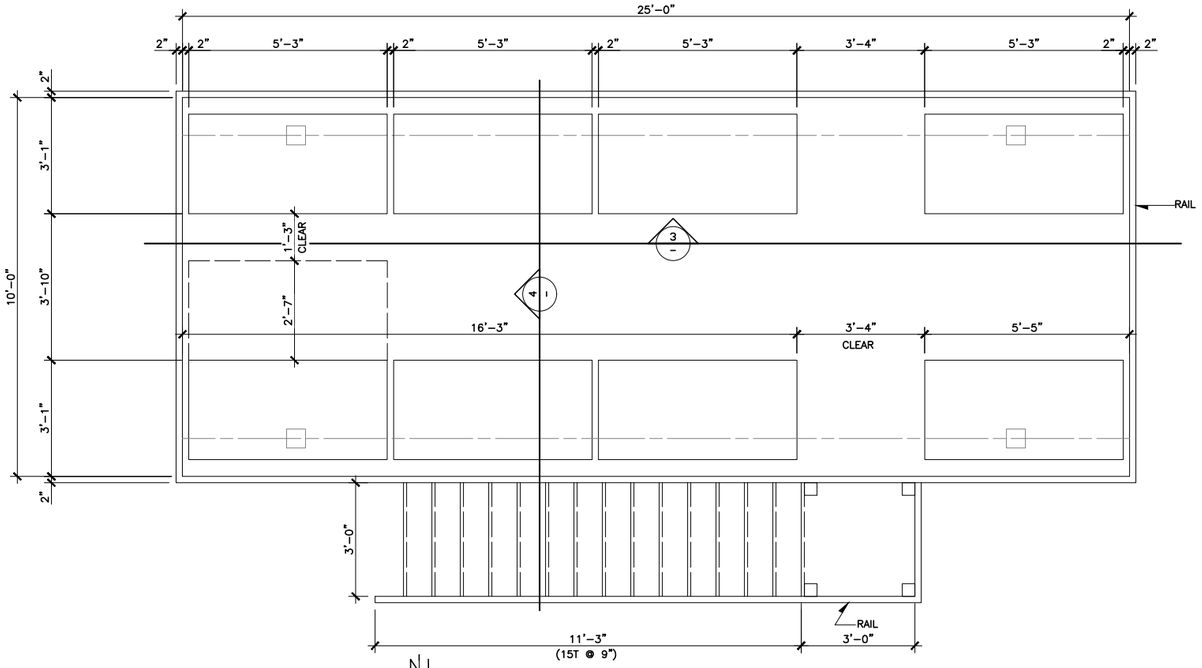
PHONE (506) 529-0093 EMAIL INFO@SORENG.CA

SHEET
D-A2
REV. 0



1 PLAN – COMPHATCH DECK

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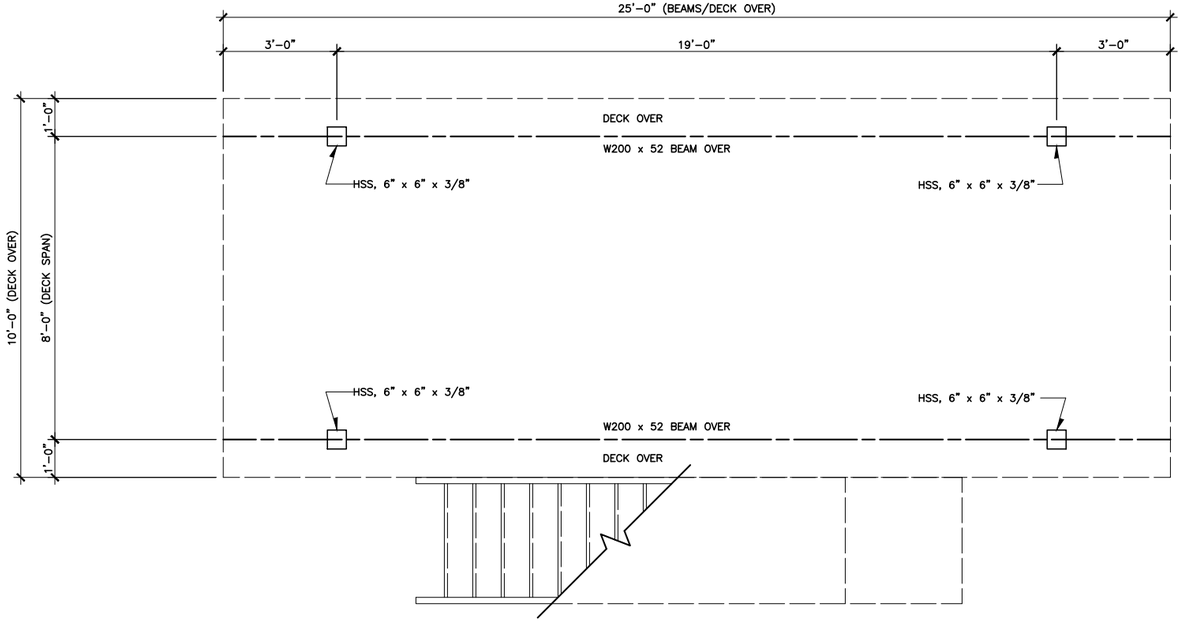
SCALE 1/2" TO 1'-0" 22"x34"



2 PLAN – DECK BEAMS & COLUMNS

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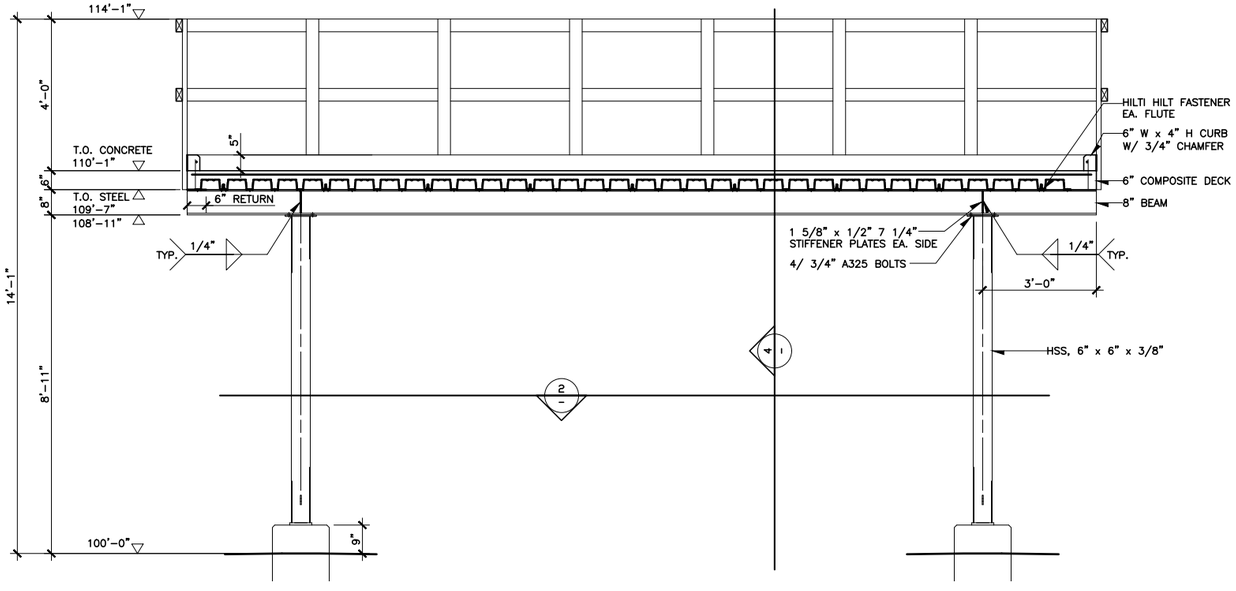
SCALE 1/2" TO 1'-0" 22"x34"



3 SECTION – DECK NORTH/SOUTH

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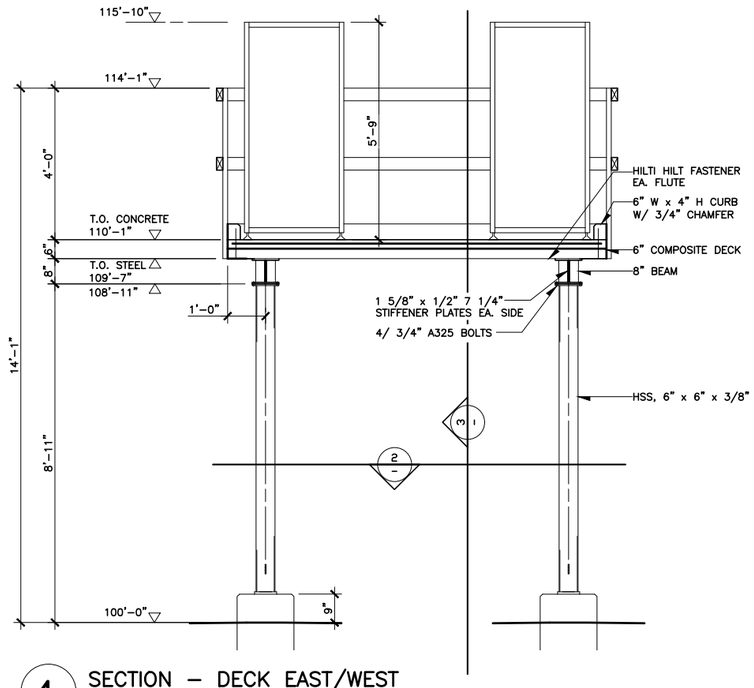
SCALE 1/2" TO 1'-0" 22"x34"



4 SECTION – DECK EAST/WEST

SCALE 1/4" TO 1'-0" 11"x17"
SCALE 1/2" TO 1'-0" 22"x34"

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Cooke AQUACULTURE Inc.

PROJECT
JOHNSON LAKE EXPANSION

LOCATION
PENNFIELD, NB

TITLE
DETAIL – COMPHATCH DECK

JOB:	DATE:	REVISED:	DRAWN:	CHECKED:
C18.13	18/11/29	–	B.A.W.B.	M.D.S.

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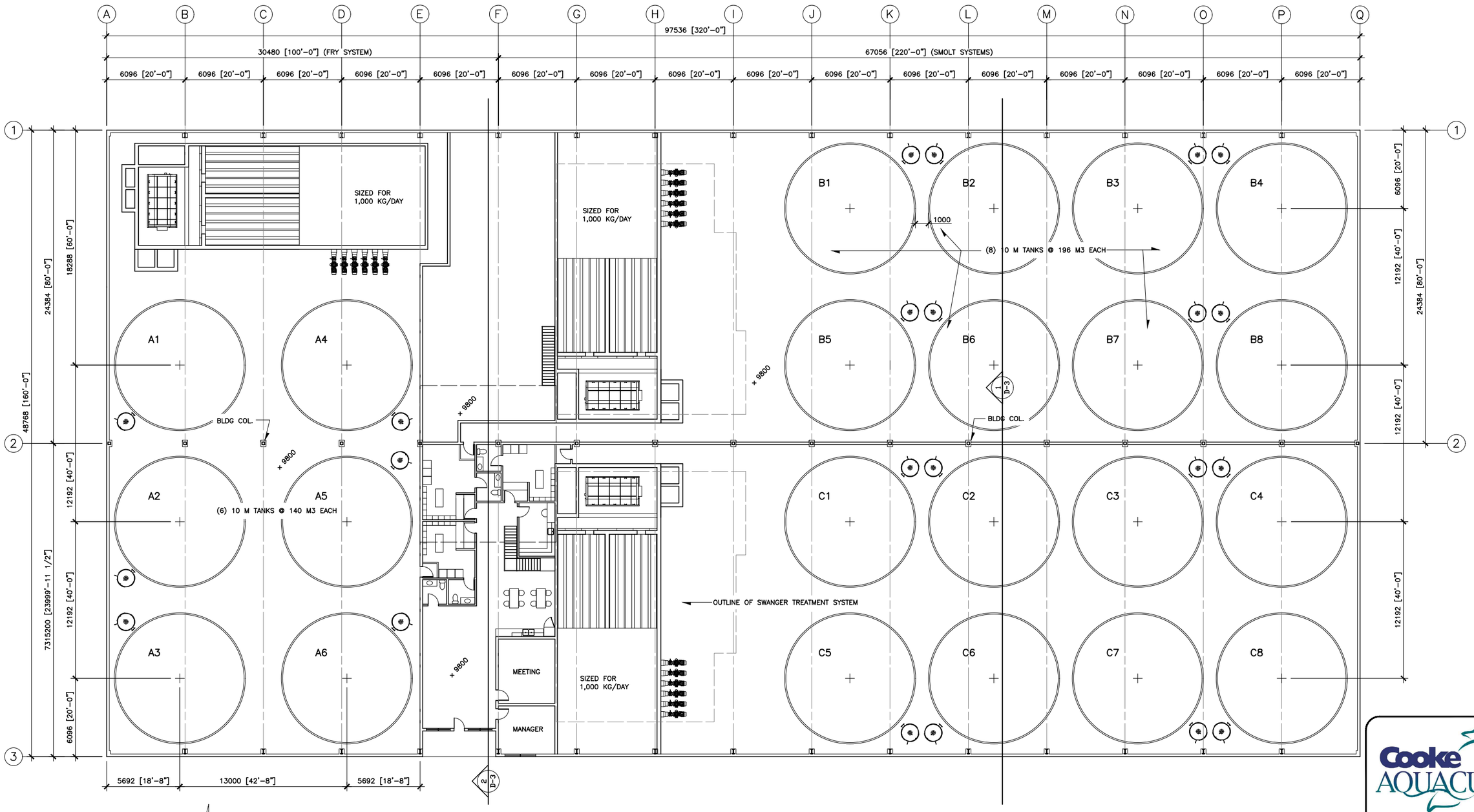
SHEET
D-A3
REV. 0



1 PLAN – BUILDING

SCALE 1 TO 300 11"x17"
SCALE 1 TO 150 22"x34"

CONST. N.

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'NOT FOR CONSTRUCTION'

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PROJECT
NEW PARR SYSTEM

LOCATION
JOHNSON LAKE

TITLE
PLAN – BUILDING

JOB:	DATE:	REVISED:	DRAWN:	CHECKED:
C17.09	18/10/16	–	M.D.S.	–

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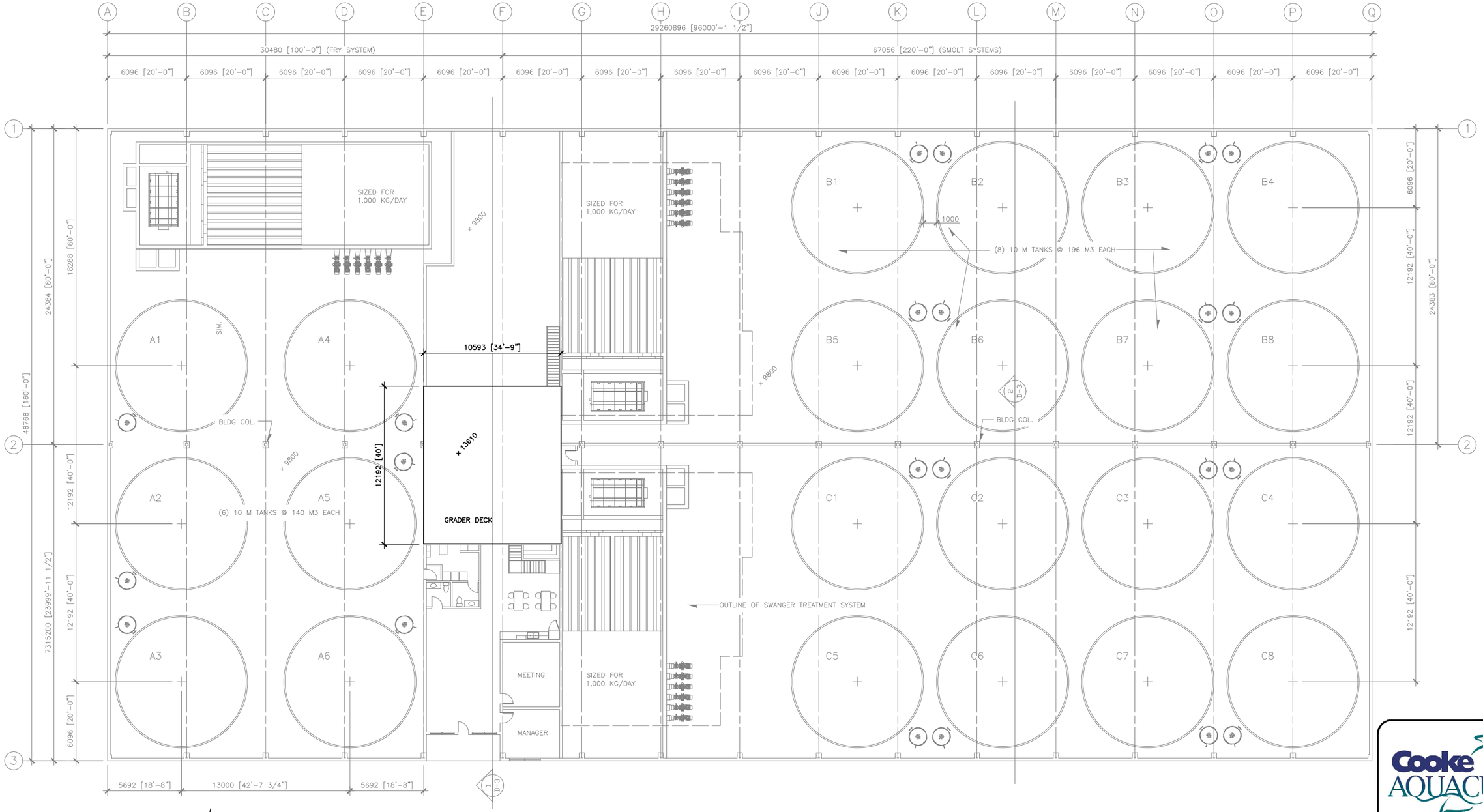
172 WATER ST., SAINT ANDREWS, NB E5B 1B2
PHONE (506) 529-0093 EMAIL INFO@SORENG.CA

SHEET
D-B1
REV. 0



1 PLAN – BUILDING

SCALE 1 TO 300 11"x17"
SCALE 1 TO 150 22"x34"

CONST. N.

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'NOT FOR CONSTRUCTION'

PRINTED ON: 2018/12/05

PROJECT: NEW PARR SYSTEM
LOCATION: JOHNSON LAKE
TITLE: PLAN – GRADING DECK

JOB:	DATE:	REVISED:	DRAWN:	CHECKED:
C17.09	18/10/16	–	M.D.S.	–

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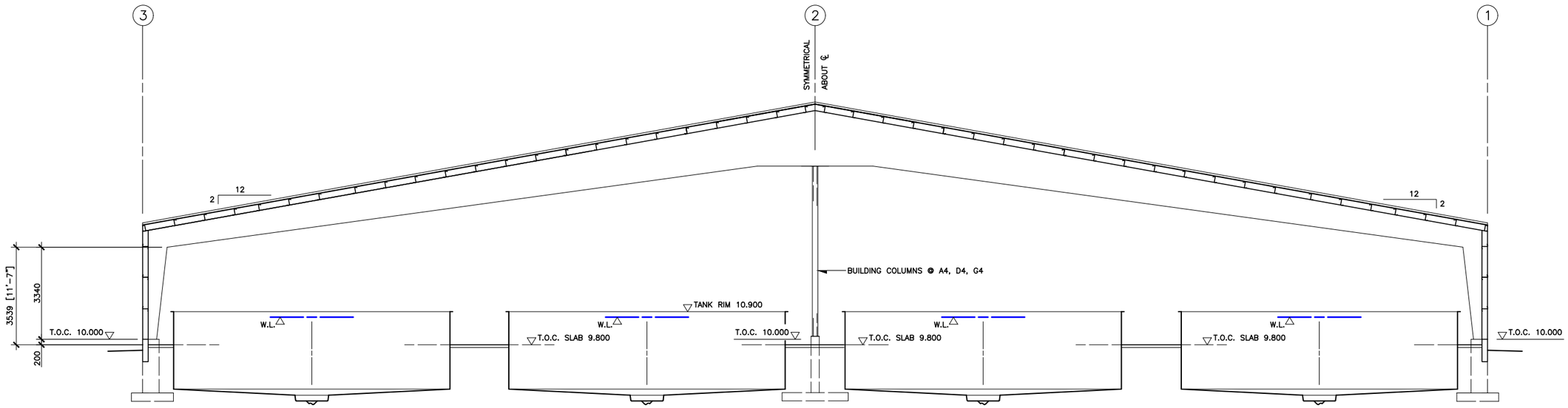
172 WATER ST., SAINT ANDREWS, NB E5B 1B2
PHONE (506) 529-0093 EMAIL INFO@SORENG.CA

SHEET D-B2 REV. 0



1 SECTION – GRID LINES: A TO G, L TO U

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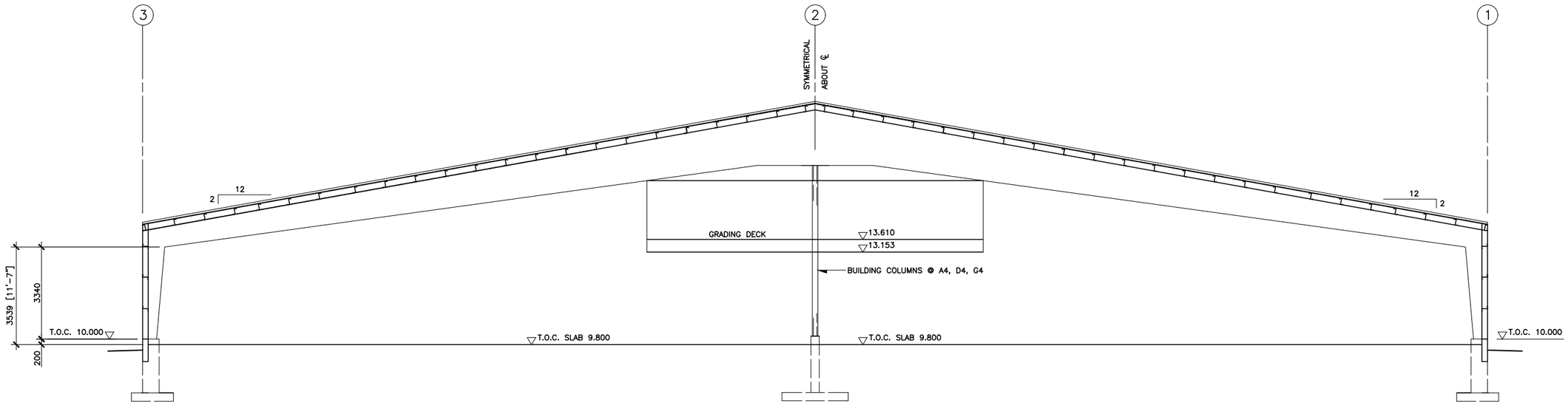
SCALE 1 TO 80 22"x34"



2 SECTION – GRADING DECK

SCALE 1 TO 160 11"x17"
SCALE 1 TO 80 22"x34"

'PRELIMINARY'
'NOT FOR CONSTRUCTION'

PRINTED ON: 2018/12/05

Cooke AQUACULTURE Inc.

PROJECT
NEW PARR SYSTEM

LOCATION
CAIRNDOW HATCHERY

TITLE
SECTIONS – BUILDING

JOB:	DATE:	REVISED:	DRAWN:	CHECKED:
C17.09	18/10/04	–	M.D.S.	–

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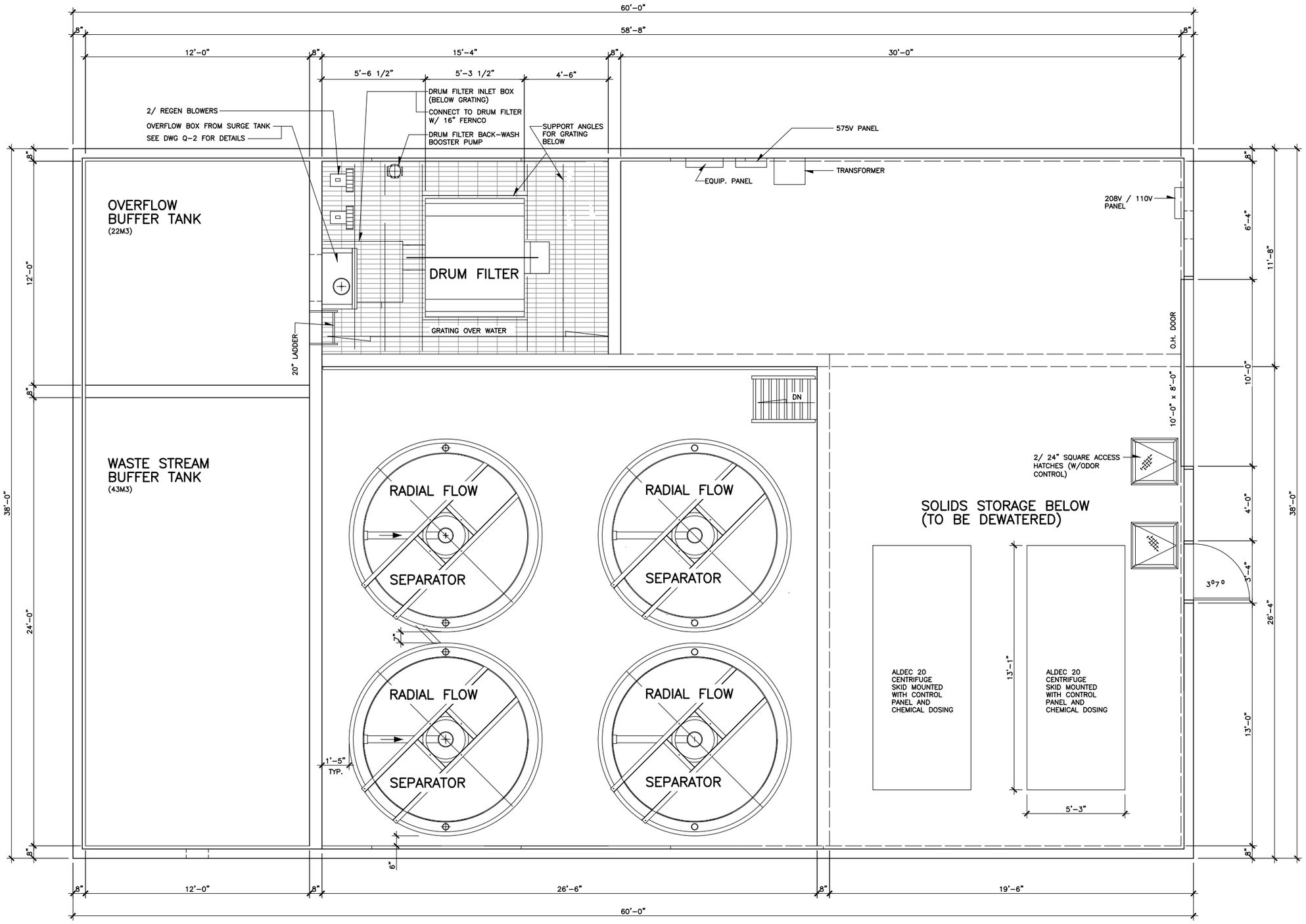

1 PLAN – EFFLUENT TREATMENT

SCALE 3/16" TO 1'-0" 11"x17"
SCALE 3/8" TO 1'-0" 22"x34"

'PRELIMINARY'
'NOT FOR CONSTRUCTION'

PRINTED ON: 2018/12/05

Cooke Inc. AQUACULTURE

PROJECT
JOHNSON LAKE EXPANSION

LOCATION
PENNFIELD, NB

TITLE
PLAN – EFFLUENT BUILDING

JOB:	DATE:	REVISED:	DRAWN:	CHECKED:
C18.13	18/11/22	–	B.A.W.B.	–

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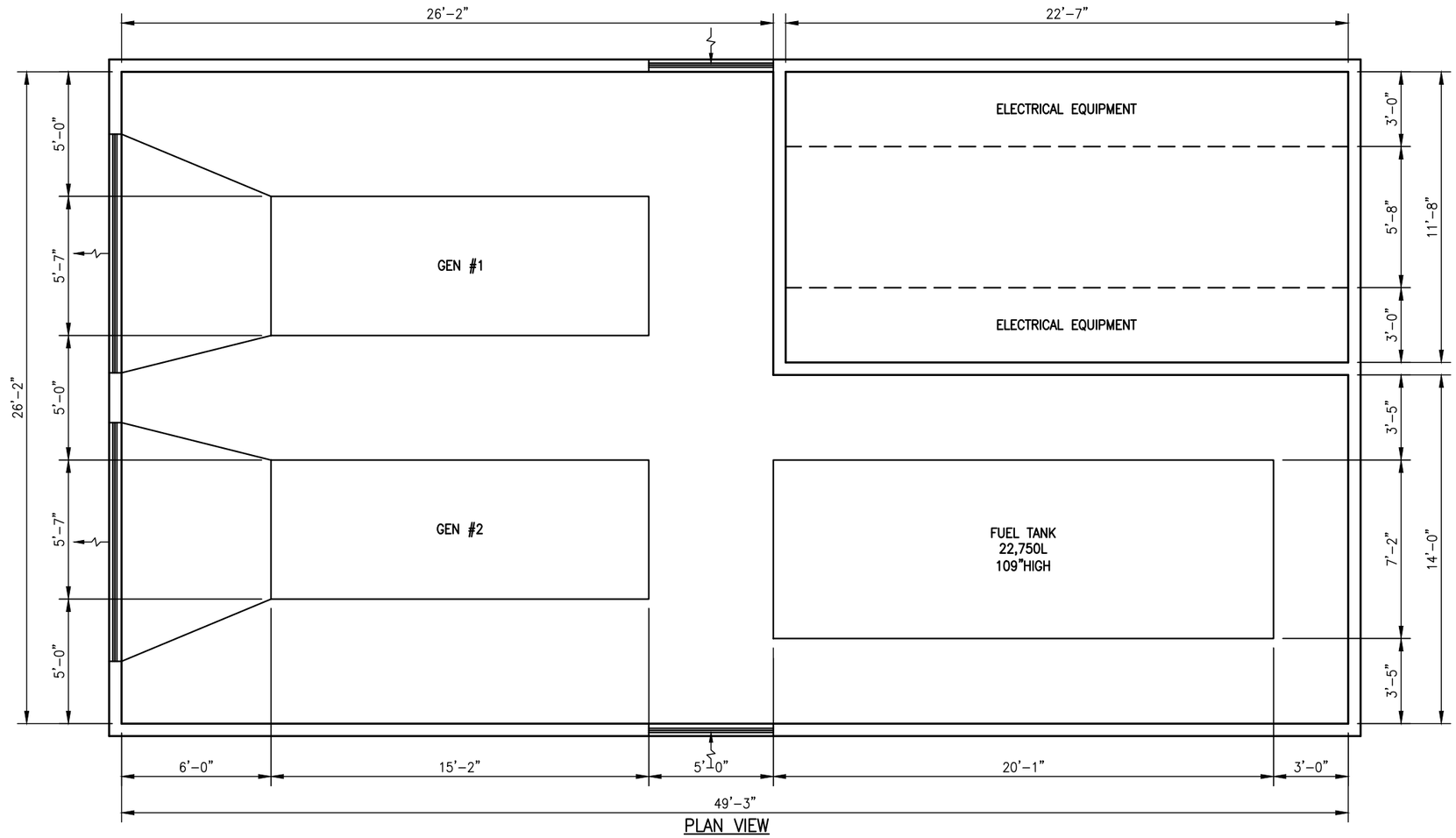
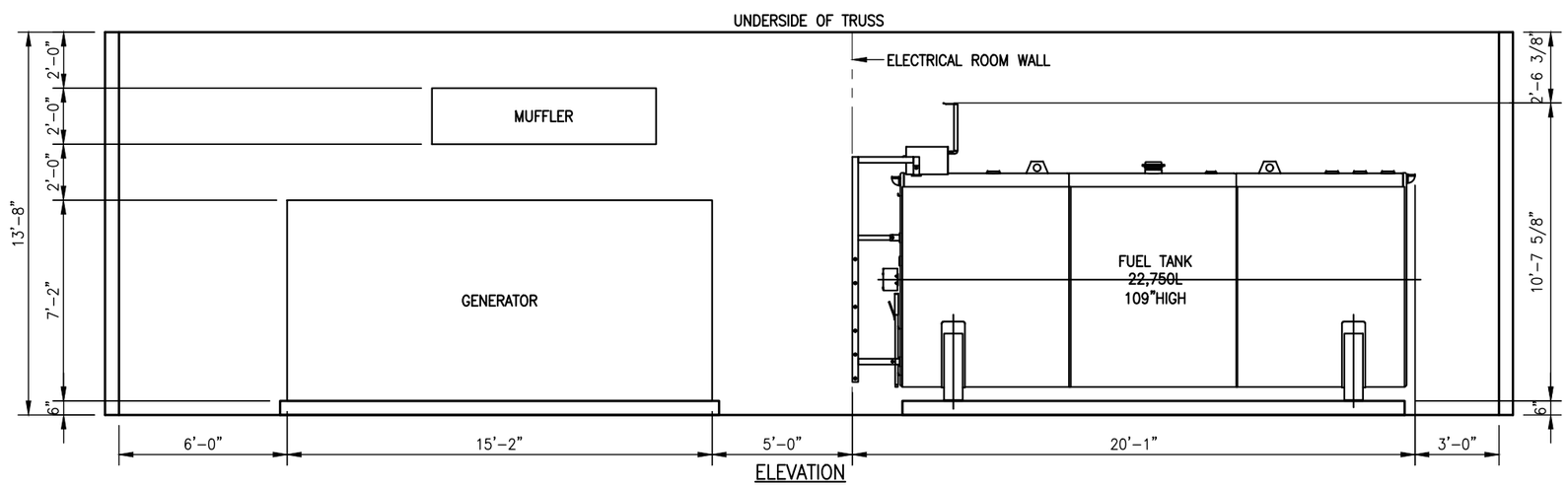


PLAN VIEW



ELEVATION

RSEI
Consultants Ltd.
261 Prospect St, Fredericton, NB Canada E3B 9M3 - 506.451.1995

PROJECT TITLE:

COOKE AQUACULTURE
JOHNSONS LAKE, NB

DRAWING TITLE:

GENERATOR &
ELECTRICAL ROOMS

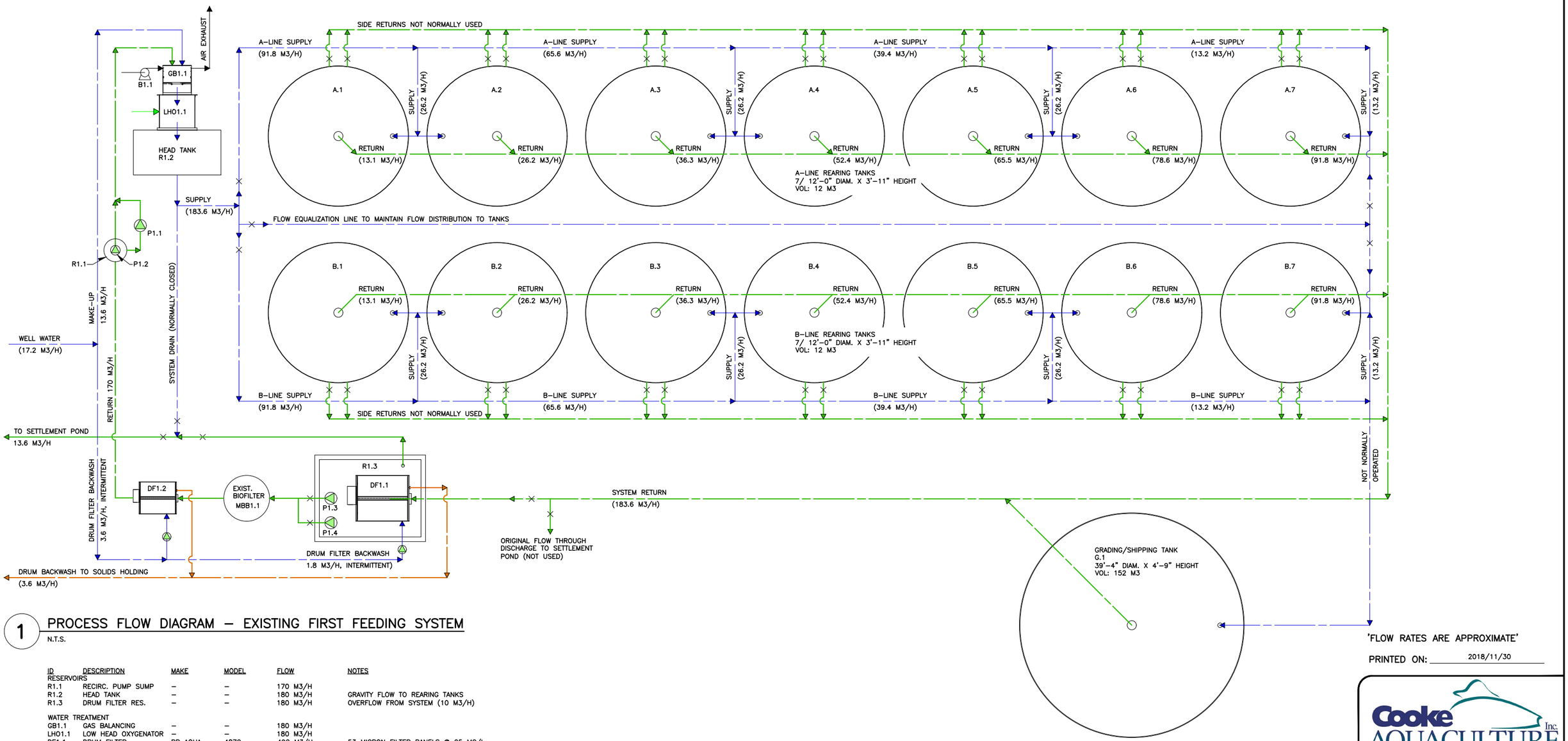
DATE: 2018.12.07

SCALE: 3/16" = 1'-0"

DWG. NO:

ESK-1

1879



1 PROCESS FLOW DIAGRAM – EXISTING FIRST FEEDING SYSTEM

N.T.S.

ID	DESCRIPTION	MAKE	MODEL	FLOW	NOTES
RESERVOIRS					
R1.1	RECIRC. PUMP SUMP	–	–	170 M3/H	
R1.2	HEAD TANK	–	–	180 M3/H	GRAVITY FLOW TO REARING TANKS
R1.3	DRUM FILTER RES.	–	–	180 M3/H	OVERFLOW FROM SYSTEM (10 M3/H)
WATER TREATMENT					
GB1.1	GAS BALANCING	–	–	180 M3/H	
LHO1.1	LOW HEAD OXYGENATOR	–	–	180 M3/H	
DF1.1	DRUM FILTER	PR AQUA	4872	492 M3/H	53 MICRON FILTER PANELS @ 25 MG/L
DF1.2	DRUM FILTER	HYDROTECH	802	158 M3/H	60 MICRON FILTER PANELS @ 25 MG/L
MBB1.1	MOVING BED BIOFILTER	–	–	170 M3/H	14.4 M3 WORKING VOLUME, 12.5 M3 MEDIA
PUMPS/BLOWERS					
P1.1	END SUCTION PUMP	BERKELEY	B3ZPM9	???	IMPELLOR: 7"
P1.2	SUBMERSIBLE PUMP	???	???	???	
P1.3	DF RES PUMP	BARNES	3SE202DS	86 M3/H	2.0 HP
P1.4	DF RES PUMP	BARNES	4SE2824L	84 M3/H	2.8 HP
B1.1	GAS BALANCING BLOWER				

'FLOW RATES ARE APPROXIMATE'

PRINTED ON: 2018/11/30

PROJECT: JOHNSON LAKE

LOCATION: PENNFIELD, NB

TITLE: PROCESS FLOW EXISTING

JOB:	DATE:	REVISED:	DRAWN:	CHECKED:
C18.13	18/11/19	–	L.T.H.	–

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SHEET: PF-A1

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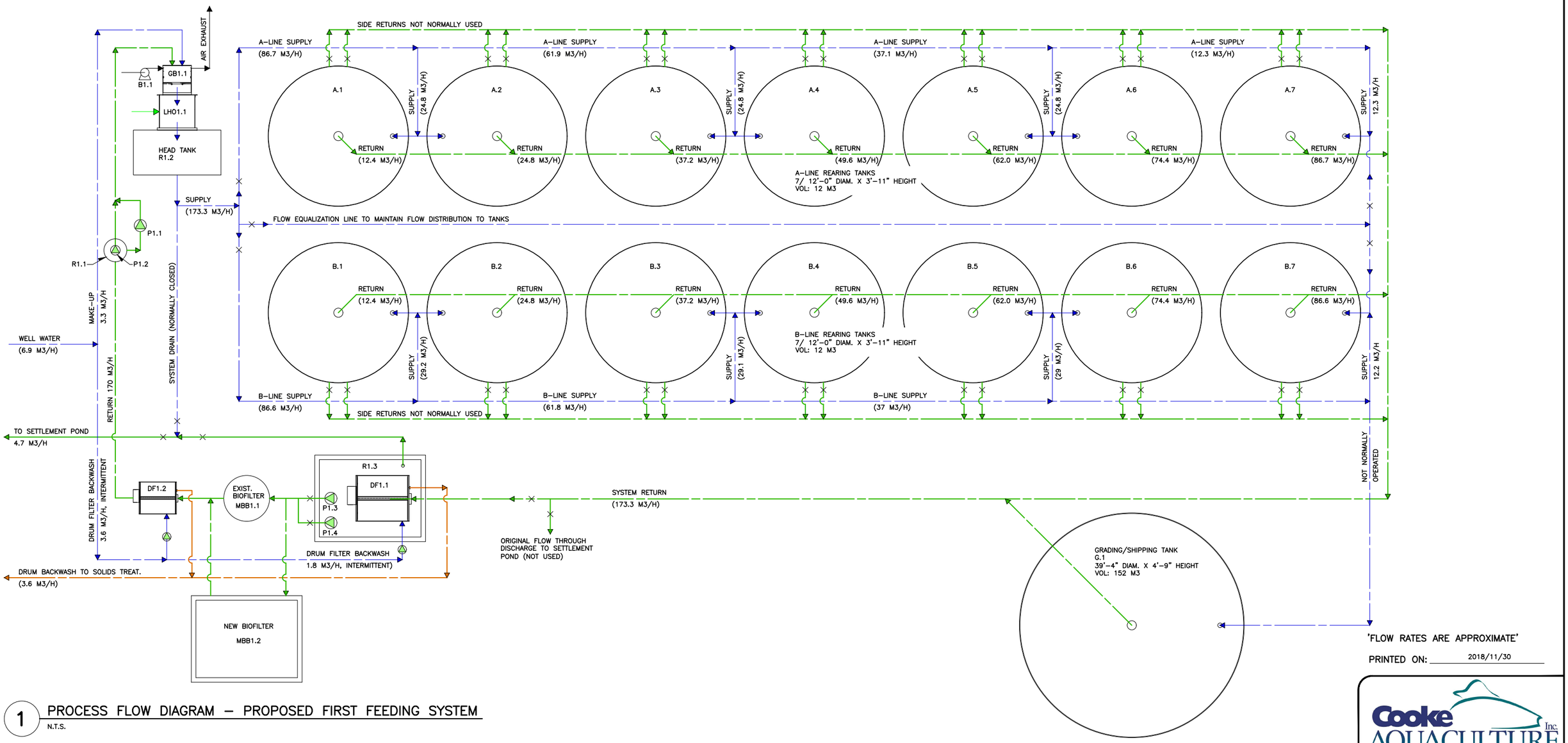

1 PROCESS FLOW DIAGRAM – PROPOSED FIRST FEEDING SYSTEM

N.T.S.

ID	DESCRIPTION	MAKE	MODEL	FLOW	NOTES
RESERVOIRS					
R1.1	RECIRC. PUMP SUMP	–	–	170 M3/H	
R1.2	HEAD TANK	–	–	180 M3/H	GRAVITY FLOW TO REARING TANKS
R1.3	DRUM FILTER RES.	–	–	180 M3/H	OVERFLOW FROM SYSTEM (4.7 M3/H)
WATER TREATMENT					
GB1.1	GAS BALANCING	–	–	180 M3/H	
LHO1.1	LOW HEAD OXYGENATOR	–	–	180 M3/H	
DF1.1	DRUM FILTER	PR AQUA	4872	492 M3/H	53 MICRON FILTER PANELS @ 25 MG/L
DF1.2	DRUM FILTER	HYDROTECH	802	158 M3/H	60 MICRON FILTER PANELS @ 25 MG/L
MBB1.1	MOVING BED BIOFILTER	–	–	44.2 M3/H	14.4 M3 WORKING VOLUME, 7.9 M3 MEDIA
MBB1.2	MOVING BED BIOFILTER	–	–	125.8 M3/H	40 M3 WORKING VOLUME, 22 M3 MEDIA
PUMPS/BLOWERS					
P1.1	END SUCTION PUMP	BERKELEY	B3ZPM9		IMPELLOR: 7"
P1.2	SUBMERSIBLE PUMP				
P1.3	DF RES PUMP	BARNES	3SE202DS	86 M3/H	2.0 HP
P1.4	DF RES PUMP	BARNES	4SE2824L	84 M3/H	2.8 HP
P1.5	DF BACKWASH PUMP				
P1.6	DF BACKWASH PUMP				
B1.1	GAS BALANCING BLOWER				

'FLOW RATES ARE APPROXIMATE'

PRINTED ON: 2018/11/30

PROJECT: JOHNSON LAKE

LOCATION: PENNFIELD, NB

TITLE: PROCESS FLOW UPGRADED EXISTING

JOB:	DATE:	REVISED:	DRAWN:	CHECKED:
C18.13	18/11/19	–	L.T.H.	–

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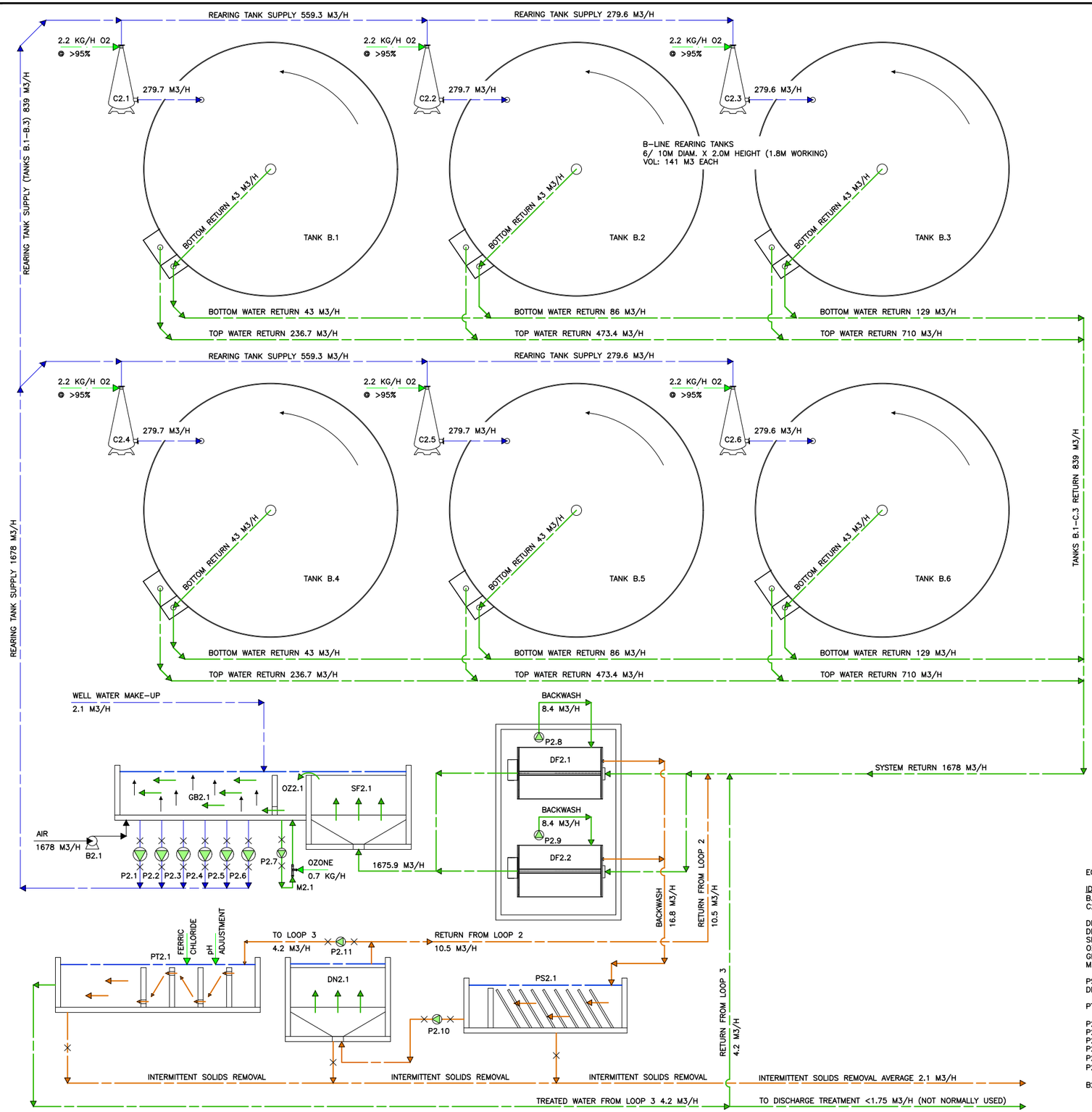

1 PROCESS FLOW DIAGRAM – LOW WATER EXCHANGE FRY

N.T.S.

EQUIPMENT LIST

ID	DESCRIPTION	NOTES
B.1–B.6	REARING TANKS	10M DIAMETER X 2.0M HEIGHT (1.8M WORKING), VOL: 141M3
C2.1–C2.6	OXYGEN CONES	PRESSURE < 1 BAR
DF2.1	DRUM FILTER	PRIMARY SOLIDS REMOVAL
DF2.2	DRUM FILTER	PRIMARY SOLIDS REMOVAL
SF2.1	STATIC FILTER	AMMONIA CONVERSION & FINE SOLIDS REMOVAL
OZ2.1	OZONE CONTACT CHAMBER	
GB2.1	GAS BALANCING	
M2.1	MAZZEI INJECTOR	FOR OZONE INJECTION
PS2.1	PLATE SEPARATOR	SECONDARY SOLIDS REMOVAL
DN2.1	DENITRIFICATION REACTOR	
PT2.1	PHOSPHORUS TREATMENT	
P2.1–2.6	RECIRCULATION PUMPS	FLOW: 279.7 M3/H EACH
P2.7	OZONE TRANSFER PUMP	
P2.8	DF BACKWASH PUMP	
P2.9	DF BACKWASH PUMP	
P2.10	LOOP 2 TRANSFER PUMP	FLOW: 16.8 M3/H
P2.11	LOOP 3 TRANSFER PUMP	FLOW: 4.2 M3/H
B2.1	GAS BALANCING BLOWER	FLOW: 1678 M3/H (G:L RATIO OF 1:1)

'FLOW RATES ARE APPROXIMATE'

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PROJECT: JOHNSON LAKE

LOCATION: PENNFIELD, NB

TITLE: PROCESS FLOW – FRY

JOB:	DATE:	REVISED:	DRAWN:	CHECKED:
C18.13	18/11/20	–	L.T.H.	–

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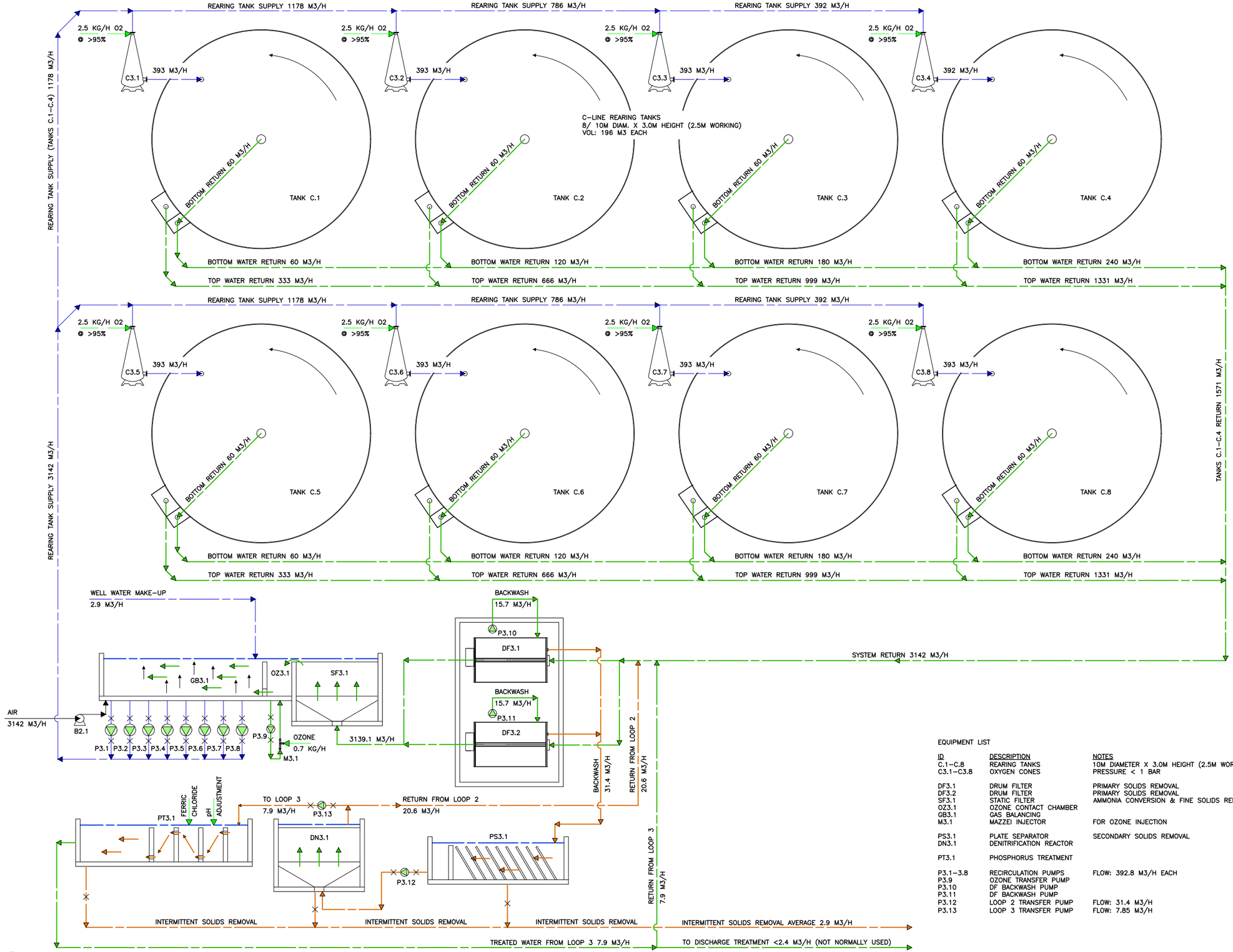

1 PROCESS FLOW DIAGRAM – LOW WATER EXCHANGE PARR 1/PARR 2

N.T.S.

EQUIPMENT LIST

ID	DESCRIPTION	NOTES
C.1–C.8	REARING TANKS	10M DIAMETER X 3.0M HEIGHT (2.5M WORKING), VOL: 196M3
C3.1–C3.8	OXYGEN CONES	PRESSURE < 1 BAR
DF3.1	DRUM FILTER	PRIMARY SOLIDS REMOVAL
DF3.2	DRUM FILTER	PRIMARY SOLIDS REMOVAL
SF3.1	STATIC FILTER	AMMONIA CONVERSION & FINE SOLIDS REMOVAL
OZ3.1	OZONE CONTACT CHAMBER	
GB3.1	GAS BALANCING	
M3.1	MAZZEI INJECTOR	FOR OZONE INJECTION
PS3.1	PLATE SEPARATOR	SECONDARY SOLIDS REMOVAL
DN3.1	DENITRIFICATION REACTOR	
PT3.1	PHOSPHORUS TREATMENT	
P3.1–3.8	RECIRCULATION PUMPS	FLOW: 392.8 M3/H EACH
P3.9	OZONE TRANSFER PUMP	
P3.10	DF BACKWASH PUMP	
P3.11	DF BACKWASH PUMP	
P3.12	LOOP 2 TRANSFER PUMP	FLOW: 31.4 M3/H
P3.13	LOOP 3 TRANSFER PUMP	FLOW: 7.85 M3/H

'FLOW RATES ARE APPROXIMATE'

PRINTED ON: 2018/11/30

Cooke AQUACULTURE Inc.

PROJECT: JOHNSON LAKE

LOCATION: PENNFIELD, NB

TITLE: PROCESS FLOW – PARR 1/PARR 2

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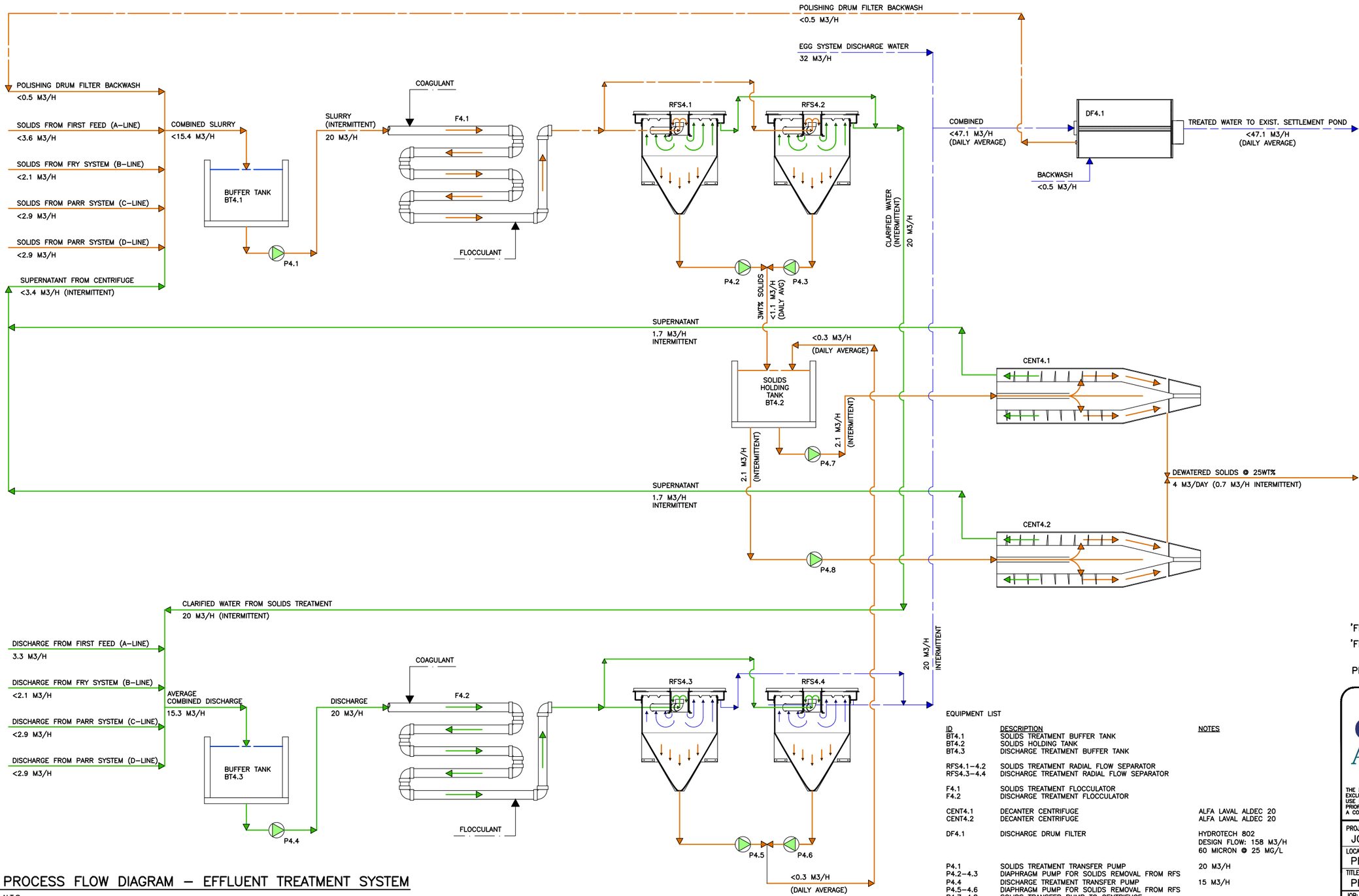

1 PROCESS FLOW DIAGRAM – EFFLUENT TREATMENT SYSTEM

N.T.S.

'FLOW RATES REPRESENT PEAK BIOMASS'
'FLOW RATES ARE APPROXIMATE'

PRINTED ON: 2018/12/04

EQUIPMENT LIST

ID	DESCRIPTION	NOTES
BT4.1	SOLIDS TREATMENT BUFFER TANK	
BT4.2	SOLIDS HOLDING TANK	
BT4.3	DISCHARGE TREATMENT BUFFER TANK	
RFS4.1–4.2	SOLIDS TREATMENT RADIAL FLOW SEPARATOR	
RFS4.3–4.4	DISCHARGE TREATMENT RADIAL FLOW SEPARATOR	
F4.1	SOLIDS TREATMENT FLOCCULATOR	
F4.2	DISCHARGE TREATMENT FLOCCULATOR	
CENT4.1	DECANTER CENTRIFUGE	ALFA LAVAL ALDEC 20
CENT4.2	DECANTER CENTRIFUGE	ALFA LAVAL ALDEC 20
DF4.1	DISCHARGE DRUM FILTER	HYDROTECH 802 DESIGN FLOW: 158 M3/H 60 MICRON @ 25 MG/L
P4.1	SOLIDS TREATMENT TRANSFER PUMP	20 M3/H
P4.2–4.3	DIAPHRAGM PUMP FOR SOLIDS REMOVAL FROM RFS	
P4.4	DISCHARGE TREATMENT TRANSFER PUMP	15 M3/H
P4.5–4.6	DIAPHRAGM PUMP FOR SOLIDS REMOVAL FROM RFS	
P4.7–4.8	SOLIDS TRANSFER PUMP TO CENTRIFUGE	

PROJECT: JOHNSON LAKE
LOCATION: PENNFIELD, NB
TITLE: PROCESS FLOW – EFFLUENT TREAT.

JOB:	DATE:	REVISED:	DRAWN:	CHECKED:
C18.13	18/11/30	–	L.T.H.	–

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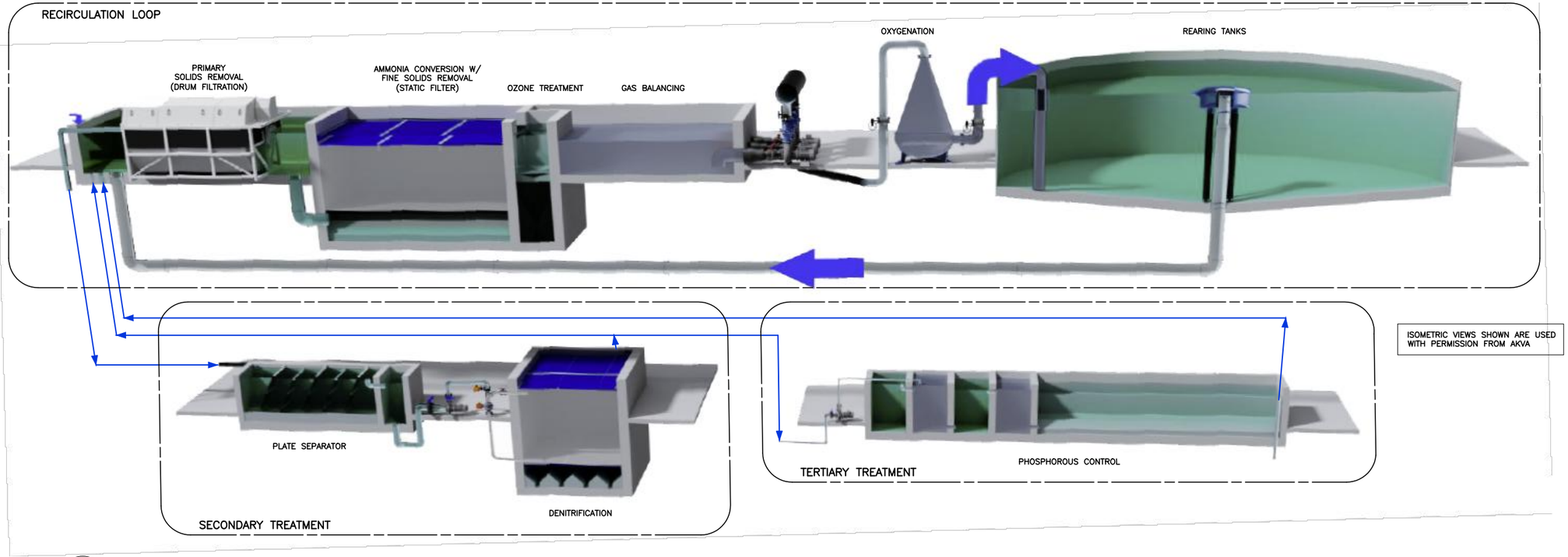
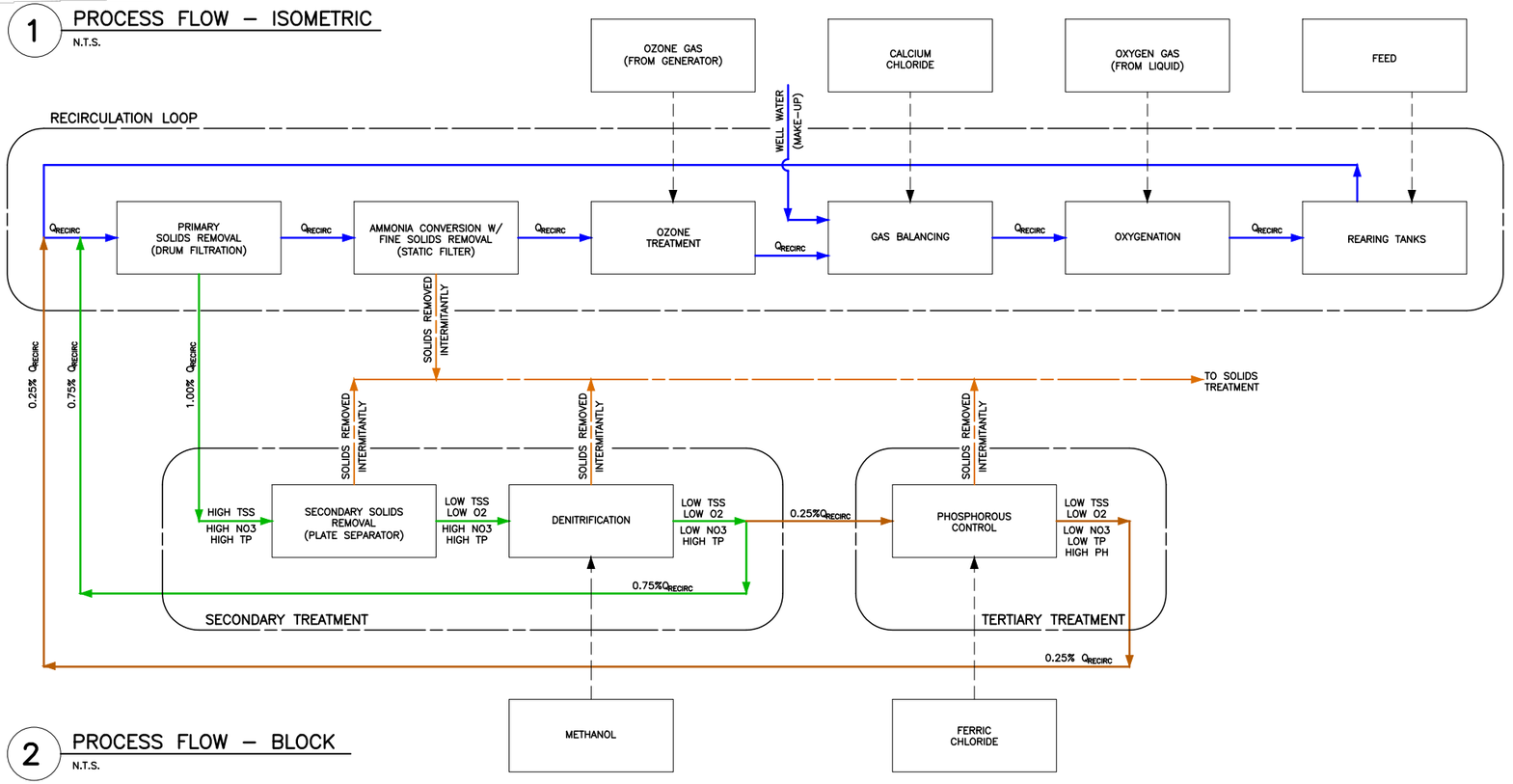


1 PROCESS FLOW – ISOMETRIC

N.T.S.



2 PROCESS FLOW – BLOCK

N.T.S.

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PRINTED ON: 2018/12/05

Cooke AQUACULTURE Inc.

PROJECT
JOHNSON LAKE

LOCATION
PENNFIELD, NB

TITLE
PROCESS FLOW SCHEMATICS

JOB:	DATE:	REVISED:	DRAWN:	CHECKED:
C18.13	18/11/14	–	M.D.S.	–

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Appendix C

Photographs

Photo 1 Approximate Location of New Building (Existing Hatchery in background)

Photo 2 Approximate Location of New Building

Photo 3 Side View of Existing Hatchery Looking Southwest

Photo 4 Sparse Vegetation Located on Northeast Portion Location of New Construction

Photo 5 Looking to Rear of Existing Hatchery Showing Amount of Fill Material

Photo 6 Interior of Existing Hatchery

Photo 7 Looking to Front of Existing Hatchery

Photo 8 Existing Settling Ponds

Photo 9 Mill Brook

Photo 10 Mill Brook – Wastewater Discharge in Background

Appendix D

Operational Plans

Best Aquaculture Practices

Integrated Contingency Plan

Waste Management Plan

Fish Health Management Plan

Animal Welfare Plan

Aquaculture Facility Certification

Finfish, Crustacean and Mollusk Hatcheries and Nurseries

Best Aquaculture Practices Certification Standards, Guidelines

Community • Environment • Animal Welfare • Food Safety • Traceability

BEST AQUACULTURE PRACTICES CERTIFICATION

The following Best Aquaculture Practices standards apply to all aquaculture facilities that produce eggs and/or juvenile aquatic animals for live transfer to other aquaculture facilities and to all species for which BAP farm standards are available. Production facilities can be ponds or tanks on land with directed inflows and outflows of water, trays located intertidally on the foreshore, or rafts or cages (net pens) floating in a body of water. For the purposes of these BAP standards, the generic term used to describe these facilities is "hatchery."

Processes within the general scope of hatchery operations include:

- broodstock collection, production, selection and management
- mollusk spawning and larvae setting
- egg collection and fertilization
- egg incubation and hatching
- feeds and feeding practices until the time juvenile animals are moved to facilities that only produce aquatic animals for harvest and slaughter for human consumption
- a nursery phase or intermediate juvenile production phase before final growout that may itself consist of one or more stages
- treatment of animals to induce sterility, manipulate gender or achieve protective immunity against pathogens, or to treat or protect against disease.

Except in the case of certain mollusk species, the collection and rearing of eggs or juveniles from the wild are not included or permitted under these standards.

These processes may be carried out in sequence at one location or in two or more locations with live aquatic products transferred between or among them. For BAP certification, each location shall be considered a separate facility.

Some requirements are system-specific, applying, for example, only to earthen ponds, facilities that produce effluents, or facilities using cages. Each section of the standards and guidelines identifies which standards apply to the different production systems. Please reference the chart on the following page.

The BAP standards are achievable, science-based and continuously improved global performance standards for the aquaculture supply chain that assure healthful foods produced through environmentally and socially responsible means. They are designed to assist program applicants in performing self-assessments of the environmental and social impacts, and food safety controls of their facilities, and to lead to third-party certification of compliance, thereby eliminating the most significant negative impacts. For further information, please refer to the additional resources listed throughout this document.

BAP standards demand compliance with local regulations as the first step toward certification. However, not all regulations are equally rigorous. For this reason, BAP standards set out requirements for documentation and procedures that must be in facility management plans, whether they are prescribed by local regulations or not. By so doing, they seek, where possible, to impose consistency in performance among facilities in different producing regions and to engage the industry as a whole in a process of continuous improvement.

In common with ISO usage, these standards use the words "shall" to mean compliance is required and "should" to mean compliance is recommended. Auditable points are "shall" statements listed at the end of each section.

To obtain BAP certification, applicants shall be audited by an independent, BAP-approved certification body. To apply for certification, contact:

Best Aquaculture Practices Management
P. O. Box 2530 – Crystal River, Florida 34423 USA
Telephone: +1-352-563-0565 – Fax: +1-425-650-3001
Web: www.bestaquaculturepractices.org – E-mail: info@aquaculturecertification.org, aquacert@tampabay.rr.com

The audit consists of an opening meeting, a site assessment, the collection of necessary samples, a review of management records and procedures, and a closing meeting. All points in the standards shall be addressed. Any non-conformity raised during the evaluation is recorded by the auditor in the formal report as:

Critical – When there is a failure to comply with a critical food safety or legal issue, or a risk to the integrity of the program, the auditor immediately informs the certification body, which then informs BAP Management. Pending clarifications, failure to certify or immediate temporary suspension can ensue.

Major – When there is a substantial failure to meet the requirements of a standard but no food safety risk or immediate risk to the integrity of the program, the auditor notifies the certification body and records this in the report. Verification of the implementation of corrective actions shall be submitted to the certification body within 28 days of the evaluation. (Major non-conformities typically reflect issues with general policies.)

Minor – When full compliance with the intent of the standards has not been demonstrated, the auditor notifies the certification body and records this in the report. Verification of the implementation of corrective actions shall be submitted to the certification body within 28 days of the evaluation. (Minor non-conformities typically reflect general housekeeping issues.)

BAP standards are developed by committees of technical experts following a process aligned to the FAO Technical Guidelines on Aquaculture Certification. See www.gaalliance.org/bap/standardsdevelopment.php.

BAP Standards Compliance Requirements

BAP Standard	Applies To
1. Community: Property Rights and Regulatory Compliance	All production systems
2. Community: Community Relations	All production systems
3. Community: Worker Safety and Employee Relations	All production systems
4. Environment: Protection of Ecologically Sensitive Areas	Land-based systems only
5. Environment: Metabolic Wastes and Uneaten Feed	All production systems 5i – Land-based systems 5ii – Cages in fresh- or brackish water below 25-ppt salinity 5iii – Cages in marine water above 25-ppt salinity
6. Environment: Soil and Water Conservation	Land-based systems only
7. Environment: Feed Biosecurity, Fishmeal and Fish Oil Conservation	All production systems
8. Environment: Stocking Sources and GMOs	All production systems
9. Environment: Control of Escapes	All production systems, several standards for cages only
10. Environment: Wildlife Interactions	All production systems, several standards for cages only
11. Environment: Storage, Disposal of Supplies and Wastes	All production systems
12. Animal Welfare: Animal Welfare	All production systems
13. Food Safety: Chemical and Drug Management	All production systems
14. Biosecurity: Disease Control	All production systems
15. Traceability: Record-Keeping Requirement	All production systems

Abbreviations

AAHP – Aquatic animal health professional
AMA – Area Management Agreement
AWS – Animal Welfare Section (of the Health Management Plan)
BAP – Best Aquaculture Practices
BOD – Biochemical oxygen demand
ESA – Ecologically sensitive area
FIFO – Fish in:fish out ratio
GIP – Genetic Improvement Plan
HMP – Health Management Plan
ILO – International Labor Organization
HMP – Health Management Plan
mt – Metric tons
ppt – Parts per thousand
RAS – Recirculating aquaculture system
SCP – Stock Containment Plan
WIP – Wildlife Interaction Plan

Definitions

Brackish water – Water that is on average below 25-ppt salinity.

Cage – A net or mesh-covered container in which aquatic animals are held. Sometimes these are also called net pens. The term cage is used throughout in these standards.

Ecologically sensitive areas – Places that have special environmental attributes worthy of retention or special care. These areas are critical to the maintenance of productive and diverse plant and wildlife populations. (See http://www.env.gov.bc.ca/wld/documents/bmp/urban_ebmp/EBMP%20PDF%204.pdf)

GMO – Genetically modified organism – An animal that has been genetically modified by artificial transfer of genetic material from another species.

Marine water – Water that is on average above 25-ppt salinity.

Point source effluents – Effluents discharged from a pipe or canal as a single stream, in contrast to effluents discharged from cages, which “leak” out through the net mesh.

Proactively prohibited therapeutants – Compounds that are specifically identified and banned for use, including extra-label use, in aquatic animals in producing or importing countries. (See http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?fr=530.41.)

Therapeutants – Antibiotics, drugs and chemicals used in the treatment of aquatic animal diseases.

1. Community (All Production Systems)

Property Rights and Regulatory Compliance

Hatcheries shall comply with local and national laws and environmental regulations, and provide current documentation that demonstrates legal rights for land use, water use, construction, operation and waste disposal.

Reasons for Standard

Regulations are needed to assure that hatcheries provide pertinent information to governments and pay fees to support relevant programs. The BAP program requires compliance with applicable business-related laws and environmental regulations, including those concerning protection of sensitive habitats, effluents, operation of landfills and predator control, because it recognizes that not all governmental agencies have sufficient resources to effectively enforce laws.

Some hatcheries may be sited in water bodies or on coastal land to which hatchery owners do not have legal right. Such facilities are usually found in undeveloped areas under government ownership where land use is poorly controlled. This land may be occupied by landless people or used by coastal communities for hunting, fishing and gathering. Water bodies in which cages have been installed can be an important fishery for local people. These waters can also have other important uses for domestic water supplies, irrigation, recreation or tourism.

Implementation

Regulations regarding the operation and resource use of hatcheries vary significantly from place to place. Among other requirements, such laws can call for:

- business licenses
- aquaculture licenses
- land deeds, leases or concession agreements
- land use taxes
- construction permits
- water use permits
- protection of sensitive habitats
- effluent permits
- therapeutics use permits
- permits related to non-native species
- predator control permits
- well operation permits
- landfill operation permits
- environmental impact assessments.

Individual auditors cannot know all laws that apply to hatcheries in all nations. Participating hatcheries have the responsibility to obtain all necessary documentation for siting, constructing and operating their facilities.

Assistance in determining these necessary permits and licenses can be sought from governmental agencies responsible for agriculture, environmental protection, fisheries, aquaculture, water management and transportation, as well as local aquaculture associations. Auditors shall also become familiar with the legal requirements within the areas they service.

During the BAP site inspection, the representative of the hatchery shall present all necessary documents to the auditor. Hatcheries shall be in compliance with the requirements stipulated by the documents. For example, if a hatchery has an effluent discharge permit with water quality standards, those standards shall be enforced. In cases where governmental agencies have waived one or more permits, proof of these waivers shall be available.

Standards

1.1: Current documents shall be available to prove legal land and water use by the applicant.

1.2: Current documents shall be available to prove all business and operating licenses have been acquired.

1.3: Current documents shall be available to prove compliance with applicable environmental regulations for construction and operation.

2. Community (All Production Systems)

Community Relations

Hatcheries shall strive for good community relations and not block access to public areas, common land, fishing grounds or other traditional natural resources used by local communities.

Reasons for Standard

Aquaculture facilities are often located in rural areas, where some individuals may rely on varied natural resources to supplement their livelihoods. Some local residents benefit from employment or infrastructure improvements associated with large-scale aquaculture development, but others may face reduced access to areas used for fishing, hunting, gathering, domestic water supply or recreation.

Implementation

Hatchery management shall attempt to accommodate traditional uses of coastal resources through a cooperative attitude toward established local interests and environmental stewardship. Facilities shall not block legal traditional access corridors to public mangrove areas and fishing grounds. In some cases, it may be necessary to provide a designated access route across the facility.

Hatcheries shall maintain a neat and attractive appearance to avoid becoming an eyesore to local residents. Sanitary measures shall be employed to prevent odors from affecting nearby neighbors. (See Section 11.) Machinery shall be maintained in good repair to avoid unnecessary noises that may disturb neighbors.

During facility inspection, the auditor shall verify compliance with this standard through examination of maps that define public and private zones; on-site inspection of fences, canals and other barriers; and interviews with local people and facility workers. The auditor shall select the individuals for interview.

Standards

2.1: The applicant shall accommodate local inhabitants by not blocking traditional access routes to fishing grounds, wetland areas and other public resources.

2.2: The applicant shall manage water usage to avoid restricting the amount of water available to other users.

2.3: The applicant shall demonstrate interaction with the local community to avoid or resolve conflicts through meetings, committees, correspondence, service projects or other activities performed annually or more often.

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3. Community (All Production Systems)

Worker Safety and Employee Relations

Hatcheries shall comply with local and national labor laws, including those related to young and/or underage workers, to assure adequate worker safety, compensation and, where applicable, on-site living conditions.

Reasons for Standard

Work at aquaculture facilities is potentially dangerous because of the types of machinery employed, the risks of drowning and electrocution, and the use of hazardous materials. Workers may not fully appreciate the risks at such facilities, and sometimes safety instruction may not be adequate.

Both local and foreign workers may be employed at hatcheries. Instances of employment of illegal foreign workers have been reported in some countries. Therefore, BAP certification requires proof of legal foreign worker documentation.

Much aquaculture takes place in developing nations where pay scales are low, and labor laws may not be consistently enforced. Hatcheries that provide on-site living quarters shall provide clean living conditions with adequate space.

Implementation

At a minimum, certified hatcheries shall provide legal wages, a safe working environment and adequate living conditions, if these are provided. Auditors shall take into account national regulations and local standards to evaluate this aspect. Efforts should be made to exceed the minimum requirements, because certified hatcheries should be progressive and socially responsible. When hiring foreign workers, hatcheries shall require documentation of legal status.

Safety equipment such as goggles, gloves, hard hats, life jackets and ear protection shall be provided when appropriate. Machinery shall have protective guards or covers, where appropriate, and electrical devices shall be correctly and safely wired. Tractors and forklifts should have roll bars, shields over power take-offs and other appropriate safety devices.

Staff and workers shall be given initial training as well as refresher training on safety in all areas of hatchery operation. Workers shall also be trained in first aid for electrical shock, profuse bleeding, drowning and other possible medical emergencies, including those related to the mishandling of chemicals. A plan shall be available for obtaining medical assistance for injured or ill workers.

Living quarters shall be well ventilated and have adequate shower and toilet facilities. Food services, where provided, shall provide wholesome meals for workers, with food storage and preparation done in a responsible manner. Trash and garbage shall not accumulate in living, food preparation or dining areas. (See Section 11.)

Hatcheries that use divers to perform underwater tasks shall develop a written plan to assure safety and require directly employed or contracted divers to follow the plan. The plan shall require specialized diver safety training, maintenance records for diving equipment and procedures for diving emergencies.

During facility inspection, the auditor will evaluate whether conditions comply with labor laws. The auditor will also interview a random sample of workers to obtain their opinions about wages, safety and living conditions.

Standards

3.1: The applicant shall meet or exceed the minimum wage rate, including benefits, required by local and national labor laws.

3.2: The applicant shall not engage in or support the use of child labor. The applicant shall comply with national child labor laws regarding minimum working age or ILO Minimum Age Convention 138, whichever is higher. ILO Minimum Age Convention 138 states the minimum age shall be 15, unless local law in developing nations is set at 14 – in accordance with developing nations exceptions under this convention.

3.3: The employment of young workers above the minimum age but under 18 years old shall be in compliance with local laws, including required access to compulsory school attendance and any restrictions on hours and time of day.

3.4: Young workers above the minimum age but under 18 years old shall not be subjected to hazardous work that can compromise their health and safety.

3.5: All work, including overtime, must be voluntary. The facility shall not engage in any form of forced or bonded labor. This includes human trafficking, the holding of original identity papers, prohibiting workers from leaving the premises after their shifts or other coercion intended to force anyone to work. Where the holding of original identity papers is required by national law, such papers must be immediately returned to employees upon request and be readily available to them at all times.

3.6: The applicant shall abide by the national mandated work week where applicable.

3.7: The applicant shall comply with national labor laws for pay, overtime and holiday compensation for hours worked beyond the regular work day or week.

3.8: The facility shall not require the payment of deposits, deductions from wages or withholding of pay that is not part of a legal contractual agreement with the employee and/or that is not provided for or permitted by national law.

3.9: The facility shall not make deductions from wages as part of a disciplinary process.

3.10: The applicant shall only employ legally documented workers, whether nationals or migrants.

3.11: The facility shall maintain all relevant documents that verify any contracted/subcontracted workers, whether contracted through a labor service or otherwise, are paid in compliance with all local wage, hour and overtime laws.

3.12: All labor, recruiting or employment services used by the facility must be licensed to operate by the local or national government as a labor provider.

3.13: The facility shall maintain all relevant documents that verify piece workers (those paid a fixed “piece rate” for each unit produced or action performed regardless of time) are paid in compliance with local law, including regulations regarding equivalence to or exceeding minimum requirements for wages, hours, overtime and holiday pay.

3.14: The facility shall provide to all workers, whether hourly, salaried, piece-rate, temporary, seasonal or otherwise prior to hire and during employment, written and understandable information regarding the terms of employment, worker rights, benefits, compensation, hours expected, details of wages for each pay period and facility policies regarding disciplinary actions, grievance procedures, authorized deductions from pay and similar labor-related issues. This information must be provided in the prevalent language of the majority of employees.

3.15: Where contracted/subcontracted or temporary workers are hired through a labor or employment service, the facility shall ensure that the labor or employment service provides the above information prior to and during hire, in appropriate languages, to ensure workers are aware of their rights and conditions of employment as described above.

3.16: Workers shall have the right to terminate their employment after reasonable notice.

3.17: The facility shall appoint a management person responsible for ensuring worker health, safety and training.

3.18: The facility shall identify and eliminate or minimize any workplace health and safety hazards by conducting a thorough risk assessment. This includes a requirement for accident investigation.

3.19: Workers shall have the right to collective bargaining, or at least one employee shall be elected by the workers to represent them to management.

3.20: There shall be a written worker grievance process, made available to all workers, that allows for the anonymous reporting of grievances to management without fear of retaliation.

3.21: The facility shall provide for equal opportunity with respect to recruitment, compensation, access to training, promotion, termination or retirement.

3.22: The facility shall treat workers with respect and not engage in or permit physical, verbal or sexual abuse, bullying or harassment.

3.23: If provided, employee housing shall meet local and national standards (e.g., water-tight structures, adequate space, heating/ventilation/cooling), and shall be free of accumulated trash and garbage, as well as equipment and inputs.

3.24: Safe drinking water shall be readily available to employees. If meals are provided, they shall be wholesome and commensurate with local eating customs.

3.25: Running water, toilets and hand-washing facilities shall be readily available to employees.

3.26: In the event of accidents or emergencies, the applicant shall provide basic medical care, including access to or communication with medical authorities. Additionally, first aid kits shall be readily available to employees, and any expired content shall be replaced.

3.27: The applicant shall provide training in general health, personal hygiene and safety (including aquatic safety and the use of boats and associated equipment), first aid and contamination risks to all employees within eight weeks after hiring. Safety documents must be available in a language understood by the workforce.

3.28: Employees shall be appropriately licensed to drive or use equipment for which public licenses are required, and a list of such licensed employees and copies of their licenses shall be available for inspection.

3.29: An emergency response plan shall be prepared for serious illnesses or accidents.

3.30: Select workers shall be made familiar with details in emergency response plans and trained in the first aid of electrical shock, profuse bleeding, drowning and other possible medical emergencies.

3.31: Protective gear and equipment in good working order shall be provided for employees (e.g., eye protection for welding, gloves for shop work and boots for wet areas). Auditor to verify deployment.

3.32: Electrical pumps and aerators shall be wired according to standard safe procedures. Machinery shall have proper driveshaft and/or drive belt safety guards.

3.33: The applicant shall comply with laws that govern diving on aquaculture facilities and develop a written dive safety plan that requires diver training and the maintenance of logs that document procedures, safety-related incidents and equipment maintenance.

4. Environment

(Land-Based Systems Only)

Protection of Ecologically Sensitive Areas

Hatcheries shall protect and conserve ecologically sensitive areas with environmental attributes worthy of retention or special care. Wetland areas removed for allowed purposes shall be mitigated.

Reasons for Standard

Hatcheries are typically operated in coastal or freshwater environments in tropical or temperate locations. Such locations can include ecologically sensitive areas (ESAs) that have special environmental attributes worthy of retention or special care. These areas, which can include but are not limited to mangrove and wetland areas and sensitive shoreline habitat, are critical to the maintenance of productive and diverse plant and wildlife populations.

Hatcheries use different rearing methods and can be built in ecologically sensitive areas adjacent to natural water bodies. This can potentially harm sensitive areas in various ways.

Implementation

These BAP standards seek to prevent damage, if possible, or mitigate damage where prevention is not possible. In all cases, hatcheries shall employ appropriate construction methods and methods of operation to protect the natural resources they use.

- Ecologically sensitive areas shall be identified and protected during construction.
- Facilities shall be designed and operated to prevent erosion or sedimentation due to effluent discharge, water flow or flooding.
- If hatchery operation requires access to water across an ecologically sensitive area, this shall only be allowed for the installation of inlet and outlet canals, pump stations and docks.
- ESAs damaged by construction or operations since 1999 shall be mitigated by restoration of an area of similar habitat three times the size of the area damaged or by a donation of equivalent value to other restoration projects. This practice is only allowable if local regulations permit it.
- In cases where ESAs were damaged before 1999, the facility shall be the subject of a five-year restoration or mitigation plan. To be considered for a possible exemption, the hatchery shall explain the extenuating circumstances regarding the damage.

Standards

Land-Based Systems

4.1: Where the site plan shows that an ESA has been damaged by facility construction and/or operation since 1999, the loss shall have been only for allowable purposes.

4.2: If net loss of ecologically sensitive area occurred on facility property since 1999, the loss shall have been mitigated by restoring an area three times as large or by an equivalent donation to restoration projects.

4.3: For facilities constructed before 1999 and where an ESA was damaged but not restored, the applicant shall propose a plan, subject to local regulations, that within five years from the date of initial BAP certification shall restore the damaged area, mitigate the damage by restoring an equal area of similar habitat or make a donation of equivalent value to other restoration projects. Alternatively, the applicant shall provide an explanation of the extenuating circumstances regarding the damage for consideration of exemption from this standard.

4.4: Operation of the facility shall not lead to erosion or beach deterioration, or cause other ecosystem damage that will not recover within the natural life cycle of the major fauna or flora damaged.

4.5: Unless specific permits apply, hatchery activities shall not alter the hydrological conditions of the surrounding watershed, and the normal flow of brackish water to mangroves or freshwater to wetlands shall not be altered.

5. Environment (All Production Systems)

Metabolic Wastes and Uneaten Feed

Hatcheries shall monitor the concentrations and/or impacts of the metabolic wastes and uneaten feed discharged from their facilities and comply with BAP effluent quality criteria, unless exempted. Where applicable, hatcheries shall also meet conditions for discharge as specified in their operating permits.

Different monitoring procedures and standards apply for different hatchery systems as described below.

Reasons for Standard

Only a portion of the nutrients added to aquaculture facilities to increase production is converted to animal tissue. The remainder becomes waste that can cause increased concentrations of nutrients, organic matter and suspended solids in and around culture systems.

Sea-based, mollusk nursery facilities where the animals feed only on naturally growing food are exempt from the effluent-monitoring requirements of this standard.

5i. Land-Based Systems

Implementation

Applicants shall monitor their effluents and meet the initial BAP effluent water quality criteria, and apply the methods for sampling and analysis given in Appendix A. Within five years, they shall meet the final criteria shown in Appendix A. Water quality records shall be documented according to the effluent data sample forms in Appendix B.

To confirm compliance with the BAP effluent criteria, the auditor shall during the inspection process witness effluent sampling and preparation for analysis by an independent laboratory. The samples collected during the audit shall be analyzed by a private or government laboratory following generally accepted analytical methods.

Limited Option: Allowable Deviation From Standard Water Quality Criteria

The source water for hatcheries can have higher concentrations of water quality variables than allowed by the BAP initial criteria. In these cases, demonstration that the concentrations of the variables do not increase (or decrease for dissolved oxygen) between the source water and hatchery effluent is an acceptable alternative to compliance with the criteria. This option does not apply to pH and chloride.

To qualify for the Limited Option, hatcheries must collect samples of both influent and effluent water according to the frequencies stated in Appendix A.

Exemptions From Effluent-Monitoring Requirements

The following land-based hatchery facilities are exempt from the effluent-monitoring requirements:

- Hatcheries that release no effluent to natural water bodies, e.g., those where effluent is used for irrigation, or where percolation ponds are used.
- Hatcheries that avoid regular discharges of effluents into natural water bodies such that less than 1% of the system volume is exchanged daily on an annual basis – for example, by reusing all water or practicing infrequent, limited exchange of water. Hatcheries qualifying for this exemption shall report an annual effluent discharge volume, water use and nutrient load as described in Appendix C.
- Hatcheries that produce less than 3 mt of live aquatic products yearly.

Standards

Land-Based Systems

5.1: If the facility is claiming the Limited Option as a justification for deviating from standard water quality criteria, it shall collect the requisite influent and effluent water quality data, and concentrations shall reflect no deterioration between intake and discharge.

5.2: If the applicant's facility is claiming exemption because the facility releases no effluent, or its effluent is exclusively destined to irrigate agricultural crops, an explanation of how this is achieved shall be provided, and these Section 5 standards do not apply. Must be verified by auditor.

5.3 If the applicant is claiming exemption because daily water exchange rates on an annual basis are less than 1% of system volume, data for annual effluent discharge volumes, water use and nutrient loads shall be provided.

5.4: If the applicant is claiming exemption because the facility produces less than 3 mt of live aquatic products per year, an explanation of how this is met shall be provided.

5.5: Records on intake water and effluent monitoring shall be maintained and available.

5.6: Effluent water quality concentrations shall comply with BAP water quality criteria or applicable regulations, if they are equivalent or more rigorous.

5.7: Hatcheries shall continue compliance with these criteria to maintain certification and comply with BAP's final criteria within five years.

5.8: The hatchery shall provide the auditor with an estimated annual water use during the last calendar year, as illustrated in Appendix C, and the input data shall also be available for review.

5ii. Cages in Fresh- or Brackish Water

Implementation

Cages do not discharge point-source effluents, but uneaten feed, feces and metabolic excretions enter the water bodies that contain the cages or net pens.

Natural water bodies can already be eutrophic when certification is sought. Sites at which water quality in the water body containing cages or net pens does not comply with BAP effluent criteria (Appendix A) shall not be eligible for certification. However, this does not apply to mollusk nursery facilities, where filter-feeding mollusks may improve water quality.

Hatcheries that use cages in freshwater or brackish water and that annually produce more than 20 mt of animals or use more than 20 mt of feed (dry weight basis) shall monitor and maintain records of water quality according to the schedule and procedures in Appendix D. Water quality measurements taken during certification inspection shall meet both BAP criteria and those of applicable government permits. Facilities shall comply with BAP's final criteria within five years.

Cages can be installed in lakes, reservoirs, streams, irrigation systems, ponds or estuarine water embayments. Rules for compliance with the BAP effluent management standards differ among the types of water bodies in which the cages and pens are installed. Guidance on improving production practices in cages is provided in Appendix E.

Cages in Lakes, Reservoirs

In addition to water quality monitoring, hatcheries that use cages in lakes and reservoirs shall comply with feeding rate limits based on the calculated hydraulic retention time of the water bodies (Appendix F).

Cages in Ponds

Ponds are mostly privately owned but usually discharge into public waters. Effluents from ponds containing cages shall comply with the BAP effluent criteria (Appendix A).

Cages in Streams, Irrigation Systems

Stream flow is variable and too difficult to measure to use as a guide to establish maximum daily feed inputs. Thus, soluble phosphate and total ammonia nitrogen concentrations shall be used as indicators for cage operations in streams.

Soluble phosphate and total ammonia nitrogen levels shall be measured monthly immediately upstream of cages at a depth of 50 cm and 200 m downstream at the same depth. The downstream concentrations shall not exceed the upstream concentrations by more than 25%. Feed input shall be adjusted downward when compliance cannot be achieved.

Cages in Brackish Water

As a general rule, cage areas with brackish water with mean salinity below 25 ppt are well flushed. Thus, daily feed input of 7.5 kg/ha of the surface area of the water body is allowed unless results from monitoring indicate non-compliance, in which case feeding rates shall be reduced until compliance is achieved.

Monitoring shall be the same as for operations in lakes or reservoirs with two exceptions: Brackish water locations do not experience thermoclines, as found in lakes and reservoirs, and it is not necessary to monitor discharges from them for compliance with BAP effluent criteria.

Standards

Cages in Lakes, Reservoirs

5.9: The water quality of the water body, including its discharge point if applicable, shall meet the BAP effluent water quality criteria, with sampling conducted following the procedures in Appendix D.

5.10: Facilities shall maintain accurate records of daily feed inputs that reflect compliance with the BAP maximum allowable daily feed input levels.

5.11: Water quality-monitoring records shall be applied in the management of feeding rates (Appendix E) when dissolved-oxygen levels are consistently below 5 mg/L in the early morning, when mean annual Secchi disk visibility decreases by 25% since initial certification, when blue-green algae comprise more than 60% of total phytoplankton or when the thermocline becomes 25% shallower since initial certification. Water quality and feeding records shall be available to substantiate compliance.

Cages in Streams, Irrigation Systems

5.12: Monthly records of upstream and downstream total ammonia nitrogen and soluble phosphorus concentrations shall be available.

5.13: Maximum daily feeding rates shall be managed such that concentrations of nutrients at 50-cm depth and 200 m downstream of the cages do not exceed upstream concentrations by more than 25%.

Cages in Brackish Water

5.14: Feeding records shall demonstrate that the maximum daily feeding rate of 7.5 kg/ha of the water body surface area is not exceeded and that feeding levels were reduced when BAP water quality criteria were exceeded.

5.15: Water quality-monitoring records shall be maintained as specified.

5iii. Cages in Marine Water Above 25-ppt Salinity

Implementation

Sediment monitoring is the most practical means of detecting the environmental impacts of hatcheries that use marine cages. Such facilities shall be located and operated so that they minimize negative impacts on sediment quality outside a defined sediment impact zone.

Cage facilities are usually located following hydrographic, biological and physical studies of the sites to determine that operations will not have significant negative impacts on animal populations that comprise the benthos under or near the cages. Then "allowable" benthic impacts are set as conditions in the operating permits for the facilities, which are defined in terms of one or more of several chemical properties of the sediments. Sometimes these are then correlated with species density and diversity determinations, which are based on prior knowledge of local sediment biology or analysis of sediment reference samples collected from the facility locations.

Production cycles and fallowing shall be coordinated with other neighboring BAP applicants or BAP-certified facilities, or with members of an established Area Management Agreement (AMA). Neighboring facilities, defined as facilities within an area twice the regulatory minimum separation distance to an upper limit of a 5-km radius, should participate in the creation and implementation of Area Management Agreements to address cumulative impacts associated with multiple aquaculture facilities.

BAP-certified hatcheries that operate in isolation should have statements of intent to enter AMAs, should other operations move into their areas.

Cage facility permits and/or local regulations usually define an allowed "sediment impact zone," "allowable zone of effect" or "footprint of deposition," and prescribe monitoring protocols to check it. Because biological sampling of sediments requires special expertise and is time-consuming and expensive, chemical sediment properties are usually used as leading indicators of sediment condition. Biological sampling is only required in some jurisdictions when an indicator trigger point is exceeded.

Chemical indicators used for this purpose include oxygen concentration in the sediment, sulfide, REDOX potential, total organic carbon or total volatile solids, or visual inspection with documentation by video. The specific environmental conditions dictate which method is most suitable.

For example, sulfide determination works well in silt or clay sediments containing up to 50% sand, as does determination of total organic carbon. Above this level of sand, an indicator such as total organic carbon works better. On hard bottoms with over 10% gravel, visual recording by video is best, because grab sampling is impossible, and many such sea bottoms are erosional in nature, not depositional.

Since different methods or combinations of methods may be required in different jurisdictions based on local hydrographic or benthic conditions, no preferred method is specified in these standards, only that whatever method is used shall be undertaken using standard methods of sampling and analysis that conform to generally accepted international standards.

In situations where sediment monitoring is a statutory requirement, and allowed sediment impact zones are defined, the following shall apply to all applicants for BAP certification.

- Hatcheries shall provide documents that describe local standards for benthic impacts under cage facilities.
- Existing facilities shall provide at least three years of monitoring data to show that they meet or exceed benthic standards required by operating permits at current production levels.
- Each new facility shall have completed a baseline study, with review by an independent expert, that describes hydrographic and benthic conditions at the site. The expert's opinion (given without liability) must indicate the facility can meet or exceed the benthic standards required by its operating permits at current or proposed production levels. This opinion shall be verified by reference to sampling results at the next audit.
- Hatcheries shall provide documents to show that sediment quality was determined using generally accepted sample collection and analytical methods.

In countries or regions where sediment monitoring is not required as described above, and/or an allowed sediment impact zone is not defined, applicants that produce more than 20 mt of animals or use more than 20 mt of feed (dry weight basis) yearly shall write and implement a monitoring plan that requires them to:

- Nominate an independent individual or company with demonstrated expertise in sediment sampling and analysis to design a sediment sampling and analysis program appropriate to the facility conditions and to conduct sediment monitoring as required below.
- Chart an allowable sediment impact zone that shall not exceed the total area of the facility plus a boundary zone of 40 m around it. The footprint may be shifted in any direction to account for normally occurring uneven current patterns, as long as the total area remains the same.
- Monitor the organic build-up on the seabed within this zone by the method deemed best for the type of sediment that exists there. The choice of method shall be justified by prior documentation of the type of sediments over which the facility is located.
- Conduct sediment sampling to coincide with the period of peak feeding during each crop cycle. Samples shall be taken along at least two transects that pass directly through the facility and align with the dominant flow of water at the site. One sample with three replicates shall be taken at the edge of the facility, and another shall be taken at the 40-m boundary.
- Take five replicate samples from at least two reference stations within 1 km of the facility that have depth and sediment characteristics similar to those that occur at the facility and where there is no production.
- Demonstrate by statistical analysis of the results that there is no organic build-up due to facility activity at the boundary of the allowable sediment impact zone in comparison to the reference station, as determined by the monitoring method chosen.

Additional Information

Finfish Aquaculture License
Under the Pacific Aquaculture Regulations
Fisheries and Oceans Canada
http://www.pac.dfo-mpo.gc.ca/aquaculture/licence-permis/docs/licence-cond-permis-mar-eng.pdf

Guide to the Assessment of Sediment Condition at Marine Finfish Farms in Tasmania
C. Macleod and S. Forbes (editors)
Tasmanian Aquaculture and Fisheries Institute
University of Tasmania
Hobart, Tasmania, Australia
http://www.imas.utas.edu.au/__data/assets/pdf_file/0011/68384/AquafinCRC_ProjectNo4.1.pdf

Norwegian Standard N. S. 9410.E
Environmental Monitoring of Marine Fish Farms

Code of Good Practice for Scottish Finfish Culture
Scottish Salmon Producers' Organisation
http://www.thecodeofgoodpractice.co.uk

Washington State Legislature, WAC 173-204-420
Sediment Impact Zone Maximum Criteria
http://apps.leg.wa.gov/WAC/default.aspx?cite=173-204-200

FAO Fisheries and Aquaculture Technical Paper No. 527
Environmental Impact Assessment and Monitoring in Aquaculture, pp. 455–535
A. Wilson, S. Magill, K. D. Black – 2009
FAO. Rome, Italy

Standards

Cages in Marine Water

5.16: The applicant shall provide documents that describe local standards for benthic impacts under cage facilities, which shall include the benthic indicator "trigger level" above which the facility would not be in full compliance with the local standard, where this is clearly defined, or with its intent where it is not clearly defined.

5.17: For established facilities, the applicant shall provide three years of monitoring data to show that the facility meets or exceeds sediment quality criteria specified in its operating permits and/or its own monitoring plan at current operating levels.

5.18: For newly established facilities or those that have expanded and do not yet have enough monitoring data, the applicant shall provide an independent study that characterizes the hydrographic and benthic characteristics of the area and provides a consultant's opinion (without liability) that the facility can meet or exceed sediment and water quality criteria if operated correctly. This opinion shall be verified by reference to sampling results at the next audit.

5.19: Monitoring of sediment conditions shall be undertaken at the time of peak feeding during the production cycle and shall be conducted according to the requirements of the facility's operating permits or its own plan in countries or regions where sediment monitoring is not required, and as specified in the implementation guidelines.

5.20: Sediment sampling and analysis performed as part of the monitoring program shall apply generally accepted international methods and be adapted to the local hydrographic or benthic conditions.

5.21: The results of sediment monitoring shall be reported to and reviewed and accepted by the appropriate regulators. Where regulatory approval is conditional upon implementing a program of remedial action, this shall have been implemented and completed.

5.22: Production cycles and fallowing shall be coordinated with other neighboring BAP applicants or BAP-certified facilities, or with members of an established Area Management Agreement.

5.23: Where an AMA has not been established, applicants shall nevertheless demonstrate cooperation on matters of stocking, fallowing, animal health and biosecurity with BAP-certified facilities within an area twice the regulatory minimum separation distance to an upper limit of a 5-km radius.

6. Environment

(Land-Based Systems Only)

Soil and Water Conservation

Hatchery construction and operations shall not cause soil and water salinization or deplete groundwater in surrounding areas. Land-based hatcheries shall properly manage and dispose of sediment from ponds, raceways, tanks, canals and settling basins.

Reasons for Standard

In some hatcheries, freshwater from underground aquifers is used as a source of process water. If saline water used elsewhere in the facility is allowed to infiltrate freshwater aquifers or is discharged into nearby freshwater lakes or streams, it can cause salinization of the groundwater. Excessive use of groundwater can also potentially lower water tables and negatively affect groundwater availability, or cause subsidence or salinization.

Solid waste (mostly feces and uneaten food) from hatchery operations can add to biochemical oxygen demand and cause the build-up of sediment at the point or points of discharge. It should therefore be treated before release.

Implementation

Salinization

Salinization can result from hatchery operation in coastal areas where saltwater or brackish water is used in ponds for production or is discharged into ponds for settlement prior to discharge. The risk of salinization can be reduced by not constructing settling or treatment ponds in highly permeable, sandy soil, or by providing clay or plastic liners to minimize seepage. Discharging into ponds where the groundwater is already saline is another approach. Other best practices include:

- Do not discharge saline water into freshwater areas.
- Avoid pumping of groundwater from freshwater aquifers that significantly lowers the water table in neighboring wells.
- Monitor chloride concentration in freshwater wells near hatcheries to determine if salinization is occurring.

Use of water from irrigation systems shall be in accordance with regulations, and effluents shall be returned to the irrigation system.

Sediment Management

Aquaculture ponds have high hydraulic retention times and function as sedimentation basins, but negative environmental impacts can arise when sediments are resuspended during harvest or when sediment is pumped from ponds during the culture period and discharged as a highly fluid sludge. The sludge contains organic material from feces and uneaten feed, and often comprises mineral particles that enter the ponds in source water from a river.

Hatcheries must incorporate suitably sized settling basins or other engineered solutions that assure the collection and removal from the effluent stream of the majority of settleable solids. An example of how the volume of such a settlement facility should be calculated is given in Appendix G. Accumulated solids must then be pumped periodically to offline sludge basins, where they can be dewatered before being disposed of responsibly.

Settlement facilities must be designed to limit or prevent erosion or scouring caused by the influent water flow. Drainpipes should extend at least 1 m beyond embankments at an elevation near the ditch bottom. The pipe outlet area should be protected with a splash shield or riprap to reduce effluent energy. Drainpipes that discharge directly into streams should extend over the stream bank to prevent erosion and be located near the stream's normal water level.

Standards

Land-Based Systems

6.1: If ponds with saline water are constructed on permeable soil, measures such as the use of pond liners shall be taken to control seepage and avoid contamination of aquifers, lakes, streams and other natural bodies of freshwater.

6.2: For inland brackish ponds, quarterly monitoring of neighboring well and surface water shall show that chloride levels are not increasing due to hatchery operations.

6.3: Data on water levels in neighboring wells shall be requested from the well owners, and where available shall show that the water table is not adversely affected by the facility's use of water for hatchery processes.

6.4: Use of water from wells, lakes, streams, springs or other natural sources shall not restrict the amount of water available to other users or cause damage to ecologically sensitive areas or subsidence in surrounding areas.

6.5: The facility shall process all sludge/sediment in sedimentation basins or by other proven sediment concentration methods, such as filters and presses, and shall not dump material in ecologically sensitive areas.

6.6: If the applicant's facility uses tanks, raceways or similar systems with short retention times, sedimentation basin capacity shall be provided to handle the associated sludge/sediment, and documents shall be available to show how the capacity was calculated.

6.7: Any accumulated sludge removed from ponds, reservoirs or sedimentation basins shall be confined within the facility property until it is disposed of harmlessly.

6.8: Removed sediment shall be properly contained and located to prevent the salinization of soil and groundwater, and shall not be placed in mangrove areas or other sensitive habitats.

6.9: The applicant shall take measures to control erosion and other impacts caused by outfalls.

7. Environment (All Production Systems)

Feed Biosecurity

Fishmeal and Fish Oil Conservation

Hatcheries shall accurately monitor feed inputs and take steps to minimize risks of contamination or spoilage. Hatcheries that produce juveniles with average live weights over 50 g and use more than 500 mt of dry feed yearly shall minimize the use of fishmeal and fish oil from wild fisheries.

Reasons for Standard

Hatcheries use live, fresh, frozen or dry feeds depending on the species grown and the stage of animal development. Live, fresh and frozen feeds can contain microorganisms that pose a biosecurity risk, while there is a risk of spoilage or the presence of toxic preservatives in some fresh and frozen feeds if they have not been handled correctly.

Dry feeds purchased from trustworthy suppliers should not pose such risks and, since most hatcheries use dry feeds in only small quantities, the amounts of fishmeal and fish oil from wild fisheries they contain are not considered an issue for BAP certification.

However, in some cases, much larger volumes of dry feed can be used. This occurs especially at hatcheries that grow fish to an intermediate size in facilities that are often referred to as "nurseries" before transfer to the final growout farm. Where feed volumes used in such nurseries exceed 500 mt of dry feed yearly, and juveniles are grown to an average live weight greater than 50 g, assurance is required regarding the responsible sourcing of fishmeal and fish oil from wild fisheries, as well as demonstration of efforts to minimize their use.

Sea-based, mollusk nursery facilities where the animals graze on naturally produced phytoplankton are exempt from compliance with these standards.

Implementation

Hatcheries shall keep accurate records of all feed brought into and used at the facilities, and shall take all reasonable measures to ensure the feed is wholesome and stored under conditions where it will not deteriorate. Biosecurity issues related to live, fresh or frozen feeds brought into the facility and/or produced at the facility shall be the subject of measures outlined in the site-specific Health Management Plan. (See Section 14.)

Hatcheries that use more than 500 mt of dry feeds yearly and produce juveniles of over 50 g average live weight shall maintain records that enable fish in:fish out ratios to be calculated as described in Appendix H.

To promote the responsible sourcing of marine ingredients, the applicant shall obtain feed from a BAP-certified feed mill or a feed mill that declares and documents compliance with BAP feed mill standards 3.1 and 3.3. These standards address sourcing policies on marine ingredients, covering traceability for species and origin, and the exclusion of any species designated on the IUCN Redlist as endangered or critically endangered.

The BAP feed mill standards require that after June 2015, for fishmeal and fish oil derived from reduction fisheries, at least 50% (calculation based on mass balance) shall come from sources that are certified by either the Marine Stewardship Council (MSC) or to the International Fishmeal and Fish Oil Organization Responsible Supply standards (IFFO RS). Alternatively, where MSC- or IFFO RS-certified fishmeal and fish oil are not produced nationally, the above minimum percentage can comprise material from active approved improvers programs as verified by IFFO (http://www.iffo.net/node/493), the Sustainable Fisheries Partnership (SFP, http://fisheryimprovementprojects.org/view-fips/) or World Wildlife Fund (WWF, https://sites.google.com/site/fisheryimprovementprojects/home). This 50% target will be periodically reassessed with the ultimate goal that all fishmeal and fish oil are derived from certified sources.

Standards

All Production Systems

7.1: Accurate records shall be kept of all feeds used, their sources and any tests undertaken for the presence of contaminants or toxicants.

7.2: Live, fresh or frozen feed brought into the hatchery from an outside source shall be accompanied by a certificate from the supplier warranting that the feed is fresh or was frozen when fresh, and has not been treated with toxic preservatives such as formalin.

7.3: All feed shall be stored under cover with temperature control (as needed) and enough space from the walls to allow ventilation and movement for inspection.

7.4: Feeds and feed additives (premixes) shall be protected from moisture and pests, and stored away from fuels, chemicals and other potential contaminants.

7.5: Biosecurity provisions for feeds brought into or produced at the facility shall be followed as described in the Health Management Plan. (See Section 14.) Records shall be available to demonstrate this.

7.6: No feeds that contain material derived from the flesh or carcasses of the same species that is reared in the facility shall be used, even if such materials have supposedly been disinfected by cooking or other treatment.

Hatcheries Using Over 500 mt Dry Feed/Year

7.7: The applicant's facility shall use feed for which the manufacturer has provided data on the wild-harvested fishmeal and fish oil content or feed fish inclusion factor.

7.8: The facility shall record the characteristics of all feeds used, the total amounts of each feed used each year and the total annual production.

7.9: The facility shall calculate and record a feed-conversion ratio for each completed production cycle.

7.10: The facility shall calculate and record a fish in:fish out ratio for each completed production cycle.

7.11: The fish in:fish out ratio shall not exceed 1.5.

7.12: The applicant shall obtain feed from a BAP-certified feed mill or a feed mill that declares and documents compliance with standards 3.1 and 3.3 of the BAP feed mill standards, as below.

Feed mill standard 3.1: The applicant shall obtain declarations from suppliers on the species and fishery origins of each batch of fishmeal and fish oil.
Feed mill standard 3.3: The applicant shall develop and implement a clear, written plan of action defining policies for responsibly sourcing fishmeal and fish oil.

8. Environment (All Production Systems)

Stocking Sources and GMOs

Certified hatcheries shall comply with government regulations regarding the use of native and non-native species, genetically modified aquaculture species and wild-caught broodstock. Except for certain molluscan shellfish, wild-caught juveniles shall not be stocked.

Reasons for Standard

The introduction of domesticated, non-native or genetically modified stocks to a country or region carries with it the risk of adverse interactions with native stocks should escapes occur. Therefore, procedures must be followed to minimize such risks.

Implementation

Hatcheries shall keep records of their sources and purchases of stocking material, and record an estimated count of the number stocked in each culture unit for each crop. A sample traceability form that records these data is provided in Appendix I.

Introductions of species to countries where such species are not native, not feral or not already approved for farming shall be subject to the provisions of the 2005 ICES Code of Prac-

tice on the Introductions and Transfers of Marine Organisms or, in the case of freshwater species, the United Nations Food and Agriculture Organization's 1988 Codes of Practice and Manual of Procedures for Consideration of Introduction and Transfers of Marine and Freshwater Organisms.

Hatcheries that engage in genetic improvement of stock through selective breeding shall have a written Genetic Improvement Plan that describes improvement goals and how genetic fitness will be maintained as these goals are pursued. Guidance on the development of such a plan is available through FAO. (See Additional Information.)

Genetically Modified Organisms

Genetically modified organisms (GMOs) are defined as organisms that have been genetically modified by artificial transfer of genetic material from another species or altered in a way that does not occur naturally. Sterile or sex-reversed organisms and their offspring created by hybridization or polyploidy are not GMOs. Should GMOs be permitted by governments for use in aquaculture in the future, producers shall, at a minimum, comply with all regulations in producing and consuming countries.

Additional Information

Code of Practice on Introductions and Transfers of Marine Organisms, 2005
International Council for the Exploration of the Sea
http://www.ices.dk/publications/Documents/Miscellaneous%20pubs/ICES%20Code%20of

FAO Technical Guidelines for Responsible Fisheries 5, Supplement 3
Aquaculture Development, Genetic Resource Management
ftp://ftp.fao.org/docrep/fao/011/i0283e/i0283e01.pdf

Codes of Practice and Manual of Procedures for Consideration of Introduction and Transfers of Marine and Freshwater Organisms
European Inland Fisheries Advisories Commission
Food and Agriculture Organization of the United Nations
Rome – 1988
ftp://ftp.fao.org/docrep/fao/009/ae989e/ae989e.pdf

Standards

8.1: The facility shall maintain accurate records of the species produced and, where relevant, any significant stock characteristics, including but not limited to non-native, specific pathogen-free, specific pathogen-resistant, sterile, hybrid, triploid, sex-reversed or genetically modified status. Records shall also include documentation to support the stock characteristic claims made.

8.2: If government regulations control the use or importation of any of the species or stocks produced, relevant permits shall be made available for inspection, even if imported eggs, juveniles or fry were purchased from an intermediary.

8.3: The facility shall keep records of sources and purchases of stocking material, and record the number stocked in each culture unit for each production lot. Numbers shall be determined either by physical count or by estimation using batch weight and average individual animal weight, with records available that also provide an estimated margin of error.

8.4: The facility shall comply with all government regulations regarding importation of native and non-native gametes, juveniles and/or broodstock, where applicable.

8.5: Wild juveniles shall not be deliberately stocked. (This standard does not apply to the collection of seed of certain wild mollusks, which when practiced, must comply with applicable regulations.)

8.6: If wild-caught broodstock are used, documents from the appropriate government agency shall be available to show their capture was approved, and the broodstock were caught from regulated and sustainable fisheries, where such information is available.

8.7: Where the species produced is neither native nor already approved for farming, further documents shall be provided to demonstrate that approval for farming is based on the 2005 ICES Codes of Practice on the Introductions and Transfers of Marine Organisms or, for freshwater species, the United Nations Food and Agriculture Organization's 1988 Codes of Practice and Manual of Procedures for Consideration of Introduction and Transfers of Marine and Freshwater Organisms.

8.8: Hatcheries that engage in genetic improvement of stock through selective breeding shall have a written Genetic Improvement Plan that describes improvement goals and how genetic fitness will be maintained as these goals are pursued.

9. Environment (All Production Systems, Several Standards for Cages Only)

Control of Escapes

Certified hatcheries shall take measures to minimize escapes and unintended releases of the facilities' stocks.

Reasons for Standard

The escape of domesticated and/or non-native culture species or the unintended release of their eggs or larvae can have adverse ecological effects through interbreeding with local populations of the same species, competition with native species or transmission of disease.

Implementation

All systems shall be designed and maintained to minimize the escape of culture animals, and all incidents involving escapes of animals shall be accurately documented. Hatcheries should demonstrate reductions in such escapes over time.

Provisions for Cages

Cages are used by some hatcheries for holding broodstock or as nursery facilities where juvenile stock are grown to an intermediate size before being transferred to the final growout facilities from which they will eventually be harvested. Cages are especially susceptible to the occurrence of escapes. Each hatchery that operates cages shall therefore have a written Stock Containment Plan that describes procedures for preventing escapes or explains why in some cases, such as certain mollusk-rearing facilities, such procedures are unnecessary.

Additional Information

British Columbia Net Cage Strength-Testing Procedure, 2002
http://www.agf.gov.bc.ca/fisheries/aqua_report/2004-5/Appendix3.pdf

Standards

All Production Systems

9.1: A site risk analysis, updated at least annually, shall be conducted that identifies the potential and actual causes of escapes, determines the relative likelihood of their occurrence or recurrence, and identifies critical control points for effective escape risk monitoring, reduction and response.

9.2: Employees shall be trained in the findings of the risk analysis, and the efficacy of procedures to monitor and reduce escape risks, and effectively respond to escape events shall be documented through the year.

9.3: All holding, transport and culture systems shall be designed, operated and maintained to minimize the unintended release of eggs, larval forms, juveniles and adult animals.

9.4: Screens, nets or other controls sized to retain the smallest live aquatic animals present shall be installed on water outlet pumps, pipes or sluices.

9.5: Screens, nets or other controls shall be installed on or near pump intakes to minimize the introduction of local aquatic fauna.

9.6: All screens shall be well maintained and checked for damage at least daily. Effluents shall be monitored for the presence of live organisms, with records kept to demonstrate compliance.

Cages

9.7: The applicant shall provide documents that show the facility's moorings were installed according to the manufacturer's and/or marine engineer's specifications.

9.8: Based on the escape risk analysis, the applicant shall have a Stock Containment Plan that describes how cage system integrity is assured and maintained. Unless it can be demonstrated by engineering specifications, operational considerations and/or government regulations that alternative procedures provide equal or better safeguards against escapes or are unnecessary, the procedures outlined in standards 9.9 to 9.14 shall be followed.

9.9: The main surface components of the cage system shall be inspected at least annually and repaired or replaced as needed. The subsurface components shall be inspected at least every two years and replaced as needed.

9.10: The ages of all nets at the facility shall be tracked, and strength tests shall be conducted on them every two years using a recognized net strength-testing method. (See Additional Information for an example.) Nets shall be retired when their strength is below 60% of the strength of new nets.

9.11: All operational nets shall be surface checked for holes at least weekly and checked subsurface with an underwater camera or by a diver at least every four weeks. Nets and cage superstructure shall be checked for holes and other indications of structural damage after risk events such as storms or big tides.

9.12: Boats shall have guards on propellers, and staff members who drive boats shall be trained to avoid contact between boats and cage nets.

9.13: At marine sites, procedures and equipment consistent with local Coast Guard rules shall be in place to warn marine traffic of the facility's presence.

9.14: The facility shall maintain equipment for the recapture of escapees and have written procedures for its use. The procedures must enable rapid response, subject to legal constraints on the types of equipment used.

9.15: The applicant shall be able to verify that all staff have been trained in all aspects of the Stock Containment Plan.

10. Environment

(All Production Systems, Several Standards for Cages Only)

Wildlife Interactions

Facilities shall manage physical interactions with wildlife to avoid adverse outcomes and employ humane, non-lethal measures for predator control where possible.

Reasons for Standard

The presence and operation of hatcheries can lead to adverse interactions with wildlife through encroachment on their habitat and/or measures taken by the facility to deter predation.

Implementation

Applicants shall obey laws related to the destruction of birds and other predators and pests. Where applicable, permits and records of predator deterrence actions taken shall be available.

The BAP program strongly encourages hatcheries to employ humane, non-lethal measures for predator and pest control, even when lethal methods are permitted. Additionally, all species listed as "endangered" and "critically endangered" by the International Union for Conservation of Nature Red List or protected by local or national laws shall be subjected to passive deterrence methods only, and no active or lethal means shall be used except under exceptional circumstances, such as risk to human life.

Provisions for Cages

Cages are used by some hatcheries for holding broodstock or as nursery facilities where juvenile stock are grown to an intermediate size before being transferred to the final growout facilities from which they will eventually be harvested. Cages are especially susceptible to the occurrence of adverse interactions with wildlife. Hatcheries that operate cages should therefore have a written Wildlife Interaction Plan that describes how to deal with potential predators.

Standards

All Production Systems

10.1: The facility shall use humane methods of predator deterrence and actively favor non-lethal control methods. Where applicable, government permits for predator control shall be made available for review.

10.2: The facility shall maintain a list of species that occur within the vicinity of the hatchery that are classified as endangered or threatened under regional laws and/or the IUCN Red List.

10.3: Except in exceptional circumstances, such as the risk to human life, no controls other than non-lethal exclusion shall be applied to predator species listed as endangered or critically endangered on the IUCN Red List or that are protected by local or national laws.

10.4: The facility shall record the species and numbers of all avian, mammalian and reptilian mortalities resulting from predator control actions and shall report them as required by local authorities.

10.5: Specific members of staff designated to carry out lethal control measures shall be trained in humane slaughter methods.

Cages

10.6: The applicant shall provide a list of relevant local laws and specific conditions of operating permits that apply to wildlife management and protection.

10.7: Marine sites shall maintain maps that identify officially designated "critical" and/or "sensitive" marine and coastal habitat in the region. If a facility is in an area so designated, a list shall be included of the classified or endangered sedentary species within a 2-km radius of the facility and of mobile coastal species within the region. The list shall be updated where necessary to show wildlife established after the facility began operations.

10.8: Documents shall be available that describe the passive measures in place to deter the entry into cages of would-be predators and procedures for the routine inspection and maintenance of the measures.

10.9: Documents shall be available to show that any active but non-lethal deterrent measures used are approved by regulators through a review of environmental impacts with specific reference to endangered, protected or cetacean species in the area. Such devices shall not be deployed if the review shows they can adversely affect these species.

11. Environment (All Production Systems)

Storage, Disposal of Supplies and Wastes

Fuel, lubricants and chemicals shall be stored and disposed of in a safe and responsible manner. Paper and plastic refuse shall be disposed of in a prompt, sanitary and responsible way. Excessive accumulation of waste and/or discarded hatchery supplies and equipment shall be removed and disposed of responsibly.

Reasons for Standard

Hatcheries use fuel, oil and grease to power and lubricate vehicles, pumps, aerators and other mechanical devices. Chemicals used in hatcheries and nurseries can include fertilizer, liming materials, insecticides, herbicides, parasiticides and algicides. Preservatives, paints, disinfectants, detergents and antifoulants are also used.

Fuels and some fertilizers are highly flammable and/or explosive, and pesticides, herbicides and algicides are toxic. They shall therefore be considered potential hazards to workers.

Spills or careless disposal of petroleum products and chemicals can also affect aquatic organisms and other wildlife in the immediate vicinity, and result in water pollution over a wider area.

Hatcheries generate waste that can cause pollution, odors and human health hazards at the facilities and in surrounding areas when not disposed of properly. Human food scraps, out-of-date feed, other organic waste, and discarded equipment or supplies can attract pests and scavengers. Runoff from refuse piles can cause pollution and contaminate groundwater.

Empty plastic bags and other containers used for feed, fertilizer and liming materials do not decompose quickly and can be a hazard to animals.

Implementation

Fuel, lubricants and chemicals shall be labeled and safely stored. Material Safety Data Sheets shall be available for inspection. Used chemicals shall be disposed of in a responsible manner.

Secondary containment shall be provided for individual or multiple fuel storage tanks. The containment volume shall be equivalent to the total stored volume plus 10%.

Oil leaks from generators, trucks and other equipment shall be prevented through good maintenance. Oil changes and refueling shall avoid spills, with used oil sent to a recycling center or otherwise properly disposed of.

Chemicals such as insecticides, herbicides, algicides and detergents shall be stored in locked, well-ventilated, watertight buildings. The buildings' concrete floors should slope to a center basin for containing spills. Warning signs indicating the presence of such materials shall be posted. Chemicals used for hatchery operations shall be neutralized or diluted before discharge into natural bodies of water.

Fertilizers, liming materials, salt and other less hazardous agricultural chemicals shall be stored under a roof or in rainproof containers, where rainfall will not wash them into surface water. Particular care shall be taken with nitrate fertilizers, which are strong oxidants that are particularly hazardous when contaminated with diesel fuel or other oils.

Procedures shall be developed for managing spills of chemicals and other products, and the supplies needed for cleaning up spills shall be readily available. Workers shall be trained to properly use the equipment and handle the contained waste.

Trash, garbage and other waste, including discarded machinery and equipment, shall not be dumped in mangrove areas, wetlands or vacant land, or allowed to accumulate on facility property. Such waste shall be disposed of responsibly. Composting shall be done by a procedure that does not create an odor problem or attract wild animals.

Paper and plastic should be recycled, if possible. Waste collection for recycling requires readily accessible waste containers that are serviced at regular intervals. All containers must be appropriately labeled with risk indicators (poisonous/explosive, etc.).

Housing for owners or workers sometimes is located near production facilities. Sewage from bathrooms, kitchens and other facilities shall be treated in septic tanks.

At cage facilities, workers often spend long hours on the floating cage platforms. Portable toilets shall be provided, and sanitary procedures for disposal of wastes onshore shall be established.

Standards

11.1: Fuel, lubricants, feed and chemicals used at the facility shall be labeled, stored, used and disposed of in a safe and responsible manner. A list of such materials together with Material Safety Data Sheets for them shall be maintained and made available to the auditor.

11.2: Chemicals used for hatchery operations shall be neutralized or diluted before discharge into natural bodies of water.

11.3: Fuel, lubricants and agricultural chemicals shall not be stored near feed, in employee housing or kitchen areas, or near harvest equipment and supplies.

11.4: Fuel, lubricants and chemical storage areas shall be marked with warning signs.

11.5: Precautions shall be taken to prevent spills, fires and explosions, and procedures and supplies shall be readily available to manage chemical and fuel spills or leaks. Designated staff shall be trained to manage such spills and leaks.

11.6: Garbage from housing and food waste shall be retained in water-tight receptacles with covers to protect contents from insects, rodents and other animals.

11.7: Garbage and other solid waste shall be disposed of to comply with local regulations and avoid environmental contamination and odor problems (e.g., recycling, burning, composting or placing in a legal landfill).

11.8: Household trash and other facility wastes shall not be dumped in mangrove areas, wetlands or other vacant land, and shall be removed regularly and properly to avoid accumulation.

11.9: Discarded hatchery supplies and equipment (e.g., tires, pallets, bags, barrels, aeration paddles or engines) shall be stored tidily, not dumped in mangrove areas, wetlands or other vacant land and removed properly to avoid excessive accumulation.

11.10: Measures shall be taken to prevent infestation by animal and insect vectors and pests.

11.11: Secondary fuel containment shall conform to BAP guidelines for fuel storage.

11.12: Domestic sewage shall be treated and properly disposed of to avoid contamination of surrounding areas (e.g., sewer system, septic system, portable toilet or outhouse).

12. Animal Welfare

(All Production Systems)

Animal Welfare

Hatcheries shall demonstrate that all facility operations are designed and operated with animal welfare in mind, and maximum survival and seed quality shall be sought. Employees shall be trained to provide appropriate levels of husbandry.

Reasons for Standard

When farmed animals are exposed to continuing stress, their feed consumption and growth rates can decline. Stressed animals are also less resistant to diseases and produce lower-quality seed. Stress usually increases mortality, as well. Animal suffering can be prevented, and production efficiency can be enhanced by applying good husbandry techniques that avoid creating stressful culture conditions.

Also, an increasing number of regulations specifically address animal welfare and the humane treatment of farmed animals. Although few such regulations address fish, crustaceans and mollusks, similar principles should be applied to ensure that farmed aquatic animals are produced using humane techniques.

Implementation

Since a high level of welfare is a prerequisite for good animal health, good aquatic animal husbandry practices must be an integral part of the facility's written Health Management Plan. (See Section 14.) An Animal Welfare Section (AWS) of the HMP shall describe procedures the facility follows to assure that animal welfare issues are addressed. Its implementation shall be overseen by a qualified aquatic animal health professional (AAHP) and/or member of facility management, one of whom shall be available at audit to present the plan and answer questions.

The AWS shall specifically include details of how brood animals are to be treated. Where this includes interventions to induce maturation or spawning, such as eyestalk ablation in shrimp, hormone injection in fish, manual extraction of eggs and sperm and/or sacrifice of brood animals of any species, procedures shall be designed to minimize animal suffering.

These procedures may include sedation of live animals before handling, use of sterile instruments if the intervention is surgical, and handling techniques that minimize animal stress. Invasive procedures shall only be used if viable, non-invasive alternatives are not available.

Standards

12.1: The facility shall include within its Health Management Plan an Animal Welfare Section (AWS), and all facility personnel shall receive training in its provisions.

12.2: The AWS shall be written and/or approved by a qualified aquatic animal health professional (AAHP), and overseen by a member of facility management or the AAHP, one of whom shall be available at audit to answer questions.

12.3: The AWS shall include procedures for the humane treatment of brood animals during spawning and/or taking of eggs and sperm (whether induced or naturally occurring), and for slaughter where this is required. The procedures shall be designed to minimize unnecessary or inadvertent animal suffering, and records shall be available to demonstrate compliance with the procedures.

12.4: The AWS shall specify methods for the slaughter of surplus, unwanted or compromised animals that minimize animal suffering. Records shall be available to show these methods are followed when animals are euthanized.

12.5: The AWS shall define and justify acceptable minimum water quality limits for the species being reared. Daily or more frequent monitoring records shall show that when these limits are breached, immediate corrective action is taken.

12.6: The appearance and behavior of all hatchery stocks shall be observed at least daily for signs of distress or ill health. Actions taken to correct signs of distress or ill health shall be documented.

12.7: The AWS shall explain, set and keep under review stocking density limits appropriate to the species and size of animals being reared. Documents shall be available to verify these limits are observed.

12.8: The facility shall develop procedures that minimize unnecessary stress or injury to animals during crowding, capture and handling of animals prior to and during transfer within the facility or transport to another. Records using survival rates as an indicator of the adequacy of such procedures shall be available.

12.9: The facility shall develop and follow procedures to estimate the numbers of animals in each shipment and provide documentation to show the estimated margin of error of the procedure used.

13. Food Safety (All Production Systems)

Chemical and Drug Management

Proactively prohibited antibiotics, drugs and other chemical compounds shall not be used. Approved therapeutic agents shall be used prudently and as directed on product labels for the treatment, control and prevention of diseases and not for prophylactic purposes without veterinary oversight.

Reasons for Standard

Some therapeutic agents can be hazardous to human health through direct contact with those who use them or if they accumulate in fish or crustacean tissue that may be eaten by humans later. Therefore, certain compounds have been proactively prohibited, and residue limits have been mandated for others.

Improper use of chemicals and therapeutants can harm or lead to accumulation in other organisms that live around hatcheries or are exposed to them in hatchery effluent. Moreover, inappropriate use of antibiotics can lead to antibiotic resistance in disease-causing organisms that can affect fish and other species, including humans.

Critical Concerns for Therapeutant Use

- Chloramphenicol and nitrofuran antibiotics are proactively prohibited for use in food production in all countries.
- Other drugs and chemicals, such as antibiotics, malachite green, heavy metals, parasiticides and hormones, may be proactively prohibited in specific countries.

Therapeutants that are proactively prohibited in the producing or importing country shall not be used. Any therapeutant use shall be guided by the principle of "prudent use" (see Additional Information), recorded and made available, if requested, to the recipient of the juvenile animals when they are shipped.

Implementation

Good health management focuses on the prevention of disease rather than disease treatment with chemical compounds. Methods by which disease prevention can be achieved include avoiding stocking diseased animals, the adoption of fallowing and "all in, all out" stocking procedures, and maintenance of good water quality in culture systems. (Also see Sections 12 and 14.) In some cases, water quality management can involve pretreatment of water, such as ultraviolet sterilization, before it flows through culture systems.

Disease prevention can require the use of vaccines, including autogenous vaccines under veterinary supervision, if these are available and thought to be effective against diseases known to be a threat to the cultured species. Where effective, vaccines should be applied to aquatic seedstock prior to known risks of exposure, such as when they are stocked in ponds or shipped to growout facilities.

If an infectious disease is diagnosed in the facility's stock, the Health Management Plan (Section 14) shall explain the steps to be taken in treating it with approved chemicals and procedures to be followed when the treatment is complete, including verification of efficacy and the application of required withdrawal times. During inspections, auditors shall have access to full records of all applications of drugs, chemicals and hormones. A sample traceability form for use at the pond, tank or cage level is provided in Appendix I.

Hormone Use for Sex Reversal

When hormones are used to produce single-sex fry, records of hormone applications shall be maintained. Employees who work with methyl testosterone or other sex-reversal hormones shall be trained in the handling of such hormones and be required to wear protective clothing and masks with air filters. The facility shall have a protocol for managing water used for sex reversal and not release hormone treatment water directly into the environment, or comply with government standards, where these exist.

Additional Information

Responsible Use of Antimicrobials in Fish Production
Responsible Use of Medicines in Agriculture Alliance – 2004
http://www.ruma.org.uk/guidelines/antimicrobials/long/fishantimicrobialguidlineslong.pdf

Judicious Use of Antimicrobials for Aquatic Veterinarians
Food and Drug Administration Center for Veterinary Medicine
American Veterinary Medical Association
http://www.fda.gov/AnimalVeterinary/SafetyHealth/AntimicrobialResistance/JudiciousUseofAntimicrobials/ucm095473.htm

Prudent Use Guidelines: A Review of Existing Veterinary Guidelines
Teale, C. J., and Moulin, G – 2012
http://www.oie.int/doc/ged/D11824.PDF

Fish and Fishery Products Hazards and Controls Guidance
Department of Health and Human Services
U.S. Food and Drug Administration Office of Food Safety – 2011
http://www.fda.gov/food/guidanceregulation/guidancedocumentsregulatoryinformation/seafood/ucm2018426.htm#toc

Standards

13.1: If used, drug treatments shall be based on recommendations and authorizations overseen by a qualified veterinarian or qualified aquatic animal health professional (AAHP) and used only to treat diagnosed diseases in accordance with instructions on product labels and national regulations. Extra-label use of drugs shall be with the approval of a qualified veterinarian only.

13.2: Records shall be maintained for every application of drugs and other chemicals for therapeutic treatment that include the date, compound used, approving veterinarian or health professional (if applicable), dose and date on which the animals were transferred to another facility and the name of the facility. If the animals were harvested for human consumption, records of compliance with required withdrawal times shall also be maintained. See the Traceability requirement in Section 15. A list of therapeutants used by the facility shall be available for inspection.

13.3: Where vaccines or anesthetics are used, records shall be available to show they were used in accordance with manufacturers' instructions and with the approval of a qualified veterinarian or AAHP, or, if used outside manufacturers' instructions, then with the express direction of a qualified veterinarian.

13.4: Antibiotics or chemicals that are proactively prohibited in producing or importing countries shall not be used in feeds, pond additives or any other treatment. The facility's Health Management Plan (Section 14) shall include a list of these prohibited substances.

13.5: For feed suppliers that are not BAP-certified, statements are required attesting to the application of production procedures that exclude proactively prohibited drugs, by-products from the same species reared in the applicant's facility and unsafe levels of heavy metals and physical or other contaminants.

13.6: Where toxicant-based antifouling agents are used on cage or net pen nets, documents shall be available to show that all necessary authorizations for their use were obtained. Net-cleaning procedures that allow the collection, treatment and disposal of wash water in compliance with national regulations shall be used.

13.7: Antibiotics, antimicrobials or hormones shall not be used as growth promoters. The use of hormones for sex reversal is not considered growth promotion.

13.8: If hormones are used for sex reversal of animals, documents shall show that such use is approved in the country of production. Workers shall be trained in the handling of hormones and wear protective clothing and masks with air filters.

13.9: The facility shall have a written procedure and facilities for treating water used in the sex reversal of aquatic animals using hormones. If governmental standards exist for the discharge of hormone-treated water, the facility shall conform with such standards.

13.10: Chemicals used for the induction of triploidy in mollusks shall be approved and used only according to manufacturers' instructions and/or local regulations.

14. Biosecurity (All Production Systems)

Disease Control

Hatcheries shall work to prevent infectious disease in facility stocks and disease transmission to recipients of their animals. Hatchery practices shall include regular disease surveillance, sanitation of equipment and personnel, quarantine of diseased animals and controlled movement of personnel and equipment. Hatchery staff and visitors shall be trained in and apply biosecurity measures. Hatcheries shall conform to relevant regulations on biosecurity and disease surveillance, and defer to the direction of a veterinarian or qualified aquatic animal health professional in all related matters.

Reasons for Standard

Hatchery processes may require the import of gametes or animals from another country, as well as transfers between hatchery facilities in the same region or country. Each time such a transfer occurs, there is a risk of transmitting pathogens or parasites, which may then infect farm and/or wild stocks. The severity of the risk will vary according to the culture species, the location of the facility and the types of pathogens in question. Responsible hatchery practices require that biosecurity and risk reduction measures proportional to the severity of risk must be applied as part of normal operations.

Implementation

Each facility involved in hatchery operations shall have a written Health Management Plan that includes policies and procedures that describe how the facility complies with applicable laws governing aquatic animal health, maintains biosecurity, responds to disease events and measures batch performance. Implementation of the plan shall be overseen by a veterinarian or qualified aquatic animal health professional who, in addition to the hatchery manager, shall be available in person or by phone at audit to present the plan and answer questions.

Additional Information

World Organization for Aquatic Health (OIE)
Aquatic Animal Health Code
http://www.oie.int/doc/ged/D7821.PDF

World Organization for Aquatic Health (OIE)
Manual of Diagnostic Tests for Aquatic Animals
http://www.oie.int/en/international-standard-setting/aquatic-manual/access-online

FAO Technical Guidelines for Responsible Fisheries 5, Supplement 2
Aquaculture Development, Health Management for the Responsible Movement of Live Aquatic Animals
Section 4.4 – Pathogen Lists
ftp://ftp.fao.org/docrep/fao/010/a1108e/a1108e00.pdf

Standards

14.1: The facility shall have a written Health Management Plan (HMP), and a qualified aquatic animal health professional (AAHP) shall oversee its implementation.

14.2: The AAHP's qualification documents shall be available for inspection by the auditor. The AAHP shall be available in person or by phone at audit to present the HMP and answer questions. If the auditor considers the AAHP's qualifications inadequate, the provisions of standard 14.19 shall apply.

14.3: The applicant shall demonstrate familiarity with the OIE Animal Health Code and FAO Technical Guidelines for Responsible Fisheries 5, Supplement 2: Health Management for the Responsible Movement of Live Aquatic Animals and be able to explain how the HMP incorporates these provisions.

14.4: The facility shall have a training program for designated facility staff who implement the HMP and documents to confirm that such training has been given. Their understanding of the HMP will be verified by interview during the facility audit.

14.5: Potential pathogens of the species reared at the facility shall be listed in the HMP and shall include diseases listed by the World Organisation for Animal Health (OIE, Ref. 1, Chapter 1.3), other diseases of national or regional concern (Ref. 2) and pathogens of concern to the facility and for which monitoring is undertaken. The HMP shall include specific measures to address each disease.

14.6: The HMP shall contain a site-specific risk analysis that identifies ways in which pathogens might be brought into the hatchery or transmitted to other facilities by its live aquatic products. The applicant shall demonstrate how the facility protects against such risks, including but not limited to diseases introduced through live aquatic products, water supply, feeds, hatchery personnel, equipment, visitors and local wildlife.

14.7: Health status documents for all live aquatic products brought into the facility since the last audit shall be available and shall demonstrate the products were free of diseases (to the extent detection is possible) listed in 14.5 or entered quarantine and were released into the rest of the hatchery only once disease-free status was established. This excludes locally endemic diseases.

14.8: The applicant shall have an isolation facility if new broodstock or other stocks of animals of uncertain health status are brought into the hatchery. The HMP shall explain how it is used to protect against the risk of bringing infectious disease agents into the hatchery and/or spreading them within it.

14.9: Disinfection procedures for all incoming and outgoing personnel, visitors, equipment and other materials brought into the facility shall be described in the HMP. The applicant shall be able to demonstrate the procedures are followed.

14.10: The HMP shall describe the procedures and indicators used by staff to monitor and document the health of facility stocks. These can include daily or more frequent observations of physical appearance, feeding response and mortality, or of larval development and/or growth rate at biologically relevant intervals.

14.11: The HMP shall describe procedures for tracking the indicators listed in 14.10, comparing them with earlier batches, and recording actions taken when trends are negative.

14.12: The HMP shall describe procedures for identifying diseases in hatchery stocks, diagnosis of pathogens and, where necessary, determination of susceptibility to therapeutants and treatment with them. Surveillance records shall be available for inspection.

14.13: The HMP shall explain how fallowing or dryout periods in different parts of the facility are planned and used to break infection cycles. Records shall be available to show this is done.

14.14: The HMP shall stipulate procedures for the routine collection, examination and sanitary disposal of dead animals, and for quarantining and/or depopulation of facility stocks, when required.

14.15: The health status of all animals or gametes shipped from the facility shall be recorded. Documents for all animals shipped since the last audit shall be available and shall show that products with diagnosed or suspected disease were not shipped, unless to a region of equal or lower health status, and that the transfer was approved by the customer and local regulator.

14.16: Where effective vaccines are available for the culture species, animals shipped from the facility shall be vaccinated according to the requirements of the importing region or country, or customer specification. Records that show this shall be available for inspection.

14.17: Transport containers for shipping live animals shall be clean and if reused, shall be sterilized between uses.

14.18: An annual or more frequent facility health status report that includes records of batch or lot health indicators, treatments for disease and customer complaints shall be available for inspection. Actions taken to correct deterioration in any performance category shall be described. Uncorrected and/or sustained deterioration are grounds for seeking independent health status examination (Standard 14.19) or denial of certification.

14.19: When the auditor has concerns about the health status of the applicant's live aquatic products and/or is not satisfied with the information provided on health status, monitoring programs or the qualifications of the AAHP, the applicant shall agree that during inspection the auditor may take samples from stocks held at the facility and submit them to an independent, third-party laboratory for verification of health status regarding the diseases for which health claims are made. The cost of such testing shall be borne by the applicant.

14.20: The hatchery shall demonstrate that it works with neighboring BAP-certified hatcheries and farms, and seeks to work with neighboring facilities that are not BAP-certified to standardize biosecurity procedures and share disease control and diagnostic information.

15. Traceability (All Production Systems)

Record-Keeping Requirement

To establish product traceability, the following data shall be recorded for each culture unit and each production cycle:

- culture unit identification number
- unit area or volume
- stocking date
- quantity of live aquatic products stocked
- source of live aquatic products
- health status of live aquatic products stocked
- drug and vaccine use
- herbicide, algicide and other pesticide use
- manufacturer and lot number or production date for each feed used
- source and lot number for each live feed used
- shipment date
- shipment quantity
- movement document number (if applicable)
- recipient(s) or purchaser(s) (identify all if any egg or juvenile crop goes to more than one farm or purchaser)
- health status of live aquatic products sold or transferred to another facility.

Reasons for Standard

Product traceability is a crucial component of the BAP program. It connects the links in the production chain and allows tracing of each processed lot back to the culture unit and inputs of origin. Food quality and safety analyses by accredited laboratories can also be included. Traceability ultimately assures purchasers that all steps in the production process were in compliance with environmental, social and food safety standards.

Implementation

Hatcheries may utilize any traceability system that meets the BAP requirements. This can be an online system; the hatchery's own in-house database, paper records, files and documents; or a combination thereof.

Where paper records, documents or notebooks are used, if possible, the information should also be transferred to computer database files to allow electronic transmission. The original files or paper records shall be kept to allow for verification of the electronic data.

The data referenced in BAP's standards on broodstock, egg, postlarvae and fingerling sources, chemical management, etc., are required for traceability. This information and other tank, pond or cage-related records can be captured on the sample Product Traceability Form in Appendix I. Each form corresponds to the shipment of hatchery products on a particular day from a particular culture unit.

The record-keeping process requires a high degree of care and organization. At large hatcheries, managers could collect initial data for those aquaculture products for which they are responsible. A single clerk or team could then be given the task of collecting the data from managers and transferring it to a computer database. Hatchery management shall, of course, review the effort at intervals to verify it satisfies BAP requirements.

Product Identity Preservation

To assure the integrity of the Best Aquaculture Practices "star" system, traceability controls must be in place that allow verification of all facilities that contribute to the claim of multiple-star BAP-certified status.

To insure the proper separation and traceability of all hatchery inputs and outputs, the following components must be in place:

- Hatcheries that purchase all of their broodstock, eggs, shrimp postlarvae, fish fry or fingerlings and feed from BAP-certified sources shall maintain records of the sources of stocking material and feeds used.
- Hatcheries that purchase stocking material and feed from both BAP- and non-BAP-certified sources shall identify all sources and have adequate systems in place to prevent mixing of BAP and non-BAP production lots.
- To enable mass balance verification of multiple-star products, certified hatcheries shall maintain a list, including harvest dates and volumes, of the farms and facilities to which they sell or deliver products.
- The number of backward and forward trace exercises conducted by the auditor will be determined by hatchery volume.

BAP Logo Use

Use of the Best Aquaculture Practices logo, a registered trademark of the Global Aquaculture Alliance, for any purpose shall be approved by BAP in advance and used in compliance with the BAP trademark usage agreement.

Customer Complaints

The applicant must prepare and implement an effective system for the management of complaints and complaint data to control and correct shortcomings relating to its products' compliance with the BAP standards.

Standards

15.1: The facility shall operate an effective record-keeping system that provides timely, organized, accurate entries, performed and overseen by a designated trained person or team responsible for collecting the data, ensuring it is complete and accurate, and that traceability requirements are met.

15.2: The facility shall keep complete and accurate records for each culture unit and production cycle, including the culture unit identification number, unit area and volume, species and, if applicable, species specification such as triploid or GMO.

15.3: The facility shall keep complete and accurate records concerning any antibiotic or other drug use at the facility.

15.4: Complete and accurate records on the use of herbicides, algicides and other pesticides shall be maintained.

15.5: Complete and accurate records regarding manufacturer and lot numbers for each feed used, and/or the sources of live feeds shall be maintained.

15.6: The facility shall maintain complete and accurate records of the sources and numbers of broodstock, eggs, postlarvae or fingerlings stocked; stocking dates and all feeds used for each culture unit.

15.7: Complete and accurate records regarding the harvest date, harvest quantity, movement document number (if applicable) and receiving farm(s) or purchaser(s) shall be maintained. If product lots are destined to more than one farm or purchaser, each lot shall be separately identified.

15.8: In order to use the BAP logo, facilities shall have such use approved and registered in advance with BAP Management.

15.9: The facility shall keep records of any customer complaints related to its products' compliance with the BAP standards.

15.10: The facility shall keep records of investigations of such complaints and actions taken to address/correct them.

Appendix A

BAP Effluent Water Quality Criteria – Land-Based Hatcheries and Nurseries

Variable (units)	Initial Value	Final (after 5 years)	Collection Frequency
pH (standard pH units)	6.0-9.5	6.0-9.0	Monthly
Total suspended solids (mg/L)	50 or less	25 or less	Quarterly
Soluble phosphorous (mg/L)	0.5 or less	0.3 or less	Monthly
Total ammonia nitrogen (mg/L)	5 or less	3 or less	Monthly
5-day biochemical oxygen demand (mg/L)	50 or less	30 or less	Quarterly
Dissolved oxygen (mg/L)	4 or more	5 or more	Monthly
Chloride Water with less than 1 ppt salinity, specific conductance below 1,500 mmhos/cm or chloride less than 550 mg/L is considered fresh.	No discharge above 800 mg/L chloride into freshwater	No discharge above 550 mg/L chloride into freshwater	Monthly

Sampling

- Samples shall be collected near the point where effluents enter natural water bodies or exit the hatchery property. A water control structure at the sampling site or suitable sampling method should be used to prevent mixing of effluent and water from the receiving body.
- Where there are more than four outfalls, three outfalls shall be selected as sampling locations.
- Water shall be collected directly from the discharge stream of pipes or dipped from the surface of ditches or canals with a clean plastic bottle. The sample shall be placed on ice in a closed, insulated chest to prevent exposure to light.
- Samples or direct measurements for dissolved oxygen and pH from pond systems shall be obtained between 0500 and 0700 hours, and 1300 and 1500 hours on the same day. The average of the two measurements for each variable will be used for verification of compliance.
- Samples for other variables from pond systems should be collected between 0500 and 0700 hours.
- Source water samples shall be collected quarterly directly in front of the upstream source, pump station or pump discharge outlet but before pumped water mixes with the supply canal. These samples enable the calculation of annual loads (Equation 2, Appendix C) and establish if the Limited Option is applicable.

Analyses

- Hach and Merck water analysis equipment or equipment of a comparable standard is approved for total ammonia nitrogen, soluble phosphorus and chloride analyses. However, auditors can reject analytical results if sampling, in situ measurements or lab protocols are deficient.
- Measurements for dissolved oxygen and pH shall be taken in situ with portable meters. Auditors shall verify the correct application of calibration procedures.
- Hatcheries that discharge into freshwater receiving bodies should determine salinity by a conductivity meter with a salinity scale, rather than a hand-held, refractometer-type salinity meter. Alternatively, specific conductance can be measured.

Assume that water with specific conductance above 2,000 mmhos/cm exceeds 1.5 ppt salinity, and water with specific conductance over 1,500 mmhos/cm exceeds 1.0 ppt salinity. Note: 1 mS/m = 10 mmhos/cm, and 1 mmho/cm= 1 mS/cm.

Rules for Compliance

At least three months of effluent data are required for initial certification. Initially, for each variable measured monthly, at least 10 values obtained during a 12-month period shall comply with the criteria. After five years, the target is no more than one annual case of non-compliance for each variable.

For variables measured quarterly, one non-compliance is initially permitted for each variable during a 12-month period. The target after five years is no more than one case of non-compliance for each variable during a 24-month period. When non-compliances occur, hatcheries should make every effort to correct the problems within 90 days.

Appendix B

Sample Effluent Monitoring Form – pH and Dissolved Oxygen

Date (day/month/year)	pH (standard units)			Dissolved Oxygen (mg/L)			No. Units Harvested
	Morning	Evening	Average	Morning	Evening	Average	
____/01/____							
____/02/____							
____/03/____							
____/04/____							
____/05/____							
____/06/____							
____/07/____							
____/08/____							
____/09/____							
____/10/____							
____/11/____							
____/12/____							
Annual Average							

Sample Effluent Monitoring Form – Soluble Phosphorus, Total Ammonia Nitrogen, Chloride

Date (day/month/year)	Soluble Phosphorus (mg/L)	Total Ammonia Nitrogen (mg/L)	Chloride (mg/L)	Number of Units Harvested
____/01/____				
____/02/____				
____/03/____				
____/04/____				
____/05/____				
____/06/____				
____/07/____				
____/08/____				
____/09/____				
____/10/____				
____/11/____				
____/12/____				
Annual Average				

Sample Effluent Monitoring Form – Total Suspended Solids, 5-Day Biochemical Oxygen Demand

Quarter	Date (day/month/year)	Total Suspended Solids (mg/L)	5-Day Biochemical Oxygen Demand (mg/L)	Number of Units Harvested
1				
2				
3				
4				
Annual Average				

Appendix C

Calculation of Annual Effluent Volume

An estimation of annual effluent volume shall be determined using one of the following equations.

Hatchery Discharge Calculation

Equation 1 – Pump Discharge Method
Hatchery discharge (m^3/yr) = Pump discharge (m^3/min) x Average time of pump operation (hr/day) x 60 min/hr x 365 days/yr

Equation 2 – Water Exchange Method
Hatchery discharge in m^3/yr = [Volume of ponds in m^3 x Number of crops/yr] + [Volume of ponds in m^3 x Average daily water exchange rate as fraction of pond volume x Crop in days x Number of crops/yr]

Equation 3 – Watershed Method
Effluent = (Water added + Precipitation + Runoff) – (Seepage + Evaporation) + (Hatchery volume, day 1 – Hatchery volume, day 365)

The terms of this equation can be estimated as follows:

Water added (m^3) = Pump capacity (m^3/hr) x Pump operation (hr/yr) or other appropriate method

Precipitation (m^3) = Annual precipitation (m) x Hatchery water surface area (m^2)

Runoff (m^3) = Annual precipitation (m) x Watershed area (m^2) × 0.25

Seepage (m^3) = Hatchery water surface area (m^2) x 0.55 m/yr

Evaporation (m^3) = Class A pan evaporation (m/yr) x 0.8 x Hatchery water surface area (m^2)

Hatchery volume = [Average depth of ponds (m) – Average distance of water level below overflow structure (m)] x Hatchery water surface area (m^2)

Additional Data

The BAP program will use data provided by facilities' application forms to calculate:

- an annual water use index, determined as described below
- annual load indices for total suspended solids, soluble phosphorus, total ammonia nitrogen and five-day biochemical oxygen demand, determined as described below.

Pooled, anonymous data for loads and indices will be used as the basis for setting metric standards by June 2015.

Annual Effluent Loads

Loads of water quality variables are more indicative of the pollution potential of facility effluents than separate measurements of concentrations of these variables and effluent volume. After the first year of effluent monitoring, annual loads for total suspended solids, soluble phosphorus, total ammonia nitrogen and five-day biochemical oxygen demand shall be calculated as follows:

Equation 4
Load of variable (kg/yr) = Hatchery discharge (m^3/yr) x [Mean annual variable concentration in effluent – mean annual variable concentration in source water (mg/L, same as g/m^3)] x 10^{-3} kg/g

Water Use and Load Indices

While not a recommended practice, it is possible to comply with numerical water quality criteria by increasing the amount of water passing through a hatchery to dilute the concentrations of tested variables. Compliance with the water use index assures that facilties meet water quality criteria through good management rather than diluting effluents before they are released into natural waters.

After the first year of effluent monitoring, water use and load indices shall be estimated using the following equations.

Equation 5
Water use index (m^3/kg fish or crustaceans) = Annual effluent volume (m^3) ÷ Annual fish or crustacean production (kg)

Equation 6
Load index (kg variable/mt fish or crustaceans) = Annual load of variable (kg/yr) ÷ Annual fish or crustacean production (mt/yr)

Example: Water Use, Load Indices For Annual Effluent Estimated By Pond Volume-Water Exchange Method

A facility has 100 ha of ponds that average 1 m deep, with average water exchange of 2.5% pond volume/day. There are 2.3 crops/year, and the average length of each crop is 120 days. The source water of the facility contains an average of 10 mg/L total suspended solids (TSS), 0.03 mg/L soluble phosphorus (S.P.), 0.15 mg/L total ammonia nitrogen (TAN) and 1.5 mg/L biochemical oxygen demand (BOD).

The hatchery effluent contains an average of 45 mg/L TSS, 0.19 mg/L S.P., 0.87 mg/L TAN and 9.6 mg/L BOD. Production for the past year was 230,000 kg (230 mt).

Calculations

Pond volume = 100 ha x 10,000 m^2/ha x 1 m = 1,000,000 m^3

Annual effluent volume = [1,000,000 m^3/crop x 2.3 crops/yr] + [1,000,000 m^3 x 0.025 pond volume/day x 120 days/crop x 2.3 crops/yr] = 9,200,000 m^3/yr

TSS load = (45 – 10 g/m^3)(9,200,000 m^3/yr)10^{-3} = 322,000 kg/yr

S.P. load = (0.19 – 0.03 g/m^3)(9,200,000 m^3/yr)10^{-3} = 1,472 kg/yr

TAN load = (0.87 – 0.15 g/m^3)(9,200,000 m^3/yr)10^{-3} = 6,624 kg/yr

BOD load = (9.6 – 1.5 g/m^3)(9,200,000 m^3/yr)10^{-3} = 74,520 kg/yr

Water use index = (9,2000,000 m^3/yr)/(230,000 kg fish or crustaceans/yr) = 40 m^3/kg fish or crustaceans

TSS index = (322,000 kg/yr)/(230 mt fish or crustaceans) = 1,400 kg TSS/mt fish or crustaceans

S.P. index = (1,472 kg/yr)/(230 mt fish or crustaceans) = 6.4 kg S.P./mt fish or crustaceans

TAN index = (6,624 kg/yr)/(230 mt fish or crustaceans) = 28.8 kg TAN/mt fish or crustaceans

BOD index = (74,520 kg/yr)/(230 mt fish or crustaceans) = 324 kg BOD/mt fish or crustaceans

Example: Water Use, Load Indices For Annual Effluent Estimated By Pump Operation Method

A facility has two pumps that discharge a combined volume of 136 m^3/min. The pumps operate an average of 8 hr/day. The source water of the facility contains an average 10 mg/L total suspended solids (TSS), 0.03 mg/L soluble phosphorus (S.P.), 0.15 mg/L total ammonia nitrogen (TAN) and 1.5 mg/L biochemical oxygen demand (BOD).

The hatchery effluent contains 91 mg/L total suspended solids, 0.23 mg/L soluble phosphorus, 1.20 mg/L total ammonia nitrogen and 12.7 mg/L biochemical oxygen demand. Production during the past year was 378,000 kg (378 mt).

Calculations

Annual effluent volume = 136 m^3/min x 60 min/hr x 8 hr/day x 365 days/yr = 23,827,200 m^3/yr

TSS load = (23,827,200 m^3/yr)(91 – 10g/m^3)10^{-3} = 1,930,000 kg/yr

S.P. load = (23,827,200 m^3/yr)(0.23 – 0.03 g/m^3)10^{-3} = 4,765 kg/yr

TAN load = (23,827,200 m^3/yr)(1.20 – 0.15 g/m^3)10^{-3} = 25,018 kg/yr

BOD load = (23,827,200 m^3/yr)(12.7 – 1.5 g/m^3)10^{-3} = 266,865 kg/yr

Water use index = (23,827,200 m^3/yr)/(378,000 kg fish or crustaceans/yr) = 63.0 m^3/kg fish or crustaceans

TSS index = (1,930,000 kg/yr)/378 mt fish or crustaceans) = 5,106 kg TSS/mt fish or crustaceans

S.P. index = (4,765 kg/yr)/(378 mt fish or crustaceans) = 12.6 kg S.P./mt fish or crustaceans

TAN index = (25,018 kg/yr)/(378 mt fish or crustaceans) = 66.2 kg TAN/mt fish or crustaceans

BOD index = (266,865 kg/yr)/(378 mt fish or crustaceans) = 706 kg BOD/mt fish or crustaceans

Appendix D

BAP Water Quality Monitoring
Cages and Net Pens in Lakes and Reservoirs

Variable	Sample Depth	Collection Frequency
Temperature	Vertical profile, 2-m intervals	Monthly
Dissolved oxygen	Vertical profile, 2-m intervals	Monthly
pH	Equal to cage mid-depth	Quarterly
Chlorophyll a	Equal to cage mid-depth	Quarterly
5-day biochemical oxygen demand	Equal to cage mid-depth	Quarterly
Secchi disk visibility	Not applicable	Weekly
Soluble phosphorus	Equal to cage mid-depth	Quarterly
Total ammonia nitrogen	Equal to cage mid-depth	Quarterly
Phytoplankton abundance and species	Equal to cage mid-depth	Quarterly

Sampling – Cages, Net Pens in Lakes, Reservoirs

A minimum of three sampling stations shall be established. One shall be in the approximate center of the cage farm or net pen area. The other two stations must be at least 200 m and preferably 500 m away from the cages, considering the direction of the predominant wind. The auditor must approve the locations of the stations, which shall be set following a study on prevailing surface currents. For methods, refer to the U.S. Army Corps of Engineers document Estimating Surface Currents Using Dyes and Drogues, http://chl.erdc.usace.army.mil/library/publications/chetn/pdf/chetn-vi-37.pdf.

Water should be collected with a Kemmerer or van Dorn water sampler, or by use of a weighted bottle from which the stopper can be removed by jerking a calibrated line. Samples should be transferred to clean plastic bottles and placed on ice in a closed, insulated chest to avoid exposure to light.

Analyses

- Analysis of the samples collected by the auditor shall be done by a private or government laboratory following standard methods as published by the American Public Health Association, American Water Works Association and Water Environment Federation – www.standardmethods.org or equivalent.
- Hach and Merck water analysis equipment, or equipment of an equivalent standard, is approved for total ammonia nitrogen, soluble phosphorus and chloride analyses. However, auditors can reject analytical results if sampling, in situ measurements or lab protocols are deficient.
- Measurements for dissolved oxygen and pH should be taken in situ with portable meters. Auditors must verify the correct application of calibration procedures.

Appendix E

Production Practices for Cages, Net Pens

The most reliable way of reducing nutrient outputs from cage and net pen culture is to improve feed use efficiency. This can be done mainly by using high-quality feed that contains no more nitrogen and phosphorus than necessary and by assuring that fish consume all of the feed offered.

Thus, culture animals should have access to the feed for enough time so that they consume it before the pellets pass through the cage or pen mesh. Also, feeding rates should be monitored to avoid overfeeding. Observations of feeding activity are enhanced by using floating feed for certain species. For waters less than 30 m deep, a diver should periodically go beneath cages to determine if uneaten feed is accumulating on the bottom. A video survey is an acceptable alternative and shall be used where depths exceed 30 m.

Nets of cages and pens often are removed and cleaned on shore. Cleaning waste shall be diverted into a sedimentation pond, sanitary sewer or other treatment system.

It is not feasible to treat wastes from cages and net pens. The main precaution against pollution is to locate culture units in open-water areas where water circulation is sufficiently high to transport wastes away from cages and rapidly mix and dilute wastes. The distance between cage bottoms and the bottoms of water bodies should be at least equal to the depth of the cages to promote water movement beneath cages.

High biomass in a particular location can obviously increase the likelihood of pollution. While there are no specific guidelines for the biomass that can be safely sustained at a particular cage site, monitoring shall be used to track the status of water quality.

In bodies of water that stratify thermally, a high biomass can result in severe organic enrichment and dissolved-oxygen depletion in the hypolimnion. Subsequent sudden thermal destratification can result in dissolved-oxygen depletion throughout the water column. This phenomenon has been responsible for serious mortality both inside and outside cages.

Wastes can accumulate beneath cages and cause deterioration of sediment quality. This is environmentally undesirable and can have negative impacts on the animals in cages, as well. Sediment quality in areas with cages can be protected by fallowing – periodically moving cages to new sites and allowing the original sites to recover. Observations on sediment quality should be used to determine when to move cages.

Appendix F

Hydraulic Rentention Time Feeding Rate Limits in Lakes, Reservoirs

Cages, Net Pens in Lakes, Reservoirs

The potential of cage and net pen culture to cause eutrophication of lakes and reservoirs depends primarily upon the location of facilities, the amount of feed input compared with the assimilation capacity of the water body, and the hydraulic retention time (HRT) or flushing rate of the water body.

Cages or net pens placed in areas with restricted water circulation, such as narrow embayments, can cause localized eutrophication without causing generalized water quality problems in the entire water body. The assimilation capacity is impractical to measure for purposes of aquaculture certification, but major factors governing the ability of a water body to assimilate wastes are its size and especially its volume.

Nutrients and organic matter are removed from water bodies by outflow, and systems with short HRTs are less likely to become eutrophic as a result of aquaculture operations than systems with longer HRTs. Of course, the nutrients and organic matter flushed from lakes and reservoirs enter downstream waters and can have adverse impacts.

Lakes and reservoirs used for cage and net pen culture shall be classified according to HRT as follows:

- Long HRT – Over 3 years
- Moderate HRT – 1-3 years
- Short HRT – Less than 1 year

Applicants for certification may choose to determine HRT by one of the techniques below.

Annual lake discharge is measured and recorded.

HRT = Lake volume (m^3) ÷ Lake discharge (m^3/yr)

Stream inflow to lake is measured and recorded.

HRT = Lake volume (m^3) ÷ [Stream inflow (m^3/yr) + Direct rainfall (m^3/yr)] – Lake evaporation (m^3/yr)

Where lake evaporation = Pan evaporation (m/yr) x 0.7 x Lake surface area (m^2) and direct rainfall = Annual rainfall (m/yr) x Lake surface area (m^2).

Catchment area is known, but discharge or stream inflow is measured:

HRT = Lake volume (m^3) ÷ [Catchment runoff (m^3/yr) + Direct rainfall (m^3/yr)] – Lake evaporation (m^3/yr)

Where catchment runoff = Catchment area (m^2) x Annual rainfall (m/yr) x 0.3.

See methods for direct rainfall and lake evaporation above. Otherwise, the auditor and applicant seeking certification will agree upon the HRT level according to the following indicators.

Long HRT: Arid climate, catchment area:water surface area ratio of 5 or less, discharge occurs only after periods of heavy rainfall, annual water level fluctuation of 2 m or more.

Moderate HRT: Humid area, catchment area:water surface area ratio 5-15, frequent or continuous discharge, annual water level fluctuation of 2 m or less.

Short HRT: Humid area, catchment area:water surface area ratio more than 15, continuous large discharge, annual water level fluctuation of 0.5 m or less, riverine system. Note: Some riverine lakes and reservoirs in arid climates have short HRTs.

The BAP maximum allowable daily feed input to cages and net pens in lakes and reservoirs shall be based on HRT as follows.

- Long HRT – 2.5 kg/ha/day x lake water surface area (ha)
- Moderate HRT – 5.0 kg/ha/day x lake water surface area (ha)
- Short HRT – 7.5 kg/ha/day x lake water surface area (ha)

If cages or net pens are installed in an embayment with restricted water exchange, the maximum daily feed input shall be reduced by 50%. If there are multiple cage and net pen operations in a water body, the total daily feed inputs of all operations shall not exceed the maximum allowable daily feed input based on HRT.

Once every three months, a water sample shall be taken and the percentage of blue-green or other potentially harmful algae assessed. See phytoplankton methods manual at http://npsi.gov.au/files/products/national-river-health-program/pr990300/pr990300.pdf.

Feed input shall be reduced until water quality improves when:

- Dissolved-oxygen concentrations are consistently below 5 mg/L in early morning at any sampling location.
- The average annual Secchi disk visibility decreases by 25% after certification is achieved.
- Blue-green algae or other potentially harmful algae comprise more than 60% of the phytoplankton.
- The thermocline becomes 25% shallower after certification is achieved.

Discharges from water bodies containing cages or net pens can cause water pollution downstream. Thus, if the feed input to the water body must be reduced because of signs of increasing eutrophication, the discharge of the lake shall be monitored. Aquaculture operations shall not be eligible for certification unless the discharge is in compliance with BAP effluent criteria.

Appendix G

Sedimentation Basins

The minimum required sedimentation basin volume can be estimated using the following equation:

Sedimentation basin volume = 37.5 x
[Fish or crustacean production (mt) ÷
Sludge transfers (times/crop)] +
Fish or crustacean production (mt) ÷ 0.6]

In the above equation, fish and crustacean production is the total quantity produced in all ponds that discharge into the sedimentation basin, and sludge transfers are the mean frequency at which sludge is moved from ponds to the sedimentation basin. It is also assumed that:

- The minimum hydraulic retention time to allow coarse and medium solids to settle out is six hours.
- One mt of production equates to 1 mt sediment.
- Sludge removal can be spread over a 24-hour period.
- Sediment bulk density is 0.6 mt/m^3.
- The solids content of sludge is 6.5 kg/m^3.
- Accumulated sediments in the basin are removed at the end of each crop to return the basin to its original capacity.

Note: If sludge is removed more frequently from ponds, the required size of the sedimentation basin is reduced.

Appendix H

Calculation of Fish in:Fish Out Ratio

Feed-Conversion Ratio

The feed-conversion ratio (FCR) is a measure of the amount of feed needed to produce a unit weight of the culture species. Hatcheries shall calculate and record FCR yearly using the following equation:

Equation 1

Feed-conversion ratio = Annual feed use (mt) ÷
Net fish or crustaceans harvested (mt)

The feed-conversion ratio is also known as the economic FCR. Note that economic FCR is very sensitive to survival rate, rising sharply if the survival rate drops significantly. For precise calculation, the total weight of stocked juveniles is subtracted from the total weight of the harvested fish or crustaceans.

"Fish In:Fish Out" Ratio

The so-called "fish in:fish out" ratio is one means of measuring the ecological efficiency of an aquaculture system. It compares the amount of fish consumed by the system (usually in the form of fishmeal and fish oil) with the amount of fish or crustaceans produced.

Aquaculture producers should strive to obtain the lowest fish in:fish out ratio practicable in order to conserve industrial fish resources. Facilities shall calculate and record a final yearly fish in:fish out ratio using Equation 2 below. In the absence of better, specific data from the feed supplier, the transformation yields for industrial fish to fishmeal and fish oil to be used are 22.5% and 5%, respectively.

Anonymous, pooled FCR and fish in:fish out data shall be used to establish metric standards before June 2015.

Equation 2

Fish in:fish out ratio = Feed fish inclusion factor of feed (from manufacturer) x feed-conversion ratio
Where feed fish inclusion factor = [Level of fishmeal in diet (%) + Level of fish oil in diet (%)] ÷
[Yield of fishmeal from wild fish (%) +
Yield of fish oil from wild fish (%)]

The inclusion levels in Equation 2 shall include any meal or oil derived from wild-caught fish, squid, krill, mollusks or any other wild marine animals. However, they shall exclude meal or oil derived from fishery by-products such as trimmings, offal and squid liver powder and aquaculture by-products such as shrimp head meal.

Appendix I

Sample Product Traceability Form

Hatchery Name	Pond or Cage Number Pond Area (ha)
POSTLARVAE OR FINGERLINGS Stocking Date	**FEED** Feed Type
Stocking Quantity Species	Manufacturer
Any Species Specifications (e.g., triploid, GMO)	Lot Number(s)
Hatchery BAP No.	
Confirmation: No Use of Proactively Prohibited Chemicals Yes No	Confirmation: No Use of Proactively Prohibited Chemicals Yes No
THERAPEUTIC DRUG USE Compound 1	**PESTICIDE USE** Compound 1
Disease Treated	Condition Treated
Application Rate	Application Rate
Application Period	Application Period
Compound 2	Compound 2
Disease Treated	Condition Treated
Application Rate	Application Rate
Application Period	Application Period
HARVEST Harvest Date	Harvest Purchaser Name/ Adddress
Harvest Quantity (kg)	

INTEGRATED CONTINGENCY PLAN

Kelly Cove Salmon Ltd.
Johnson Lake Hatchery

250 Jack Road
Pennfield, NB E5H 1X4

Oil Spill Prevention Control and Countermeasures (SPCC) Plan

Hazardous Matter Spill Prevention Control and Cleanup Plan

Facility Emergency Response Plan

November 2018

Oil SPCC, Hazardous Matter SPCC and Emergency Response
Integrated Contingency Plan

Kelly Cove Salmon Ltd.
Johnson Lake Hatchery

TABLE OF CONTENTS

PROMULGATION STATEMENT

To All Recipients:

Transmitted herewith is the Hazardous Materials Emergency Plan and Integrated Contingency Plan for Johnson Lake Hatchery. It provides a framework to use in the performing of emergency functions during a hazardous materials incident and/or oil spill.

This Hazardous Materials Emergency Plan includes the four phases of emergency management: (1) Mitigation - those activities which eliminate or reduce the probability of an incident; (2) Preparedness - those activities developed to save lives and minimize damage; and (3) Response - immediate activities which prevent loss of lives and property and provide emergency assistance.

This plan is in accord with existing Federal and Provincial statutes. It will be tested, revised and updated as required. All recipients of this plan are requested to advise Glenn Ketchum regarding recommendations for improvements.

_____

Glenn Ketchum
Freshwater Supper Manager

_____

(Date)

MANAGEMENT APPROVAL

I, the undersigned, having the necessary authority to commit Johnson Lake Hatchery personnel to the implementation of this Plan, hereby certify that this Spill Prevention, Control, and Countermeasures (SPCC) Plan will be implemented as herein described. A copy of this Plan shall be kept at the facility and will be made available upon request.

Name and Address of Owner/Operator: Kelly Cove Salmon FW

Address: Johnson Lake Hatchery

250 Jack Road
Pennfield, NB E5H 1X4

Authorized Signature

Name (Print): Dr. J.A.K. Elliott.

Title: Vice President of Freshwater Operations.

Date:

Emergency Coordinators

Name/Title	Telephone #
Glenn Ketchum, Freshwater Support Manager	(w) (506) 755-5281 Mobile: (506) 754-2328
Cory Taylor, Fresh Water Production Manager	(w) (506) 755-5285 Mobile: (506)754-5527
Mitchell Dickie, Freshwater Maintenance Manager	(w) (506) 755-5282 Mobile: (506) 754-2109

1.0 PURPOSE

The purpose of this Oil Spill Prevention Control and Countermeasures (SPCC), Hazardous Matter Spill Prevention Control and Cleanup, and Facility Emergency Response Plan ("the Plan") is to prevent oil spills and/or releases of hazardous matter from occurring, and to perform safe, efficient and timely response in the event of a spill or leak (both referred to as "spills" herein).

This Integrated Contingency Plan also addresses the proper procedures for prevention and response to releases of hazardous matter in accordance with Water Quality Regulations under the Clean Environment Act and the current Approval to Operate as issued by the New Brunswick Department of Environment.

One purpose of this plan is to identify the chemical hazards that pose a threat to the employees and property at Johnson Lake Hatchery, and to the citizens and property of the surrounding community. This plan develops mitigation efforts, lessens the potential effects of a hazardous materials incident, coordinates response and necessary assistance during emergencies, and establishes a recovery system to return the facility to its normal condition.

Reference should also be made to Environmental Management System.

This plan will be reviewed every two years and amended within six months of the review to include more effective prevention and control technology if;

- Such technology will significantly reduce the likelihood of a spill event form the facility
- If such technology has been field-proven at the time of the review.

1.1 Using the Plan

In addition to satisfying regulatory requirements, this Plan is a working document at the hatchery. The plan will be used in the following ways:

- As a reference for oil storage and containment system information
- As a reference for storage of hazardous materials
- As a procedure for emergency response
- As a tool for informing new employees (and refreshing existing employees) on practices for preventing and responding to spills and emergencies
- As a guide to periodic training programs for employees
- As a guide to facility environmental inspections

The Emergency Coordinator and the Alternate Emergency Coordinator will be trained in the safe and effective implementation of this Plan. In addition, they will train all hatchery personnel in these procedures for spill prevention and control, and emergency evacuation.

During a chemical emergency or oil spill at the Johnson Lake Hatchery, response is coordinated by the Emergency Coordinator, Mr. Glenn Ketchum, or the Alternate, Mr. Cory Taylor.

The Emergency Coordinator identifies the character, exact source, amount and extent of any released material. With the assistance of other personnel as needed, the Emergency Coordinator assesses the possible hazards to human health and the environment that may result from the release. This assessment must consider both direct and indirect effects of the incident (e.g., the effects of any toxic, irritating, or asphyxiating gases that are released or generated by fire or the effects of any hazardous surface runoffs from water or chemical agents used to control the release or fire).

The Emergency Coordinator notifies hatchery employees regarding the release and provides emergency notification to the proper local, Provincial, and Federal officials and agencies, when necessary.

1.2 SPCC Plan Revisions

Johnson Lake Hatchery will revise this Plan for any change in the facility design, construction, operation or maintenance that affects the facility's potential for discharging oil or hazardous matter. Revisions must occur as soon as possible, but no later than six months after the change occurs. The Freshwater Production Manager is responsible for initiating and coordinating such revisions. Additional requirements for the Plan's development and maintenance in accordance with the emergency management rules are described in the following section.

1.3 Development and Maintenance

Johnson Lake Hatchery has the responsibility for the development and maintenance of this Integrated Contingency Plan and its specific emergency response procedures.

Mock drills for evacuation and other pertinent emergency/spill response activities will be exercised annually at our hatchery. It is assumed that there may be deficiencies in the plan that will become evident when the plan is activated or exercised. If these are discovered, corrective actions will be implemented and the Plan will be revised accordingly.

An ongoing file of recommended changes of improvements is maintained. An annual review of the plan by Johnson Lake Hatchery ensures that all procedures, policies, data, and responsibilities are current and reflect actual assignments.

1.4 Facility Description

Johnson Lake Hatchery operates a tank based freshwater salmon hatchery in Pennfield, New Brunswick. The Hatchery is location adjacent to Johnson Lake in Pennfield, NB. The facility currently consists of a greenhouse building, drum filter/biofilter building, disinfection building, storage buildings and settling pond. The greenhouse building and drum filter/biofilter building are proposed to be connected into a single building, encompassing the current system under one roof. There is additional room available on the current property for a new building.

2.0 PREPAREDNESS AND PREVENTION

Training will be provided for employees to recognize potentially hazardous situations and to initiate appropriate responses to minimize employee injury, property damage, and environmental impact. Designated personnel will be trained in the proper and safe use of emergency response equipment, other respiratory protection, personal protective equipment (PPE), and will be fit-tested for respirator use.

Further, the following conditions are met:

A. Engineering controls are in place to minimize the risk of fire, explosion, or release of hazardous waste.

    1. Hazardous materials are labeled and stored appropriately.
    2. Signs mark areas containing risks that note the danger and cautions necessary.
    3. All chemical processes introduced to the facility are approved for use by the Hatchery Manager.

B. Emergency equipment is maintained as follows:

    1. Telephones are readily available throughout the facility.
    2. Fire extinguishers are situated throughout the facility and are inspected on an annual basis.
    3. Spill control equipment is available in appropriate areas.

2.1 Hazard Identification

Johnson Lake Hatchery is committed to the safety of its employees and the surrounding community. Due to the storage of formaldehyde and liquid oxygen, the Johnson Lake Hatchery has developed this Emergency Response Plan to provide safeguards and an incident response system to implement in the event of a release of hazardous materials.

Knowing what could happen, the likelihood of it happening, and having some idea of the magnitude of the problem(s) that could arise are essential ingredients for emergency planning. Therefore, the first step in this process is the identification and analysis of potential hazardous materials incidents.

Johnson Lake Hatchery will develop a hazard recognition process, warning systems, emergency response, evacuation procedures, first aid, mitigation and notification requirements to implement in the event of a release of hazardous substances.

Summary of Internal Chemical Hazards

Johnson Lake Hatchery has evaluated hazardous chemicals that will be used at the facility. The maximum quantity of chemicals that will be stored on site is not yet known. Estimates are given and will be updated, as required.

The following have been identified as extremely hazardous substances that will be at our facility which require emergency planning:

	MAXIMUM Quantity Stored Estimation
Formaldehyde	16,000 liters
Liquid Oxygen	9,000 gallons

Other chemicals that may be present at the facility that are not extremely hazardous are (maximum quantity stored is estimated):

Calcium Chloride	30 ton
Caustic Soda beads	10 ton
Chloramine T	5 kg
Diesel	15,000 liters
Hydrochloric Acid	100 liters
Ferric Chloride	4,000 liters
Magnesium Chloride	30 ton
Ozone	40 kg/day not stored
Virkon	80 kg
Ovadine	20 liters
TMS	5 kg

All chemicals and petroleum products will be replaced with biodegradable alternatives when possible. In addition, Johnson Lake Hatchery will strive to minimize usage of chemical and petroleum products.

Hazardous materials will be stored in secure areas to prevent entry by unauthorized personnel. Storage areas will be inspected periodically to verify that no storage containers are rusting, bulging or leaking, and that there is sufficient aisle space between containers to allow for inspection and, if necessary, remediation and clean-up. All chemicals will be stored according to manufacturer's specifications and MSDS sheets for all products will be available close to the point of use and in the office. All necessary protective equipment will be available as described in the MSDS sheets and in compliance with WHSCC and Cooke Aquaculture's health and safety policy.

All sources of oil and hazardous materials are located inside the facilities or within locking containment buildings. During non-operational hours, the facilities are locked, preventing unauthorized access to the oil storage areas at the facility. Adequate lighting has been provided such that any person unauthorized to access the facility could be spotted.

All bulk fuel tanks at the hatchery will be double walled tanks and be placed in a containment pit.

2.2 SPCC Compliance

Employees will be trained to contact the Emergency Coordinator in the event of a potentially significant spill or leak. The Emergency Coordinator is responsible for evaluating the spill or emergency and taking appropriate action to address the situation (such as notifying the appropriate authorities and/or contacting a clean-up contractor(s), if necessary).

If a spill, leak or other condition is discovered that may result in the release of oil, action to contain or eliminate the release or otherwise prevent the release will be taken immediately. In the event of an incidental spill or leak, if the substance and its hazards are known and they do not pose a threat, then appropriate absorbent material will be applied by the person who discovered the release in order to contain or control the spill.

Following any spill event, the team will evaluate the success of the spill response and offer recommendations necessary to improve the effectiveness of the hatchery's spill response procedures, equipment or construction. If the release and corrective actions result in changes to the hatchery's operation or maintenance, revision of this Plan is required within six months.

Spill notification forms in Attachment 5.2 and 5.3 of this Plan will be completed and copies will be kept on file in the main office.

2.3 Oil and Hazardous Material Storage Tables

PROPOSED ABOVEGROUND OIL STROAGE TANKS

LOCATION	CAPACITY (liters)	PRODUCT	ESTIMATED SPILL DIRECTION AND RATE	CONTAINMENT & SPILL CONTROL FEATURES
Outside Generator Room	6,000	Fuel No. 2	Fully Contained	Located outside on impervious surface, no floor drains, spill kit immediately available
Outside Generator Room	15,000	Diesel	Fully Contained	Located inside on impervious surface, no floor drains, spill kit on-hand

PROPOSED CHEMICAL STORAGE

BLDG. or LOCATION	Container / Tank	PRODUCT	NEAREST DRAIN	ESTIMATED SPILL DIRECTION AND RATE	CONTAINMENT & SPILL CONTROL FEATURES
Chemical Storage Area in Both New Building and Current Building	Barrels	Formaldehyde 37%	< 10 ft from nearest drain	Containment Pallet	Will be on concrete surface of acceptable integrity Spill kit will be immediately available
Chemical Storage Area in Both New Building/ Current Building	Pallets	Caustic Soda	n/a	n/a Dry Beads in Plastic Bags	On concrete surface of acceptable integrity Broom and dust pan will be available Spill kit will be immediately available in location of mixed caustic solution

3.0 SPILL PREVENTION

3.1 SPCC Features and Operating Procedures

Hatchery employees will be trained to implement spill prevention practices for work with and around oil sources. Hatchery personnel shall use common sense and rely on spill prevention practices at all times to minimize the potential for a release of oil.

For example, the following "common sense" practices are recommended:

- keep container lids securely fastened at all times;
- do not leave portable sources unattended (outside);
- return portable sources to their storage location after use;
- use pads, drip pans, and funnels when transferring product from a portable container;
- protect oil and hazardous material storage from damage by moving equipment;
- any contaminated water within the diked area shall be removed and disposed of by a licensed spill response contractor;
- do not store oil/hazardous matter sources near catch basins or floor drains; and
- loading and unloading of petroleum products shall be attended at all times.

Spill prevention during oil deliveries (offloading) is the primary responsibility of the supplier until the product is safely in the tank or vessel. Dispensing fuel to Johnson Lake Hatchery equipment is the responsibility of hatchery personnel. Johnson Lake Hatchery implements spill prevention measures for equipment filling and truck unloading operations.

Supplier Approval

The supplier approval process endeavors to ensure that the vendor meets the minimum requirements and regulations for tank truck unloading as established by the Department of Transportation. These supplier approval procedures also ensure that the vendor understands the site layout, knows the protocols for entering the site and unloading product, and has the necessary spill equipment on board to respond to a spill from the vehicle or fuel delivery hose.

Observation of Deliveries

The Hatchery Manager (or his designee) will supervise deliveries for all new suppliers and will periodically observe deliveries for existing, approved suppliers. Delivery observations include:

- vehicle inspection prior to delivery and departure
- inquiry to ensure the truck contains the right product for the tank
- assurance that the tank can hold what the supplier intends to deliver
- adequate spill response equipment is present
- Facility personnel will monitor the fueling area for safe and proper operation, and will take immediate action to correct any deficiencies

3.2 Tests and Inspections

The personnel at the facility shall perform testing, inspection, and maintenance of all petroleum equipment to keep it performing in an efficient and environmentally sound manner. The tests and inspections shall be performed as discussed in the following subsections.

Inspecting Aboveground Storage Tanks (ASTs)

The AST shall be inspected monthly, and the results shall be recorded on the Monthly AST Inspection Report (Attachment 5.4). Spill response kits kept on site shall also be checked during the monthly AST inspection, and restocked as necessary. The monthly inspection reports shall be kept for at least three years in a file maintained by the Hatchery Manager. Inspections include observations of the exterior of the tank for signs of deterioration or spills (leaks), observations of the tank foundation and supports for signs of instability, and observations of the vent, fill and discharge pipes for signs of poor connection, that could cause a spill. In addition to these monthly inspections, the facility will periodically verify the integrity of each tank every ten years, or more often as deemed necessary by the inspection results.

Tank Maintenance

All petroleum tank and piping problems shall be immediately reported to the Environmental Manager and Operations Manager. Visible oil spills/leaks from tank walls, piping or other components shall be repaired or replaced immediately to prevent the potential for a major spill from the source, or any discharge to the environment.

3.3 Training

Johnson Lake Hatchery will provide SPCC spill training, Annual Emergency Response training and mock drills for personnel involved with handling petroleum products and hazardous matter. The Hatchery Manager arranges for annual training, which includes the following training topics:

- an introduction to pollution control laws;
- rules and regulations pertaining to the use and storage of petroleum products;
- inspection, operation and maintenance of spill equipment, and petroleum storage and dispensing equipment;
- emergency and spill response / cleanup;
- spill notification and record keeping;
- spill prevention practices; and
- storm water pollution prevention plan compliance.

The annual Emergency Response and SPCC training will be documented to include the instructor's name, course outline, date and duration of training, attendant's names and signatures, and corrective action list for areas in need of improvement, if any. This information is filed and maintained for at least 3 years at the main office. A Certificate of Training will be presented to each employee that has completed the training. The Human Resources Department maintains a copy of training certificates in each employee's personnel file.

3.4 Security

Site security includes fencing, warning signs and security lighting around the property. All visitors and contractors at the site must check-in with hatchery personnel; and personnel are trained to challenge anyone who is not on a scheduled visit of the property.

4.0 SPILL RESPONSE

This section describes the cleanup response and protocols to follow in the event of oil/hazardous matter spill or other emergency. The uncontrolled discharge of oil to groundwater, surface water or soil is prohibited. It is imperative that action be taken to respond to a spill once it has occurred, and to have a systematic response to any other types of emergencies. In the event of a spill, depending on the volume and characteristics of the material released, Johnson Lake Hatchery has defined spill response as either a "Minor Spill Response" or "Major Spill Response" ("Spill Emergency"). A list of Emergency Contacts is included in Attachment 5.1.

4.1 Discovery

Every employee working within areas of hazardous substances shall be trained in recognizing spills. Upon discovery of a discharge, or imminent discharge, of any oil or hazardous substance, the discoverer shall immediately notify the Emergency Response Coordinator as to the nature and extent of the emergency.

4.2 Minor Spill Response

A “Minor Spill Response” is defined as one that poses no significant harm to human health or the environment. These spills involve generally less than 5 gallons and can usually be cleaned up by Hatchery personnel. Other characteristics of a minor spill include the following:

- the spilled material is easily stopped or controlled at the time of the spill;
- the spill is localized;
- the spilled material is not likely to reach surface water or groundwater;
- there is little danger to human health; and
- there is little danger of fire or explosion.

In the event of a minor spill the following guidelines shall apply:

1. Immediately notify the senior on-site person (i.e. Hatchery Manager).
2. The Hatchery Manager will notify the New Brunswick Department of Environment.
3. Identify the contents of the spill and refer to the MSDS for chemical hazard information, clean-up tips and special handling procedures.
4. Trained personnel will contain the spill with spill response materials and equipment.
5. Place spill debris in properly labeled waste containers.
6. Complete the Minor Hazardous Material spill/leak Form (Attachment 5.2) and file.

4.3 Major Spill Response

A “major spill” is defined as one involving a spill that cannot be safely controlled or cleaned up. Characteristics include the following:

- the spill is large enough to spread beyond the immediate spill area;
- the spilled material enters surface water or groundwater (regardless of spill size);
- the spill requires special training and equipment to cleanup;
- the spilled material is dangerous to human health; and
- there is a danger of fire or explosion.

In the event of a spill emergency, the following guidelines shall apply:

1. All workers shall immediately evacuate the spill site and move upwind/upgrade to a safe distance away from the spill.
2. The Emergency Coordinator (or his alternate) will call for medical assistance if workers are injured (no worker shall engage in rescue operations unless they have been properly trained and equipped).
3. The Emergency Coordinator shall immediately contact the Department of Environment.
4. Notify the local Fire Department and/or Police Department.
5. The Emergency Coordinator shall contact the Freshwater (FW) Production Manager and provide details regarding the spill.
6. The Emergency Coordinator and Freshwater Production Manager will coordinate cleanup and seek assistance from a cleanup contractor as necessary.
7. Complete the Spill Notification Form (Attachment 5.3)
8. In the event of a worker is injured during an accidental spill The Emergency Coordinator shall contact the Company Health and Safety Coordinator.

4.4 Evacuation Information

All employees except those designated are to exit the facility. Emergency Escape Route diagrams will be developed and place in a prominent place inside each building. An Evacuation Plan will be developed and posted with the Escape Route Diagrams.

The Emergency Coordinator, or his designee, is responsible for a head count once employees are evacuated. If persons are missing, the Emergency Coordinator must notify all personnel and make every effort.

Once the building is evacuated, no one can re-enter until the Emergency Response Coordinator confirms the facility is safe and authorized return to work.

4.5 Waste Disposal

Wastes resulting from a minor spill response will be containerized in impervious bags, drums or buckets. The waste will be removed from the site by a licensed waste hauler and taken to an approved facility.

Wastes resulting from a major spill response will be removed and disposed by a licensed cleanup contractor under the direction of the Department of the Environment.

ATTACHMENTS

ATTACHMENT 5.1

EMERGENCY CONTACTS

ORGANIZATION	PHONE
Fire Department	Emergency – 911
Ambulance Service	911
RCMP	911
Charlotte County Hospital	262-5000
Poison Control Center	911
Department of Environment Report a spill during normal business hours	1-506-658-2558
Canadian Coast Guard Report a spill after hours	1-800-565-1633

EMERGENCY COORDINATORS		
Primary Emergency Response Coordinator	Glenn Ketchum	Office: 506-755-5281 Mobile: 506-754-2328
First Alternate Emergency Response Coordinator	Cory Taylor	Office: 506-755-5285 Mobile: 506-754-5527

Waste Management Plan

November 7th

2018

The following document is the WMP for Johnson Lake Hatchery. It includes waste definitions, handling/storage and removal as well as service provider contacts. This document should be updated on an as needed basis.

Johnson Lake Hatchery

Waste Management Plan
Johnson Lake Hatchery

Waste is generally defined as damaged, defective, or excess material produced through normal operations of the facility. A waste is considered uncontrolled should it leave the facility in a manner not covered in this WMP.

Types of waste that may be generated from a facility and potential sources are described as follows:

- Operational Debris including feed bags, pallets, rope, tanks, and litter and other inorganic materials that may come from daily operation of the facility.
- Hazardous Wastes could potentially include petroleum products, paints, or other materials used at the facility.
- Human Waste includes metabolic waste products from staff and visitors to the facility.
- Routine Mortalities include dead and moribund stock removed from the tanks.
- Major Stock Loss includes mortalities greater than that expected through normal operations.
- Feed and Feces includes fish feed that was not consumed by the stock and spills from automatic or manual feeding systems, as well as feces produced by the stock.

1.1 Operational Debris

Generation will be limited by daily inspection for materials that may be discharged from the facility, and by containing these materials for disposal at a suitable facility.

- Debris will be stored in marked, securely covered containers that are readily accessible by site staff and visitors.
- Items such as pop cans and other recyclable materials are sent for recycling where such a facility is available.
- Large materials (pallets, for example) will be reused or recycled.
- Feed bags will be collected and stored as they are emptied and taken to Fundy Plastics for recycling.
- All contained operational debris described above will be transported as needed to an approved solid waste landfill or recycling facility.
- Staff will be encouraged to participate in regional inspections and clean-ups.
- Any construction related materials or waste created during regular facility maintenance or construction is collected and stored until proper disposal/recycling can be arranged.
- Only facility property will be used for short or long-term storage of operation equipment and/or debris. Shorelines and other off-facility lands, either public or private, must not be used for short or long-term storage of equipment, gear, and/or other operational debris unless they have been approved by the land owner and/or the regulators for this purpose.

1.2 Hazardous Waste

Hazardous materials such as cleaning agents, fuels, paints and oils will only be brought to the facility if they are required for use.

- Any items that may be considered hazardous waste will be transported in appropriate leak proof containers to an approved facility for recycling or disposal.
- Where applicable, chemical and hazardous materials are disposed of as per the manufacturer's instructions on the product labels.
- Used petroleum products associated with normal equipment maintenance will be stored and transported in sealed containers to the nearest waste oil recycling facility.
- Waste oil obtained from the forklift is managed by Liftow.
- Any accidental release of a hazardous substance or contaminant in an amount to be of concern to human health or safety or environmental harm will be reported immediately to the Saint John Regional Office of DELG and to the Canada Coast Guard (506-658-2558, 800-565-1633).

1.3 Human Waste

The intended policy is that no human waste will be discharged directly from the facility. The facility owns and will maintain a septic system serviced by A One Pumping Service.

1.4 Routine Mortalities

Generation of this waste type will be minimized by maintaining optimal husbandry and health conditions for the stock.

- Dead and moribund fish will be removed from the tanks once per day. The intention will be to remove mortalities as frequently as possible such that the quantity of the waste per week is minimized.
- All mortalities will be frozen and sent to Fero Waste and Recycling Inc. for composting.
- At no time will dead or moribund fish be released into a watershed.

1.5 Major Stock Loss

Major stock loss includes mortalities greater than that expected through normal operations, and could occur through equipment failure, adverse environmental conditions (low oxygen, low temperature), or fish health causes. Major stock loss is not a normal operating condition. However, it is an operational possibility that warrants some pre-planning and preparation.

- Major stock loss mortalities will be removed from tanks with the use of a septic truck, such as A One pumping.
- Mortalities will be disposed of at Cardwell Composting Facility in Penobsquis, New Brunswick. Other avenues may be used in the event that Cardwell is unable to handle the excess fish, this includes other compost facilities, rendering plants, and mink farms in the province of NB.

1.6 Feed and Feces

Feces waste generation will be limited by maintaining optimal stock husbandry and health conditions at the facility, and by feeding the fish according to best available techniques. Waste feed generation will be limited by following clear delivery, storage, and feeding practices.

- Feed will be stored at the facility in covered secure areas including hoppers, bins or buildings. Bags of feed will not be left outside and unattended at the facility.
- Feed will only be brought to the facility on an as-needed basis. Maximum storage capacity will be 30 tonnes.
- Facility staff and feed delivery personnel will take all reasonable and safe precautions to reduce spills during feeding, feed spills will be cleaned up as they occur.
- Amounts of feed given to stock will be based on biomass and environmental conditions present. Feeding will be reduced or stopped if conditions such as low temperature, low oxygen, or fish health events suggest that utilization of feed by the stock will be affected.
- Feeding of stock will be monitored by trained facility staff. Feeding rates will be reduced or stopped as staff observe changes in fish activity indicating a reduction in appetite and/or if uneaten feed is sitting on the bottom of the tank.
- Wastewater quality requirements will be adhered to as per the Approval to Operate.
- Solids (Feces and Excess Feed) filtered out in the system will be retained in septic tanks. The facility's effluent stream is sent to a settling pond. The septic tanks and settling pond will be emptied either a minimum of once per year, as required by licenses and/or permits, or as necessary to meet regulatory effluent discharge requirements.

1.7 Waste Management Services Contact

A One Pumping Service Ltd. (Human Waste & Fish Waste)
30 Old Bay Road
St Stephen, New Brunswick
E3L 3X1
506-466-4407

Cardwell Farms Composting Products Inc (Composting)
12315 Route 114
Penobsquis, New Brunswick
E4G 2X9
506-433-4078

Fundy Plastics (Plastic Recycling)
5284 Route 1
Pennfield, NB
E5H 2C4
506-755-2135

Fero Waste & Recycling Inc (Operational Debris and Recycling)
1300 Berry Mills Road
Moncton, New Brunswick
E1E 4R8
506-855-FERO(3376)

Liftow Limited (Waste Oil)
275 Baig Blvd.
Moncton, New Brunswick
E1E 1E1
506-853-5083

Animal Welfare Plan

for Hatcheries and Nursery Sites in North America

Cooke Aquaculture Inc.

This Animal Welfare Plan (AWP) has been created to meet the requirements for Section 12 Animal Welfare – Animal Welfare of the Best Aquaculture Practices (BAP) Finfish, Crustacean and Mollusk Hatcheries and Nurseries Standard. The guidance and practice herein have and will continue to be followed by all North American employees of Cooke Aquaculture who are employed in the Freshwater Division, relevant Salt Water Division personnel and those who directly interact with the salmon hatcheries and nursery sties. This plan merely acts as an overall summary of the current requirements that each hatchery must follow and in the effect of any conflict of information or direction between this document and the Fish Health Management Plan, the Plan will prevail.

Animal Welfare Plan
for Hatcheries in North America

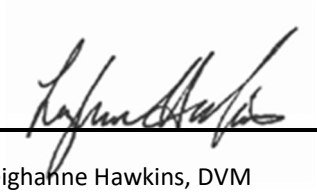
Table of Contents

Reference Document

Freshwater Fish Health Management Plan
Salt Water Fish Health Management Plan (Nursery Cage Sites)

ANIMAL WELFARE PLAN – ENDORSEMENT

As Fish Health Manager of Kelly Cove Salmon and on behalf of the Company, I endorse this Animal Welfare Plan in coordination with the Fish Health Management Plan for both the Salt Water and Freshwater Operations.



April 1, 2015

Leighanne Hawkins, DVM **Date Signed**
Fish Health Manager

As a member of Cooke Aquaculture Inc.'s Management team, I am responsible for overseeing this AWP and the associated FHMP. I have read, understood and have received training adequate to comply with the requirements of these documents, and agree to ensure all staff implements said documents.

NAME	POSITON	SIGNATURE
Jake Elliott	VP Freshwater Operations	
Greg Lambert	US FW Production Manager	
Cory Taylor	CA FW Production Manager	
Glenn Ketchum	FW Support Manager	
Michael Szemerda	VP Saltwater Operations	
Sheldon George	NL SW Production Manager	

Section 1; Introduction

When farmed animals are exposed to stressors, feed consumption and growth rates can be affected. Stressed animals are also less resistant to diseases, may suffer from increased mortality and produce lower-quality end product and offspring. Undue stress can be minimized through good husbandry techniques that focus on rearing habitat and handling.

Often animal welfare is depicted as important only for agricultural animals, however, similar principles must be applied to aquaculture facilities as well to ensure that farmed aquatic animals, be it fish, crustaceans or mollusks, are produced using humane techniques.

Such techniques are already described in the Fish Health Management Plans – both for Freshwater and Salt Water operations. As a supplement to the Fish Health Management Plans this Animal Welfare Plan provides a summary of the animal welfare practices that our hatcheries and nursery sites adhere to. All facility personnel shall receive training in this Plan.

Section 2; Water Quality

Animal Welfare, particularly for aquatic species is highly dependent upon water quality and can vary greatly from species to species and from facility to facility. Below are defined water quality parameters that shall be monitored, at what **minimum** frequency and for which type of hatchery – recirculation or flow through/reuse. Normal ranges for operation have been identified and staff shall alert management in the event that any parameter is outside of the range so that immediate corrective action can be taken. The parameters below are for normal operation and are separate from any water quality monitoring necessary to be in compliance with Government Regulations or third party certifications.

Recirculation facilities are differentiated from Reuse facilities by the presence/lack of biofiltration.

2.1 Recirculation[a]

Parameter	*Minimum Frequency*	*Recommended Range for Normal Operation*
Water Temperature	Daily	6-20°C
Dissolved Oxygen	Daily	>6 ppm at tank outlet
pH	Daily	6.0-8.5
Hardness	Weekly	>100 mg/l
Nitrite	Weekly	<1 mg/L
Toxic Ammonia (Unionized)	Weekly	<0.0125 mg/l
Carbon Dioxide	Weekly	<20 mg/l

2.2 Flow Through/Reuse

Parameter	*Minimum Frequency*	*Recommended Range for Normal Operation*
Water Temperature	Daily	0.5-25°C
Dissolved Oxygen	Daily	>6 ppm at tank outlet

2.3 Lake Site

Even though a lake site is located in freshwater, it is more closely related operationally to a sea site and as such shall adhere to the FHMP for Saltwater (FHMP SW). As per section 2.4 of the FHMP SW, water quality monitoring conducted at the Lake Site(s) shall follow a combination of the requirements set forth in SOP 1: Water Quality Monitoring as well as the requirements of BAP.

[a] Recirculating Aquaculture. 2007. M.B. Timmons and J.M. Ebeling

Section 3; Daily Observations

The appearance and behaviour of all stocks shall be observed at least daily for signs of distress or ill health. Staff shall document abnormal fish behaviour within the site diary or daily activity log and alert management immediately when signs of distress or ill health are observed so that action may be taken to correct the problem and reduce strain on the fish and the population as a whole.

Signs that fish may be in distress or ill health include;

- External physical changes – scale loss, skin lesions, dark appearance, pale gills
- Behavioural changes – excessive finning at the surface of the water, excessive jumping, abnormal swimming and schooling behaviour
- Appetite changes – poor feeding response
- Sudden increase in mortalities

Daily observations are also discussed in the Fish Health Management Plan for Freshwater – Introduction, under Common Fish Handling and Health Management Procedures; Monitoring Fish Health and Behaviour and Disease Recognition. For the Lake Site(s), daily observations as discussed in the FHMP SW under section 2.7 – Monitoring Fish Health.

Section 4; Stocking Density

There are many factors, both internal and external, within a single facility that decide at what density fish are kept. A variety of parameters including water quality, species, and life stage can affect a systems stocking density capability. The key factors impacting density are oxygen systems, temperature, water treatment and turnover periods. The following outlines density ranges for the various life stages and rearing systems for Atlantic salmon however these values represent a goal value and it is important to recognize that the true measure of adequate stocking density is reflected in the health of the fish.

Average hatchery stocking density shall not normally exceed the maximum densities as described below but may be allowed to rise higher for up to 25% of the lifecycle if the fish show other indicators of good welfare such as low mortality and if water quality is considered good. It is important to keep in mind that facilities and equipment will be used to the maximum capabilities of their systems while ensuring animal welfare is maintained.

4.1 Freshwater Systems

4.1.1 Eggs

	Heath Trays	*EWOS Trays*	*CompHatch*	*Egg Tubes*	*Combi-Trays*
# of Eggs	***20,000***	***15,000***	***350,000***	***100,000 – 300,000***	***125,000***

4.1.2 Post Hatch

	Up to 1 Year	*1 to 2 Years*	*2-3 Years*	*4 or More Years*
Maximum Density	***60 kg/m³***	***80 kg/m³***	***100 kg/m³***	***120 kg/m³***

- SOP FHMPFW 1.22: EGG MANAGEMENT PROCEDURES

4.2 Nursery Cage Sites

4.2.1 Smolt

Average nursery density shall not normally exceed 25 kg / m^3 however; cage sites are permitted to operate at a higher density for no greater than 5% of the time fish are stocked at the nursery site.

Section 5; Handling and Transferring Fish

5.1 Grow Out

Throughout the freshwater production cycle, fish shall be handled with care to prevent stress, injury and promote animal welfare. Materials used during handling shall be clean and in good repair to prevent potential disease transfer and damage to the fish. During periods of vaccination and grading, fish will be properly anesthetized as necessary with adequate water supply of good quality. Any downgrades or poor performers culled during these operations shall be handled with animal welfare in mind.

- SOP FHMPFW 1.12: Grading and Splitting Fish
- SOP FHMPFW 1.13: Weight Sampling Fish
- SOP FHMPFW 1.18: Water Quality Monitoring
- SOP FHMPFW 1.24: Vaccine Handling and Storage for Immersion and Intraperitoneal Vaccination

- FHMP SW Section 2.3 – Proper Fish Handling Techniques
- FHMP SW SOP 1: Water Quality Monitoring

5.2 Transfers

Each facility has developed techniques and procedures that minimize unnecessary stress or injury to animals during crowding, capture and handling of animals prior to and during transfer within the facility or transport to another. Survival rates shall be used as an indicator of success of the methods used. Poor results shall result in a review of the system and an investigation into new or different techniques performed.

Densities during transfers are normally maintained in the 60 – 80 kg/m^3 range, however, factors such as length of time in transit, water temperature and size of fish will affect this range, be it higher or lower.

- SOP FHMPFW 1.09: Freshwater Fish Pumping Techniques
- SOP FHMPFW 1.10: Freshwater Fish Netting/Bucketing
- SOP FHMPFW 1.11: Moving Fish via Hard Pipe
- SOP FHMPFW 1.17: Fry and Smolt Transport Protocols

- FHMP SW Section 2.5.7 – Moving Fish Between Sites

5.3 Moribund Fish or Mass Mortality

Moribund fish are either used for fish health sampling when there are concerns or collected as routine mortality. Once retrieved, fish are stunned and treated accordingly dependent upon intended purpose.

In the unfortunate event of mass mortality or the need to euthanize large populations, methods will be employed that consider animal welfare, the health of the remaining populations and Government regulations.

- SOP FHMPFW 1.06: Euthanasia Protocols
- SOP FHMPFW 1.21: Freshwater Mortality Collection, Disposal and Follow-Up Investigation

- FHMP SW SOP 8: Mortality Collection and Disposal
- FHMP SW SOP 10: Anesthetic Use

5.4 Actual vs. Projected

Egg numbers are estimated based on weight (as described in section 6.5 below). After the first sort, true fish numbers are counted. During that period until the next handling event, fish numbers are tracked through the recording of mortalities. At grading and vaccination events, fish are fed through counters at which time a new inventory number is derived.

During vaccinations small percentages of the populations are culled due to poor performance or low quality of fish. Fish may be counted individually or weighed as a group depending on the number of fish culled and the cohesiveness of size. A good practice when using weight estimation is to perform a random check of the weights each time a new tank is handled.

At transfer the fish are once again sent through a counter which is compared against the inventory software program FishTalk ®. When fish are shipped between hatcheries, a counted number is used. When fish are shipped to sea sites, an electronic counter is used. Delivery slips accompany each shipment of fish, be it eggs, fry or smolt which includes the number of fish moved.

- SOP FHMPFW 1.14: Fish Inventory Practices

Section 6; Handling of Broodstock

Broodstock are those fish that have been selected, based on genetic profiles, to produce the progeny for future production cycles. These fish are within the system the longest – even outlasting sea site production fish and as such need to be treated appropriately.

6.1 Grow Out

During grow out (time from smolt to spawn) the fish shall be treated as any other production fish. Adequately fed a nutritious diet, supplied clean, well oxygenated water and observed daily for signs of stress or ill health.

6.2 During Spawning

Once fish have been sorted and the broodstock identified, those selected shall be separated. Females shall be anesthetised in an anesthetic bath and stunned prior to being bled for spawning. Males shall be anesthetised as well to calm them for handling.

- SOP FHMPFW 1.22: Egg Management Procedures.

6.3 Post Spawn

Fish spawned will be subject to routine fish health sampling then treated as regular mortality.

6.4 Disposal of Surplus

Fish that have been within the system for more than 5 years will be removed from the broodstock program, unless a particular male or female has demonstrated above average breeding value in which case it may be held an additional year. Those fish that have not matured will be disposed of, either through harvesting and sent to the processing plants for processing or euthanized and treated as mortalities. Fish within the 2-3 year range showing undesirable traits or to simply reduce the size of the broodstock population will also be treated as surplus.

6.5 Egg Estimation

Egg numbers are estimated based on volume once fertilized. To obtain an estimation of the number of fertilized eggs, two different methods are used within the hatcheries. The simplest method is simply to estimate that 10,000 eggs per female were obtained. The second, and most used method, is to measure how many eggs in 25cm, followed by a chart converting egg count to egg/liter and then you have to measure the litres eggs. These counts are performed approximately 1 hour after fertilization. These estimations are the standing inventory until a real count is taken when sorting is done, approximately 300 degree days after spawning.

Appendix E

Hydrogeological Information

Table 2

CDWQG = Canadian Drinking Water Quality Guideline

NBDOE Groundwater Chemistry Database

Parameter	ALK_T (mg/L)	Al (mg/L)	As (µg/L)	B (mg/L)	Ba (mg/L)	Br (mg/L)	COND (µSIE/cm)	Ca (mg/L)	Cd (µg/L)
	45.9	0.025	1.5	0.01	0.01	0.1	142	15.9	0.5
	107	0.025	1.5	0.01	0.032	0.1	261	32.3	0.5
	61.3	0.025	2.2	0.01	0.01	0.1	150	23.4	0.5
	15.4	0.025	1.5	0.01	0.01	0.1	55.5	5.98	0.5
	31.5	0.025	1.5	0.01	0.01	0.1	91	12	0.5
	10.3	0.025	1.5	0.01	0.01	0.1	49.7	4.34	0.5
	70.9	0.025	3.2	0.01	0.01	0.1	169	27.2	0.7
	52.2	0.025	1.5	0.01	0.01	0.1	152	20.6	0.5
Mean	**49.3**	**0.025**	**1.8**	**0.010**	**0.013**	**0.1**	**134**	**17.7**	**0.5**
CDWQG			**<10**	**<5.0**	**<1.0**				**<5.0**

Parameter	Cl (mg/L)	Cr (µg/L)	Cu (µg/L)	E_coli P/A (P/A)	F (mg/L)	Fe (mg/L)	HARD (mg/L)	K (mg/L)	Mg (mg/L)
	10.7	10	10	Ab	0.133	0.292	46.9	0.65	1.75
	8.68	12	10	Ab	0.916	0.04	105	0.7	5.96
	4.13	10	10	Ab	0.448	0.032	67.5	1	2.19
	3.14	10	22	Ab	0.1	**0.492**	18.7	0.5	0.9
	3	10	10	Ab	0.162	0.04	35.3	0.6	1.29
	3.14	10	24	Ab	0.122	0.058	13.6	0.6	0.67
	4.55	10	10	Ab	0.117	0.031	77.4	0.8	2.28
				Ab					
	9.38	10	10	Ab	0.131	**1.55**	60.6	0.668	2.23
Mean	**5.8**	**10**	**13**		**0.27**	**0.317**	**53.1**	**0.69**	**2.16**
CDWQG	**<250**	**<50**	**<1000**		**<1.5**	**<0.3**			

Table 2

CDWQG = Canadian Drinking Water Quality Guideline

NBDOE Groundwater Chemistry Database

Parameter	Mn (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	Na (mg/L)	PH (pH)	Pb (µg/L)	SO4 (mg/L)	Sb (µg/L)
	0.03	0.05	0.34	0.39	6.8	7.29	1	6.27	1
	0.005	0.05	0.24	0.29	9.17	7.95	1	9.69	1
	0.005	0.05	0.08	0.13	4.24	8.2	1	7.06	1
	0.012	0.05	0.06	0.11	3.27	7.04	1	4.44	1
	0.006	0.05	0.32	0.37	2.58	7.27	1	5.21	1
	0.024	0.05	0.08	0.13	2.33	7.14	22	4.56	1
	0.005	0.05	0.23	0.28	4.45	8.14	1.3	6.24	1
	0.064	0.05	0.27	0.32	5.16	7.63	1	6.34	1
Mean	**0.019**	**0.05**	**0.20**	**0.25**	**4.75**	**7.58**	**3.7**	**6.23**	**1**
CDWQG	**<0.05**	**<10**	**<10**	**<10**	**<200**	**7.0-10.5**	**<10**	**<500**	

Parameter	Se (µg/L)	TC-P/A (P/A)	TURB (NTU)	Tl (µg/L)	U (µg/L)	Zn (µg/L)	TDS (mg/L)
	1.5	Ab	4.09	1	0.5	5	72
	1.5	Ab	2.98	1	25	5	133
	1.5	Ab	0.44	1	5.1	5	80
	1.5	Ab	13	1	0.5	6	29
	1.5	**Pr**	0.3	1	0.5	5	46
	1.5	Ab	0.4	1	0.5	32	23
	1.5	Ab	0.3	1	1.9	5	90
		Pr					
	1.5	Ab	14.5	1	0.5	5	79
Mean	**1.5**		**4.5**	**1**	**4.3**	**9**	**69**
CDWQG			**<1.0**		**<20**	**<5000**	**<500**

Johnson Lake Fisheries`

1600 meter radius around PID 15162282

Well Depth (Feet)	**Estimated Yield** (igpm)	**Depth to Bedrock** (Feet)	**Casing Length** (Feet)	
40	20		40	gravel
40	20		40	gravel
185	4.5	35	41	top of Bed
40	30		40	gravel
60	20		60	gravel
90	10	70	71	top of bedı
118	150	116	116	top of bedı
40	20		40	gravel
60	15		60	gravel
60	15		60	gravel
Well Depth (Feet)	**Estimated Yield** (igpm)	**Depth to Bedrock** (Feet)	**Casing Length** (Feet)	

Median	60	20	70	50.5	Median
average	73.3	30.5	73.7	56.8	AVERAG
max	185	150	116	116	max
min	40	4.5	35	40	min
count	10				

New Nouveau Brunswick

Environment

Report Number **10923**

Well Driller's Report

Date printed 2018/11/12

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	New Well		09/23/2005

Casing Information

Casing above ground

Drive Shoe Used?

Well Log	Casing Type	Diameter	From	End	Slotted?
10923	**Steel**	**6 inch**	**0ft**	**40ft**	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	15ft	20 igpm	1hr	15ft	20 igpm	No	0 igpm
	(BTC - Below top of casing)						

Well Grouting

There is no Grout information.

Drilling Fluids Used
Other

Disinfectant
Chlorine Pucks
Qty 0 ig

Pump Installed
Submersible
Intake Setting (BTC)
25ft

Driller's Log

Well Log	From	End	Colour	Rock Type
10923	**0ft**	**40ft**	**Brown**	**Gravel**

Overall Well Depth
40ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
10923	**40ft**	**20 igpm**

Setbacks

Well Log	Distance	Setback From
10923	**100ft**	**Right of any Public Way Road**

New Nouveau Brunswick

Environment

Report Number **16007**

Well Driller's Report

Date printed 2018/11/12

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	New Well	Rotary	08/12/2007

Casing Information

Casing above ground

Drive Shoe Used?

Well Log	Casing Type	Diameter	From	End	Slotted?
16007	**Steel**	**6 inch**	**0ft**	**40ft**	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	18ft	20 igpm	1hr	18ft	20 igpm	No	0 igpm
	(BTC - Below top of casing)						

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
Bleach (Javex)
Qty 0 ig

Pump Installed
Submersible
Intake Setting (BTC)
30ft

Driller's Log

Well Log	From	End	Colour	Rock Type
16007	**0ft**	**20ft**	**Brown**	**Sand**
16007	**20ft**	**40ft**	**Brown**	**Gravel**

Overall Well Depth
40ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
16007	**40ft**	**20 igpm**

Setbacks

Well Log	Distance	Setback From
16007	**65ft**	**Septic Tank**
16007	**85ft**	**Leach Field**
16007	**70ft**	**Right of any Public Way Road**

New Nouveau Brunswick

Environment

Report Number **17660**

Well Driller's Report

Date printed 2018/11/12

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	New Well	Rotary	12/02/2008

Casing Information — Casing above ground — Drive Shoe Used?

Well Log	Casing Type	Diameter	From	End	Slotted?
17660	**Steel**	**6 inch**	**0ft**	**41ft**	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	30ft	4.5 igpm	1hr	30ft	4.5 igpm	No	0 igpm

(BTC - Below top of casing)

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
Bleach (Javex)
Qty 0 ig

Pump Installed
Submersible
Intake Setting (BTC)
170ft

Driller's Log

Well Log	From	End	Colour	Rock Type
17660	**0ft**	**35ft**	**Brown**	**Till**
17660	**35ft**	**185ft**	**Red and grey**	**Granite**

Overall Well Depth
185ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
17660	**95ft**	**1.5 igpm**
17660	**163ft**	**3 igpm**

Setbacks

Well Log	Distance	Setback From
17660	**70ft**	**Right of any Public Way Road**

New Nouveau Brunswick

Environment

Report Number **17661**

Well Driller's Report

Date printed 2018/11/12

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	New Well	Rotary	12/02/2008

Casing Information

Casing above ground

Drive Shoe Used?

Well Log	Casing Type	Diameter	From	End	Slotted?
17661	**Steel**	**6 inch**	**0ft**	**40ft**	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	10ft	30 igpm	1hr	10ft	30 igpm	No	0 igpm

(BTC - Below top of casing)

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
Bleach (Javex)

Qty 0 ig

Pump Installed
Submersible

Intake Setting (BTC)
30ft

Driller's Log

Well Log	From	End	Colour	Rock Type
17661	**0ft**	**2ft**	**Brown**	**Topsoil and Gravel**
17661	**2ft**	**20ft**	**Brown**	**Gravel**
17661	**20ft**	**30ft**	**Soft brown**	**Gravel**
17661	**30ft**	**40ft**	**Brown**	**Gravel**

Overall Well Depth
40ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
17661	**40ft**	**30 igpm**

Setbacks

Well Log	Distance	Setback From
17661	**70ft**	**Septic Tank**

New Nouveau Brunswick

Environment

Report Number **24638**

Well Driller's Report

Date printed 2018/11/12

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	New Well	Rotary	06/23/2010

Casing Information

Casing above ground

Drive Shoe Used?

Well Log	Casing Type	Diameter	From	End	Slotted?
24638	**Steel**	**6 inch**	**0ft**	**60ft**	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	25ft	20 igpm	1hr	25ft	20 igpm	No	0 igpm

(BTC - Below top of casing)

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
Bleach (Javex)
Qty 0 ig

Pump Installed
Submersible
Intake Setting (BTC)
45ft

Driller's Log

Well Log	From	End	Colour	Rock Type
24638	**0ft**	**40ft**	**EMPTY VALUE**	**Gravel**
24638	**40ft**	**60ft**	**Purple & grey**	**Gravel**

Overall Well Depth
60ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
24638	**60ft**	**20 igpm**

Setbacks

Well Log	Distance	Setback From
24638	**55ft**	**Septic Tank**
24638	**75ft**	**Leach Field**
24638	**62ft**	**Right of any Public Way Road**

New Nouveau Brunswick

Environment

Report Number **26491**

Well Driller's Report

Date printed 2018/11/12

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	New Well	Rotary	06/13/2011

Casing Information

Casing above ground

Drive Shoe Used?

Well Log	Casing Type	Diameter	From	End	Slotted?
26491	**Steel**	**6 inch**	**0ft**	**71ft**	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	90ft	10 igpm	1hr 01min	38ft	10 igpm	No	0 igpm

(BTC - Below top of casing)

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
Bleach (Javex)

Qty 0 ig

Pump Installed
N/A

Intake Setting (BTC)
0ft

Driller's Log

Well Log	From	End	Colour	Rock Type
26491	**0ft**	**70ft**	**Brown**	**Gravel and Fine Sand**
26491	**70ft**	**90ft**	**Grey**	**Granite**

Overall Well Depth
90ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
26491	**79ft**	**10 igpm**

Setbacks

Well Log	Distance	Setback From
26491	**60ft**	**Septic Tank**
26491	**90ft**	**Leach Field**
26491	**200ft**	**Right of any Public Way Road**

New Nouveau Brunswick

Environment

Report Number **31504**

Well Driller's Report

Date printed 2018/11/12

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Non-Drinking Water, Industrial	Deepened	Rotary	10/16/2012

Casing Information

Casing above ground

Drive Shoe Used?

Well Log	Casing Type	Diameter	From	End	Slotted?
31504	**Steel**	**6 inch**	**0ft**	**110ft**	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	118ft	150 igpm	6hrs	50ft	150 igpm	No	0 igpm

(BTC - Below top of casing)

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
N/A

Qty 0 ig

Pump Installed
Submersible

Intake Setting (BTC)
90ft

Driller's Log

Well Log	From	End	Colour	Rock Type
31504	**108ft**	**116ft**	**Brown**	**Gravel**
31504	**116ft**	**118ft**	**Brown**	**Granite**

Overall Well Depth
118ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
31504	**118ft**	**150 igpm**

Setbacks

Well Log	Distance	Setback From
31504 metres	**2000ft**	**Right of any Public Way Road**
31504 metres	**2010ft**	**Center of road**

New Nouveau Brunswick

Environment

Report Number **40192**

Well Driller's Report

Date printed 2018/11/12

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	New Well	Rotary	05/11/2015

Casing Information — Casing above ground — Drive Shoe Used?

Well Log	Casing Type	Diameter	From	End	Slotted?
40192	Steel	6 inch	0ft	40ft	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	25ft	20 igpm	1hr	20ft	20 igpm	No	0 igpm

(BTC - Below top of casing)

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
Bleach (Javex)
Qty 0 ig

Pump Installed
Submersible
Intake Setting (BTC)
30ft

Driller's Log

Well Log	From	End	Colour	Rock Type
40192	0ft	40ft	Brown	Gravel

Overall Well Depth
40ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
40192	40ft	20 igpm

Setbacks

Well Log	Distance	Setback From
40192	150ft	Right of any Public Way Road

New Nouveau Brunswick

Environment

Report Number **90009000**

Well Driller's Report

Date printed 2018/11/12

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	New Well (NEW WELL)	Rotary (ROTARY)	05/31/1995

Casing Information

Casing above ground

Drive Shoe Used?

Well Log	Casing Type	Diameter	From	End	Slotted?
90009000	**Steel**	**6 inch**	**0ft**	**60ft**	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	20ft	0 igpm	0hr 30min	55ft	15 igpm	No	0 igpm
	(BTC - Below top of casing)						

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
N/A

Qty 0 ig

Pump Installed
N/A

Intake Setting (BTC)
50ft

Driller's Log

Well Log	From	End	Colour	Rock Type
90009000	**0ft**	**20ft**	**Brown**	**Boulders and Sand**
90009000	**20ft**	**40ft**	**Brown**	**Sand**
90009000	**40ft**	**60ft**	**Brown and grey**	**Gravel**

Overall Well Depth
60ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
90009000	**60ft**	**15 igpm**

Setbacks

There is no Setback information.

New Nouveau Brunswick

Environment

Report Number **91876400**

Well Driller's Report

Date printed 2018/11/12

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	New Well	Rotary	05/09/2001

Casing Information

Casing above ground

Drive Shoe Used?

Well Log	Casing Type	Diameter	From	End	Slotted?
91876400	**Steel**	**6 inch**	**0ft**	**60ft**	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	0ft	0 igpm	0hr	0ft	15 igpm	No	0 igpm

(BTC - Below top of casing)

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
N/A

Qty 0 ig

Pump Installed
N/A

Intake Setting (BTC)
0ft

Driller's Log

Well Log	From	End	Colour	Rock Type
91876400	**0ft**	**60ft**	**Brown**	**Sand and Gravel**

Overall Well Depth
60ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
91876400	**60ft**	**15 igpm**

Setbacks

There is no Setback information.

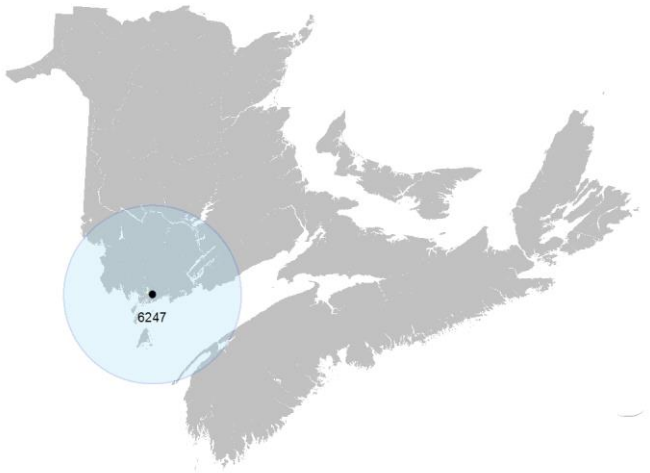
Appendix F

ACCDC Data

DATA REPORT 6247: Pennfield, NB

Prepared 8 November 2018
by J. Churchill, Data Manager

CONTENTS OF REPORT



Map 1. A 100 km buffer around the study area

1.0 PREFACE

The Atlantic Canada Conservation Data Centre (AC CDC; www.accdc.com) is part of a network of NatureServe data centres and heritage programs serving 50 states in the U.S.A, 10 provinces and 1 territory in Canada, plus several Central and South American countries. The NatureServe network is more than 30 years old and shares a common conservation data methodology. The AC CDC was founded in 1997, and maintains data for the jurisdictions of New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador. Although a non-governmental agency, the AC CDC is supported by 6 federal agencies and 4 provincial governments, as well as through outside grants and data processing fees.

Upon request and for a fee, the AC CDC queries its database and produces customized reports of the rare and endangered flora and fauna known to occur in or near a specified study area. As a supplement to that data, the AC CDC includes locations of managed areas with some level of protection, and known sites of ecological interest or sensitivity.

1.1 DATA LIST

Included datasets:

Filename	Contents
PennfldNB_6247ob.xls	All Rare and legally protected *Flora and Fauna* in your study area
PennfldNB_6247ob100km.xls	A list of Rare and legally protected *Flora and Fauna* within 100 km of your study area
PennfldNB_6247ma.xls	All *Managed Areas* in your study area
PennfldNB_6247sa.xls	All *Significant Natural Areas* in your study area
PennfldNB_6247ff.xls	Rare and common *Freshwater Fish* in your study area (DFO database)

1.2 RESTRICTIONS

The AC CDC makes a strong effort to verify the accuracy of all the data that it manages, but it shall not be held responsible for any inaccuracies in data that it provides. By accepting AC CDC data, recipients assent to the following limits of use:

a) Data is restricted to use by trained personnel who are sensitive to landowner interests and to potential threats to rare and/or endangered flora and fauna posed by the information provided.
b) Data is restricted to use by the specified Data User; any third party requiring data must make its own data request.
c) The AC CDC requires Data Users to cease using and delete data 12 months after receipt, and to make a new request for updated data if necessary at that time.
d) AC CDC data responses are restricted to the data in our Data System at the time of the data request.
e) Each record has an estimate of locational uncertainty, which must be referenced in order to understand the record's relevance to a particular location. Please see attached Data Dictionary for details.
f) AC CDC data responses are not to be construed as exhaustive inventories of taxa in an area.
g) The absence of a taxon cannot be inferred by its absence in an AC CDC data response.

1.3 ADDITIONAL INFORMATION

The accompanying Data Dictionary provides metadata for the data provided.

Please direct any additional questions about AC CDC data to the following individuals:

Plants, Lichens, Ranking Methods, All other Inquiries
Sean Blaney, Senior Scientist, Executive Director
Tel: (506) 364-2658
sean.blaney@accdc.ca

Animals (Fauna)
John Klymko, Zoologist
Tel: (506) 364-2660
john.klymko@accdc.ca

Plant Communities
Sarah Robinson, Community Ecologist
Tel: (506) 364-2664
sarah.robinson@accdc.ca

Data Management, GIS
James Churchill, Data Manager
Tel: (902) 679-6146
james.churchill@accdc.ca

Billing
Jean Breau
Tel: (506) 364-2657
jean.breau@accdc.ca

Questions on the biology of Federal Species at Risk can be directed to AC CDC: (506) 364-2658, with questions on Species at Risk regulations to: Samara Eaton, Canadian Wildlife Service (NB and PE): (506) 364-5060 or Julie McKnight, Canadian Wildlife Service (NS): (902) 426-4196.

For provincial information about rare taxa and protected areas, or information about game animals, deer yards, old growth forests, archeological sites, fish habitat etc., in New Brunswick, please contact Hubert Askanas, Energy and Resource Development: (506) 453-5873.

For provincial information about rare taxa and protected areas, or information about game animals, deer yards, old growth forests, archeological sites, fish habitat etc., in Nova Scotia, please contact Donna Hurlburt, NS DLF: (902) 679-6886. To determine if location-sensitive species (section 4.3) occur near your study site please contact a NS DLF Regional Biologist:

Western: Duncan Bayne
(902) 648-3536
Duncan.Bayne@novascotia.ca

Western: Sarah Spencer
(902) 634-7555
Sarah.Spencer@novascotia.ca

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(902) 893-6350
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Eastern: Lisa Doucette
(902) 863-4513
Lisa.Doucette@novascotia.ca

Eastern: Terry Power
(902) 563-3370
Terrance.Power@novascotia.ca

For provincial information about rare taxa and protected areas, or information about game animals, fish habitat etc., in Prince Edward Island, please contact Garry Gregory, PEI Dept. of Communities, Land and Environment: (902) 569-7595.

2.0 RARE AND ENDANGERED SPECIES

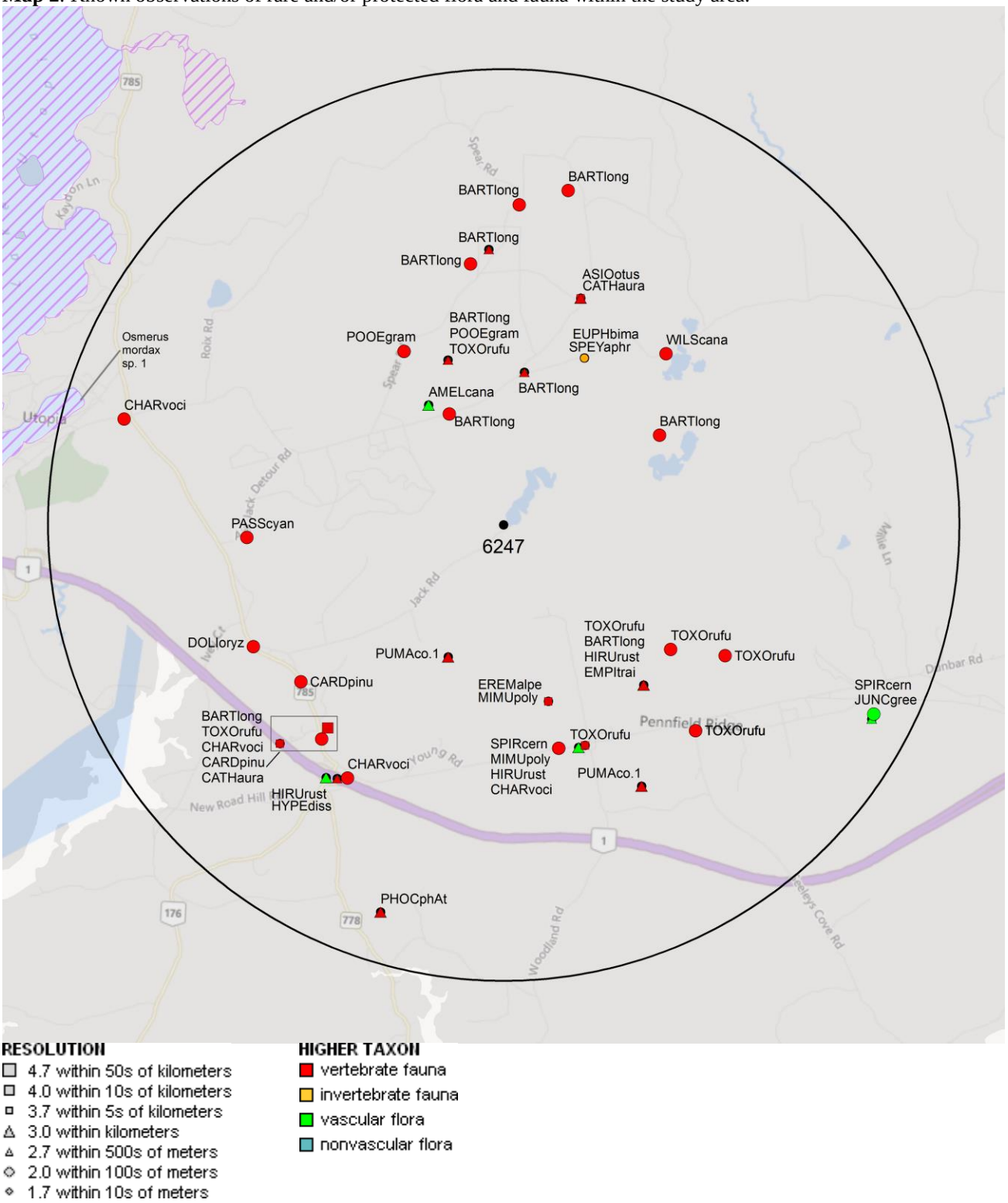
2.1 FLORA

The study area contains 5 records of 4 vascular, no records of nonvascular flora (Map 2 and attached: *ob.xls).

2.2 FAUNA

The study area contains 58 records of 16 vertebrate, 2 records of 2 invertebrate fauna (Map 2 and attached data files - see 1.1 Data List). Please see section 4.3 to determine if 'location-sensitive' species occur near your study site.

Map 2: Known observations of rare and/or protected flora and fauna within the study area.



RESOLUTION

- 4.7 within 50s of kilometers
- 4.0 within 10s of kilometers
- 3.7 within 5s of kilometers
- 3.0 within kilometers
- 2.7 within 500s of meters
- 2.0 within 100s of meters
- 1.7 within 10s of meters

HIGHER TAXON

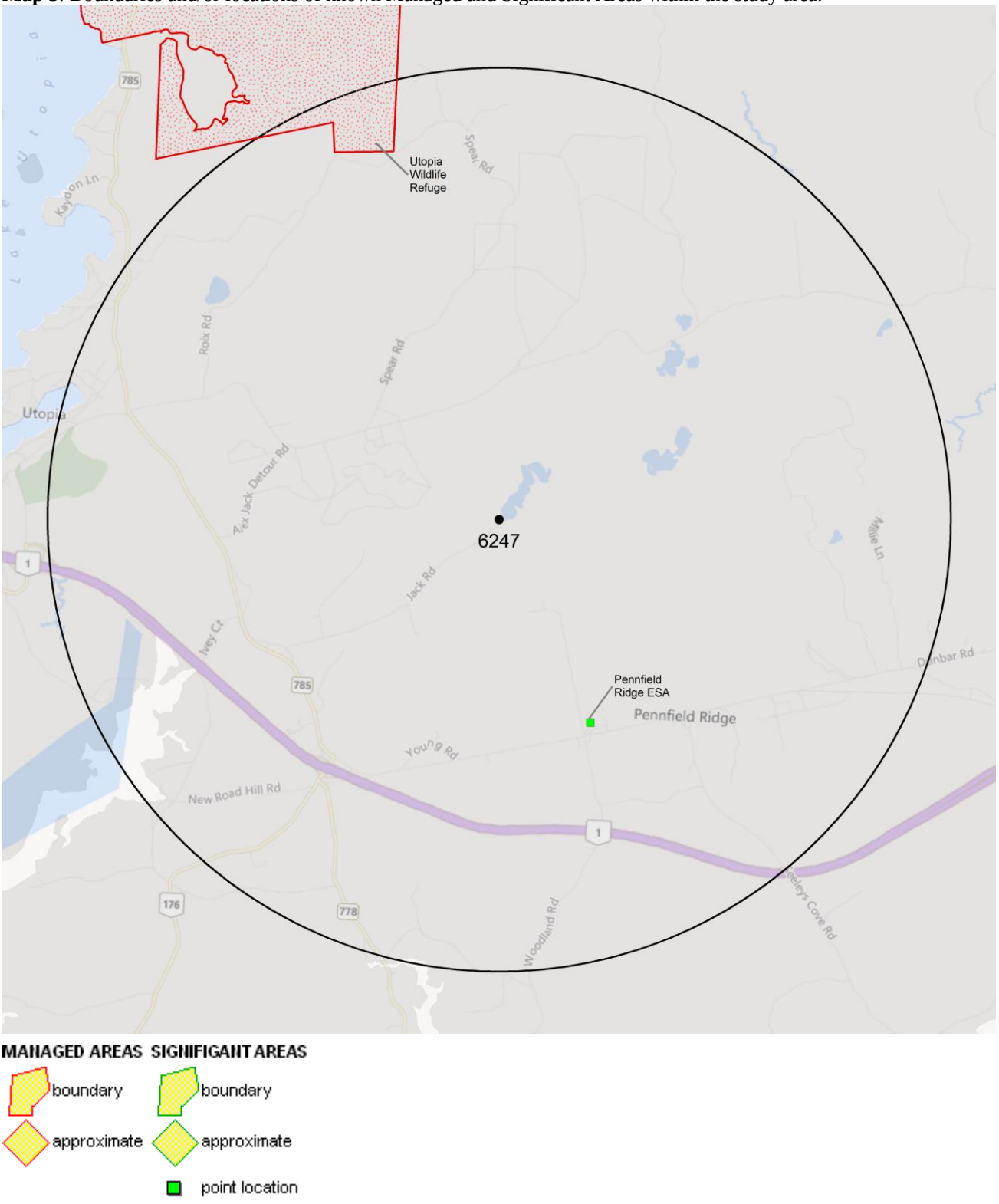
- vertebrate fauna
- invertebrate fauna
- vascular flora
- nonvascular flora

3.0 SPECIAL AREAS

3.1 MANAGED AREAS
The GIS scan identified 1 managed area in the vicinity of the study area (Map 3 and attached file: *ma*.xls).

3.2 SIGNIFICANT AREAS
The GIS scan identified 1 biologically significant site in the vicinity of the study area (Map 3 and attached file: *sa*.xls).

Map 3: Boundaries and/or locations of known Managed and Significant Areas within the study area.



4.0 RARE SPECIES LISTS

Rare and/or endangered taxa (excluding "location-sensitive" species, section 4.3) within the study area listed in order of concern, beginning with legally listed taxa, with the number of observations per taxon and the distance in kilometers from study area centroid to the closest observation (± the precision, in km, of the record). [P] = vascular plant, [N] = nonvascular plant, [A] = vertebrate animal, [I] = invertebrate animal, [C] = community. Note: records are from attached files *ob.xls/*ob.shp only.

4.1 FLORA

	Scientific *Name*	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)
P	*Juncus greenei*	Greene's Rush				S1	2 May Be At Risk	1	4.6 ± 0.0
P	*Hypericum dissimulatum*	Disguised St John's-wort				S2	3 Sensitive	1	3.4 ± 1.0
P	*Spiranthes cernua*	Nodding Ladies'-Tresses				S2S3	3 Sensitive	2	2.6 ± 1.0
P	*Amelanchier canadensis*	Canada Serviceberry				S3	4 Secure	1	1.6 ± 1.0

4.2 FAUNA

	Scientific *Name*	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)
A	*Hirundo rustica*	Barn Swallow	Threatened	Threatened	Threatened	S2B,S2M	3 Sensitive	3	2.3 ± 2.0
A	*Wilsonia canadensis*	Canada Warbler	Threatened	Threatened	Threatened	S3B,S3M	1 At Risk	2	2.6 ± 0.0
A	*Dolichonyx oryzivorus*	Bobolink	Threatened	Threatened	Threatened	S3B,S3M	3 Sensitive	1	3.1 ± 0.0
A	*Phocoena phocoena (NW Atlantic pop.)*	Harbour Porpoise - Northwest Atlantic pop.	Special Concern	Threatened		S4		4	4.5 ± 1.0
A	*Puma concolor pop. 1*	Eastern Cougar	Data Deficient		Endangered	SNA	5 Undetermined	2	1.6 ± 1.0
A	*Bartramia longicauda*	Upland Sandpiper				S1B,S1M	3 Sensitive	14	1.4 ± 0.0
A	*Eremophila alpestris*	Horned Lark				S1B,S4N,S5M	2 May Be At Risk	1	2.0 ± 7.0
A	*Empidonax traillii*	Willow Flycatcher				S1S2B,S1S2M	3 Sensitive	1	2.3 ± 2.0
A	*Mimus polyglottos*	Northern Mockingbird				S2B,S2M	3 Sensitive	3	2.0 ± 7.0
A	*Toxostoma rufum*	Brown Thrasher				S2B,S2M	3 Sensitive	13	1.9 ± 0.0
A	*Pooecetes gramineus*	Vesper Sparrow				S2B,S2M	2 May Be At Risk	2	1.9 ± 0.0
A	*Asio otus*	Long-eared Owl				S2S3	5 Undetermined	1	2.6 ± 6.0
A	*Carduelis pinus*	Pine Siskin				S3	4 Secure	2	2.8 ± 0.0
A	*Cathartes aura*	Turkey Vulture				S3B,S3M	4 Secure	3	2.6 ± 2.0
A	*Charadrius vociferus*	Killdeer				S3B,S3M	3 Sensitive	5	2.5 ± 0.0
A	*Passerina cyanea*	Indigo Bunting				S3B,S3M	4 Secure	1	2.8 ± 0.0
I	*Euphyes bimacula*	Two-spotted Skipper				S3	4 Secure	1	2.0 ± 0.0
I	*Speyeria aphrodite*	Aphrodite Fritillary				S3	4 Secure	1	2.0 ± 0.0

4.3 LOCATION SENSITIVE SPECIES

The Department of Natural Resources in each Maritimes province considers a number of species "location sensitive". Concern about exploitation of location-sensitive species precludes inclusion of precise coordinates in this report. Those intersecting your study area are indicated below with "YES".

New Brunswick

Scientific *Name*	Common Name	SARA	Prov Legal Prot	Known within the Study Site?
Chrysemys picta picta	Eastern Painted Turtle			No
Chelydra serpentina	Snapping Turtle	Special Concern	Special Concern	No
Glyptemys insculpta	Wood Turtle	Threatened	Threatened	No
Haliaeetus leucocephalus	Bald Eagle		Endangered	No
Falco peregrinus pop. 1	Peregrine Falcon - anatum/tundrius pop.	Special Concern	Endangered	No
Cicindela marginipennis	Cobblestone Tiger Beetle	Endangered	Endangered	No
Coenonympha nipisiquit	Maritime Ringlet	Endangered	Endangered	No
Bat Hibernaculum		[Endangered][1]	[Endangered][1]	No

1 *Myotis lucifugus* (Little Brown Myotis), *Myotis septentrionalis* (Long-eared Myotis), and *Perimyotis subflavus* (Tri-colored Bat or Eastern Pipistrelle) are all Endangered under the Federal Species at Risk Act and the NB Species at Risk Act.

4.4 SOURCE BIBLIOGRAPHY

The recipient of these data shall acknowledge the AC CDC and the data sources listed below in any documents, reports, publications or presentations, in which this dataset makes a significant contribution.

# recs	CITATION
21	eBird. 2014. eBird Basic Dataset. Version: EBD_relNov-2014. Ithaca, New York. Nov 2014. Cornell Lab of Ornithology, 25036 recs.
12	Lepage, D. 2014. Maritime Breeding Bird Atlas Database. Bird Studies Canada, Sackville NB, 407,838 recs.
12	Pardieck, K.L. & Ziolkowski Jr., D.J.; Hudson, M.-A.R. 2014. North American Breeding Bird Survey Dataset 1966 - 2013, version 2013.0. U.S. Geological Survey, Patuxent Wildlife Research Center <www.pwrc.usgs.gov/BBS/RawData/>.
4	Erskine, A.J. 1992. Maritime Breeding Bird Atlas Database. NS Museum & Nimbus Publ., Halifax, 82,125 recs.
4	Sollows, M.C,. 2008. NBM Science Collections databases: mammals. New Brunswick Museum, Saint John NB, download Jan. 2008, 4983 recs.
3	Benedict, B. Connell Herbarium Specimens. University New Brunswick, Fredericton. 2003.
2	Benedict, B. Connell Herbarium Specimens (Data) . University New Brunswick, Fredericton. 2003.
2	Doucet, D.A. 2007. Lepidopteran Records, 1988-2006. Doucet, 700 recs.
2	Erskine, A.J. 1999. Maritime Nest Records Scheme (MNRS) 1937-1999. Canadian Wildlife Service, Sackville, 313 recs.
2	Scott, Fred W. 1998. Updated Status Report on the Cougar (Puma Concolor couguar) [Eastern population]. Committee on the Status of Endangered Wildlife in Canada, 298 recs.
1	Dept of Fisheris & Oceans, source unspecified.
1	NSDNR website
1	Pike, E., Tingley, S. & Christie, D.S. 2000. Nature NB Listserve. University of New Brunswick, listserv.unb.ca/archives/naturenb. 68 recs.
1	Tims, J. & Craig, N. 1995. Environmentally Significant Areas in New Brunswick (NBESA). NB Dept of Environment & Nature Trust of New Brunswick Inc.

5.0 RARE SPECIES WITHIN 100 KM

A 100 km buffer around the study area contains 31191 records of 145 vertebrate and 1046 records of 74 invertebrate fauna; 5914 records of 346 vascular, 258 records of 107 nonvascular flora (attached: *ob100km.xls).

Taxa within 100 km of the study site that are rare and/or endangered in the province in which the study site occurs (including "location-sensitive" species). All ranks correspond to the province in which the study site falls, even for out-of-province records. Taxa are listed in order of concern, beginning with legally listed taxa, with the number of observations per taxon and the distance in kilometers from study area centroid to the closest observation (± the precision, in km, of the record).

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
A	*Myotis lucifugus*	Little Brown Myotis	Endangered	Endangered	Endangered	S1	1 At Risk	60	44.1 ± 5.0	NB
A	*Myotis septentrionalis*	Northern Long-eared Myotis	Endangered	Endangered	Endangered	S1	1 At Risk	14	43.8 ± 1.0	NB
A	*Perimyotis subflavus*	Eastern Pipistrelle	Endangered	Endangered	Endangered	S1	1 At Risk	2	48.7 ± 0.0	NB
A	*Eubalaena glacialis*	North Atlantic Right Whale	Endangered	Endangered	Endangered	S1		7	23.8 ± 1.0	NB
A	*Sterna dougallii*	Roseate Tern	Endangered	Endangered	Endangered	S1?B,S1?M	1 At Risk	21	20.6 ± 0.0	NB
A	*Charadrius melodus melodus*	Piping Plover melodus ssp	Endangered	Endangered	Endangered	S1B,S1M	1 At Risk	24	19.6 ± 0.0	NB
A	*Dermochelys coriacea (Atlantic pop.)*	Leatherback Sea Turtle - Atlantic pop.	Endangered	Endangered	Endangered	S1S2N	1 At Risk	4	27.2 ± 0.0	NB
A	*Salmo salar pop. 1*	Atlantic Salmon - Inner Bay of Fundy pop.	Endangered	Endangered	Endangered	S2	2 May Be At Risk	7	14.7 ± 0.0	NB
A	*Calidris canutus rufa*	Red Knot rufa ssp	Endangered		Endangered	S2M	1 At Risk	379	19.6 ± 0.0	NB
A	*Rangifer tarandus pop. 2*	Woodland Caribou (Atlantic-Gasp├⌐sie pop.)	Endangered	Endangered	Extirpated	SX	0.1 Extirpated	4	47.1 ± 1.0	NB
A	*Sturnella magna*	Eastern Meadowlark	Threatened	Threatened	Threatened	S1B,S1M	2 May Be At Risk	28	22.8 ± 7.0	NB
A	*Ixobrychus exilis*	Least Bittern	Threatened	Threatened	Threatened	S1S2B,S1S2M	1 At Risk	28	6.0 ± 7.0	NB
A	*Hylocichla mustelina*	Wood Thrush	Threatened	Threatened	Threatened	S1S2B,S1S2M	2 May Be At Risk	163	7.0 ± 7.0	NB
A	*Caprimulgus vociferus*	Whip-Poor-Will	Threatened	Threatened	Threatened	S2B,S2M	1 At Risk	71	7.0 ± 7.0	NB
A	*Hirundo rustica*	Barn Swallow	Threatened	Threatened	Threatened	S2B,S2M	3 Sensitive	1036	2.3 ± 2.0	NB
A	*Catharus bicknelli*	Bicknell's Thrush	Threatened	Special Concern	Threatened	S2B,S2M	1 At Risk	21	7.3 ± 7.0	NB
A	*Glyptemys insculpta*	Wood Turtle	Threatened	Threatened	Threatened	S2S3	1 At Risk	66	12.7 ± 0.0	NB
A	*Chaetura pelagica*	Chimney Swift	Threatened	Threatened	Threatened	S2S3B,S2M	1 At Risk	272	6.0 ± 7.0	NB
A	*Riparia riparia*	Bank Swallow	Threatened	Threatened		S2S3B,S2S3M	3 Sensitive	323	6.7 ± 0.0	NB
A	*Acipenser oxyrinchus*	Atlantic Sturgeon	Threatened		Threatened	S3	4 Secure	1	58.0 ± 1.0	NB
A	*Wilsonia canadensis*	Canada Warbler	Threatened	Threatened	Threatened	S3B,S3M	1 At Risk	654	2.6 ± 0.0	NB
A	*Dolichonyx oryzivorus*	Bobolink	Threatened	Threatened	Threatened	S3B,S3M	3 Sensitive	531	3.1 ± 0.0	NB
A	*Anguilla rostrata*	American Eel	Threatened		Threatened	S4	4 Secure	35	17.7 ± 0.0	NB
A	*Osmerus mordax pop. 2*	Lake Utopia Smelt large-bodied pop.	Threatened		Threatened			2	6.9 ± 10.0	NB
A	*Coturnicops noveboracensis*	Yellow Rail	Special Concern	Special Concern	Special Concern	S1?B,SUM	2 May Be At Risk	3	87.1 ± 7.0	NB
A	*Histrionicus histrionicus pop. 1*	Harlequin Duck - Eastern pop.	Special Concern	Special Concern	Endangered	S1B,S1S2N,S2M	1 At Risk	205	18.3 ± 0.0	NB
A	*Falco peregrinus pop. 1*	Peregrine Falcon - anatum/tundrius	Special Concern	Special Concern	Endangered	S1B,S3M	1 At Risk	559	8.2 ± 7.0	NB
A	*Asio flammeus*	Short-eared Owl	Special Concern	Special Concern	Special Concern	S2B,S2M	3 Sensitive	17	46.1 ± 7.0	NB
A	*Bucephala islandica (Eastern pop.)*	Barrow's Goldeneye - Eastern pop.	Special Concern	Special Concern	Special Concern	S2M,S2N	3 Sensitive	55	13.0 ± 1.0	NB
A	*Balaenoptera physalus*	Fin Whale - Atlantic pop.	Special Concern	Special Concern	Special Concern	S2S3		5	38.5 ± 1.0	NB
A	*Acipenser brevirostrum*	Shortnose Sturgeon	Special Concern	Special Concern	Special Concern	S3	3 Sensitive	7	47.9 ± 10.0	NB
A	*Chelydra serpentina*	Snapping Turtle	Special Concern	Special Concern	Special Concern	S3	3 Sensitive	28	10.7 ± 1.0	NB
A	*Euphagus carolinus*	Rusty Blackbird	Special Concern	Special Concern	Special Concern	S3B,S3M	2 May Be At Risk	108	7.0 ± 7.0	NB
A	*Contopus cooperi*	Olive-sided Flycatcher	Special Concern	Threatened	Threatened	S3B,S3M	1 At Risk	229	6.4 ± 0.0	NB
A	*Coccothraustes vespertinus*	Evening Grosbeak	Special Concern			S3B,S3S4N,SUM	3 Sensitive	166	7.0 ± 7.0	NB
A	*Chordeiles minor*	Common Nighthawk	Special Concern	Threatened	Threatened	S3B,S4M	1 At Risk	258	5.2 ± 0.0	NB
A	*Phalaropus lobatus*	Red-necked Phalarope	Special Concern			S3M	3 Sensitive	222	16.7 ± 0.0	NB
A	*Phocoena phocoena (NW*	Harbour Porpoise -	Special Concern	Threatened		S4		231	4.5 ± 1.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
	Atlantic pop.)	Northwest Atlantic pop.								
A	*Contopus virens*	Eastern Wood-Pewee	Special Concern	Special Concern	Special Concern	S4B,S4M	4 Secure	434	6.0 ± 7.0	NB
A	*Podiceps auritus*	Horned Grebe	Special Concern		Special Concern	S4N,S4M	4 Secure	269	10.5 ± 0.0	NB
A	*Bubo scandiacus*	Snowy Owl	Not At Risk			S1N,S2S3M	4 Secure	30	29.6 ± 0.0	NB
A	*Accipiter cooperii*	Cooper's Hawk	Not At Risk			S1S2B,S1S2M	2 May Be At Risk	19	55.0 ± 1.0	NB
A	*Fulica americana*	American Coot	Not At Risk			S1S2B,S1S2M	3 Sensitive	4	7.3 ± 7.0	NB
A	*Aegolius funereus*	Boreal Owl	Not At Risk			S1S2B,SUM	2 May Be At Risk	5	45.7 ± 1.0	NB
A	*Sorex dispar*	Long-tailed Shrew	Not At Risk	Special Concern		S2	3 Sensitive	2	55.4 ± 1.0	NB
A	*Buteo lineatus*	Red-shouldered Hawk	Not At Risk	Special Concern		S2B,S2M	2 May Be At Risk	44	16.5 ± 0.0	NB
A	*Chlidonias niger*	Black Tern	Not At Risk			S2B,S2M	3 Sensitive	136	58.5 ± 4.0	NB
A	*Globicephala melas*	Long-finned Pilot Whale	Not At Risk			S2S3		3	14.6 ± 1.0	NB
A	*Lynx canadensis*	Canadian Lynx	Not At Risk		Endangered	S3	1 At Risk	7	22.9 ± 50.0	NB
A	*Desmognathus fuscus*	Northern Dusky Salamander	Not At Risk			S3	3 Sensitive	57	30.5 ± 1.0	NB
A	*Megaptera novaeangliae*	Humpback Whale (NW Atlantic pop.)	Not At Risk	Special Concern		S3		4	23.8 ± 5.0	NB
A	*Sterna hirundo*	Common Tern	Not At Risk			S3B,SUM	3 Sensitive	306	19.9 ± 11.0	NB
A	*Podiceps grisegena*	Red-necked Grebe	Not At Risk			S3M,S2N	3 Sensitive	680	9.8 ± 0.0	NB
A	*Lagenorhynchus acutus*	Atlantic White-sided Dolphin	Not At Risk			S3S4		1	56.6 ± 1.0	NB
A	*Haliaeetus leucocephalus*	Bald Eagle	Not At Risk		Endangered	S4	1 At Risk	1406	6.0 ± 7.0	NB
A	*Canis lupus*	Gray Wolf	Not At Risk		Extirpated	SX	0.1 Extirpated	3	43.0 ± 1.0	NB
A	*Puma concolor pop. 1*	Eastern Cougar	Data Deficient		Endangered	SNA	5 Undetermined	43	1.6 ± 1.0	NB
A	*Morone saxatilis*	Striped Bass	E,E,SC			S3	2 May Be At Risk	10	30.7 ± 1.0	NB
A	*Vireo flavifrons*	Yellow-throated Vireo				S1?B,S1?M	8 Accidental	16	41.6 ± 0.0	NB
A	*Tringa melanoleuca*	Greater Yellowlegs				S1?B,S5M	4 Secure	953	10.4 ± 0.0	NB
A	*Aythya americana*	Redhead				S1B,S1M	8 Accidental	4	32.2 ± 0.0	NB
A	*Gallinula chloropus*	Common Moorhen				S1B,S1M	3 Sensitive	18	8.8 ± 5.0	NB
A	*Grus canadensis*	Sandhill Crane				S1B,S1M	8 Accidental	7	20.6 ± 0.0	NB
A	*Bartramia longicauda*	Upland Sandpiper				S1B,S1M	3 Sensitive	47	1.4 ± 0.0	NB
A	*Phalaropus tricolor*	Wilson's Phalarope				S1B,S1M	3 Sensitive	58	34.0 ± 7.0	NB
A	*Leucophaeus atricilla*	Laughing Gull				S1B,S1M	3 Sensitive	89	12.5 ± 0.0	NB
A	*Progne subis*	Purple Martin				S1B,S1M	2 May Be At Risk	193	27.7 ± 0.0	NB
A	*Thryothorus ludovicianus*	Carolina Wren				S1B,S1M	8 Accidental	35	15.7 ± 0.0	NB
A	*Oxyura jamaicensis*	Ruddy Duck				S1B,S2S3M	4 Secure	48	11.2 ± 0.0	NB
A	*Uria aalge*	Common Murre				S1B,S3N,S3M	4 Secure	145	17.7 ± 0.0	NB
A	*Aythya affinis*	Lesser Scaup				S1B,S4M	4 Secure	203	18.9 ± 2.0	NB
A	*Aythya marila*	Greater Scaup				S1B,S4M,S2N	4 Secure	36	19.5 ± 1.0	NB
A	*Eremophila alpestris*	Horned Lark				S1B,S4N,S5M	2 May Be At Risk	26	2.0 ± 7.0	NB
A	*Sterna paradisaea*	Arctic Tern				S1B,SUM	2 May Be At Risk	149	13.0 ± 1.0	NB
A	*Fratercula arctica*	Atlantic Puffin				S1B,SUN,SUM	3 Sensitive	186	13.0 ± 1.0	NB
A	*Branta bernicla*	Brant				S1N, S2S3M	4 Secure	545	9.2 ± 10.0	NB
A	*Chroicocephalus ridibundus*	Black-headed Gull				S1N,S2M	3 Sensitive	42	11.6 ± 0.0	NB
A	*Butorides virescens*	Green Heron				S1S2B,S1S2M	3 Sensitive	22	29.6 ± 7.0	NB
A	*Nycticorax nycticorax*	Black-crowned Night-heron				S1S2B,S1S2M	3 Sensitive	62	8.7 ± 0.0	NB
A	*Empidonax traillii*	Willow Flycatcher				S1S2B,S1S2M	3 Sensitive	78	2.3 ± 2.0	NB
A	*Stelgidopteryx serripennis*	Northern Rough-winged Swallow				S1S2B,S1S2M	2 May Be At Risk	24	6.0 ± 7.0	NB
A	*Troglodytes aedon*	House Wren				S1S2B,S1S2M	5 Undetermined	31	13.9 ± 0.0	NB
A	*Rissa tridactyla*	Black-legged Kittiwake				S1S2B,S4N,S5M	4 Secure	49	16.5 ± 0.0	NB
A	*Calidris bairdii*	Baird's Sandpiper				S1S2M	3 Sensitive	102	37.6 ± 1.0	NB
A	*Cistothorus palustris*	Marsh Wren				S2B,S2M	3 Sensitive	86	31.1 ± 0.0	NB
A	*Mimus polyglottos*	Northern Mockingbird				S2B,S2M	3 Sensitive	147	2.0 ± 7.0	NB
A	*Toxostoma rufum*	Brown Thrasher				S2B,S2M	3 Sensitive	76	1.9 ± 0.0	NB
A	*Pooecetes gramineus*	Vesper Sparrow				S2B,S2M	2 May Be At Risk	62	1.9 ± 0.0	NB
A	*Anas strepera*	Gadwall				S2B,S3M	4 Secure	89	26.0 ± 7.0	NB
A	*Alca torda*	Razorbill				S2B,S3N,S3M	4 Secure	181	17.7 ± 0.0	NB
A	*Pinicola enucleator*	Pine Grosbeak				S2B,S4S5N,S4S5M	3 Sensitive	22	21.6 ± 7.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
A	*Tringa solitaria*	Solitary Sandpiper				S2B,S5M	4 Secure	255	6.6 ± 0.0	NB
A	*Oceanodroma leucorhoa*	Leach's Storm-Petrel				S2B,SUM	3 Sensitive	140	16.5 ± 0.0	NB
A	*Chen caerulescens*	Snow Goose				S2M	4 Secure	7	46.2 ± 0.0	NB
A	*Phalacrocorax carbo*	Great Cormorant				S2N,S2M	4 Secure	312	10.5 ± 0.0	NB
A	*Somateria spectabilis*	King Eider				S2N,S2M	4 Secure	56	13.3 ± 32.0	NB
A	*Larus hyperboreus*	Glaucous Gull				S2N,S2M	4 Secure	156	8.9 ± 0.0	NB
A	*Asio otus*	Long-eared Owl				S2S3	5 Undetermined	20	2.6 ± 6.0	NB
A	*Picoides dorsalis*	American Three-toed Woodpecker				S2S3	3 Sensitive	10	21.6 ± 7.0	NB
A	*Salmo salar*	Atlantic Salmon				S2S3	2 May Be At Risk	35	8.8 ± 1.0	NB
A	*Anas clypeata*	Northern Shoveler				S2S3B,S2S3M	4 Secure	76	8.1 ± 4.0	NB
A	*Myiarchus crinitus*	Great Crested Flycatcher				S2S3B,S2S3M	3 Sensitive	192	7.0 ± 7.0	NB
A	*Petrochelidon pyrrhonota*	Cliff Swallow				S2S3B,S2S3M	3 Sensitive	411	6.0 ± 7.0	NB
A	*Pluvialis dominica*	American Golden-Plover				S2S3M	3 Sensitive	266	19.6 ± 0.0	NB
A	*Calcarius lapponicus*	Lapland Longspur				S2S3N,SUM	3 Sensitive	38	44.2 ± 1.0	NB
A	*Cepphus grylle*	Black Guillemot				S3	4 Secure	783	8.2 ± 7.0	NB
A	*Loxia curvirostra*	Red Crossbill				S3	4 Secure	99	6.0 ± 7.0	NB
A	*Carduelis pinus*	Pine Siskin				S3	4 Secure	200	2.8 ± 0.0	NB
A	*Prosopium cylindraceum*	Round Whitefish				S3	4 Secure	2	70.2 ± 10.0	NB
A	*Salvelinus namaycush*	Lake Trout				S3	3 Sensitive	4	24.0 ± 0.0	NB
A	*Sorex maritimensis*	Maritime Shrew				S3	4 Secure	1	92.6 ± 1.0	NB
A	*Eptesicus fuscus*	Big Brown Bat				S3	3 Sensitive	47	11.1 ± 1.0	NB
A	*Cathartes aura*	Turkey Vulture				S3B,S3M	4 Secure	267	2.6 ± 2.0	NB
A	*Rallus limicola*	Virginia Rail				S3B,S3M	3 Sensitive	112	6.0 ± 7.0	NB
A	*Charadrius vociferus*	Killdeer				S3B,S3M	3 Sensitive	705	2.5 ± 0.0	NB
A	*Tringa semipalmata*	Willet				S3B,S3M	3 Sensitive	159	19.6 ± 0.0	NB
A	*Coccyzus erythropthalmus*	Black-billed Cuckoo				S3B,S3M	4 Secure	159	6.0 ± 7.0	NB
A	*Vireo gilvus*	Warbling Vireo				S3B,S3M	4 Secure	198	6.0 ± 7.0	NB
A	*Piranga olivacea*	Scarlet Tanager				S3B,S3M	4 Secure	150	6.0 ± 7.0	NB
A	*Passerina cyanea*	Indigo Bunting				S3B,S3M	4 Secure	98	2.8 ± 0.0	NB
A	*Molothrus ater*	Brown-headed Cowbird				S3B,S3M	2 May Be At Risk	221	7.3 ± 7.0	NB
A	*Icterus galbula*	Baltimore Oriole				S3B,S3M	4 Secure	158	6.0 ± 7.0	NB
A	*Somateria mollissima*	Common Eider				S3B,S4M,S3N	4 Secure	1955	7.3 ± 7.0	NB
A	*Dendroica tigrina*	Cape May Warbler				S3B,S4S5M	4 Secure	111	7.0 ± 7.0	NB
A	*Anas acuta*	Northern Pintail				S3B,S5M	3 Sensitive	47	31.6 ± 1.0	NB
A	*Mergus serrator*	Red-breasted Merganser				S3B,S5M,S4S5N	4 Secure	371	7.3 ± 7.0	NB
A	*Arenaria interpres*	Ruddy Turnstone				S3M	4 Secure	706	19.6 ± 0.0	NB
A	*Phalaropus fulicarius*	Red Phalarope				S3M	3 Sensitive	126	16.7 ± 0.0	NB
A	*Melanitta nigra*	Black Scoter				S3M,S1S2N	3 Sensitive	803	7.6 ± 0.0	NB
A	*Bucephala albeola*	Bufflehead				S3M,S2N	3 Sensitive	1113	8.3 ± 0.0	NB
A	*Calidris maritima*	Purple Sandpiper				S3M,S3N	4 Secure	269	9.2 ± 21.0	NB
A	*Uria lomvia*	Thick-billed Murre				S3N,S3M	5 Undetermined	67	12.1 ± 0.0	NB
A	*Synaptomys cooperi*	Southern Bog Lemming				S3S4	4 Secure	18	56.4 ± 1.0	NB
A	*Tyrannus tyrannus*	Eastern Kingbird				S3S4B,S3S4M	3 Sensitive	409	6.0 ± 7.0	NB
A	*Actitis macularius*	Spotted Sandpiper				S3S4B,S5M	4 Secure	862	6.0 ± 7.0	NB
A	*Gallinago delicata*	Wilson's Snipe				S3S4B,S5M	4 Secure	564	6.0 ± 7.0	NB
A	*Larus delawarensis*	Ring-billed Gull				S3S4B,S5M	4 Secure	230	11.2 ± 0.0	NB
A	*Dendroica striata*	Blackpoll Warbler				S3S4B,S5M	4 Secure	86	7.3 ± 7.0	NB
A	*Pluvialis squatarola*	Black-bellied Plover				S3S4M	4 Secure	841	10.4 ± 0.0	NB
A	*Limosa haemastica*	Hudsonian Godwit				S3S4M	4 Secure	92	31.9 ± 0.0	NB
A	*Calidris pusilla*	Semipalmated Sandpiper				S3S4M	4 Secure	2050	10.4 ± 0.0	NB
A	*Calidris melanotos*	Pectoral Sandpiper				S3S4M	4 Secure	310	22.3 ± 0.0	NB
A	*Calidris alba*	Sanderling				S3S4M,S1N	3 Sensitive	843	19.6 ± 0.0	NB
A	*Morus bassanus*	Northern Gannet				SHB,S5M	4 Secure	840	12.6 ± 0.0	NB
A	*Lanius ludovicianus*	Loggerhead Shrike				SXB,SXM	1 At Risk	1	55.0 ± 1.0	NB
C	*Quercus macrocarpa - Acer rubrum / Onoclea sensibilis -*	Bur Oak - Red Maple / Sensitive Fern - Northern				S2		1	92.3 ± 0.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
	Carex arcta Forest	Clustered Sedge Forest								
C	*Acer saccharinum / Onoclea sensibilis - Lysimachia terrestris Forest*	Silver Maple / Sensitive Fern - Swamp Yellow Loosestrife Forest				S3		1	60.5 ± 0.0	NB
C	*Acer saccharum - Fraxinus americana / Polystichum acrostichoides Forest*	Sugar Maple - White Ash / Christmas Fern Forest				S3S4		1	74.8 ± 0.0	NB
I	*Cicindela marginipennis*	Cobblestone Tiger Beetle	Endangered	Endangered	Endangered	S1	1 At Risk	4	97.9 ± 0.0	NB
I	*Gomphus ventricosus*	Skillet Clubtail	Endangered		Endangered	S1S2	2 May Be At Risk	48	83.8 ± 0.0	NB
I	*Danaus plexippus*	Monarch	Endangered	Special Concern	Special Concern	S3B,S3M	3 Sensitive	111	7.3 ± 5.0	NB
I	*Ophiogomphus howei*	Pygmy Snaketail	Special Concern	Special Concern	Special Concern	S2	2 May Be At Risk	17	13.2 ± 0.0	NB
I	*Alasmidonta varicosa*	Brook Floater	Special Concern		Special Concern	S2	3 Sensitive	1	66.4 ± 0.0	NB
I	*Lampsilis cariosa*	Yellow Lampmussel	Special Concern	Special Concern	Special Concern	S2	3 Sensitive	81	60.5 ± 0.0	NB
I	*Bombus terricola*	Yellow-banded Bumblebee	Special Concern			S3?	3 Sensitive	19	25.7 ± 0.0	NB
I	*Appalachina sayana*	Spike-lip Crater	Not At Risk			S3?		1	59.2 ± 1.0	NB
I	*Haematopota rara*	Shy Cleg				S1	5 Undetermined	1	88.4 ± 1.0	NB
I	*Lycaena dorcas*	Dorcas Copper				S1	2 May Be At Risk	1	43.2 ± 0.0	NB
I	*Erora laeta*	Early Hairstreak				S1	2 May Be At Risk	4	68.6 ± 7.0	NB
I	*Somatochlora septentrionalis*	Muskeg Emerald				S1	2 May Be At Risk	1	89.5 ± 1.0	NB
I	*Arigomphus furcifer*	Lilypad Clubtail				S1	5 Undetermined	8	57.8 ± 0.0	NB
I	*Polites origenes*	Crossline Skipper				S1?	5 Undetermined	5	79.7 ± 0.0	NB
I	*Plebejus saepiolus*	Greenish Blue				S1S2	4 Secure	3	14.2 ± 0.0	NB
I	*Ophiogomphus colubrinus*	Boreal Snaketail				S1S2	2 May Be At Risk	36	19.9 ± 1.0	NB
I	*Brachyleptura circumdata*	a Longhorned Beetle				S2		6	87.5 ± 0.0	NB
I	*Satyrium calanus falacer*	Banded Hairstreak				S2	4 Secure	17	87.8 ± 0.0	NB
I	*Strymon melinus*	Grey Hairstreak				S2	4 Secure	4	30.7 ± 1.0	NB
I	*Aeshna clepsydra*	Mottled Darner				S2	3 Sensitive	8	44.3 ± 1.0	NB
I	*Somatochlora tenebrosa*	Clamp-Tipped Emerald				S2	5 Undetermined	4	51.7 ± 1.0	NB
I	*Ladona exusta*	White Corporal				S2	5 Undetermined	10	25.2 ± 0.0	NB
I	*Hetaerina americana*	American Rubyspot				S2	3 Sensitive	2	66.4 ± 0.0	NB
I	*Ischnura posita*	Fragile Forktail				S2	2 May Be At Risk	9	9.7 ± 0.0	NB
I	*Callophrys henrici*	Henry's Elfin				S2S3	4 Secure	15	77.1 ± 0.0	NB
I	*Celithemis martha*	Martha's Pennant				S2S3	5 Undetermined	3	39.5 ± 0.0	NB
I	*Sphaeroderus nitidicollis*	a Ground Beetle				S3	4 Secure	1	91.1 ± 0.0	NB
I	*Lepturopsis biforis*	a Longhorned Beetle				S3		1	55.1 ± 1.0	NB
I	*Orthosoma brunneum*	a Longhorned Beetle				S3		1	95.6 ± 5.0	NB
I	*Elaphrus americanus*	a Ground Beetle				S3	4 Secure	1	87.6 ± 0.0	NB
I	*Desmocerus palliatus*	Elderberry Borer				S3		4	55.1 ± 1.0	NB
I	*Agonum excavatum*	a Ground Beetle				S3	4 Secure	1	87.6 ± 0.0	NB
I	*Clivina americana*	a Ground Beetle				S3	4 Secure	1	87.6 ± 0.0	NB
I	*Olisthopus parmatus*	a Ground Beetle				S3	4 Secure	1	91.1 ± 0.0	NB
I	*Paratachys scitulus*	a Ground Beetle				S3	5 Undetermined	1	87.6 ± 0.0	NB
I	*Coccinella hieroglyphica kirbyi*	a Ladybird Beetle				S3	4 Secure	1	55.1 ± 1.0	NB
I	*Hippodamia parenthesis*	Parenthesis Lady Beetle				S3	4 Secure	2	55.1 ± 1.0	NB
I	*Stenocorus vittigera*	a Longhorned Beetle				S3		1	87.6 ± 0.0	NB
I	*Gnathacmaeops pratensis*	a Longhorned Beetle				S3		5	55.1 ± 1.0	NB
I	*Pogonocherus mixtus*	a Longhorned Beetle				S3		1	55.1 ± 1.0	NB
I	*Badister neopulchellus*	a Ground Beetle				S3	4 Secure	1	87.6 ± 0.0	NB
I	*Saperda lateralis*	a Longhorned Beetle				S3		2	42.9 ± 0.0	NB
I	*Hesperia sassacus*	Indian Skipper				S3	4 Secure	9	50.5 ± 7.0	NB
I	*Euphyes bimacula*	Two-spotted Skipper				S3	4 Secure	10	2.0 ± 0.0	NB
I	*Lycaena hyllus*	Bronze Copper				S3	3 Sensitive	6	31.1 ± 1.0	NB
I	*Satyrium acadica*	Acadian Hairstreak				S3	4 Secure	9	49.1 ± 1.0	NB
I	*Callophrys polios*	Hoary Elfin				S3	4 Secure	13	42.7 ± 7.0	NB
I	*Plebejus idas empetri*	Crowberry Blue				S3	4 Secure	14	8.2 ± 7.0	NB
I	*Speyeria aphrodite*	Aphrodite Fritillary				S3	4 Secure	26	2.0 ± 0.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
I	*Boloria bellona*	Meadow Fritillary				S3	4 Secure	41	12.4 ± 1.0	NB
I	*Polygonia satyrus*	Satyr Comma				S3	4 Secure	13	43.8 ± 1.0	NB
I	*Polygonia gracilis*	Hoary Comma				S3	4 Secure	5	45.8 ± 7.0	NB
I	*Nymphalis l-album*	Compton Tortoiseshell				S3	4 Secure	24	44.5 ± 1.0	NB
I	*Gomphus vastus*	Cobra Clubtail				S3	3 Sensitive	55	73.8 ± 0.0	NB
I	*Gomphus abbreviatus*	Spine-crowned Clubtail				S3	4 Secure	23	45.6 ± 0.0	NB
I	*Gomphaeschna furcillata*	Harlequin Darner				S3	5 Undetermined	10	49.1 ± 1.0	NB
I	*Dorocordulia lepida*	Petite Emerald				S3	4 Secure	22	42.7 ± 1.0	NB
I	*Somatochlora cingulata*	Lake Emerald				S3	4 Secure	11	24.7 ± 1.0	NB
I	*Somatochlora forcipata*	Forcipate Emerald				S3	4 Secure	18	25.7 ± 1.0	NB
I	*Williamsonia fletcheri*	Ebony Boghaunter				S3	4 Secure	13	49.1 ± 1.0	NB
I	*Lestes eurinus*	Amber-Winged Spreadwing				S3	4 Secure	8	38.3 ± 1.0	NB
I	*Lestes vigilax*	Swamp Spreadwing				S3	3 Sensitive	35	9.7 ± 0.0	NB
I	*Enallagma geminatum*	Skimming Bluet				S3	5 Undetermined	12	44.3 ± 1.0	NB
I	*Enallagma signatum*	Orange Bluet				S3	4 Secure	15	6.6 ± 0.0	NB
I	*Stylurus scudderi*	Zebra Clubtail				S3	4 Secure	68	12.8 ± 0.0	NB
I	*Alasmidonta undulata*	Triangle Floater				S3	3 Sensitive	25	32.3 ± 1.0	NB
I	*Leptodea ochracea*	Tidewater Mucket				S3	4 Secure	56	47.3 ± 1.0	NB
I	*Striatura ferrea*	Black Striate				S3		1	88.5 ± 1.0	NB
I	*Neohelix albolabris*	Whitelip				S3		2	88.5 ± 1.0	NB
I	*Spurwinkia salsa*	Saltmarsh Hydrobe				S3		34	39.8 ± 0.0	NB
I	*Pantala hymenaea*	Spot-Winged Glider				S3B,S3M	4 Secure	6	20.0 ± 0.0	NB
I	*Satyrium liparops strigosum*	Striped Hairstreak				S3S4	4 Secure	7	46.6 ± 7.0	NB
I	*Cupido comyntas*	Eastern Tailed Blue				S3S4	4 Secure	9	41.8 ± 0.0	NB
I	*Coccinella transversoguttata richardsoni*	Transverse Lady Beetle				SH	2 May Be At Risk	2	45.7 ± 0.0	NB
N	*Erioderma pedicellatum (Atlantic pop.)*	Boreal Felt Lichen - Atlantic pop.	Endangered	Endangered	Endangered	SH	1 At Risk	1	32.2 ± 1.0	NB
N	*Degelia plumbea*	BluDegelia plumbeae Felt Lichen	Special Concern	Special Concern	Special Concern	S1	2 May Be At Risk	2	31.4 ± 5.0	NB
N	*Pseudevernia cladonia*	Ghost Antler Lichen	Not At Risk			S2S3	5 Undetermined	17	7.9 ± 0.0	NB
N	*Bryum muehlenbeckii*	Muehlenbeck's Bryum Moss				S1	2 May Be At Risk	1	48.5 ± 1.0	NB
N	*Sphagnum macrophyllum*	Sphagnum				S1	2 May Be At Risk	2	37.5 ± 0.0	NB
N	*Coscinodon cribrosus*	Sieve-Toothed Moss				S1	2 May Be At Risk	1	52.0 ± 0.0	NB
N	*Peltigera collina*	Tree Pelt Lichen				S1	2 May Be At Risk	1	49.3 ± 10.0	NB
N	*Atrichum angustatum*	Lesser Smoothcap Moss				S1?	2 May Be At Risk	1	98.2 ± 3.0	NS
N	*Calliergon trifarium*	Three-ranked Moss				S1?	2 May Be At Risk	1	42.4 ± 0.0	NB
N	*Dichelyma falcatum*	a Moss				S1?	2 May Be At Risk	2	46.9 ± 1.0	NB
N	*Dicranum bonjeanii*	Bonjean's Broom Moss				S1?	2 May Be At Risk	1	90.4 ± 1.0	NB
N	*Eurhynchium hians*	Light Beaked Moss				S1?	2 May Be At Risk	1	92.2 ± 1.0	NB
N	*Plagiothecium latebricola*	Alder Silk Moss				S1?	2 May Be At Risk	1	48.4 ± 0.0	NB
N	*Racomitrium ericoides*	a Moss				S1?	2 May Be At Risk	1	63.5 ± 3.0	NB
N	*Splachnum pennsylvanicum*	Southern Dung Moss				S1?	2 May Be At Risk	1	88.6 ± 0.0	NB
N	*Platylomella lescurii*	a Moss				S1?	5 Undetermined	1	32.8 ± 1.0	NB
N	*Jungermannia obovata*	Egg Flapwort				S1S2	6 Not Assessed	1	62.1 ± 0.0	NB
N	*Pallavicinia lyellii*	Lyell's Ribbonwort				S1S2	6 Not Assessed	1	65.0 ± 1.0	NB
N	*Reboulia hemisphaerica*	Purple-margined Liverwort				S1S2	6 Not Assessed	1	32.6 ± 1.0	NB
N	*Brachythecium acuminatum*	Acuminate Ragged Moss				S1S2	5 Undetermined	4	92.2 ± 10.0	NB
N	*Bryum salinum*	a Moss				S1S2	2 May Be At Risk	1	15.7 ± 1.0	NB
N	*Campylium radicale*	Long-stalked Fine Wet Moss				S1S2	5 Undetermined	1	92.2 ± 1.0	NB
N	*Tortula obtusifolia*	a Moss				S1S2	2 May Be At Risk	1	97.0 ± 0.0	NB
N	*Ditrichum pallidum*	Pale Cow-hair Moss				S1S2	2 May Be At Risk	1	82.8 ± 1.0	NB
N	*Sphagnum platyphyllum*	Flat-leaved Peat Moss				S1S2	5 Undetermined	2	60.2 ± 0.0	NB
N	*Tomentypnum falcifolium*	Sickle-leaved Golden Moss				S1S2	2 May Be At Risk	1	25.1 ± 1.0	NB
N	*Pseudotaxiphyllum distichaceum*	a Moss				S1S2	2 May Be At Risk	2	15.7 ± 1.0	NB
N	*Hamatocaulis vernicosus*	a Moss				S1S2	2 May Be At Risk	1	77.6 ± 100.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
N	*Calypogeia neesiana*	Nees' Pouchwort				S1S3	6 Not Assessed	1	74.2 ± 1.0	NB
N	*Cephaloziella elachista*	Spurred Threadwort				S1S3	6 Not Assessed	1	42.3 ± 5.0	NB
N	*Porella pinnata*	Pinnate Scalewort				S1S3	6 Not Assessed	2	60.4 ± 1.0	NB
N	*Amphidium mougeotii*	a Moss				S2	3 Sensitive	2	33.4 ± 8.0	NB
N	*Anomodon viticulosus*	a Moss				S2	2 May Be At Risk	4	51.5 ± 1.0	NB
N	*Cynodontium strumiferum*	Strumose Dogtooth Moss				S2	3 Sensitive	1	33.4 ± 8.0	NB
N	*Dicranella palustris*	Drooping-Leaved Fork Moss				S2	3 Sensitive	2	93.2 ± 100.0	NB
N	*Didymodon ferrugineus*	a moss				S2	3 Sensitive	1	73.3 ± 1.0	NB
N	*Anomodon tristis*	a Moss				S2	2 May Be At Risk	1	59.7 ± 1.0	NB
N	*Hypnum pratense*	Meadow Plait Moss				S2	3 Sensitive	1	45.7 ± 0.0	NB
N	*Meesia triquetra*	Three-ranked Cold Moss				S2	2 May Be At Risk	1	97.3 ± 100.0	NB
N	*Physcomitrium immersum*	a Moss				S2	3 Sensitive	6	79.0 ± 1.0	NB
N	*Sphagnum centrale*	Central Peat Moss				S2	3 Sensitive	2	58.7 ± 0.0	NB
N	*Sphagnum lindbergii*	Lindberg's Peat Moss				S2	3 Sensitive	8	15.7 ± 1.0	NB
N	*Tayloria serrata*	Serrate Trumpet Moss				S2	3 Sensitive	1	84.6 ± 1.0	NB
N	*Tetraplodon mnioides*	Entire-leaved Nitrogen Moss				S2	3 Sensitive	3	15.7 ± 1.0	NB
N	*Tortula mucronifolia*	Mucronate Screw Moss				S2	3 Sensitive	1	51.6 ± 0.0	NB
N	*Ulota phyllantha*	a Moss				S2	3 Sensitive	2	15.7 ± 1.0	NB
N	*Anomobryum filiforme*	a moss				S2	5 Undetermined	1	92.2 ± 1.0	NB
N	*Fuscopannaria leucosticta*	Rimmed Shingles Lichen				S2	2 May Be At Risk	41	48.1 ± 0.0	NB
N	*Nephroma laevigatum*	Mustard Kidney Lichen				S2	2 May Be At Risk	1	49.3 ± 10.0	NB
N	*Andreaea rothii*	a Moss				S2?	3 Sensitive	1	72.4 ± 0.0	NB
N	*Brachythecium digastrum*	a Moss				S2?	3 Sensitive	2	85.1 ± 0.0	NB
N	*Bryum pallescens*	Pale Bryum Moss				S2?	5 Undetermined	2	41.2 ± 1.0	NB
N	*Dichelyma capillaceum*	Hairlike Dichelyma Moss				S2?	3 Sensitive	1	81.3 ± 4.0	NB
N	*Dicranum spurium*	Spurred Broom Moss				S2?	3 Sensitive	2	25.0 ± 0.0	NB
N	*Schistostega pennata*	Luminous Moss				S2?	3 Sensitive	2	92.2 ± 1.0	NB
N	*Seligeria campylopoda*	a Moss				S2?	3 Sensitive	1	77.6 ± 100.0	NB
N	*Seligeria diversifolia*	a Moss				S2?	3 Sensitive	1	94.9 ± 0.0	NB
N	*Sphagnum angermanicum*	a Peatmoss				S2?	3 Sensitive	2	27.8 ± 10.0	NB
N	*Bryum uliginosum*	a Moss				S2S3	3 Sensitive	1	75.1 ± 4.0	NB
N	*Buxbaumia aphylla*	Brown Shield Moss				S2S3	3 Sensitive	2	33.4 ± 8.0	NB
N	*Calliergonella cuspidata*	Common Large Wetland Moss				S2S3	3 Sensitive	5	24.9 ± 10.0	NB
N	*Campylium polygamum*	a Moss				S2S3	3 Sensitive	1	76.3 ± 1.0	NB
N	*Didymodon rigidulus*	Rigid Screw Moss				S2S3	3 Sensitive	1	78.6 ± 8.0	NB
N	*Fissidens bushii*	Bush's Pocket Moss				S2S3	3 Sensitive	1	98.2 ± 3.0	NS
N	*Orthotrichum speciosum*	Showy Bristle Moss				S2S3	5 Undetermined	3	20.4 ± 2.0	NB
N	*Racomitrium fasciculare*	a Moss				S2S3	3 Sensitive	1	25.9 ± 0.0	NB
N	*Scorpidium scorpioides*	Hooked Scorpion Moss				S2S3	3 Sensitive	4	42.4 ± 0.0	NB
N	*Sphagnum subfulvum*	a Peatmoss				S2S3	2 May Be At Risk	4	25.1 ± 1.0	NB
N	*Taxiphyllum deplanatum*	Imbricate Yew-leaved Moss				S2S3	3 Sensitive	1	15.7 ± 1.0	NB
N	*Zygodon viridissimus*	a Moss				S2S3	2 May Be At Risk	3	27.2 ± 3.0	NB
N	*Schistidium agassizii*	Elf Bloom Moss				S2S3	3 Sensitive	2	20.4 ± 2.0	NB
N	*Loeskeobryum brevirostre*	a Moss				S2S3	3 Sensitive	4	85.9 ± 3.0	NS
N	*Cynodontium tenellum*	Delicate Dogtooth Moss				S3	3 Sensitive	1	15.7 ± 1.0	NB
N	*Hypnum curvifolium*	Curved-leaved Plait Moss				S3	3 Sensitive	1	30.0 ± 5.0	NB
N	*Schistidium maritimum*	a Moss				S3	4 Secure	2	15.7 ± 1.0	NB
N	*Cladonia strepsilis*	Olive Cladonia Lichen				S3	4 Secure	1	79.6 ± 0.0	NB
N	*Aulacomnium androgynum*	Little Groove Moss				S3?	4 Secure	3	30.0 ± 5.0	NB
N	*Dicranella rufescens*	Red Forklet Moss				S3?	5 Undetermined	2	86.7 ± 4.0	NB
N	*Rhytidiadelphus loreus*	Lanky Moss				S3?	2 May Be At Risk	1	61.8 ± 10.0	NB
N	*Sphagnum lescurii*	a Peatmoss				S3?	5 Undetermined	2	58.1 ± 1.0	NB
N	*Anomodon rugelii*	Rugel's Anomodon Moss				S3S4	3 Sensitive	1	98.2 ± 3.0	NS
N	*Barbula convoluta*	Lesser Bird's-claw Beard Moss				S3S4	4 Secure	1	78.6 ± 8.0	NB
N	*Brachythecium velutinum*	Velvet Ragged Moss				S3S4	4 Secure	3	28.1 ± 0.0	NB

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N	*Dicranella cerviculata*	a Moss				S3S4	3 Sensitive	3	15.7 ± 1.0	NB
N	*Dicranum majus*	Greater Broom Moss				S3S4	4 Secure	6	15.7 ± 1.0	NB
N	*Fissidens bryoides*	Lesser Pocket Moss				S3S4	4 Secure	2	73.1 ± 5.0	NB
N	*Heterocladium dimorphum*	Dimorphous Tangle Moss				S3S4	4 Secure	1	20.4 ± 2.0	NB
N	*Isopterygiopsis muelleriana*	a Moss				S3S4	4 Secure	6	28.1 ± 0.0	NB
N	*Myurella julacea*	Small Mouse-tail Moss				S3S4	4 Secure	1	33.4 ± 8.0	NB
N	*Physcomitrium pyriforme*	Pear-shaped Urn Moss				S3S4	3 Sensitive	3	85.6 ± 0.0	NB
N	*Pogonatum dentatum*	Mountain Hair Moss				S3S4	4 Secure	1	15.7 ± 1.0	NB
N	*Sphagnum torreyanum*	a Peatmoss				S3S4	4 Secure	4	38.8 ± 0.0	NB
N	*Sphagnum austinii*	Austin's Peat Moss				S3S4	4 Secure	1	38.8 ± 1.0	NB
N	*Sphagnum contortum*	Twisted Peat Moss				S3S4	4 Secure	1	61.1 ± 0.0	NB
N	*Splachnum rubrum*	Red Collar Moss				S3S4	4 Secure	1	78.6 ± 1.0	NB
N	*Tetraphis geniculata*	Geniculate Four-tooth Moss				S3S4	4 Secure	4	15.4 ± 0.0	NB
N	*Tetraplodon angustatus*	Toothed-leaved Nitrogen Moss				S3S4	4 Secure	2	15.7 ± 1.0	NB
N	*Trichostomum tenuirostre*	Acid-Soil Moss				S3S4	4 Secure	2	28.1 ± 0.0	NB
N	*Cladonia floerkeana*	Gritty British Soldiers Lichen				S3S4	4 Secure	1	79.6 ± 0.0	NB
N	*Nephroma parile*	Powdery Kidney Lichen				S3S4	4 Secure	1	82.8 ± 0.0	NB
N	*Protopannaria pezizoides*	Brown-gray Moss-shingle Lichen				S3S4	4 Secure	1	53.1 ± 0.0	NB
N	*Pseudocyphellaria perpetua*	Gilded Specklebelly Lichen				S3S4	3 Sensitive	4	50.1 ± 0.0	NB
N	*Pannaria conoplea*	Mealy-rimmed Shingle Lichen				S3S4	3 Sensitive	4	50.2 ± 0.0	NB
N	*Dermatocarpon luridum*	Brookside Stippleback Lichen				S3S4	4 Secure	2	83.0 ± 0.0	NB
N	*Grimmia anodon*	Toothless Grimmia Moss				SH	5 Undetermined	2	53.6 ± 10.0	NB
N	*Leucodon brachypus*	a Moss				SH	2 May Be At Risk	3	25.1 ± 100.0	NB
N	*Thelia hirtella*	a Moss				SH	2 May Be At Risk	2	97.3 ± 100.0	NB
P	*Juglans cinerea*	Butternut	Endangered	Endangered	Endangered	S1	1 At Risk	53	58.7 ± 1.0	NB
P	*Polemonium vanbruntiae*	Van Brunt's Jacob's-ladder	Threatened	Threatened	Threatened	S1	1 At Risk	72	5.5 ± 0.0	NB
P	*Symphyotrichum anticostense*	Anticosti Aster	Threatened	Threatened	Endangered	S2S3	1 At Risk	4	92.3 ± 0.0	NB
P	*Isoetes prototypus*	Prototype Quillwort	Special Concern	Special Concern	Endangered	S2	1 At Risk	21	50.8 ± 0.0	NB
P	*Pterospora andromedea*	Woodland Pinedrops			Endangered	S1	1 At Risk	11	92.3 ± 0.0	NB
P	*Sanicula trifoliata*	Large-Fruited Sanicle				S1	2 May Be At Risk	1	82.3 ± 5.0	NB
P	*Antennaria parlinii*	a Pussytoes				S1	2 May Be At Risk	7	43.7 ± 0.0	NB
P	*Antennaria howellii ssp. petaloidea*	Pussy-Toes				S1	2 May Be At Risk	4	46.2 ± 1.0	NB
P	*Bidens discoidea*	Swamp Beggarticks				S1	2 May Be At Risk	3	90.5 ± 0.0	NB
P	*Helianthus decapetalus*	Ten-rayed Sunflower				S1	2 May Be At Risk	13	92.2 ± 1.0	NB
P	*Hieracium kalmii*	Kalm's Hawkweed				S1	2 May Be At Risk	6	14.7 ± 1.0	NB
P	*Hieracium kalmii var. kalmii*	Kalm's Hawkweed				S1	2 May Be At Risk	7	14.0 ± 1.0	NB
P	*Hieracium paniculatum*	Panicled Hawkweed				S1	2 May Be At Risk	14	73.2 ± 1.0	NB
P	*Senecio pseudoarnica*	Seabeach Ragwort				S1	2 May Be At Risk	14	52.7 ± 0.0	NB
P	*Cardamine parviflora var. arenicola*	Small-flowered Bittercress				S1	2 May Be At Risk	12	21.6 ± 1.0	NB
P	*Cardamine concatenata*	Cut-leaved Toothwort				S1	2 May Be At Risk	1	84.5 ± 1.0	NB
P	*Draba arabisans*	Rock Whitlow-Grass				S1	2 May Be At Risk	7	35.4 ± 0.0	NB
P	*Draba breweri var. cana*	Brewer's Whitlow-grass				S1	2 May Be At Risk	10	98.1 ± 0.0	NB
P	*Draba glabella*	Rock Whitlow-Grass				S1	2 May Be At Risk	7	48.5 ± 1.0	NB
P	*Minuartia groenlandica*	Greenland Stitchwort				S1	2 May Be At Risk	4	36.4 ± 0.0	NB
P	*Chenopodium capitatum*	Strawberry-blite				S1	2 May Be At Risk	4	54.5 ± 1.0	NB
P	*Chenopodium simplex*	Maple-leaved Goosefoot				S1	2 May Be At Risk	10	58.4 ± 1.0	NB
P	*Callitriche terrestris*	Terrestrial Water-Starwort				S1	5 Undetermined	1	60.6 ± 0.0	NB
P	*Triadenum virginicum*	Virginia St John's-wort				S1	2 May Be At Risk	7	52.7 ± 0.0	NB
P	*Viburnum acerifolium*	Maple-leaved Viburnum				S1	2 May Be At Risk	10	50.8 ± 0.0	NB
P	*Corema conradii*	Broom Crowberry				S1	2 May Be At Risk	1	52.3 ± 10.0	NB

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P	*Vaccinium boreale*	Northern Blueberry				S1	2 May Be At Risk	1	18.2 ± 0.0	NB
P	*Vaccinium corymbosum*	Highbush Blueberry				S1	3 Sensitive	7	41.8 ± 5.0	NB
P	*Chamaesyce polygonifolia*	Seaside Spurge				S1	2 May Be At Risk	8	49.0 ± 0.0	NB
P	*Desmodium glutinosum*	Large Tick-Trefoil				S1	2 May Be At Risk	1	53.8 ± 1.0	NB
P	*Lespedeza capitata*	Round-headed Bush-clover				S1	2 May Be At Risk	6	97.5 ± 0.0	NB
P	*Gentiana rubricaulis*	Purple-stemmed Gentian				S1	2 May Be At Risk	14	20.4 ± 0.0	NB
P	*Lomatogonium rotatum*	Marsh Felwort				S1	2 May Be At Risk	2	22.3 ± 0.0	NB
P	*Proserpinaca pectinata*	Comb-leaved Mermaidweed				S1	2 May Be At Risk	2	14.5 ± 0.0	NB
P	*Pycnanthemum virginianum*	Virginia Mountain Mint				S1	2 May Be At Risk	4	77.9 ± 0.0	NB
P	*Decodon verticillatus*	Swamp Loosestrife				S1	2 May Be At Risk	1	99.1 ± 0.0	NB
P	*Lysimachia hybrida*	Lowland Yellow Loosestrife				S1	2 May Be At Risk	15	47.1 ± 0.0	NB
P	*Lysimachia quadrifolia*	Whorled Yellow Loosestrife				S1	2 May Be At Risk	16	45.1 ± 1.0	NB
P	*Primula laurentiana*	Laurentian Primrose				S1	2 May Be At Risk	8	86.3 ± 1.0	NS
P	*Ranunculus sceleratus*	Cursed Buttercup				S1	2 May Be At Risk	6	45.3 ± 1.0	NB
P	*Crataegus jonesiae*	Jones' Hawthorn				S1	2 May Be At Risk	5	26.3 ± 0.0	NB
P	*Galium brevipes*	Limestone Swamp Bedstraw				S1	2 May Be At Risk	3	46.2 ± 5.0	NB
P	*Saxifraga paniculata ssp. neogaea*	White Mountain Saxifrage				S1	2 May Be At Risk	7	61.9 ± 10.0	NB
P	*Agalinis paupercula var. borealis*	Small-flowered Agalinis				S1	2 May Be At Risk	8	72.2 ± 1.0	NB
P	*Agalinis tenuifolia*	Slender Agalinis				S1	2 May Be At Risk	6	88.0 ± 0.0	NB
P	*Gratiola aurea*	Golden Hedge-Hyssop				S1	3 Sensitive	2	33.9 ± 5.0	NB
P	*Pedicularis canadensis*	Canada Lousewort				S1	2 May Be At Risk	20	25.5 ± 0.0	NB
P	*Viola sagittata var. ovata*	Arrow-Leaved Violet				S1	2 May Be At Risk	23	45.7 ± 0.0	NB
P	*Alisma subcordatum*	Southern Water Plantain				S1	5 Undetermined	6	61.2 ± 5.0	NB
P	*Carex backii*	Rocky Mountain Sedge				S1	2 May Be At Risk	5	97.6 ± 1.0	NB
P	*Carex cephaloidea*	Thin-leaved Sedge				S1	2 May Be At Risk	2	89.7 ± 0.0	NB
P	*Carex merritt-fernaldii*	Merritt Fernald's Sedge				S1	2 May Be At Risk	2	28.7 ± 0.0	NB
P	*Carex saxatilis*	Russet Sedge				S1	2 May Be At Risk	13	51.4 ± 10.0	NB
P	*Carex sterilis*	Sterile Sedge				S1	2 May Be At Risk	1	92.5 ± 0.0	NB
P	*Carex grisea*	Inflated Narrow-leaved Sedge				S1	2 May Be At Risk	9	82.8 ± 0.0	NB
P	*Cyperus diandrus*	Low Flatsedge				S1	2 May Be At Risk	7	87.8 ± 1.0	NB
P	*Cyperus lupulinus*	Hop Flatsedge				S1	2 May Be At Risk	4	92.0 ± 0.0	NB
P	*Cyperus lupulinus ssp. macilentus*	Hop Flatsedge				S1	2 May Be At Risk	12	91.6 ± 0.0	NB
P	*Eleocharis olivacea*	Yellow Spikerush				S1	2 May Be At Risk	4	48.5 ± 1.0	NB
P	*Rhynchospora capillacea*	Slender Beakrush				S1	2 May Be At Risk	3	92.2 ± 0.0	NB
P	*Sisyrinchium angustifolium*	Narrow-leaved Blue-eyed-grass				S1	2 May Be At Risk	5	53.7 ± 1.0	NB
P	*Juncus greenei*	Greene's Rush				S1	2 May Be At Risk	1	4.6 ± 0.0	NB
P	*Juncus subtilis*	Creeping Rush				S1	2 May Be At Risk	1	77.6 ± 5.0	NB
P	*Allium canadense*	Canada Garlic				S1	2 May Be At Risk	11	78.0 ± 0.0	NB
P	*Goodyera pubescens*	Downy Rattlesnake-Plantain				S1	2 May Be At Risk	1	91.1 ± 0.0	NB
P	*Malaxis brachypoda*	White Adder's-Mouth				S1	2 May Be At Risk	3	49.0 ± 10.0	NB
P	*Platanthera flava var. herbiola*	Pale Green Orchid				S1	2 May Be At Risk	12	30.9 ± 0.0	NB
P	*Platanthera macrophylla*	Large Round-Leaved Orchid				S1	2 May Be At Risk	1	90.6 ± 1.0	NB
P	*Spiranthes casei*	Case's Ladies'-Tresses				S1	2 May Be At Risk	6	94.0 ± 0.0	NB
P	*Bromus pubescens*	Hairy Wood Brome Grass				S1	5 Undetermined	6	92.2 ± 0.0	NB
P	*Cinna arundinacea*	Sweet Wood Reed Grass				S1	2 May Be At Risk	22	45.2 ± 0.0	NB
P	*Danthonia compressa*	Flattened Oat Grass				S1	2 May Be At Risk	3	90.4 ± 0.0	NB
P	*Dichanthelium dichotomum*	Forked Panic Grass				S1	2 May Be At Risk	19	45.3 ± 0.0	NB
P	*Glyceria obtusa*	Atlantic Manna Grass				S1	2 May Be At Risk	6	24.8 ± 0.0	NB
P	*Sporobolus compositus*	Rough Dropseed				S1	2 May Be At Risk	17	91.4 ± 0.0	NB
P	*Potamogeton friesii*	Fries' Pondweed				S1	2 May Be At Risk	6	45.3 ± 5.0	NB
P	*Potamogeton nodosus*	Long-leaved Pondweed				S1	2 May Be At Risk	4	86.7 ± 1.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
P	*Potamogeton strictifolius*	Straight-leaved Pondweed				S1	2 May Be At Risk	2	67.7 ± 0.0	NB
P	*Xyris difformis*	Bog Yellow-eyed-grass				S1	5 Undetermined	3	52.7 ± 0.0	NB
P	*Asplenium ruta-muraria var. cryptolepis*	Wallrue Spleenwort				S1	2 May Be At Risk	3	61.4 ± 0.0	NB
P	*Botrychium oneidense*	Blunt-lobed Moonwort				S1	2 May Be At Risk	4	59.4 ± 0.0	NB
P	*Botrychium rugulosum*	Rugulose Moonwort				S1	2 May Be At Risk	1	47.7 ± 1.0	NB
P	*Schizaea pusilla*	Little Curlygrass Fern				S1	2 May Be At Risk	18	27.5 ± 0.0	NB
P	*Hieracium kalmii var. fasciculatum*	Kalm's Hawkweed				S1?	5 Undetermined	6	26.3 ± 0.0	NB
P	*Cuscuta campestris*	Field Dodder				S1?	2 May Be At Risk	1	99.6 ± 10.0	NB
P	*Drosera rotundifolia var. comosa*	Round-leaved Sundew				S1?	5 Undetermined	5	18.4 ± 1.0	NB
P	*Wolffia columbiana*	Columbian Watermeal				S1?	2 May Be At Risk	5	83.2 ± 0.0	NB
P	*Rumex aquaticus var. fenestratus*	Western Dock				S1S2	2 May Be At Risk	1	82.9 ± 1.0	NB
P	*Saxifraga virginiensis*	Early Saxifrage				S1S2	2 May Be At Risk	14	88.1 ± 0.0	NB
P	*Potamogeton bicupulatus*	Snailseed Pondweed				S1S2	2 May Be At Risk	5	21.0 ± 0.0	NB
P	*Selaginella rupestris*	Rock Spikemoss				S1S2	2 May Be At Risk	20	84.8 ± 0.0	NS
P	*Thelypteris simulata*	Bog Fern				S1S2	2 May Be At Risk	1	92.0 ± 0.0	NB
P	*Cuscuta cephalanthi*	Buttonbush Dodder				S1S3	2 May Be At Risk	2	51.4 ± 1.0	NB
P	*Listera australis*	Southern Twayblade			Endangered	S2	1 At Risk	11	72.2 ± 0.0	NB
P	*Osmorhiza longistylis*	Smooth Sweet Cicely				S2	3 Sensitive	3	29.3 ± 0.0	NB
P	*Sanicula odorata*	Clustered Sanicle				S2	2 May Be At Risk	1	97.1 ± 0.0	NB
P	*Pseudognaphalium macounii*	Macoun's Cudweed				S2	3 Sensitive	9	52.0 ± 0.0	NB
P	*Solidago simplex var. racemosa*	Sticky Goldenrod				S2	2 May Be At Risk	12	90.9 ± 1.0	NB
P	*Ionactis linariifolius*	Stiff Aster				S2	3 Sensitive	1	95.0 ± 0.0	NB
P	*Symphyotrichum racemosum*	Small White Aster				S2	3 Sensitive	8	71.0 ± 0.0	NB
P	*Alnus serrulata*	Smooth Alder				S2	3 Sensitive	35	48.6 ± 0.0	NB
P	*Arabis drummondii*	Drummond's Rockcress				S2	3 Sensitive	10	51.6 ± 1.0	NB
P	*Sagina nodosa*	Knotted Pearlwort				S2	3 Sensitive	20	12.4 ± 0.0	NB
P	*Sagina nodosa ssp. borealis*	Knotted Pearlwort				S2	3 Sensitive	2	36.7 ± 0.0	NB
P	*Stellaria longifolia*	Long-leaved Starwort				S2	3 Sensitive	5	51.9 ± 10.0	NB
P	*Atriplex franktonii*	Frankton's Saltbush				S2	4 Secure	3	25.1 ± 1.0	NB
P	*Chenopodium rubrum*	Red Pigweed				S2	3 Sensitive	4	49.2 ± 0.0	NB
P	*Hypericum dissimulatum*	Disguised St John's-wort				S2	3 Sensitive	6	3.4 ± 1.0	NB
P	*Triosteum aurantiacum*	Orange-fruited Tinker's Weed				S2	3 Sensitive	8	90.2 ± 1.0	NB
P	*Viburnum lentago*	Nannyberry				S2	4 Secure	89	45.6 ± 0.0	NB
P	*Viburnum recognitum*	Northern Arrow-Wood				S2	4 Secure	168	8.3 ± 0.0	NB
P	*Astragalus eucosmus*	Elegant Milk-vetch				S2	2 May Be At Risk	10	73.1 ± 0.0	NB
P	*Oxytropis campestris var. johannensis*	Field Locoweed				S2	3 Sensitive	8	61.1 ± 50.0	NB
P	*Quercus macrocarpa*	Bur Oak				S2	2 May Be At Risk	44	28.0 ± 1.0	NB
P	*Gentiana linearis*	Narrow-Leaved Gentian				S2	3 Sensitive	5	92.1 ± 5.0	NB
P	*Myriophyllum humile*	Low Water Milfoil				S2	3 Sensitive	7	71.0 ± 0.0	NB
P	*Proserpinaca palustris var. crebra*	Marsh Mermaidweed				S2	3 Sensitive	24	5.6 ± 0.0	NB
P	*Hedeoma pulegioides*	American False Pennyroyal				S2	4 Secure	58	27.7 ± 1.0	NB
P	*Nuphar lutea ssp. rubrodisca*	Red-disked Yellow Pond-lily				S2	3 Sensitive	9	35.2 ± 0.0	NB
P	*Orobanche uniflora*	One-Flowered Broomrape				S2	3 Sensitive	13	25.1 ± 0.0	NB
P	*Polygala paucifolia*	Fringed Milkwort				S2	3 Sensitive	11	11.2 ± 1.0	NB
P	*Polygala senega*	Seneca Snakeroot				S2	3 Sensitive	2	90.2 ± 1.0	NB
P	*Polygonum amphibium var. emersum*	Water Smartweed				S2	3 Sensitive	37	7.8 ± 0.0	NB
P	*Polygonum careyi*	Carey's Smartweed				S2	3 Sensitive	8	28.5 ± 1.0	NB
P	*Podostemum ceratophyllum*	Horn-leaved Riverweed				S2	3 Sensitive	23	44.9 ± 0.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
P	*Anemone multifida*	Cut-leaved Anemone				S2	3 Sensitive	1	91.8 ± 0.0	NB
P	*Hepatica nobilis var. obtusa*	Round-lobed Hepatica				S2	3 Sensitive	33	44.8 ± 1.0	NB
P	*Ranunculus flabellaris*	Yellow Water Buttercup				S2	4 Secure	17	52.7 ± 0.0	NB
P	*Ranunculus longirostris*	Eastern White Water-Crowfoot				S2	5 Undetermined	4	22.1 ± 1.0	NB
P	*Crataegus scabrida*	Rough Hawthorn				S2	3 Sensitive	4	61.2 ± 0.0	NB
P	*Crataegus succulenta*	Fleshy Hawthorn				S2	3 Sensitive	1	92.2 ± 5.0	NB
P	*Cephalanthus occidentalis*	Common Buttonbush				S2	3 Sensitive	66	45.5 ± 0.0	NB
P	*Salix candida*	Sage Willow				S2	3 Sensitive	2	84.9 ± 1.0	NB
P	*Agalinis neoscotica*	Nova Scotia Agalinis				S2	3 Sensitive	31	39.8 ± 1.0	NB
P	*Euphrasia randii*	Rand's Eyebright				S2	2 May Be At Risk	23	21.4 ± 0.0	NB
P	*Scrophularia lanceolata*	Lance-leaved Figwort				S2	3 Sensitive	3	72.7 ± 5.0	NB
P	*Dirca palustris*	Eastern Leatherwood				S2	2 May Be At Risk	5	92.4 ± 1.0	NB
P	*Phryma leptostachya*	American Lopseed				S2	3 Sensitive	2	96.2 ± 1.0	NB
P	*Verbena urticifolia*	White Vervain				S2	2 May Be At Risk	12	89.7 ± 1.0	NB
P	*Viola novae-angliae*	New England Violet				S2	3 Sensitive	5	5.5 ± 1.0	NB
P	*Symplocarpus foetidus*	Eastern Skunk Cabbage				S2	3 Sensitive	98	5.5 ± 0.0	NB
P	*Carex comosa*	Bearded Sedge				S2	2 May Be At Risk	5	98.6 ± 0.0	NS
P	*Carex granularis*	Limestone Meadow Sedge				S2	3 Sensitive	7	61.5 ± 0.0	NB
P	*Carex gynocrates*	Northern Bog Sedge				S2	3 Sensitive	4	52.8 ± 0.0	NB
P	*Carex hirtifolia*	Pubescent Sedge				S2	3 Sensitive	3	86.1 ± 0.0	NB
P	*Carex livida var. radicaulis*	Livid Sedge				S2	3 Sensitive	1	52.0 ± 2.0	NB
P	*Carex prairea*	Prairie Sedge				S2	3 Sensitive	1	86.0 ± 5.0	NS
P	*Carex rostrata*	Narrow-leaved Beaked Sedge				S2	3 Sensitive	1	43.3 ± 0.0	NB
P	*Carex salina*	Saltmarsh Sedge				S2	3 Sensitive	2	50.2 ± 1.0	NB
P	*Carex sprengelii*	Longbeak Sedge				S2	3 Sensitive	1	93.4 ± 0.0	NB
P	*Carex tenuiflora*	Sparse-Flowered Sedge				S2	2 May Be At Risk	11	45.0 ± 0.0	NB
P	*Carex albicans var. emmonsii*	White-tinged Sedge				S2	3 Sensitive	4	59.3 ± 0.0	NB
P	*Cyperus squarrosus*	Awned Flatsedge				S2	3 Sensitive	27	79.3 ± 0.0	NB
P	*Eriophorum gracile*	Slender Cottongrass				S2	2 May Be At Risk	7	91.3 ± 0.0	NB
P	*Blysmus rufus*	Red Bulrush				S2	3 Sensitive	3	46.4 ± 0.0	NB
P	*Elodea nuttallii*	Nuttall's Waterweed				S2	3 Sensitive	8	49.0 ± 0.0	NB
P	*Allium tricoccum*	Wild Leek				S2	2 May Be At Risk	7	74.4 ± 0.0	NB
P	*Najas gracillima*	Thread-Like Naiad				S2	3 Sensitive	11	8.5 ± 0.0	NB
P	*Calypso bulbosa var. americana*	Calypso				S2	2 May Be At Risk	3	58.1 ± 0.0	NB
P	*Coeloglossum viride var. virescens*	Long-bracted Frog Orchid				S2	2 May Be At Risk	5	78.2 ± 5.0	NB
P	*Cypripedium parviflorum var. makasin*	Small Yellow Lady's-Slipper				S2	2 May Be At Risk	5	46.9 ± 1.0	NB
P	*Spiranthes lucida*	Shining Ladies'-Tresses				S2	3 Sensitive	11	48.6 ± 1.0	NB
P	*Spiranthes ochroleuca*	Yellow Ladies'-tresses				S2	2 May Be At Risk	9	49.2 ± 0.0	NB
P	*Dichanthelium linearifolium*	Narrow-leaved Panic Grass				S2	3 Sensitive	7	45.0 ± 0.0	NB
P	*Elymus canadensis*	Canada Wild Rye				S2	2 May Be At Risk	14	83.6 ± 1.0	NB
P	*Leersia virginica*	White Cut Grass				S2	2 May Be At Risk	42	76.9 ± 10.0	NB
P	*Piptatherum canadense*	Canada Rice Grass				S2	3 Sensitive	5	56.3 ± 0.0	NB
P	*Poa glauca*	Glaucous Blue Grass				S2	4 Secure	1	52.0 ± 2.0	NB
P	*Puccinellia phryganodes*	Creeping Alkali Grass				S2	3 Sensitive	15	16.9 ± 0.0	NB
P	*Schizachyrium scoparium*	Little Bluestem				S2	3 Sensitive	22	69.7 ± 0.0	NB
P	*Zizania aquatica var. aquatica*	Indian Wild Rice				S2	5 Undetermined	4	87.6 ± 0.0	NB
P	*Potamogeton vaseyi*	Vasey's Pondweed				S2	3 Sensitive	10	45.6 ± 1.0	NB
P	*Asplenium trichomanes*	Maidenhair Spleenwort				S2	3 Sensitive	9	49.2 ± 0.0	NB
P	*Woodwardia virginica*	Virginia Chain Fern				S2	3 Sensitive	19	59.7 ± 1.0	NB
P	*Woodsia alpina*	Alpine Cliff Fern				S2	3 Sensitive	5	61.9 ± 0.0	NB

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P	*Selaginella selaginoides*	Low Spikemoss				S2	3 Sensitive	4	25.4 ± 0.0	NB
P	*Toxicodendron radicans*	Poison Ivy				S2?	3 Sensitive	13	57.8 ± 0.0	NB
P	*Symphyotrichum novi-belgii var. crenifolium*	New York Aster				S2?	5 Undetermined	9	20.6 ± 0.0	NB
P	*Humulus lupulus var. lupuloides*	Common Hop				S2?	3 Sensitive	4	85.8 ± 0.0	NB
P	*Rubus recurvicaulis*	Arching Dewberry				S2?	4 Secure	5	48.8 ± 1.0	NB
P	*Galium obtusum*	Blunt-leaved Bedstraw				S2?	4 Secure	3	87.8 ± 1.0	NB
P	*Salix myricoides*	Bayberry Willow				S2?	3 Sensitive	7	29.3 ± 0.0	NB
P	*Carex vacillans*	Estuarine Sedge				S2?	3 Sensitive	4	20.6 ± 1.0	NB
P	*Platanthera huronensis*	Fragrant Green Orchid				S2?	5 Undetermined	2	54.4 ± 1.0	NB
P	*Solidago altissima*	Tall Goldenrod				S2S3	4 Secure	6	69.3 ± 0.0	NB
P	*Barbarea orthoceras*	American Yellow Rocket				S2S3	3 Sensitive	2	47.5 ± 10.0	NB
P	*Ceratophyllum echinatum*	Prickly Hornwort				S2S3	3 Sensitive	16	46.0 ± 0.0	NB
P	*Callitriche hermaphroditica*	Northern Water-starwort				S2S3	4 Secure	6	35.2 ± 0.0	NB
P	*Lonicera oblongifolia*	Swamp Fly Honeysuckle				S2S3	3 Sensitive	16	33.7 ± 6.0	NB
P	*Elatine americana*	American Waterwort				S2S3	3 Sensitive	8	45.1 ± 1.0	NB
P	*Bartonia paniculata*	Branched Bartonia				S2S3	3 Sensitive	5	27.7 ± 0.0	NB
P	*Bartonia paniculata ssp. iodandra*	Branched Bartonia				S2S3	3 Sensitive	14	18.2 ± 1.0	NB
P	*Geranium robertianum*	Herb Robert				S2S3	4 Secure	21	21.0 ± 0.0	NB
P	*Myriophyllum quitense*	Andean Water Milfoil				S2S3	4 Secure	71	45.6 ± 0.0	NB
P	*Epilobium coloratum*	Purple-veined Willowherb				S2S3	3 Sensitive	9	54.5 ± 1.0	NB
P	*Rumex pallidus*	Seabeach Dock				S2S3	3 Sensitive	6	10.8 ± 1.0	NB
P	*Rubus pensilvanicus*	Pennsylvania Blackberry				S2S3	4 Secure	9	28.2 ± 3.0	NB
P	*Galium labradoricum*	Labrador Bedstraw				S2S3	3 Sensitive	6	18.1 ± 1.0	NB
P	*Valeriana uliginosa*	Swamp Valerian				S2S3	3 Sensitive	1	44.9 ± 1.0	NB
P	*Carex adusta*	Lesser Brown Sedge				S2S3	4 Secure	3	48.9 ± 1.0	NB
P	*Corallorhiza maculata var. occidentalis*	Spotted Coralroot				S2S3	3 Sensitive	6	28.7 ± 0.0	NB
P	*Corallorhiza maculata var. maculata*	Spotted Coralroot				S2S3	3 Sensitive	2	89.7 ± 1.0	NB
P	*Listera auriculata*	Auricled Twayblade				S2S3	3 Sensitive	9	46.4 ± 1.0	NB
P	*Spiranthes cernua*	Nodding Ladies'-Tresses				S2S3	3 Sensitive	15	2.6 ± 1.0	NB
P	*Eragrostis pectinacea*	Tufted Love Grass				S2S3	4 Secure	14	26.7 ± 0.0	NB
P	*Stuckenia filiformis ssp. alpina*	Thread-leaved Pondweed				S2S3	3 Sensitive	6	52.0 ± 0.0	NB
P	*Potamogeton praelongus*	White-stemmed Pondweed				S2S3	4 Secure	14	49.3 ± 0.0	NB
P	*Isoetes acadiensis*	Acadian Quillwort				S2S3	3 Sensitive	9	21.9 ± 0.0	NB
P	*Ophioglossum pusillum*	Northern Adder's-tongue				S2S3	3 Sensitive	6	41.1 ± 1.0	NB
P	*Botrychium tenebrosum*	Swamp Moonwort				S2S3	3 Sensitive	1	51.0 ± 0.0	NB
P	*Panax trifolius*	Dwarf Ginseng				S3	3 Sensitive	7	47.1 ± 0.0	NB
P	*Artemisia campestris*	Field Wormwood				S3	4 Secure	7	92.1 ± 0.0	NB
P	*Artemisia campestris ssp. caudata*	Field Wormwood				S3	4 Secure	53	50.6 ± 0.0	NB
P	*Erigeron hyssopifolius*	Hyssop-leaved Fleabane				S3	4 Secure	6	44.5 ± 0.0	NB
P	*Prenanthes racemosa*	Glaucous Rattlesnakeroot				S3	4 Secure	64	46.5 ± 1.0	NB
P	*Tanacetum bipinnatum ssp. huronense*	Lake Huron Tansy				S3	4 Secure	22	59.5 ± 1.0	NB
P	*Symphyotrichum boreale*	Boreal Aster				S3	3 Sensitive	13	9.8 ± 0.0	NB
P	*Betula pumila*	Bog Birch				S3	4 Secure	22	53.0 ± 0.0	NB
P	*Arabis hirsuta var. pycnocarpa*	Western Hairy Rockcress				S3	4 Secure	13	51.6 ± 0.0	NB
P	*Cardamine maxima*	Large Toothwort				S3	4 Secure	26	54.9 ± 0.0	NB
P	*Subularia aquatica var. americana*	Water Awlwort				S3	4 Secure	18	9.1 ± 0.0	NB
P	*Lobelia cardinalis*	Cardinal Flower				S3	4 Secure	361	7.4 ± 0.0	NB

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P	*Stellaria humifusa*	Saltmarsh Starwort				S3	4 Secure	6	19.4 ± 0.0	NB
P	*Hudsonia tomentosa*	Woolly Beach-heath				S3	4 Secure	3	31.0 ± 0.0	NB
P	*Cornus amomum ssp. obliqua*	Pale Dogwood				S3	3 Sensitive	189	45.1 ± 0.0	NB
P	*Crassula aquatica*	Water Pygmyweed				S3	4 Secure	10	53.2 ± 1.0	NB
P	*Rhodiola rosea*	Roseroot				S3	4 Secure	41	12.9 ± 1.0	NB
P	*Penthorum sedoides*	Ditch Stonecrop				S3	4 Secure	68	7.5 ± 0.0	NB
P	*Elatine minima*	Small Waterwort				S3	4 Secure	46	7.4 ± 0.0	NB
P	*Astragalus alpinus var. brunetianus*	Alpine Milk-Vetch				S3	4 Secure	3	87.0 ± 0.0	NB
P	*Hedysarum alpinum*	Alpine Sweet-vetch				S3	4 Secure	2	73.8 ± 0.0	NB
P	*Gentianella amarella ssp. acuta*	Northern Gentian				S3	4 Secure	9	51.4 ± 5.0	NB
P	*Geranium bicknellii*	Bicknell's Crane's-bill				S3	4 Secure	6	27.7 ± 1.0	NB
P	*Myriophyllum farwellii*	Farwell's Water Milfoil				S3	4 Secure	22	9.5 ± 0.0	NB
P	*Myriophyllum heterophyllum*	Variable-leaved Water Milfoil				S3	4 Secure	40	44.8 ± 0.0	NB
P	*Myriophyllum verticillatum*	Whorled Water Milfoil				S3	4 Secure	18	5.7 ± 0.0	NB
P	*Stachys tenuifolia*	Smooth Hedge-Nettle				S3	3 Sensitive	12	73.1 ± 0.0	NB
P	*Teucrium canadense*	Canada Germander				S3	3 Sensitive	3	50.8 ± 1.0	NB
P	*Utricularia radiata*	Little Floating Bladderwort				S3	4 Secure	38	8.2 ± 0.0	NB
P	*Nuphar lutea ssp. pumila*	Small Yellow Pond-lily				S3	4 Secure	14	52.0 ± 0.0	NB
P	*Epilobium hornemannii*	Hornemann's Willowherb				S3	4 Secure	3	20.5 ± 0.0	NB
P	*Epilobium strictum*	Downy Willowherb				S3	4 Secure	22	38.6 ± 1.0	NB
P	*Polygala sanguinea*	Blood Milkwort				S3	3 Sensitive	8	71.6 ± 0.0	NB
P	*Polygonum arifolium*	Halberd-leaved Tearthumb				S3	4 Secure	11	49.1 ± 0.0	NB
P	*Polygonum punctatum*	Dotted Smartweed				S3	4 Secure	2	92.0 ± 0.0	NB
P	*Polygonum punctatum var. confertiflorum*	Dotted Smartweed				S3	4 Secure	15	38.0 ± 1.0	NB
P	*Polygonum scandens*	Climbing False Buckwheat				S3	4 Secure	31	15.4 ± 0.0	NB
P	*Littorella uniflora*	American Shoreweed				S3	4 Secure	26	6.3 ± 5.0	NB
P	*Primula mistassinica*	Mistassini Primrose				S3	4 Secure	12	45.1 ± 1.0	NB
P	*Pyrola minor*	Lesser Pyrola				S3	4 Secure	2	20.7 ± 0.0	NB
P	*Clematis occidentalis*	Purple Clematis				S3	4 Secure	19	42.4 ± 0.0	NB
P	*Ranunculus gmelinii*	Gmelin's Water Buttercup				S3	4 Secure	5	87.6 ± 0.0	NB
P	*Thalictrum venulosum*	Northern Meadow-rue				S3	4 Secure	77	19.7 ± 0.0	NB
P	*Amelanchier canadensis*	Canada Serviceberry				S3	4 Secure	15	1.6 ± 1.0	NB
P	*Rosa palustris*	Swamp Rose				S3	4 Secure	40	5.6 ± 0.0	NB
P	*Rubus occidentalis*	Black Raspberry				S3	4 Secure	22	72.4 ± 0.0	NB
P	*Galium boreale*	Northern Bedstraw				S3	4 Secure	5	44.7 ± 0.0	NB
P	*Salix interior*	Sandbar Willow				S3	4 Secure	27	81.2 ± 1.0	NB
P	*Salix nigra*	Black Willow				S3	3 Sensitive	92	46.2 ± 1.0	NB
P	*Salix pedicellaris*	Bog Willow				S3	4 Secure	48	5.3 ± 0.0	NB
P	*Parnassia glauca*	Fen Grass-of-Parnassus				S3	4 Secure	1	84.4 ± 10.0	NB
P	*Limosella australis*	Southern Mudwort				S3	4 Secure	10	45.0 ± 5.0	NB
P	*Veronica serpyllifolia ssp. humifusa*	Thyme-Leaved Speedwell				S3	4 Secure	2	89.8 ± 100.0	NB
P	*Boehmeria cylindrica*	Small-spike False-nettle				S3	3 Sensitive	131	14.3 ± 0.0	NB
P	*Pilea pumila*	Dwarf Clearweed				S3	4 Secure	24	77.3 ± 0.0	NB
P	*Viola adunca*	Hooked Violet				S3	4 Secure	5	21.6 ± 1.0	NB
P	*Viola nephrophylla*	Northern Bog Violet				S3	4 Secure	7	48.8 ± 0.0	NB
P	*Carex arcta*	Northern Clustered Sedge				S3	4 Secure	48	57.0 ± 0.0	NB
P	*Carex atratiformis*	Scabrous Black Sedge				S3	4 Secure	1	52.0 ± 0.0	NB
P	*Carex capillaris*	Hairlike Sedge				S3	4 Secure	2	52.0 ± 2.0	NB
P	*Carex chordorrhiza*	Creeping Sedge				S3	4 Secure	20	29.1 ± 1.0	NB
P	*Carex conoidea*	Field Sedge				S3	4 Secure	26	27.6 ± 1.0	NB
P	*Carex exilis*	Coastal Sedge				S3	4 Secure	81	12.3 ± 0.0	NB
P	*Carex garberi*	Garber's Sedge				S3	3 Sensitive	2	48.6 ± 1.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
P	*Carex haydenii*	Hayden's Sedge				S3	4 Secure	37	10.9 ± 1.0	NB
P	*Carex lupulina*	Hop Sedge				S3	4 Secure	102	45.4 ± 1.0	NB
P	*Carex michauxiana*	Michaux's Sedge				S3	4 Secure	54	6.2 ± 0.0	NB
P	*Carex ormostachya*	Necklace Spike Sedge				S3	4 Secure	8	60.7 ± 0.0	NB
P	*Carex rosea*	Rosy Sedge				S3	4 Secure	17	71.2 ± 0.0	NB
P	*Carex tenera*	Tender Sedge				S3	4 Secure	43	28.7 ± 1.0	NB
P	*Carex tuckermanii*	Tuckerman's Sedge				S3	4 Secure	68	35.9 ± 0.0	NB
P	*Carex vaginata*	Sheathed Sedge				S3	3 Sensitive	9	47.9 ± 6.0	NB
P	*Carex wiegandii*	Wiegand's Sedge				S3	4 Secure	33	11.4 ± 0.0	NB
P	*Carex recta*	Estuary Sedge				S3	4 Secure	7	25.6 ± 0.0	NB
P	*Cyperus dentatus*	Toothed Flatsedge				S3	4 Secure	71	6.5 ± 1.0	NB
P	*Cyperus esculentus*	Perennial Yellow Nutsedge				S3	4 Secure	42	78.4 ± 0.0	NB
P	*Eleocharis intermedia*	Matted Spikerush				S3	4 Secure	2	57.7 ± 0.0	NB
P	*Eleocharis quinqueflora*	Few-flowered Spikerush				S3	4 Secure	4	61.2 ± 0.0	NB
P	*Rhynchospora capitellata*	Small-headed Beakrush				S3	4 Secure	7	49.5 ± 0.0	NB
P	*Rhynchospora fusca*	Brown Beakrush				S3	4 Secure	36	5.2 ± 0.0	NB
P	*Trichophorum clintonii*	Clinton's Clubrush				S3	4 Secure	6	6.5 ± 5.0	NB
P	*Schoenoplectus fluviatilis*	River Bulrush				S3	3 Sensitive	58	45.4 ± 0.0	NB
P	*Schoenoplectus torreyi*	Torrey's Bulrush				S3	4 Secure	27	14.5 ± 0.0	NB
P	*Lemna trisulca*	Star Duckweed				S3	4 Secure	22	63.6 ± 1.0	NB
P	*Triantha glutinosa*	Sticky False-Asphodel				S3	4 Secure	8	72.7 ± 0.0	NB
P	*Cypripedium reginae*	Showy Lady's-Slipper				S3	3 Sensitive	19	46.1 ± 0.0	NB
P	*Liparis loeselii*	Loesel's Twayblade				S3	4 Secure	17	26.1 ± 0.0	NB
P	*Platanthera blephariglottis*	White Fringed Orchid				S3	4 Secure	17	54.7 ± 1.0	NB
P	*Platanthera grandiflora*	Large Purple Fringed Orchid				S3	3 Sensitive	32	7.7 ± 0.0	NB
P	*Bromus latiglumis*	Broad-Glumed Brome				S3	3 Sensitive	2	53.0 ± 0.0	NB
P	*Calamagrostis pickeringii*	Pickering's Reed Grass				S3	4 Secure	104	11.8 ± 0.0	NB
P	*Dichanthelium depauperatum*	Starved Panic Grass				S3	4 Secure	12	53.1 ± 0.0	NB
P	*Muhlenbergia richardsonis*	Mat Muhly				S3	4 Secure	9	92.0 ± 0.0	NB
P	*Heteranthera dubia*	Water Stargrass				S3	4 Secure	58	51.9 ± 0.0	NB
P	*Potamogeton obtusifolius*	Blunt-leaved Pondweed				S3	4 Secure	14	42.2 ± 0.0	NB
P	*Potamogeton richardsonii*	Richardson's Pondweed				S3	3 Sensitive	15	52.0 ± 1.0	NB
P	*Xyris montana*	Northern Yellow-Eyed-Grass				S3	4 Secure	25	18.3 ± 0.0	NB
P	*Zannichellia palustris*	Horned Pondweed				S3	4 Secure	5	45.5 ± 0.0	NB
P	*Adiantum pedatum*	Northern Maidenhair Fern				S3	4 Secure	8	44.7 ± 1.0	NB
P	*Cryptogramma stelleri*	Steller's Rockbrake				S3	4 Secure	1	72.0 ± 1.0	NB
P	*Asplenium trichomanes-ramosum*	Green Spleenwort				S3	4 Secure	15	45.2 ± 1.0	NB
P	*Dryopteris fragrans var. remotiuscula*	Fragrant Wood Fern				S3	4 Secure	2	49.2 ± 0.0	NB
P	*Dryopteris goldiana*	Goldie's Woodfern				S3	3 Sensitive	6	96.2 ± 5.0	NB
P	*Woodsia glabella*	Smooth Cliff Fern				S3	4 Secure	1	81.9 ± 1.0	NB
P	*Equisetum palustre*	Marsh Horsetail				S3	4 Secure	6	84.9 ± 10.0	NB
P	*Isoetes tuckermanii*	Tuckerman's Quillwort				S3	4 Secure	20	22.1 ± 1.0	NB
P	*Lycopodium sabinifolium*	Ground-Fir				S3	4 Secure	5	43.9 ± 5.0	NB
P	*Huperzia appalachiana*	Appalachian Fir-Clubmoss				S3	3 Sensitive	2	53.9 ± 1.0	NB
P	*Botrychium dissectum*	Cut-leaved Moonwort				S3	4 Secure	26	27.2 ± 5.0	NB
P	*Botrychium lanceolatum var. angustisegmentum*	Lance-Leaf Grape-Fern				S3	3 Sensitive	11	49.2 ± 0.0	NB
P	*Botrychium simplex*	Least Moonwort				S3	4 Secure	9	41.1 ± 0.0	NB
P	*Polypodium appalachianum*	Appalachian Polypody				S3	4 Secure	10	21.5 ± 0.0	NB
P	*Utricularia resupinata*	Inverted Bladderwort				S3?	4 Secure	19	20.4 ± 0.0	NB
P	*Crataegus submollis*	Quebec Hawthorn				S3?	3 Sensitive	18	26.0 ± 1.0	NB
P	*Mertensia maritima*	Sea Lungwort				S3S4	4 Secure	26	12.5 ± 0.0	NB
P	*Lobelia kalmii*	Brook Lobelia				S3S4	4 Secure	18	26.3 ± 0.0	NB
P	*Suaeda calceoliformis*	Horned Sea-blite				S3S4	4 Secure	5	27.0 ± 5.0	NB
P	*Myriophyllum sibiricum*	Siberian Water Milfoil				S3S4	4 Secure	26	25.4 ± 1.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
P	*Stachys pilosa*	Hairy Hedge-Nettle				S3S4	5 Undetermined	4	80.8 ± 1.0	NB
P	*Utricularia gibba*	Humped Bladderwort				S3S4	4 Secure	41	5.7 ± 0.0	NB
P	*Rumex maritimus*	Sea-Side Dock				S3S4	4 Secure	2	26.8 ± 1.0	NB
P	*Potentilla arguta*	Tall Cinquefoil				S3S4	4 Secure	32	22.0 ± 1.0	NB
P	*Rubus chamaemorus*	Cloudberry				S3S4	4 Secure	55	7.4 ± 1.0	NB
P	*Geocaulon lividum*	Northern Comandra				S3S4	4 Secure	9	15.0 ± 1.0	NB
P	*Juniperus horizontalis*	Creeping Juniper				S3S4	4 Secure	21	21.6 ± 1.0	NB
P	*Cladium mariscoides*	Smooth Twigrush				S3S4	4 Secure	42	18.8 ± 0.0	NB
P	*Eriophorum russeolum*	Russet Cottongrass				S3S4	4 Secure	2	42.6 ± 1.0	NB
P	*Triglochin gaspensis*	Gasp ├⌐ Arrowgrass				S3S4	4 Secure	16	20.6 ± 1.0	NB
P	*Spirodela polyrrhiza*	Great Duckweed				S3S4	4 Secure	36	47.3 ± 0.0	NB
P	*Corallorhiza maculata*	Spotted Coralroot				S3S4	3 Sensitive	10	8.0 ± 0.0	NB
P	*Calamagrostis stricta*	Slim-stemmed Reed Grass				S3S4	4 Secure	1	46.1 ± 2.0	NB
P	*Potamogeton oakesianus*	Oakes' Pondweed				S3S4	4 Secure	40	7.5 ± 0.0	NB
P	*Montia fontana*	Water Blinks				SH	2 May Be At Risk	4	19.1 ± 1.0	NB
P	*Solidago caesia*	Blue-stemmed Goldenrod				SX	0.1 Extirpated	2	54.5 ± 1.0	NB
P	*Celastrus scandens*	Climbing Bittersweet				SX	0.1 Extirpated	3	84.6 ± 100.0	NB
P	*Carex swanii*	Swan's Sedge				SX	0.1 Extirpated	52	52.2 ± 1.0	NB

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The recipient of these data shall acknowledge the AC CDC and the data sources listed below in any documents, reports, publications or presentations, in which this dataset makes a significant contribution.

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DATA DICTIONARY: revised December 18, 2017

I. Observation Records

The following fields of data may be included (and may or may not be populated) in occurrence records.
Text fields are 255 char max. (and may truncate text).

TAXONOMY	*type*	*definition*
MCODE	TXT	8 character 'Museum Code' (1 to 4 = genus, 5 to 8 = sp+ssp)
ELCODE	TXT	Unique Identifier of taxon[1]
SCINAME	TXT	Global Scientific Name of taxon[1]
COMNAME	TXT	English Common Name of taxon[1]
NOMCOMMUN	TXT	French Common Name

LOCATION

SURVEYSITE	TXT	General locality of occurrence (not necessarily protected)
DIRECTIONS	TXT	Specific locality: e.g. bearings and distance from enduring landmark
SUBNAT	TXT	Province/State: 2 character ISO code
COCODE	TXT	County Code (2 chars for province + 4 chars for county name)
MAPCODE	TXT	Map number: NTS identifier in Canada
UTME20	NUM	Easting in UTM Zone 20
UTMN20	NUM	Northing in UTM Zone 20
LONDEC	DEC	Decimal Longitude (5 decimal places, negative for west of Greenwich)
LATDEC	DEC	Decimal Latitude (5 decimal places)
LOCUNCM	NUM	Horizontal precision in metres
PREC	DEC	Precision in metres by power of 10 (e.g. 3 = 10 to the 3rd = 1000 m = 1 km)

prec	*common speech*	*example*	*unit size*	*literal range (m)*
6.0	within province	province	1000.0 km	562.3 - 1778.3
5.7	in part of province	'NW NB'	500.0 km	281.2 - 889.1
5.0	within in county	county	100.0 km	56.2 - 177.8
4.7	within 50s of kilometres		50.0 km	28.1 - 88.9
4.0	within 10s of kilometres	BBA grid	10.0 km	5.6 - 17.8
3.7	within 5s of kilometres		5.0 km	2.8 - 8.9
3.0	within kilometres	topo grid	1.0 km	0.6 - 1.8
2.7	within 500s of metres		500.0 m	281.2 - 889.1
2.0	within 100s of metres	ball field	100.0 m	56.2 - 177.8
1.7	within 50s of metres		50.0 m	28.1 - 88.9
1.0	within 10s of metres	boxcar	10.0 m	5.6 - 17.8
0.7	within 5s of metres		5.0 m	2.8 - 8.9
0.0	within metres ***NOT USED***	pace	1.0 m	0.6 - 1.8
-1.0	within 10s of centimetres	fingernail	0.1 m	0.1 - 0.2

RARITY STATUS

NRANK	TXT	National Rarity Rank of taxon (in Canada)[1]
NPROT	TXT	National Protection Status of taxon (= COSEWIC in Canada)
NPROTSAR	TXT	National Protection Status of taxon (= SARA in Canada)

code	*rank and short definition*
X	Extinct in Canada and elsewhere
XT	Extirpated in Canada but surviving elsewhere
E	Endangered in Canada
T	Threatened in Canada
V	Vulnerable in Canada
SC	Special Concern in Canada
DD	Data Deficient: data inadequate for assessment
NAR	Not At Risk in Canada

SRANK** TXT Subnational (Provincial) Rarity Rank of taxon[1]

code	*rank and short definition*
SX	Extinct or extirpated in province
SH	Historically occurring but currently undetected in province
S1	Extremely rare in province
S2	Rare in province
S3	Uncommon in province
S4	Widespread, common and apparently secure in province
S5	Widespread, abundant and demonstrably secure in province
SE	Exotic in province
SA	Accidental, infrequent and outside of range within province
SNA	Ranking not applicable in province
SNR	Not yet assessed in province

SPROT** TXT Provincial rank/status of taxon; cf provincial websites

SGSRANK	TXT	Provincial General Status Rank
IUCN	TXT	International Union of Conservation Naturalists rarity rank; cf IUCN website

code	*rank and short definition*
EX	Extinct: no individuals remaining
EW	Extinct in the Wild: only captive or naturalised survivors
CR	Critically Endangered: extreme risk of extinction in wild
EN	Endangered: high risk of extinction in wild
VU	Vulnerable: high risk of endangerment in wild
NT	Near Threatened: likely to become endangered soon
LC	Least Concern: lowest risk, widespread and abundant
DD	Data Deficient: data inadequate for assessment
NE	Not Evaluated, not yet assessed against criteria

OBSERVATION

OBSERVER	TXT	Person or persons collecting specimen, in bibliographic form
OBDATE	TXT	Date of specimen collection as YYYY MM DD
OBDATA	TXT	Concatenation of fields below, relating to specimen (OBEVID, OBCOUNT etc)
OBEVID	TXT	Type of evidence (specimen, photo etc)
OBCOUNT	TXT	Number of individuals at location
OBABUN	TXT	Relative rarity of taxon at location, e.g. 'common', 'scattered'
OBSIZE	TXT	Size of specimen
SIZE	TXT	Size of occurrence 'patch' (in m2, ha or acres)
OBDESC	TXT	Details of specimen appearance
OBPHEN	TXT	Lifestage of specimen (bud, flowering etc)
OBSEX	TXT	Male/female if relevant
OBACTIV	TXT	Activity of taxon when observed (nesting, crossing road etc)
OBASSP	TXT	Other taxa associated with specimen
NOTETAX	TXT	Identifier's note on taxonomic issues
GENDESC	TXT	Concatenation of fields below, relating to site (HABITAT, ECOL etc)
HABITAT	TXT	Habitat characterization of location
ECODIST	NUM	National Ecological Framework EcoDistrict identifier
WSCODE	TXT	Quaternary Watershed identifier
GENCOM	TXT	General Comments: concatenation of Notes (NOTE1, NOTE2, NOTE3)

COLLECTION

CITATION	TXT	Primary source of data

DATA MANAGEMENT

IDNUM	TXT	Field Office Number: Internal ACCDC record reference (not the EONUM)
EDITION	TXT	Last editor's initials and date as YYYY MM DD

Notes:

[1] Methodology of NatureServe, Arlington, VA

** Field name followed by 2-character ISO provincial abbreviation.

II. Managed or Special Areas

The following fields of data may be included (and may or may not be populated) for Protected Areas and Ecologically Significant Areas.

IDENTITY

MACODE	TXT	Unique identifier for Managed Area[1] with some level of protection
SACODE	TXT	Unique identifier for Ecologically Special Area[1] with or without protection
MANAME	TXT	Name of Protected Area containing occurrence
SANAME	TXT	Name of Ecologically Special Area containing occurrence
SITECODE	TXT	External agency site identity code

JURISDICTION / OWNERSHIP

LOCALJURIS	TXT	Abbreviation for mandated agency
OWNER	TXT	Short name or category of title holder
OWNERCOM	TXT	Short detail of multiparty arrangements
OWNERCODE	TXT	Canadian Conservation Area DB ownercodes (modified)

group	*code*	*designation*
Owner	GN	government, national (federal)
	GS	government, subnational (prov., state)
	GM	government, municipal
	IN	international
	NG	non-governmental organisation
	OR	organisational
	CO	corporate
	PR	private

CLASSIFICATION

PROTSTAT	TXT	Activities permitted or restricted (when known)
LEGALACT	TXT	Short title of enabling legislation
LEGALDATE	TXT	Year of enabling legislation
ESTABDATE	TXT	Year of site designation
IBP	TXT	International Biological Program identity number (Y=unknown)
IBPSTATUS	TXT	International Biological Program status: proposed or declared
IUCN	TXT	IUCN protection level, e.g. I very restricted, VI few restrictions
LEVEL1	TXT	Canadian Conservation Area DB type
LEVEL2	TXT	Canadian Conservation Area DB subtype(s)

group	*code*	*designation*
Conservation	CEP	Conservation Easement Property
	ESA	Environmentally Sensitive Area
	NAC	Nature Conservancy
	NAT	Natural Area
	NCA	NCC Conservation Land
	PCA	Private Conservation Area
	PRA	Protected Area
	PRB	Protected Beach
	RER	Representative Area Ecological Reserve
	TRA	Nature Trail
Heritage	ARS	Archaeological Site
	HEA	Heritage Area or Park
	HEC	Heritage Canal
	HEP	Heritage Park
	HER	Heritage River
	HIA	Historic Area or Park
	NHP	National Historic Park
	NHS	National Historic Site
	PEP	Provincial Heritage Property
	PHP	Provincial Historic/Heritage Park
	PHS	Provincial Heritage Site
	WHS	World Heritage Site
Parks	CMG	Campground
	CMP	Community Park
	DUP	Day Use Park
	MUP	Municipal Park
	NAP	National Park
	NEP	Natural Environment Park
	NTP	Nature Park
	PKW	Parkway
	PNS	Picnic Site
	PPR	Provincial Park Reserve
	PVP	Provincial Park
	WAP	Wayside Park

group	*code*	*designation*
Wilderness	ECR	Ecological Reserve
	NTA	Nature Trust Area
	NTR	Nature Reserve
	SES	Significant Ecological Area
	WDA	Wilderness Area
	WDR	Wilderness Reserve
Wildlife	BSR	Bird Sanctuary
	EHJ	Eastern Habitat Joint Venture
	GAS	Game Sanctuary
	MBS	Migratory Bird Sanctuary
	NWA	National Wildlife Area
	PWA	Provincial Wildlife Area
	SBS	Sea Bird Sanctuary
	WHR	Western Hemispheric Shorebird Reserve
	WLP	Wildlife Park
	WLR	Wildlife Reserve
	WLS	Wildlife Sanctuary
	WMA	Wildlife Management Area
	WPA	Wildlife Protection Area
	WRF	Wildlife Refuge
Other	AGF	Agreement Forest
	ASI	Area of Scientific Interest
	DUN	Ducks Unlimited Canada
	EDA	Education Area
	FCP	Federal Community Pasture
	IBP	International Biological Program
	NCC	National Capital Commission
	NSA	Natural Scenic Area
	PLS	Palaeontological Site
	PSL	Public Safety Lands: watershed protection
	RAM	Ramsar Wetland Site
	RTA	Research and Teaching Area
NS SigHab	380	wetland habitat
	381	saltmarsh habitat
	382	deer/moose wintering
	383	other significant habitats

Appendix G

Regulatory EMP Results

Johnson Lake Hatchery Regulatory Results Summary

When operating under Johnson Lake Fisheries, the Johnson Lake Hatchery has had a good record of being in compliance with the parameters set out in the Approval to Operate. The Approval to Operate states that the total phosphorus (TP) concentration 100m downstream of the point of discharge (in Mill Stream) must be in accordance with Table 2.6 in the most recent EMP (NBDELG 2013). In the most current EMP, the TP limit 100 m downstream is < 0.035 mg/L. The following table shows TP measurements taken in late 2017/early 2018. Total phosphorus measurements 100 m downstream varied from 0.01 to 0.033 mg/L, with an average of 0.021 ± 0.01 mg/L (SD). The upstream TP in Mill Stream is approximately 0.008 mg/L.

Regulatory Results Summary

Date	Location	Total Phosphorus (mg/L)
September 2017	10m Upstream	0.008
	Effluent Outfall	0.568
	100 m Downstream	0.020
October 2017	10m Upstream	0.009
	Effluent Outfall	0.692
	100 m Downstream	0.033
June 2018	10m Upstream	0.008
	Effluent Outfall	0.248
	100 m Downstream	0.011
July 2018	10m Upstream	0.007
	Effluent Outfall	0.325
	100 m Downstream	0.031

Report ID: 279488-IAS
Report Date: 23-Jul-18
Date Received: 04-Jul-18

CERTIFICATE OF ANALYSIS

for

Johnson Lake Fisheries
PO Box 280
Pennfield, NB E5H 2M1

rpc
921 College Hill Rd
Fredericton NB
Canada E3B 6Z9
Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Kathy Koteff
Project #: Not Available

Analysis of Water

RPC Sample ID:			279488-1	279488-2	279488-3
Client Sample ID:			Direct Effluent	Before Outlet	After Outlet
Date Sampled:			3-Jul-18	3-Jul-18	3-Jul-18
Analytes	**Units**	**RL**			
Phosphorus - Total	mg/L	0.002	0.325	0.007	0.031

This report relates only to the sample(s) and information provided to the laboratory.

RL = Reporting Limit

0.02125
0.01024

Ross Kean
Department Head
Inorganic Analytical Chemistry

Brannen Burhoe
Chemical Technician
Inorganic Analytical Services

Report ID: 275629-IAS
Report Date: 19-Jun-18
Date Received: 07-Jun-18

CERTIFICATE OF ANALYSIS

for
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Fredericton NB
Canada E3B 6Z9
Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Kathy Koteff
Project #: Not Available

Analysis of Water

RPC Sample ID:			275629-1	275629-2	275629-3
Client Sample ID:			Direct Effluent	Before Inlet	After Outlet
Date Sampled:			6-Jun-18	6-Jun-18	6-Jun-18
Analytes	**Units**	**RL**			
Phosphorus - Total	mg/L	0.002	0.248	0.008	0.011

This report relates only to the sample(s) and information provided to the laboratory.

RL = Reporting Limit

Peter Crowhurst
Analytical Chemist
Inorganic Analytical Chemistry

Krista Skinner
Chemical Technician
Inorganic Analytical Chemistry

Report ID: 252770-IAS
Report Date: 23-Oct-17
Date Received: 17-Oct-17

CERTIFICATE OF ANALYSIS

for

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Canada E3B 6Z9
Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Kathy Koteff
Project #: Not Available
Location: Johnson Lake

Analysis of Water

RPC Sample ID:			252770-1	252770-2	252770-3
Client Sample ID:			Direct Effluent	Before Inlet	After Outlet
Date Sampled:			16-Oct-17	16-Oct-17	16-Oct-17
Analytes	**Units**	**RL**			
Phosphorus - Total	mg/L	0.002	0.692	0.009	0.033

This report relates only to the sample(s) and information provided to the laboratory.

RL = Reporting Limit

A. Ross Kean, M.Sc.
Department Head
Inorganic Analytical Chemistry

Peter Crowhurst, B.Sc., C.Chem
Analytical Chemist
Inorganic Analytical Chemistry

Report ID: 249289-IAS
Report Date: 27-Sep-17
Date Received: 14-Sep-17

CERTIFICATE OF ANALYSIS

for

Johnson Lake Fisheries
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Canada E3B 6Z9
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Fax: 506.452.0594
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Attention: Kathy Koteff
Project #: Not Available

Analysis of Water

Analytes:			Phosphorus - Total
Units:			mg/L
RL:			0.002
RPC Sample ID	**Client Sample ID**	**Date Sampled**	
249289-1	Direct Effluent	13-Sep-17	0.568
249289-2	Before Inlet	13-Sep-17	0.008
249289-3	After Outlet	13-Sep-17	0.020

This report relates only to the sample(s) and information provided to the laboratory.
RL = Reporting Limit

A. Ross Kean, M.Sc.
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Peter Crowhurst, B.Sc., C.Chem
Analytical Chemist
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