Registration Submission for the New Brunswick Department of Environment: Environmental Impact Assessment

Conceptual development of Commercial-Scale Culture Methodologies for White Pacific Shrimp in Land-Based Intensive Saltwater Recirculation Systems

Submitted by: Steven Lambert

Submission Contents

Culture of White Pacific Shrimp in intensive saltwater recirculation systems

Proponent: Steven Lambert
Deer Island New Brunswick

Contact person for purposes of the EIA:

Steven Lambert
Leonardville, Deer Island, New Brunswick
Email: sblambert@xplornet.ca
506 747 2166

The Undertaking

Project Overview

The project is an evaluation of a limited commercial-scale production model for commercial culture of White Pacific shrimp

Species to be produced in culture: **White Pacific Shrimp (*Litopenaeus vannamei* Boone, 1931)**

*Pure genetic strain- no genetically modified species/ types/ strains to be reared

Purpose and Rationale for Undertaking

Background Information

White Pacific Shrimp (WPS) are large, penacid shrimp which have been raised commercially in large quantities for several decades. Culture of these shrimp occurs globally, with several large farms undertaking commercial-scale culture in Canada and the United States. Culture techniques for the species are well-known and successful through-out the world. Saltwater pond and land-based recirculation system culture are the primary methods to produce large quantities of WPS.

Project Objective

The proposed project is an evaluation of a land-based recirculation system designed to grow WPS in a facility on Deer Island, N.B. The facility will incorporate known shrimp culture system technologies. The overall objective of the proposed project is to determine the biological aspects of WPS (growth, mortality, response to water quality parameters) and recirculation system operational characterisitics. Additionally, the secondary objective is to determine the economic feasibility of WPS culture in land-based culture systems in New Brunswick. **The project as proposed evaluates a closed recirculation system based on very limited artificial saltwater introduction and even more limited effluent release (to a residential sewer system)**

Project Location

The project will be located in a residential area near Leonardville, Deer Island. The Service New Brunswick Parcel Identification Number is 15014350. An aerial photograph, of the site is included within this submission (Appendix 1). The site is basically a small building (garage) located on the site of the proponent's residence.

Site Considerations

The Lambert site is not located near a coastal zone; the site (location shown on topographic map- Appendix 1.) is on a residential land plot. **Freshwater (which will only be used to provide minimal volumes to create artificial seawater- see below, section on water use) originates from a drilled residential well on site.**

Physical Components and Dimensions of the Project

The aerial photograph (enclosed) of the site shows the general layout of existing buildings. ***The small culture system proposed will be installed in the proponent's garage on the site.*** There are no plans to alter existing infrastructure, other than addition of a wall in the garage to separate the WPS culture area from the rest of the building.

The total dimensions of the proposed WPS culture area within the existing garage will be 60ft (length) x 20ft (width).
-There are no plans to acquire additional land or use other space on site for the proposed project.

Proposed rearing infrastructure (Recirculation facility):

The proposed new construction within the garage is a small-scale installation of a culture tank system (planned location shown on aerial photograph 2, Appendix 1) will include a 3 primary culture tank production system housed in the garage. The system as proposed is based on flocculant retention and nitrogenous waste removal/ conversion in Kaldness media-based biofilters. The system is compressed air-driven; Total dynamic head and air-lift systems provide flow-rate and recirculation rate characteristics. **The system to be installed is based on proven WPS commercial culture methods used through-out the world**; no new technologies are incorporated, other than the possible inclusion of high oxygen/ low nitrogen technology (PurGro2 units: see gasinfusion.com).

Part of the culture system includes a very small (based on the extremely limited amount of water periodically leaving the system) effluent treatment system, to be located within the building (configured adjacent to the recirculation systems). This system (chlorine exposure-based) is to be used to treat any potential WPS pathogens/ disease in the effluent water.
The garage will incorporate ventilation fans and vents, to limit carbon dioxide accumulation. The garage is insulated to provide stable temperature environments through-out the year (critical aspect of WPS culture).

Recirculation system design

The garage will house an intensive saltwater recirculation system (schematic plan enclosed, Appendix 1). The process-flow design is premised on a low head, low pressure, Kaldness media-based biofilter systems. It is incorporated into the building as 3 isolated systems based on 3 circular, fiberglass primary culture tanks (each 8m3 maximum water volume). All recirculation system components are located inside the building and configured to allow maximum single airlift/pass, low-pressure, gravity flow.

The recirculated water flows from the tank collection pods (at the surface sides of each tank) to a small biofilter via airlift/ gravity. The side collection pods allow for high volume-low solids water to be delivered to the biofilters. There is one biofilter/ tank, so in-effect, each tank is a separate recirculation system. The airlifts deliver tank water to the biofilters, treated water from the biofilters flows back to the tank by gravity. Total hydraulic retention time in each tank is 1.2 hours at a projected recirculation flow rate of 10-15gpm.

Based on the standard system model, particulate removal is not used; flocculent material is retained and forms the basis for bacterial growth which assists in nitrification (heterotrophic and autotrophic bacterial metabolic process conversion) and provides an in-tank food source to the WPS. Basically the flocculent material is surface area for bacterial growth and biomass expansion which is used optimally for metabolic processes- shrimp and system-based.

The culture system, to be efficacious and meet time/ production targets, must operate at 22-26C for optimal shrimp production. A heating loop (based on electric immersion heaters) is incorporated in the recirculation water path to maintain water temperatures in this range.

Construction Details (Recirculation facility)

There is limited construction required for the project. The main construction involves only construction of a wall within the garage and actual installation of the tank recirculation systems. Pending approval to construct from DELG, the construction activities will begin sometime in fall 2017.

Details of Anticipated Effluent Treatment

A single main, collective discharge drain (resulting from installation of the effluent treatment systems (see below) will be installed to receive any effluent from the systems- all water from the systems passes from the effluent treatment system to the residential sewer system on site.

The total effluent discharge will be minimal- 10-20 Imp. gallons/ week. All of this volume will be pre-treated at 2.5-ppm residual chlorine before it passes to the sewer system. The amount of effluent predicted is so small that there will not be a need for a large effluent treatment system. The only reason for a treatment system at all is to eliminate potential shrimp pathogens passing to the sewer system. A small collection sump will receive any tank system effluent; chlorine will be added to this sump periodically through-out each week to effectively destroy any potential pathogens. Since the residential sewer system receives chlorinated water anyway, the addition of the sump treatment loop is redundant, however, it will be operated as a precaution.

Waste Disposal: Not required based on all pre-treated water passing to the house-hold sewer system.

Chemical disposal: no significant use of chemicals for treating shrimp or cleaning tanks or culture infrastructure is anticipated.

Disposal of shrimp due to stock loss:

Obviously, given adequate culture conditions, shrimp reared at the site will not suffer large mortalities. However, should a mortality event occur, a local waste disposal company would be contacted and engaged for proper removal of dead shrimp from the site. Considering the small biomass to be produced, there should be no major issues with disposal of dead animals.

Proposed Rearing Plan

The proposed production plan calls for the importation (details of stock origin provided below) of larval (L4, post-metamorphic juveniles) shrimp from a known and recognized source in the U.S. A dedicated Introductions and Transfer Permit will be required for the importation. A single importation of 10,000 shrimp will be transferred to the Deer Island facility and on-grown in the primary culture tanks. **Total time for a single production cycle (initial stocking of larva to market-size shrimp) is 8-10 months**.

Once the facility culture infrastructure has been installed and is operational, the shrimp will be imported and stocked in the culture tanks. Initially, and as part of the validation of shrimp growth performance estimates in the system, the shrimp will be divided equally between the 3 culture tanks. All shrimp will be stocked at densities which have been pre-determined to be comfortable rearing densities for WPS (based on previous reports and literature). Maximum end densities of market-size shrimp (based on 50g average weight/ individual) will be no more than 28kg/m3 within each primary culture tank- less than one-half of the usual commercial-scale production/ density levels as shown in literature related to WPS culture.

The maximum biomass within the recirculation facility is to be no more than 470kgs and this biomass is only evident just before harvest of market-size shrimp. This biomass assumes no mortality during the production cycle; actual mortality rate can only be determined during the production cycle.

Source of imported WPS larva:

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Shrimp Improvement Systems
88081 Overseas Highway
Islamorada, Florida, USA 33036
Ph: 1 305 852 0872
Email: sales@shrimpimprovement.com

Shrimp: Food Ration and Feeding Strategy

All of the shrimp in the tanks in the recirculation facility will be fed on a continual basis and the amounts of food introduced into the tanks routinely recorded. The average food ration (based on standard commercial protocols) is predicted at a maximum 1.2% body weight/day or approximately a maximum of 1.6kgs/day/tank at the end of the production cycle when shrimp are harvested. Obviously the introduced food will be very small in volume after introduction of larva and will increase as the shrimp grow during the production cycle.

The total food allocation for the facility during the production cycle (8-10 months) at the site will not exceed 4kgs/day and this will be evident only just before the market-size shrimp are harvested.

Mitigating disease

WPS have been reported as being impacted by viral, bacterial and protozoan diseases. In general, the mortality of WPS from disease has been very low, in spite of high density production in intensive culture. In order to obtain imported stock, the facility supplying the larva must provide health certificates for each importation and transfer. This is routine for two currently operating WPS farms in Ontario. We assume that the imported stock will not have disease issues, based on the review process as related to transfer and importation. However the shrimp stock will be monitored carefully during the grow-out cycle for signs of disease-including periodic disease testing of sampled shrimp.

Chemical Use: The proponent will not use any harmful chemicals (to human health or environmental impacts) to rear shrimp at any point in the production cycle. We do not predict the use of any chemicals in the culture process on Deer Island.

Water Use and Water Volume Requirements

The water (new/make-up water) available at the site will originate only from dechlorinated freshwater to which instant ocean is added (artificial seawater). As described above, only minimal amounts of added saltwater is necessary to complete the production cycle. A maximum new water introduction rate/ tank is to be 5 Imp. gallons/ week or 15gallons total facility/ week. The assumptions of water use are based on turn-over/residence times required for optimal operations of the recirculation and flow-through systems. For the recirculation facility, a minimum make-up volume is required to provide a dilution effect sufficient to suppress nitrate accumulation. The ammonia/nitrite/carbon dioxide removal rates are not contingent on large amounts of introduced new water (the recirculation systems as designed

remove efficiently these compounds) and minimal new water volumes require less introduced heat for optimal environmental control. The new water is added predominately to suppress nitrate levels.

Description of receiving waters (existing environment)

There are no receiving waters as pertains to this project- effluent to house-hold sewer system only.

Physical and Natural Features

Current Information as related to the physical and natural features:
-Site topography is shown on the topographic map of the site enclosed in Appendix 1.
-General surface drainage is does not apply to the proposed project
-There are no geological or hydrogeological features that will be impacted by construction or operation of the proposed culture production
-There are no predicted adverse environmental conditions that are anticipated as a result of the construction or operation of the proposed facility
-There is one (1) residential well on the site which will not be impacted
-There are no identified Environmentally Significant Areas adjacent to the site
-The vegetation species profile is not related to the project
-No species of risk have been identified or occur on or adjacent to the site
-No critical or sensitive habitats have been identified or occur on or adjacent to the site

There are no culturally sensitive features on or adjacent to the proposed site

Design of proposed effluent treatment and its relationship to environmental impacts on adjacent receiving waters

The intention of the project is to have the minimal culture system effluent passing to the on-site sewer system- no receiving waters are implicated

Calculated (predicted) phosphorous level in effluent water passed to the receiving water

All effluent (minimal) will pass to the on-site sewer system- no receiving waters identified or impacted

Locations of other aquaculture or fishery activities

There are no other aquaculture facilities within 3kms of the proposed site. Commercial fisheries are not undertaken on or near the site.

Summary of Environmental Impacts

Effects of environmental impacts (construction mode)

The construction phase involves minor in-building system installation only. There are no environmental impacts during the construction phase of the project.

Impact on adjacent activities: none predicted

Summary of Proposed Mitigation

A detailed effluent treatment strategy (see above description of this methodology) which will efficiently destroy pathogens and mitigate effluent treatment will be incorporated. The minimal new water (make-up water) amounts used in the proposed facility are anticipated to dilute and prohibit accumulation, or limit directly, the ammonia production within the culture systems. Our proposed mitigation strategy is contingent on directly removing and/or limiting the dispersion of these compounds.

Monitoring of effluent water quality

As is currently proposed, routine monitoring of the water quality of discharged effluent on the site (if required by the Approval to Operate) will be completed. A routine recording of biomass at the site will also be completed each month.

Funding

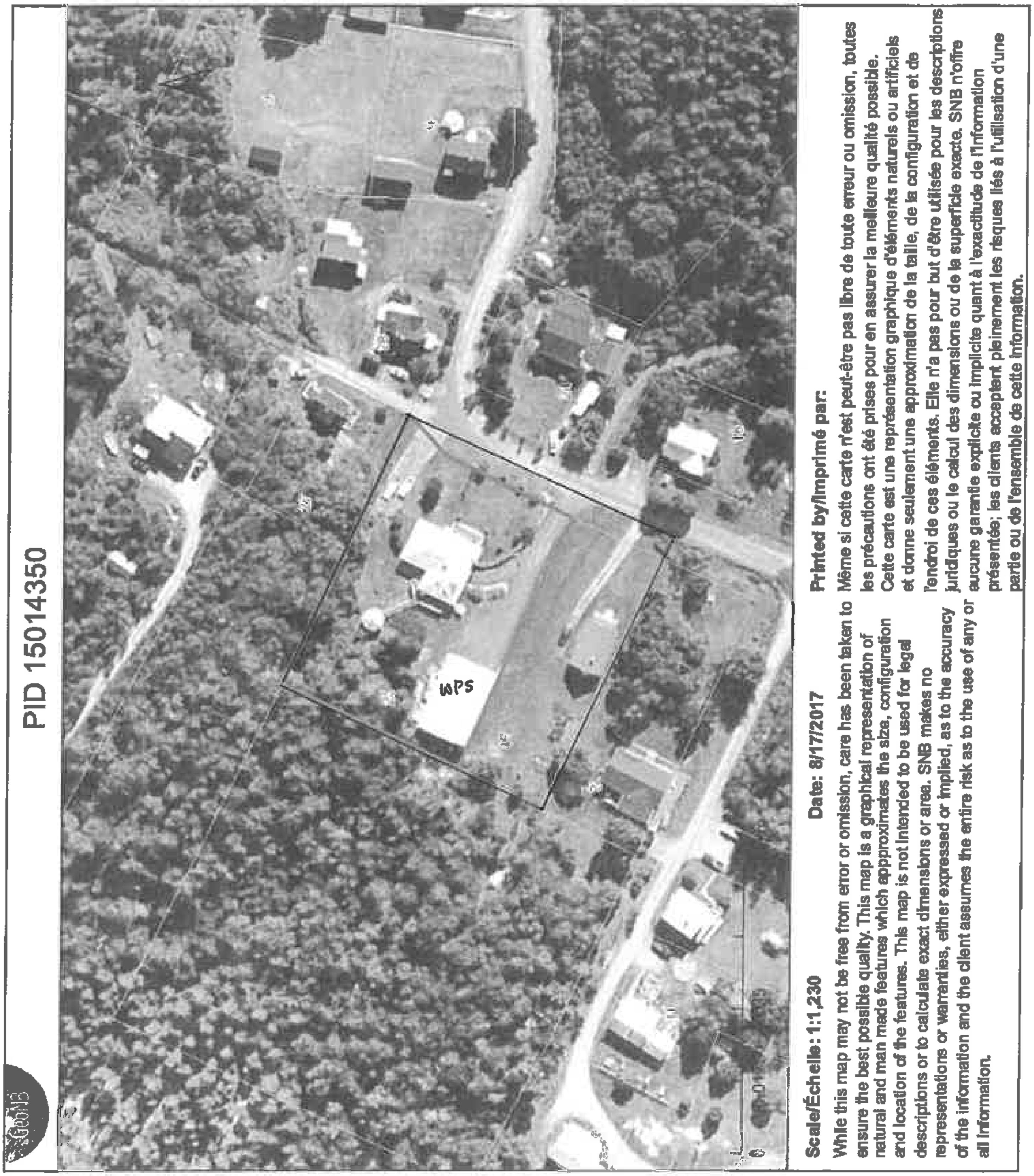
A small Total Development Fund (through DAAF) program related to the conceptual development of this WPS culture project will be considered to assist in covering infrastructural costs. All other costs required will be covered by the proponent.

APPENDICES

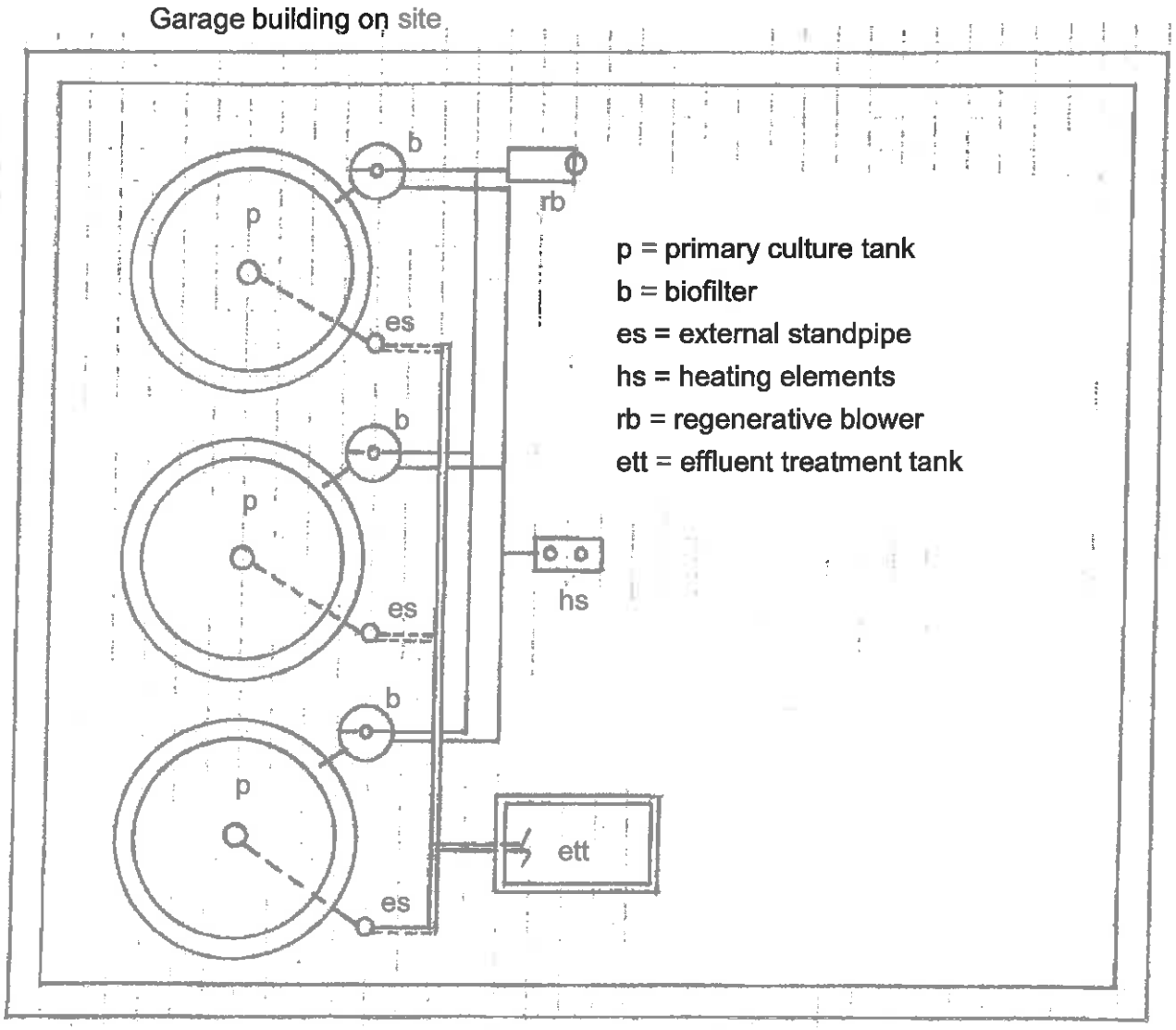
Appendix 1. Photographs and Maps showing the location and culture infrastructure of the WPS culture facility on Deer Island.

1) Aerial photograph of site and adjacent area
2) Schematic diagram of proposed culture system
3) Topographic map detail showing location of proposed site

Aerial photograph showing White Pacific Shrimp culture site on Deer Island, New Brunswick (PID location outlined)



Schematic (top view) of White Pacific Shrimp intensive saltwater reciculation system on Deer Island, New Brunswick (low-head, airlift/ gravity-based flow system; biofiltration using fluidized Kaldness media)



-Total system volume = 24.8m3
-All tank drains to effluent treatment tank
-Drain from effluent treatment tank to residential sewer system

Topographic map showing location (arrowed) of White Pacific Shrimp culture facility located near Leonardville, Deer Island, New Brunwick