# Environmental Registration
# for
# Northern Harvest Smolt Ltd.,
# Stephenville, NL

*This document is prepared for Northern Harvest Smolt Ltd., pursuant to the Newfoundland and Labrador Environmental Protection Act, and the Canadian Environmental Assessment Agency (Project Description), pursuant to the Canadian Environmental Assessment Act.*

**Prepared By:**


Edwards and Associates Limited
P.O. Box 158
Marystown, NL
A0E 2M0

and

Mel-Mor Science
379 Poets Trail Drive
Nanaimo, BC
V9R 7B1


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# PREFACE

This document was prepared by Edwards and Associates Limited, of Marystown, NL, and Mel-Mor Science of Nanaimo, BC, on behalf of Northern Harvest Smolt Ltd. (NHS), of St. Alban's, NL.

The proponent has assembled a team of engineering, environmental and legal experts to supply required technical support for the project which includes the following.

| Company | Responsibilities |
|---|---|
| Edwards and Associates Ltd. | Land surveying/acquisitions/permitting, site development plans, environmental management, project management. |
| Sweeney International Management Corp. | Advisory capacity for the completion of department of Fisheries and aquaculture application for the Aquaculture License. |
| Blake, Cassels & Graydon LLP | Legal counsel to MHAC, dealing with land acquisitions, regulatory approvals and environmental applications. |
| FracFlow Consulting Ltd. | Water analysis, well pump tests, engineering consulting, geotechnical analysis |
| Pentair Aquatic Eco Systems Inc. | Design of hatchery processes |

Site preparations will begin immediately following approval from the environmental regulatory process and receipt of all necessary permits and authorizations. Site preparation and construction is currently scheduled to begin August of 2018, with final construction being completed by the end of 2020.

# EXECUTIVE SUMMARY

This document is prepared for the Newfoundland and Labrador Department of Municipal Affairs and Environment (Project Registration), pursuant to the Newfoundland and Labrador Environmental Protection Act, for the expansion and upgrading of the licensed Indian Head Hatchery, owned by Northern Harvest Smolt (NHS), in Stephenville, NL.

The Indian Head Hatchery provides smolt for the Northern Harvest Sea Farms (NHSF) licensed saltwater farms, with a production capacity of 4.5 million fish annually from egg incubation through to smolt. The proposed expansion will bring production to 6.7 million smolt annually.

This document provides a detailed description of the components associated with the proposed expansion project and operations that will use the latest in re-circulating aquaculture system technology (RAS), to improve smolt production.

The proposed project will include the following improvements.

- Upgrade of current production systems – incubation, vaccination/grading, biosecurity.
- Expansion of smolt production with a new building and modular RAS production units and supporting infrastructure such as freshwater and saltwater wells.
- Enhanced effluent treatment and disposal
- High efficient fish transport system

The company has completed extensive investigations, researching the property adjacent to the existing Indian Head hatchery for the site of the expansion, the freshwater aquifer and the saltwater capacity. A recap of the results of this work is as follows.

- The proposed expansion site, immediately adjacent to the existing facility in an industrial zoned area with road access and established power and municipal water, is suitable for the proposed expansion.
- The land identified as the site for the proposed expansion is available for purchase from the Town of Stephenville.
- Easements and lease agreements for other properties have been identified.
- Extensive soil testing of the proposed project site has identified contaminated areas from a previous owner that will not be purchased nor used for this project.
- There is ample fresh and saltwater to supply this project without negatively impacting neither the freshwater aquifer nor the saltwater supply.
- There are no contaminants leeching into the salt or fresh water supplies resulting from known contamination in the area.
- Potential impacts during site clearing and preparation have been recognized, and mitigation measures included in the development plan.
- Arrangements have been made for appropriate construction and operational waste removal and recycling.

NHS has consulted with all levels of government throughout the development of the proposed expansion project, as well as, consultations with municipal authorities. Furthermore, Marine Harvest, the owner of NHS and the Indian Head Hatchery has held several meetings regarding the hatchery with Town of Stephenville Council, Chamber of Commerce, business owners, First Nations and other interested members of the public from both Stephenville and Corner Brook.

Construction on the proposed Project is planned to commence August 2018 and complete by the end of 2020. The Project has an estimated cost of $51 million.

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# 1 INTRODUCTION

Northern Harvest Smolt (NHS) is a wholly owned subsidiary of Northern Harvest Sea Farms (NHSF). NHSF owns 33 licensed marine farms and NHS has provided smolt from the Indian Head Hatchery, at Stephenville, Newfoundland, for these farms since 2012. Both NHS and NHSF are now owned by Marine Harvest (MH) and will continue to operate as distinct corporate entities, with Marine Harvest as the owner of the corporations.


Figure 2: Location of Indian Head Hatchery, Stephenville, NL


Figure 1: Stephenville Area

The NHS Indian Head Hatchery was registered as an undertaking for environmental assessment with the Department of Environment and Conservation (now Municipal Affairs and Environment) in November of 2010 and released from review with conditions in January 2011, see Appendix A: Indian Head Hatchery 2011 Environmental Review and Release. The facility was constructed in 2011 and began producing smolt in 2012 exclusively for the NHSF saltwater farms. The facility operates under an aquaculture license AQ1087 issued by the Department of Fisheries and Land Resources.

The Indian Head Hatchery Expansion Project (the Project) proposes to upgrade and expand the facility providing more smolt at a higher quality in order to fully utilize the existing licensed NHSF saltwater farms. The NHS facility produces 4.5 million smolt annually and the proposed expansion will increase capacity to 6.7 million.

## 1.1 Benefits of Expansion

The proposed Project is necessary to improve capacity and quality of Atlantic salmon smolt produced to fully utilize licensed NHSF saltwater farms. For the salmon aquaculture industry in general and the Province of Newfoundland and Labrador, the following benefits will be realized.

- Expansion of the existing hatchery will lead to increased salmon aquaculture production in the province of Newfoundland and Labrador, a Way Forward commitment by the provincial government.
- Production of smolt in the province is a more bio-secure option than shipping smolts in from outside the province. In-province production results in better smolt quality, improved fish welfare, improved farming logistics and improved biosecurity of the industry.
- Through this project, state-of-art technology will be employed in the Newfoundland industry improving overall industry performance.
- This project will improve an existing licensed hatchery and expand the facility to create greater efficiency in production and transportation of fish, increase production capacity, produce larger more robust smolt thereby improving industry productivity and security.
- Existing hatchery systems will be upgraded with new technology implemented in order to meet the certification standards of the Aquaculture Stewardship Council (ASC) and Best Aquaculture Practices (BAP) thereby improving the environmental and social standing of the company and the industry.

For the company, the Project will result in greater control over production processes, increased production, healthier fish which result in greater harvest per unit effort.

- Smolt production of 4.5 million annually will increase to 6.7 million annually.
- New Modular RAS Production unit to increase production has 97% water reuse resulting in improved conservation of water resources.
- Heat pumps will be employed to cool the system providing greater control of culture environment and reducing the amount of ground water required during periods of higher water temperature.
- Upgrading the incubation system with newer substrate and chilling capacity will allow batching will accommodate more eggs.
- Additional tanks will be added for all levels of production increasing capacity and providing greater control of the culture stages.
- Life stages will be physically separated to enhance biosecurity during production at all life stages.
- A modern, centralized grading and vaccination system will create greater efficiency and higher fish survival.

- Additional freshwater wells will be developed to ensure adequate water for the expansion. A comprehensive program will monitor the quality and quantity of water.
- Saltwater wells will provide saline water to be used to acclimatize smolt prior to being transported to the saltwater farms for greater survival and enhanced growth to harvest.
- Enhanced effluent treatment system will include grey water clarifiers/solids removal, UV treatment to kill microorganisms and potential pathogens and discharge to the marine environment outside of the harbour.

# 2 GENERAL INFORMATION

## 2.1 Name of Undertaking

Indian Head Hatchery Expansion Project

## 2.2 Proponent Contact Information

**Name of Corporate Body:**

Northern Harvest Smolt Ltd.
P.O. Box 460
St. Alban's, NL
A0H 2E0

**Chief Executive Officer**

James Gaskill
Managing Director
Tel: (506) 608-2581
Email: Jamie.Gaskill@marineharvest.com

**Principal Contact for Environmental Registration**

Elizabeth Barlow
Sustainability Manager
Tel: (709) 743-5546
Email: elizabeth.barlow@marineharvest.com

## 2.3 Nature of the Undertaking

The purpose of the Project is to improve the production at a producing Atlantic salmon facility - Indian Head Hatchery license number AQ1087. Improvements will provide greater numbers of higher quality, healthier smolt in order to fully utilize the existing production capacity of the company's licensed saltwater farms.

The upgrades to the existing hatchery systems will be undertaken without affecting the current production and all activity will take place on the established licensed site. A new Modular RAS Production unit will be located on land adjacent to the existing hatchery site, see figure 1 below. The two facilities will be kept separate for biosecurity reasons but will be linked via employee walkways and fish transport lines. Both the existing and new locations will be enclosed separately with security fences.


Figure 3: Existing Indian Head Hatchery and Location of the Proposed Expansion

## 2.4 Authorizations Required / Approval of the Undertaking

The proposed project will require authorizations from the Federal, Provincial and Municipal authorities. The following table lists the permits that may apply as the project develops.

Table 1: Authorizations and Permits that May Apply to the Proposed Project

| Agency | Department | Approval Form |
|---|---|---|
| Department of Fisheries and Aquaculture | Fisheries and Aquaculture | Amendment to the Aquaculture License |
| Transport Canada | Transport Canada | Navigable Water Protection Act approval, markings and other conditions |
| Transport Canada | Transport Canada | Land Acquisitions |
| Services NL | Government Services | Waste Management Plan |
| Municipal Affairs and Environment | Ground Water Division | Permit to Extract Water from Stephenville Aquifer |
| Municipal Affairs and Environment | Assessment Division | Release of Undertaking |
| Municipal Affairs and Environment | Water Resource Division | Alterations to Body of Water |
| Municipal Affairs and Environment | Water Resource Division | Certificate of Approval – Water and Sewer Distribution System |
| Municipal Affairs and Environment | Water Resource Division | Installation of culverts, water crossings, etc. |
| Municipal Affairs and Environment | Water Resource Division | Water use Authorization |
| Municipal Affairs and Environment | Pollution Prevention Division | Certificate of Approval for Industrial Facility or Processing Work may be required |
| Municipal Affairs and Environment | Pollution Prevention Division | Environmental Protection Plan - Construction |
| Municipal Affairs and Environment | Crown Lands Division | Application for easements over Crown Land for water main from well sites to hatchery as required |
| Department of Fisheries and Land Resources | Forestry Resources | Cutting and Burning Permit |
| Department of Natural Resources | Mines and Energy | Quarry Permit – required by site works contractor to import fill material |
| Services NL | Government Services | Certificate of approval for storage of gasoline and related products to run emergency generator |
| Services NL | Government Services | Storage Tank Application |
| Services NL | Government Services | Compliance national Fire Code; national Building Code; Life Safety Codes |
| Services NL | Government Services | Building Accessibility |

| Agency continued | Department | Approval Form |
|---|---|---|
| Department of Human Resources, Labour and Employment | Human Resources Labour and Employment | Compliance Standards Occupational Health and Safety |
| Town of Stephenville | Town of Stephenville | Development Permit |
| Fisheries and Oceans Canada | Fisheries Protection Program | Permit – Discharge Line |

The company is providing this environmental registration document as requested by MAE.

The project includes the acquisition of lands adjacent to the Indian Head Hatchery currently owned by the Town of Stephenville. This land is within the Planning Area Boundary of the Town of Stephenville, and therefore any development will abide by municipal regulations and bylaws as established by the Town.

## 2.5 Public Consultations

Stakeholders in the Stephenville and Corner Brook areas were engaged to provide information about the project and receive feedback. Feedback was overwhelmingly supportive. Stakeholder engagement has included the following meetings.

- Town Council of Stephenville on several occasions.
- Bay St. George Chamber of Commerce and Business Owners
- Port of Stephenville on several occasions
- Fisheries and Oceans Canada
- Qualipu Mi'kmaq First Nation
- General Public

In addition to these meetings, discussions with local businesses in Stephenville have been initiated for possible beneficial and alternative uses for the effluent from the proposed expansion. Some options for the use of liquid and solid effluent are as follows.

- Irrigation for the golf course, which will reduce the golf course's reliance on the municipal water supply currently being used
- Hydroponics production, food security
- Compost operations (two local operations)
- Field crops, local crops, food security

# 3 DESCRIPTION OF THE UNDERTAKING

## 3.1 Geographical Location

The following sections deal with the geographical location, current and historic land use, zoning information and land ownership of the proposed project.

### 3.1.1 Site Location

The existing hatchery and the proposed expansion site, which is adjacent to the existing hatchery, is located within the town boundaries of the Town of Stephenville, in the provincial electoral district of Stephenville - Port au Port. More specifically, the site is located on the northeastern shore of Port Harmon which borders on the northerly shore of St. George's Bay. The site of the expansion is directly adjacent to and on the southeasterly side of the existing hatchery. Figure above and 1:50,000 map of the area are found in Appendix D: Aerial Photos shows the location of the hatchery and the proposed expansion.

### 3.1.2 Site Description Including Boundaries

The existing Indian Head Hatchery is located within the Port Harmon Complex Industrial Park, between Connecticut Drive and the Waters of Port Harmon, and is located directly adjacent to the proposed expansion property. The site contains a combined area of 13.232 hectares, or 32.70 acres, and was surveyed by R. Davies Surveys Ltd. See Appendix E: Zoning and Land Ownership.

The site for the Project expansion, for the Modular RAS Production unit and supporting infrastructure, will be also located within the Port Harmon Complex Industrial Park adjacent to the existing Indian Head Hatchery and is situated between Connecticut Drive and the Waters of Port Harmon. The site contains a combined area of 8.598 hectares, see Appendix C: Legal Survey for the full legal description and survey plan. The site generally slopes from the north to the south allowing for natural storm water drainage and the natural topography is well suited for the proposed building layout.

### 3.1.3 Current and Historical Land Use

Aerial photographs obtained from the Surveys and Mapping Services division of the Department of Fisheries and Land Resources indicate that as far back as 1941 the proposed expansion site has generally been unoccupied and undeveloped. Aerial photographs were obtained for the years of 1941, 1966, 1974, 1984, 1997, and 2016 and copies can be found in Appendix D: Aerial Photographs. The following is a brief description of the occupation and development which can be seen from each of the photos:

*1941 Aerial Photo:* The 1941 aerial photo shows the subject site nearly completely covered in trees with no evidence of structures or development on the subject property during that time. Connecticut Drive can be clearly identified to the north of the subject property.

*1966 Aerial Photo:* The 1966 aerial photo also shows that the subject property still remains undeveloped. It is evident that some storage tanks and buildings were erected on the property to the immediate east of the subject property. Again, Connecticut Drive can be clearly identified to the north of the subject property.

*1974 Aerial Photo:* The 1974 aerial photo again shows that the subject property remains mainly covered in trees and relatively undeveloped. There are no structures or buildings erected on the subject property, however, a gravel access road has been constructed through the northerly portion running in an east to west direction, parallel to Connecticut Drive which is again clearly identifiable. It is also evident that there is a small stream, running north to south into the Waters of Port Harmon, situated on the easterly portion of the subject property.

*1984 Aerial Photo:* The 1984 aerial photo shows yet again that the subject property remains undeveloped and that the site is still tree covered. The gravel access road from the 1974 aerial photo is still visible as well as Connecticut Drive. No buildings or structures are evident on the subject property.

*1997 Aerial Photo:* The 1997 aerial photo shows that the subject property remains unchanged and undeveloped. It is evident that the site is densely covered with tree growth and the gravel road from the previous pictures is still evident. Connecticut Drive is also visible from the photo.

*2016 Aerial Photo:* As in the previous photos, the 2016 aerial photo shows that the subject site is still densely covered in trees and no development has taken place on the site. The gravel access road appears to be grown in and covered with more vegetation which may indicate that is no longer used as an access road. It is evident from this photo that some development has occurred on the site to the east of the subject property and some tree clearing on the property to the west of the subject site. Connecticut Drive remains clearly visible to the north of the subject property.

Although the aerial photos discussed above show little development on the subject property it should be noted that throughout history the area surrounding the subject site has undergone some occupation and development. The majority of Stephenville remained undeveloped up until the early 1940's at which time the United States of America decided that Stephenville would become a vital refueling stop for American aircraft on route to Europe (Town of Stephenville, 2018). The first wave of US Army troops arrived in January 1941 and in December of 1942 the

United States of America declared war on Japan. The Americans occupied the area around the subject property up until the mid-1960's until the base was officially closed in 1966. Many of the buildings and fuel storage tanks remain and are used to this day by businesses who operate within the industrial park.

It should also be noted that even though the aerial photos show a lack of occupation on the subject site throughout history, there is an apparent gap between the 1941 photo and the 1966 photo during the time of the American occupation and according to Town of Stephenville records the site was occupied by the American Air Force and an established camp was located on the site.

### 3.1.4 Zoning Information

Both the existing hatchery and the proposed expansion site are situated in an Industrial General (IG) Zone. Permitted uses in this zone are outlined in Schedule C of the Town of Stephenville Development Regulations, 2014 and include all uses in the Assembly Use except Educational, all uses in the Business Professional and Personal Service uses group, Commercial-Residential (Condition 3), Conservation, General Industry, Light Industry, all uses in the Mercantile Uses group, Recreational Open Space, Service Station, Transportation, and Antenna. Discretionary uses classes in this zone include Hazardous Industry, Mineral Exploration, Mineral Working, and Scrap Yard. The complete Town of Stephenville Development Regulations, 2014 can be found at the following link as supplied by the Department of Municipal Affairs: http://www.mae.gov.nl.ca/registry/community/stephenville/files/DR.pdf

The following figure shows the extents of the Industrial general (IG) Zone surrounding the proposed site. A larger version of the map, illustrated in the figure below, can be found in Appendix E: Zoning and Land Ownership.

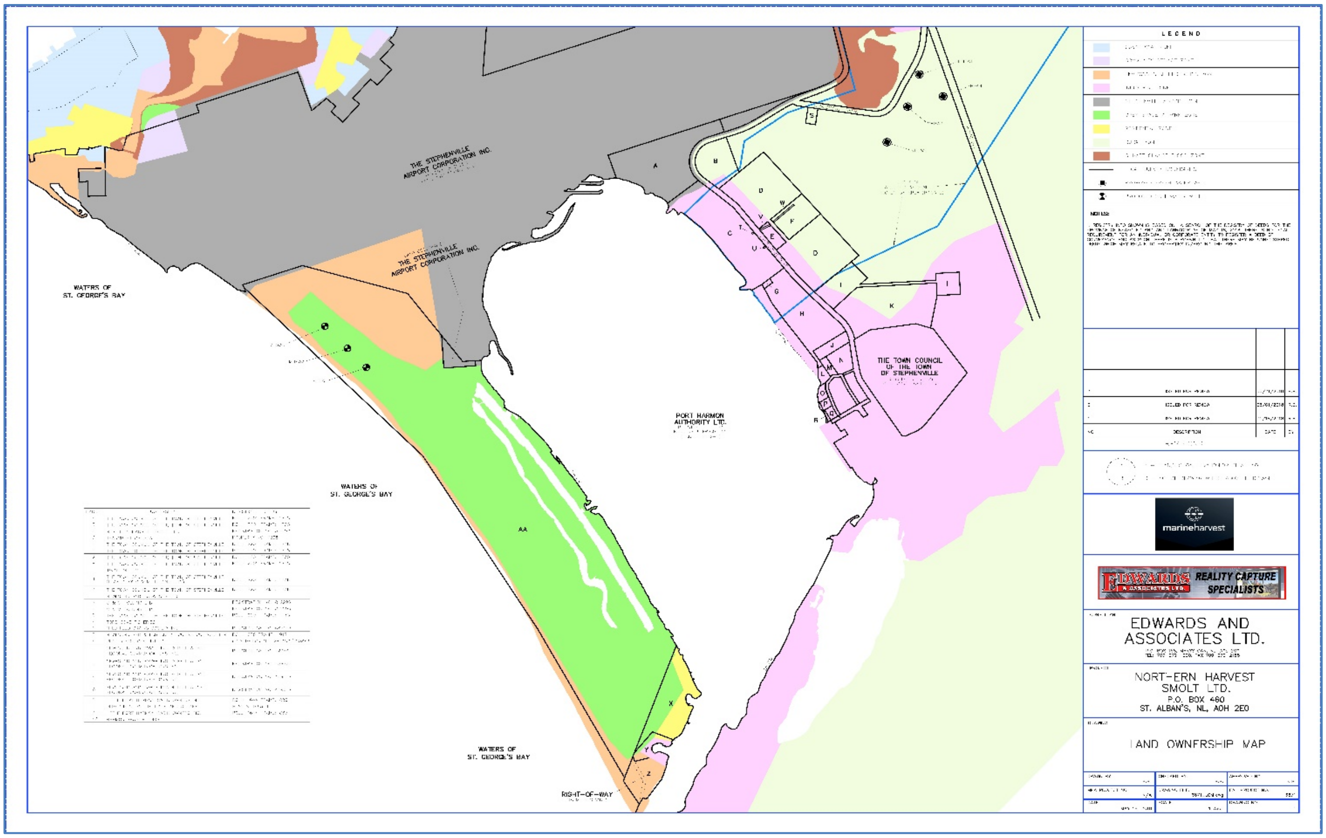



Figure 4: Zoning Information

### 3.1.5 Land Ownership

The existing hatchery site was purchased by NHS from the Town Council of the Town of Stephenville through a deed of conveyance dated December 16, 2011 and is identified as "Parcel C" in figure above (refer to Appendix E: Zoning and Land Ownership for a larger copy of the Land Ownership Map). The conveyance can be seen in Registration Number 525341at the Registry of Deeds for the Province of Newfoundland and Labrador. A copy of the registered deed can also be found in Appendix I: Surveys for Land Purchases and Easements.

Land acquisition or easement agreements required for the proposed project are provided in the table below.

Table 2: Land Acquisitions or Easements Required for the Project

| OWNER | AGREEMENT TYPE | PURPOSE | DRAWING NUMBER[1] |
|---|---|---|---|
| Town of Stephenville | PURCHASE | Modular RAS Production Site | SV-CD-MARINE-1A |
| Town of Stephenville | PURCHASE | Water Treatment Facility | SV-CD-MARINE-1 |
| Town of Stephenville | EASEMENT | Freshwater Wells | MHAC-6 |
| Town of Stephenville | EASEMENT | Freshwater Lines | MHAC-2 |
| Town of Stephenville | EASEMENT | Modular RAS Production Site | SV-CD-FFLOW-B |
| Town of Stephenville | EASEMENT | Modular RAS Production Site | SV-CD-FFLOW-A |
| Port of Stephenville | LEASE | Fish Transport Line | MHAC-3 |
| Port of Stephenville | LEASE | Saltwater Influent Line, Effluent Lines | MHAC-1 |
| Port of Stephenville | LEASE | Saltwater Influent Line, Effluent Lines | SV-CD-FFLOW-1 |
| Stephenville Airport Authority | EASEMENT | Effluent Lines | MHAC-5 |
| Seaside Links Golf Course | EASEMENT ON LEASE | Saltwater Influent Line, Effluent Lines | MHAC-4 |

[1]Refers to drawing number in Appendix I: Surveys for Land Purchases and Easements

The property for the proposed expansion to the Indian Head Hatchery is currently owned by the Town of Stephenville and was purchased from Newfoundland and Labrador Housing Corporation through a deed of conveyance being shown in Volume 2201 Frame 1738 of the Registry of Deeds for the Province of Newfoundland and Labrador. Discussions to purchase the subject property, identified as "Parcel H" in figure above are ongoing.  For legal registration, refer Appendix I: Surveys for Land Purchases and Easements.

## 3.2 Physical Features

The following provides information the physical features of the proposed Project, the existing site conditions, topography and the geology of the property for the proposed expansion.

### 3.2.1 Major Physical Features Associated with the Project

The major physical features associated with the proposed expansion project are the buildings constructed to house new technology, effluent and fish transport lines and platforms for supporting infrastructure.  For details on the technology see Section 3.3.

#### *3.2.1.1 Indian Head Hatchery Existing Site*

- Vaccination/Grading Building will be constructed to the south of the existing production building close to

- Fish Transport Lines will be permanent and be located as required to efficiently transport fish between the existing Indian Head Hatchery and the expansion site and Modular RAS Production units.

#### *3.2.1.2 Expansion Site (Adjacent to the existing Indian Head Hatchery)*

- Diesel Generator and Fuel Storage will be located immediately to the west of the entrance to the expansion site is the diesel generator and fuel tanks to supply backup power to the site in the event of a power outage. The exact size of the permanent structure will be determined once the generators are sized to ensure that site has 100% backup power and fuel storage for 72 hours. The generator and fuel tank are located inside the property fence but outside the biosecurity fence.
- Oxygen Storage Tank will be located directly south of the generator inside the property fence but outside the biosecurity fence.
- Modular RAS Production Building, approximately 160m x 65m, will be located on the property adjacent to the existing hatchery, towards the south end of the site. The design will use the natural slope of the property with the main floor entrance at the same elevation of the building at approximate elevation of 7.0m. The building will also have an entrance at the bottom of the tank level at approximate elevation of 4.0m. This building will also house the primary water treatment and recirculation systems and include secure storage areas.
- Fish Transport System will have a dedicated area (3m x 3m) on the southeast corner of the Modular RAS Production building. A permanent discharge pipeline will carry fish to a well boat docked at the existing wharf located east of the site for transport to the saltwater farms.
- Water Treatment Facility will be located on the north side of the proposed Modular RAS Production site on the opposite side of Connecticut Drive. The facility will include header tanks and UV treatment for both the influent fresh and saltwater. The treated water will be supplied by gravity to the production systems.
- Effluent Treatment Plant will be located on the southwest corner of the expansion site. Effluent from both the existing hatchery and the Modular RAS production units will be collected at a treatment plant (30m by 30m).

#### *3.2.1.3 Saltwater Influent and Effluent Discharge Systems*

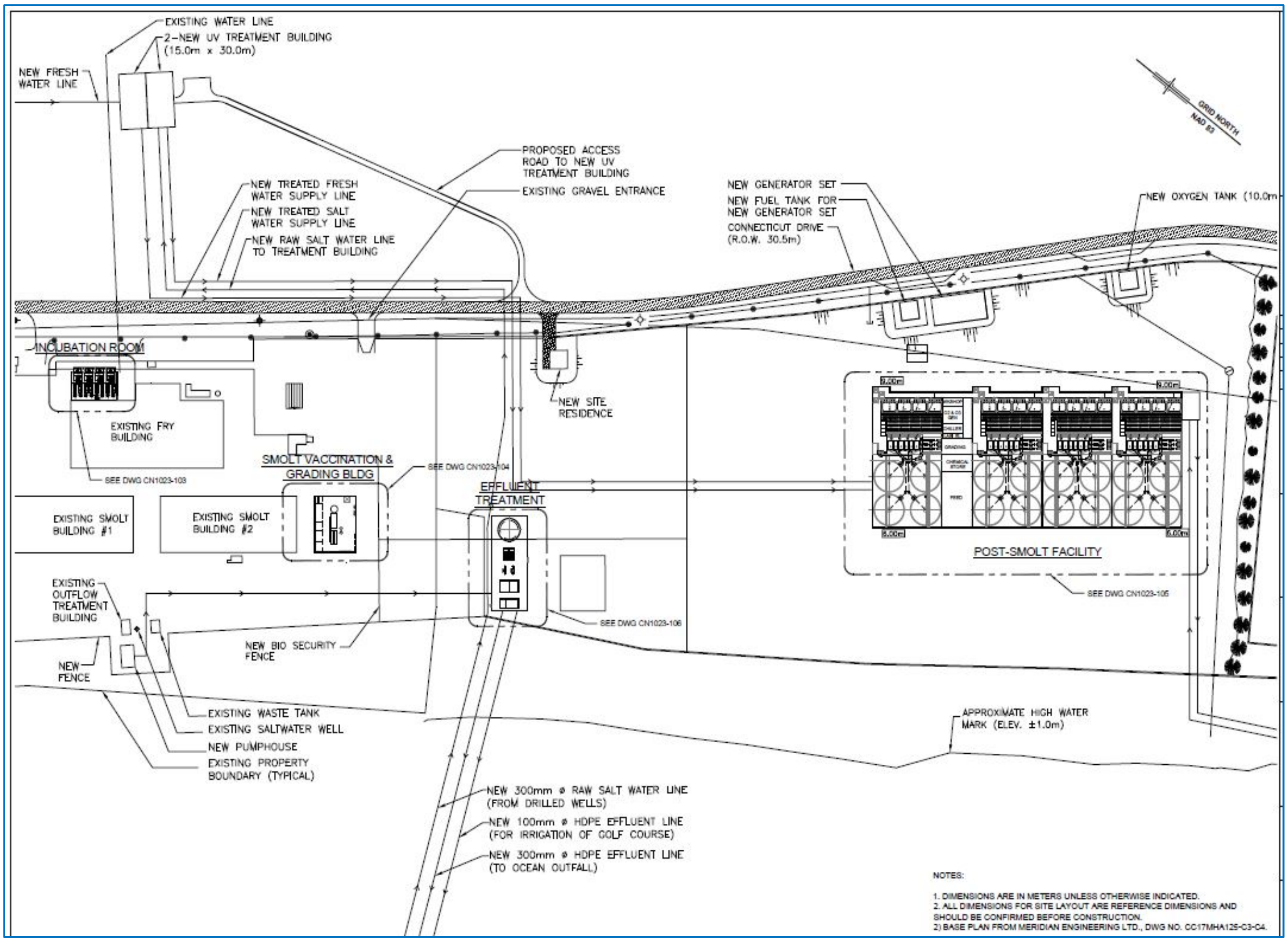
- Saltwater influent lines, 300mm HDPE, will run from the saltwater wells on the Seaside Links Golf Course across the Port of Stephenville to the Water Treatment Facility.
- Effluent Discharge System will include two separate 400 mm HDPE lines to transport salt and freshwater effluent individually from the treatment plant across the Port of Stephenville and underground across the golf course to a discharge in St. George's Bay. A smaller 100mm HDPE effluent line will be installed to provide freshwater effluent for irrigation to the golf course. The outfall will be located 20m below low tide which is approximately 800m from the shoreline.
- It is proposed that the pipelines be floated across the harbour and then fixed to the harbour bottom using weights or collars distributed along the pipelines, see figure below. The presence of soft sediments on the harbour bottom and variability in the thickness of the soft sediments will determine where the anchors will be placed and the exact

location of the pipelines. Sonar profiles and analyses of the harbour benthos were completed and are available in Appendix H Saltwater Supply and Lines.

- The saltwater intake line and the effluent discharge lines will be laid subsurface through the Golf Course in a single existing cement trench, see figure below.

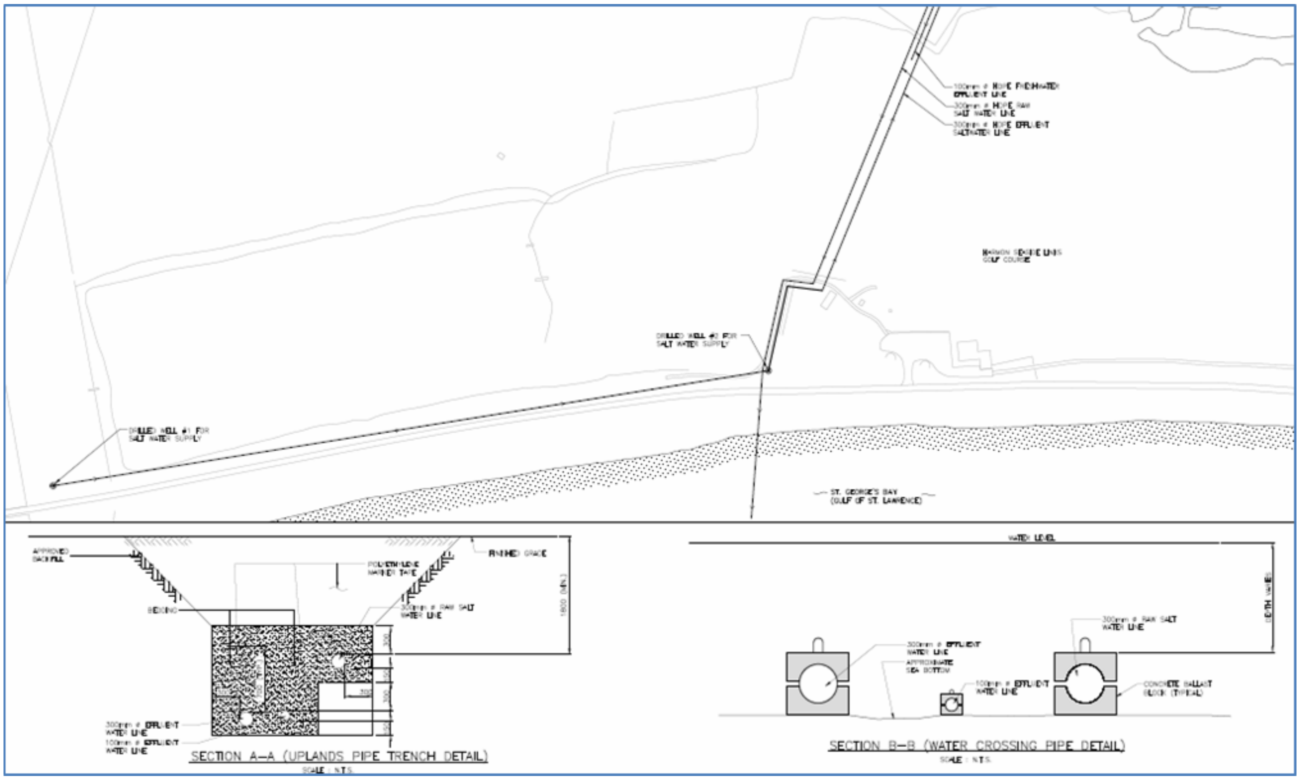
The figure below shows the proposed major structures for the Project. The existing Indian Head Hatchery is on the left of the schematic with the proposed Modular RAS Production units and supporting infrastructure expansion on the right.

Figure 5: Proposed Layout with Major Physical Features




The figure below shows the saltwater influent line running from the saltwater production wells on the to the Water Treatment Facility. Also shown are the double effluent lines, one with freshwater effluent and the other with saline effluent, carrying treated wastewater from the production facility to the discharge in St. George's Bay.

Figure 6: Saltwater Supply and Effluent Discharge Lines and Structures




### 3.2.2 Topography, Surficial Geology, Bedrock Geology, Hydrogeology

A number of small water bodies including Noel's Pond, Mine Pond and Gull Pond drain into Port Harmon adjacent to the project site. Several protected well fields also exist to the north-west of the site. The closest, Stephenville well field, is 3.5km away, and the Kippens well field, which is further west, is 5.5km from the site. The project site is down-gradient of the established well fields as the general topography of the area consists of elevated hills to the west, north and east of the site with the majority of the precipitation collecting in nearby drainage basins (Noel's Pond, Mine Pond, etc.) and eventually flowing towards the ocean near the site at Port Harmon.

The existing hatchery and the proposed expansion site are located near the cusp of two physiographic regions in western Newfoundland, the Stephenville Lowlands and the Blow-Me-Down Highlands. (AMEC Earth and Environmental, 2008).

The surficial geology is predominantly sand and gravel within the Stephenville area and the topographic terrain ranges from approximately 50m to 150m above sea level throughout defined as unconsolidated sediments. Gravel is pebble to cobble in size and forms approximately 50-95% of the sediment including eskers, kames and outwash planes. (AMEC, 2008) The bedrock geology is comprised of clastic sedimentary rocks and minor coal beds. Bedrock geology in the area can be defined as part of the Barachois Group, Arkosic and subarkosic, grey to red sandstones, grey to red siltstones, grey to black shale and coal beds as well as Codroy Group rock, coarse to fine red beds, evaporates such as sulphate and chloride salts, limestones and dolostones with some grey lacustrine siliciclastic rocks. (AMEC Earth and Environmental, 2008)

#### *3.2.2.1 Geotechnical Site Assessment*

A geotechnical and environmental site assessment was conducted on the proposed expansion site, see Appendix F: Expansion Site Environmental Assessment. The scope of work completed included auguring eight boreholes/monitoring wells and the installation of two-level piezometers in three of those eight monitoring wells.

In each borehole, Standard Penetration Tests (SPTs), using split spoons, were completed on a continuous basis over the upper part of the borehole, and Direct Cone Penetration Tests (DCPTs) were then completed by driving the DCPTs out through the open end of the augers to some agreed depth. Soil samples were collected from each split spoon and stored for future geotechnical work and two soil samples from each borehole, one in the one metre zone above the water table and one in the one metre zone below the water table, were collected and submitted for BTEX/TPH analysis.

Falling/rising head or constant head flow tests were completed in each piezometer to provide data needed to calculate the permeability of the formation around the piezometer well screens. The water in each well was purged and water samples were collected for BTEX/TPH analysis and for both total metals and dissolved metals in selected monitoring wells. The elevation of the ground surface at each monitoring well was surveyed, including the stick-up of the piezometer pipes. Static water levels were measured to provide an initial measurement of the water table or hydraulic heads across the subject property.

#### *3.2.2.2 Geotechnical Properties Based on SPT and DCPT Data*

The borehole logs are provided in Appendix F: Expansion Site Environmental Assessment. These logs provide soil descriptions and monitoring well installation data plus water level measurements. The SPT blow counts and N- Values for the upper part of each borehole are also included. The N-Values provide the basis for estimating the bearing capacity of the overburden as a function of depth using the empirical procedures that are provided in the Canadian Foundation Engineering Manual.

The allowable bearing pressure for a footing on sand can be estimated from the results of a Standard Penetration Test (SPT) by means of the relationship between the SPT index or N-Values (the sum of the blow counts for the second and third set of blow counts from the SPT) and the footing width (CGS, 1992; Chapter 10). Values determined using this empirical approach correspond to the situation where the groundwater table is located deep below the proposed footing foundation elevation. If the water table rises to the foundation level, no more than half the pressure values that are determined using this approach should be used. Given the groundwater table elevations at the proposed expansion site, the need for this correction to the computed bearing capacities will be determined by the depth of the proposed building and tank foundations and by any decision to under-drain the site to lower the water table. In addition, for shallow footings where the effective overburden pressure is less than 100 kPa (about 5 m of depth) an additional adjustment has to be made to the computed bearing capacities. The allowable bearing capacities that are computed using this empirical approach are expected to produce settlements that are smaller than 25 mm (CGS, 1992). This approach is applicable to cohesionless soils and can only be used as a guideline for cohesive soils. At the proposed expansion site, cohesive soils were not identified in any of the eight boreholes that were completed as part of this site investigation.

For this site, we can use the formulae proposed by Meyerhof (1956) to compute the allowable bearing capacity where the footing is less than 1.2 m in width. In this case the allowable bearing pressure, qa, is given by:

> qa = (12000 N Kd ) where all parameters are given in SI units (Pa and m), where N is the SPT index number or N-Value and Kd is the depth coefficient.
> The depth coefficient is computed in terms of the footing width and the footing depth such that; Kd = (1 + D/3B) where the depth D is less than the footing width B.
> When the footing width is greater than or equal to 1.2 m, then,
> qa = (8000 N Kd )((B+0.3)/B)2.

When the depth D is greater than the footing width, B, Kd = 1.3, which is the condition that is expected to exist for the structures that will be constructed at the site. Since we expect that the footings will be more than 1.2 m wide and that the depth of the footing will be greater than the width of the footing, the last equation will be used to compute allowable bearing capacities.

For the SPT data for FHM1, if we combine the second and third blow counts, we obtain N-Values that range from 55 to 92 for the first 4.5 m of depth, and this will produce an allowable bearing capacity or allowable bearing pressure qa that ranges from 1,430 kPa to 1,924 kPa. Since the groundwater level will be at or just below the footing level, without passive drainage, the allowable bearing capacity is reduced by 50% giving a range of 715 kPa to 962 kPa. However, no corrections have been made for the effective vertical overburden pressure at the depth at which the SPTs were completed.

The water table at the time the monitoring wells were completed was between 4.784 m and 4.863 m below the ground surface. For the SPT data for FHM1 from approximately 5 m to 12 m of depth, the N-Values range from 8 to 82 which produces a range of computed allowable bearing capacities of that ranges from 104 kPa to 1,066 kPa when the values are corrected for water table depth. The borehole log for FHM1 identifies the zones where sand up-coned into the augers when the auger plug was pulled. When the sand flows up into the augers it weakens the sand or formation immediately below the augers and when the SPT is conducted in this weaken material, low blow counts are produced. If the N-Values for those zones are ignored, the range of computed allowable bearing capacities is approximately 300 kPa to 1,066 kPa.

Once a decision is made as to the depth to which the footings and tanks will be placed and if the site will be under-drained, the final allowable bearing capacities can be computed. Normally, the bearing capacities that are computed from N-Values are then adjusted to reflect the assigned safety factors.

The water levels were measured in the eleven piezometers that were completed in the eight monitoring wells – three monitoring wells with two piezometer points (nested piezometers) in each well and five wells that are completed as single piezometers. The depth to water for each piezometer is provided in the borehole logs. The elevation data for each monitoring well was used to compute the hydraulic head for the groundwater in each monitoring well. These data show that along the up- gradient side of the property the deeper piezometers have lower hydraulic head values indicating that this is a groundwater recharge area and not a groundwater discharge area. One can also infer from this pattern of hydraulic heads that there are no confining or low permeability layers in the depth interval over which these piezometers were constructed. This indicates that the site would be amenable to passive under-draining to lower the water table to a level that would not interfere with the building footings and tank locations. If the site is under-drained by a passive drainage system, then the much higher bearing capacities can be applied in foundation design.

The hydraulic head data also show that while the hydraulic heads decrease down across the property, they increase as one moves from the west side of the property to the east end of the property. This most likely reflects the role of the small stream in recharging the local groundwater system on the east end of the property and supports the need to bury the stream in a culvert at the level of the high-water mark.

#### *3.2.2.3 BTEX/TPH and Metals in Soil and Groundwater*

The laboratory analyses reports are provided in Appendix F: Expansion Site Environmental Assessment. Three soil samples were submitted for analysis of metals in soil, P1-3 on the up-gradient side of the group of test pits, sample P2-2 down-gradient from P1-3 and soil sample P3-2 down-gradient from P2-2. The three soil samples show a systematic increase in copper, lead, nickel and zinc from the up-gradient location to the down-gradient locations suggesting that this increase is fuel related. None of the other metals show a similar strong increase in the down-gradient direction.

The following tables provide analytical results of the monitoring wells.

- BTEX/TPH data for soil samples from the three up-gradient boreholes. The soil samples from both FHM1 and FHM4 show modified TPH concentrations of 86 and 30 mg/kg, respectively. There are no BTEX components in either soil sample and the hydrocarbons detected are in the C21 to C32 range, a lube oil fraction. The modified TPH concentration in FHM8 was less than 20 mg/kg or below detection levels.
- BTEX/TPH data for the soil samples from the five lower boreholes. Two of the boreholes, FHM2 and FHM3 are in the area of known hydrocarbon impacts and the hydrocarbons in those two samples, at 23 and 390 mg/kg, respectively, are in the light hydrocarbon range or they resemble a gas fraction. The soil sample from FHM9 also showed a BTEX/TPH of 42 mg/kg but this was in the heavy oil, C21 to C32, range but it was not classified by the laboratory.
- BTEX/TPH data for the water samples from two of the up-gradient monitoring wells, FHM4 and FHM8. Both monitoring wells show dissolved hydrocarbons in the heavy oil range, close to the detection levels.
- BTEX/TPH data from the remaining monitoring wells. Only, FHM2 and FHM3 monitoring wells show dissolved BTEX/TPH as expected since both monitoring wells are in the area with known hydrocarbon impacts. The measured dissolved hydrocarbons are classified as being gas fraction. None of the water samples from the other monitoring wells showed dissolved hydrocarbons above detection levels.

Table 3: Soil Analytical Results of the Nested Monitoring Wells

| Project 3113 - Geotechnical and Environmental Assessment | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Fracflow Sample ID** | **Units** | **Tier I (mg/kg)** | **RDL** | **3113-FHM1-SS6** | **3113-FHM1-SS7** | **3113-FHM4-SS8** | **3113-FHM4-SS9** | **3113-FHM8-2-SS7** |
| **Sampling Date** | | | | 01/17/2018 | 01/17/2018 | 01/23/2018 | 01/23/2018 | 01/27/2018 |
| **AGAT ID** | | | | 9028190 | 9028200 | 9028210 | 9028211 | 9050551 |
| **Petroleum Hydrocarbons** | | | | | | | | |
| Benzene | mg/kg | 2.5 | 0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 |
| Toluene | mg/kg | 10000 | 0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 |
| Ethylbenzene | mg/kg | 10000 | 0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 |
| Xylene (Total) | mg/kg | 110 | 0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| C6-C10 (less BTEX) | mg/kg | | 3 | <3 | <3 | <3 | <3 | <3 |
| >C10-C16 Hydrocarbons | mg/kg | | 15 | <15 | <15 | <15 | <15 | <15 |
| >C16-C21 Hydrocarbons | mg/kg | | 15 | <15 | <15 | <15 | <15 | <15 |
| >C21-C32 Hydrocarbons | mg/kg | | 15 | <15 | 86 | 30 | <15 | <15 |
| Modified TPH (Tier 1) | mg/kg | 870 | 20 | <20 | 86 | 30 | <20 | <20 |
| Resemblance Comment | | | | NR | LOF | LR | NR | NR |
| Return to Baseline at C32 | | | | Y | Y | Y | Y | Y |
| **Surrogate Recovery (%)** | | | | | | | | |
| Isobutylbenzene - EPH | % | | | 92 | 95 | 92 | 97 | 103 |
| Isobutylbenzene - VPH | % | | | 121 | 116 | 116 | 120 | 92 |
| n-Dotriacontane - EPH | % | | | 92 | 99 | 94 | 96 | 107 |
| **Inorganics** | | | | | | | | |
| % Moisture | % | | | 11 | 19 | 16 | 23 | 15 |

Table 4: Soil Analytical Results of the Monitoring Wells

| Project 3113 - Geotechnical and Environmental Assessment | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Fracflow Sample ID** | **Units** | **Tier I (mg/kg)** | **RDL** | **3113-FHM2-SS2** | **3113-FHM2-SS3** | **3113-FHM3-SS2** | **3113-FHM3-SS3** | **3113-FHM5-SS2** | **3113-FHM5-SS3** | **3113-FHM7-2-SS3** | **3113-FHM9-SS3** |
| **Sampling Date** | | | | 01/20/2018 | 01/20/2018 | 01/19/2018 | 01/19/2018 | 01/25/2018 | 01/25/2018 | 01/29/2018 | 01/26/2018 |
| **AGAT ID** | | | | 9028202 | 9028205 | 9028206 | 9028208 | 9050547 | 9050549 | 9050550 | 9050552 |
| **Petroleum Hydrocarbons** | | | | | | | | | | | |
| Benzene | mg/kg | 2.5 | 0.03 | <0.03 | <0.03 | <0.03 | 0.03 | <0.03 | <0.03 | <0.03 | <0.03 |
| Toluene | mg/kg | 10000 | 0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 |
| Ethylbenzene | mg/kg | 10000 | 0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 |
| Xylene (Total) | mg/kg | 110 | 0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| C6-C10 (less BTEX) | mg/kg | | 3 | 8 | <3 | <3 | 261 | <3 | <3 | <3 | <3 |
| >C10-C16 Hydrocarbons | mg/kg | | 15 | <15 | <15 | <15 | 129 | <15 | <15 | <15 | <15 |
| >C16-C21 Hydrocarbons | mg/kg | | 15 | <15 | <15 | <15 | <15 | <15 | <15 | <15 | <15 |
| >C21-C32 Hydrocarbons | mg/kg | | 15 | 15 | <15 | 15 | <15 | <15 | <15 | <15 | 42 |
| Modified TPH (Tier 1) | mg/kg | 870 | 20 | 23 | <20 | <20 | 390 | <20 | <20 | <20 | 42 |
| Resemblance Comment | | | | GR+LR | NR | LR | GF | NR | NR | NR | UC |
| Return to Baseline at C32 | | | | Y | Y | Y | Y | Y | Y | Y | Y |
| **Surrogate Recovery (%)** | | | | | | | | | | | |
| Isobutylbenzene - EPH | % | | | 97 | 90 | 96 | 106 | 106 | 99 | 105 | 107 |
| Isobutylbenzene - VPH | % | | | 118 | 118 | 116 | 118 | 95 | 100 | 98 | 94 |
| n-Dotriacontane - EPH | % | | | 97 | 90 | 95 | 92 | 113 | 98 | 111 | 115 |
| **Inorganics** | | | | | | | | | | | |
| % Moisture | % | | | 10 | 11 | 12 | 16 | 10 | 10 | 21 | 20 |

Table 5: Water Analytical Results of the Monitoring Wells

| Project 3113 - Geotechnical and Environmental Assessment | | | | | | |
|---|---|---|---|---|---|---|
| **Fracflow Sample ID** | **Units** | **Tier I (mg/kg)** | **RDL** | **3113-FHM4-1.0-WS1** | **3113-FHM8-2-1.0-WS1** | **3113-FHM8-2-1.25-WS1** |
| **Sampling Date** | | | | 02/03/2018 | 02/03/2018 | 02/02/2018 |
| **AGAT ID** | | | | 9050693 | 9050695 | 9050696 |
| **Petroleum Hydrocarbons** | | | | | | |
| Benzene | mg/L | 20 | 0.001 | <0.001 | <0.001 | <0.001 |
| Toluene | mg/L | 20 | 0.001 | <0.001 | <0.001 | <0.001 |
| Ethylbenzene | mg/L | 20 | 0.001 | <0.001 | <0.001 | <0.001 |
| Xylene (Total) | mg/L | 20 | 0.001 | <0.001 | <0.001 | <0.001 |
| C6-C10 (less BTEX) | mg/L | | 0.01 | <0.01 | <0.01 | <0.01 |
| >C10-C16 Hydrocarbons | mg/L | | 0.05 | <0.05 | <0.05 | <0.05 |
| >C16-C21 Hydrocarbons | mg/L | | 0.05 | <0.05 | <0.05 | <0.05 |
| >C21-C32 Hydrocarbons | mg/L | | 0.01 | 0.09 | 0.12 | <0.01 |
| Modified TPH (Tier 1) | mg/L | 20 | 0.1 | <0.1 | 0.1 | <0.1 |
| Resemblance Comment | | | | LOF | LOF | NR |
| Return to Baseline at C32 | | | | Y | Y | Y |
| **Surrogate Recovery (%)** | | | | | | |
| Isobutylbenzene - EPH | % | | | 115 | 87 | 99 |
| Isobutylbenzene - VPH | % | | | 86 | 78 | 81 |
| n-Dotriacontane - EPH | % | | | 120 | 96 | 77 |

Table 6: Water Analytical Results of the Monitoring Wells

| Project 3113 - Geotechnical and Environmental Assessment | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Fracflow Sample ID** | **Units** | **Tier I (mg/kg)** | **RDL** | **3113-FHM1-1.0-WS1** | **3113-FHM1-1.25-WS1** | **3113-FMH2-2.0-WS1** | **3113-FHM3-2.0-WS1** | **3113-FHM4-1.25-WS1** | **3113-FHM5-2.0-WS1** | **3113-FHM7-2-2.0-WS1** | **3113-FHM9-2.0-WS1** |
| **Sampling Date** | | | | 02/04/2018 | 02/04/2018 | 02/05/2018 | 02/05/2018 | 02/04/2018 | 02/05/2018 | 02/06/2018 | 02/05/2018 |
| **AGAT ID** | | | | 9063713 | 9063716 | 9063717 | 9063718 | 9063719 | 9063720 | 9063721 | 9063722 |
| **Petroleum Hydrocarbons** | | | | | | | | | | | |
| Benzene | mg/L | 20 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Toluene | mg/L | 20 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 | <0.001 |
| Ethylbenzene | mg/L | 20 | 0.001 | <0.001 | <0.001 | 0.008 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Xylene (Total) | mg/L | 20 | 0.002 | <0.002 | <0.002 | 0.015 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| C6-C10 (less BTEX) | mg/L | | 0.01 | <0.01 | <0.01 | 1.93 | 3.62 | <0.01 | <0.01 | <0.01 | <0.01 |
| >C10-C16 Hydrocarbons | mg/L | | 0.05 | <0.05 | <0.05 | 0.26 | 0.3 | <0.05 | <0.05 | <0.05 | <0.05 |
| >C16-C21 Hydrocarbons | mg/L | | 0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| >C21-C32 Hydrocarbons | mg/L | | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Modified TPH (Tier 1) | mg/L | 20 | 0.1 | <0.1 | <0.1 | 2.2 | 3.9 | <0.1 | <0.1 | <0.1 | <0.1 |
| Resemblance Comment | | | | NR | NR | GF | GF | NR | NR | NR | NR |
| Return to Baseline at C32 | | | | Y | Y | Y | Y | Y | Y | Y | Y |
| **Surrogate Recovery (%)** | | | | | | | | | | | |
| Isobutylbenzene - EPH | % | | | 111 | 107 | 99 | 114 | 113 | 113 | 99 | 116 |
| Isobutylbenzene - VPH | % | | | 81 | 80 | 80 | 78 | 77 | 78 | 77 | 78 |
| n-Dotriacontane - EPH | % | | | 118 | 115 | 111 | 121 | 120 | 120 | 106 | 121 |

Note that most of these water samples were analyzed using low level detection procedures and that all of the measured dissolved hydrocarbon levels are below the Tier I criteria of 20 mg/L. The measured dissolved hydrocarbon levels may represent migration of hydrocarbons from up-gradient sources but the lack of information regarding what impacts if any that exist on the up-gradient properties prevent one from drawing any firm conclusions as to the source of these low level dissolved heavy hydrocarbons in the groundwater.

### 3.2.3 Water Bodies and Drainage Basins

During the site survey significant water bodies or drainage basins were not identified on the proposed expansion site.

#### *3.2.3.1 On-Site Stream*

Although no major water bodies were present on the subject property, there is a small stream on the eastern end of the property which will need to be redirected to facilitate the construction of some of the Project buildings. Figure below shows the location of the steam in relation to the subject property. It should be noted that this image is the 1974 aerial photograph obtained from the Surveys and Mapping Services division of the Department of Fisheries and Land Resources and it shows the subject stream in the most detail. The stream location is not suspected to have changed significantly since the date that this photo was taken.


Figure 7: Location of Small Stream

The subject stream originates at a small water body located to the north of the subject site on the northerly side of Connecticut Drive and flows in a general southwest direction, through the eastern portion of the proposed site before spilling into the Waters of Port Harmon. The stream runs through at least two existing culverts; one that crosses Connecticut Drive; and one that crosses an access road that runs through the proposed site. The outlet of these culverts has a waterfall that occurs where there is a vertical separation of approximately eighteen inches between the bottom of the culvert and the stream bed. This vertical separation makes it highly unlikely that any fish can safely navigate up or down the stream. Figure below shows the vertical separation mentioned above.


Figure 8: Vertical Separation of Stream at Culvert Location

There are also several locations throughout the course of the stream where the steam runs nearly dry and is obstructed with naturally occurring organic material, sticks, and twigs. Again, the low water level and numerous obstructions make it unlikely that the stream can be navigated by fish. Figure below illustrates some of the blockages present in the stream.

Figure 9: Stream Obstructions

Diversions and major watercourse alterations are regulated under provincial legislation through Section 11 of the Environment Act. Federal and municipal statutes and regulations also apply in most situations (Government of Newfoundland and Labrador, 1997). The Province has the mandate to protect all water resources from potential impact such as pollution, changes to domestic, municipal or industrial water supplies, flooding, aesthetic damages, changes in the flow regime, impact to wildlife or any other alteration. Prior written approval must be obtained from the MAE for diversions and watercourse alterations because of the potential to adversely affect water resources or the environment in general (Government of Newfoundland and Labrador, 1997). In addition to this, DFO retains direct management of fisheries and accordingly their regulations apply, but only if fish habitat is affected (Government of Newfoundland and Labrador, 1997). The major factor that determines whether these applications are required from both MAE and DFO is whether or not the stream is fish bearing. Any stream is identified as fish bearing if it contains at any time of the year certain types of species or subspecies of fish such as those listed below (Forest Practices of British Columbia Act Operation Planning Regulation, 1998):

- Anadromous salmonids (i.e. salmon that divide their lives between freshwater and the ocean)
- Freshwater game fish species
- Identified, threatened, or endangered fish
- Regionally important fish

Based on information gathered during the site investigations, discussions with locals and project consultants, and review of topographic and provincial mapping, there is reasonable assurance that the subject stream does not contain any type of species that would classify it as a fish bearing stream.

A certificate of environmental approval for watercourse alterations includes terms and conditions which are binding on the proponent and any persons working for the proponent. An application for approval must be completed by the proponent or the proponent's agent or consultant and submitted to the MAE, as per Section 11 Subsection (1) of the Environment Protection Act (Government of Newfoundland and Labrador, 1997).

### 3.2.4 Vegetation

The proposed expansion site is mainly covered by mature trees which are a mixture of balsam fir and black spruce that are large enough to supply sawmill logs or pulpwood. Some of this vegetation and will have to harvested from the areas where buildings will be placed. The remainder of the site is covered by alders and other small brush with the occasional large birch tree. There are some open areas, some areas have been cleared to facilitate site investigations and while several areas on the eastern side of the property have been cut by local residents for firewood or lumber. Aerial photographs of the site also show a small area on the south east corner of the property where discoloration suggests that the vegetation is stressed.

### 3.2.5 Other Features

Several areas contain some metal debris and minor garbage. Several large piles, having a cumulative weight estimated at two tons, of coiled galvanized steel cables are located at the edge of the tree line on the southwest side of the area of mature trees. A large section of metal plate with a large open collar is present near the harbour shoreline and a large semi-circular section of metal, possibly from an old fuel tank, is located close to the old concrete tank supports on the west side of the subject property. It is expected that many of the raised soil berms will also contain garbage and metal debris and that other debris, from the military activities, the linerboard mill operations and local activities, will be encountered when the site is cleared for construction. It should also be noted that during the auguring of monitoring well FHM9, the auger encountered a hard, buried, object at 2.5 m to 3 m of depth and rusty material was brought to the surface on the augur flights. This area will be excavated as part of the site preparation to determine if the buried material is an issue.

### 3.2.6 Wildlife Species of Concern

FLR is responsible for managing and conserving Newfoundland and Labrador's biodiversity and wildlife resources for the benefit of present and future generations (Government of Newfoundland and Labrador, 2018). Newfoundland and Labrador's Endangered Species Act provides special protection for plant and animal species considered to be endangered, threatened, or vulnerable in the province, and fulfils the province's commitment under the National Accord for the Protection of Species at Risk (Government of Newfoundland and Labrador, 2018).

Species identified by the Species Status Advisory Council (SSAC), Committee on the Status of Endangered Wildlife (COSEWIC) and the Species at Risk Act (SARA) are given a specific status based on their risk of extinction which include special concern, vulnerable, threatened, endangered or extirpated. (Government of Newfoundland and Labrador, 2018).

The following species have been identified under the NL legislation or the federal SSAC, COSEWIC and SARA, are suspected or known to have distribution ranges or migratory patterns that encompass the west coast of Newfoundland.

- Birds: Piping Plover *(Charadrius melodus melodus),* Bobolink (*Dolichonyx oruzivorus*),
- Fish: American Eel *(Anguilla rostrate),* Atlantic Codfish *(Gadus morhua)*
- Marine Mammals: Harbour Porpoise *(Phocoena phocoena)*
- Plants: Gmelin's Watercrowfoot *(Ranunculus gmelinii),* Low Northern Rockcress *(Braya humilis or Neotorularia humilis),* Tradescant's Aster *(Symphyotrichum tradescantii),* Wooly Arnica *(Arnica angustifolia subsp. tomentosa)*

(Government of Newfoundland and Labrador, 2010)

It should be noted that none of the above species were observed within the proposed project site during the site investigations and it is unlikely that the project will affect any of these species given the location of the project and range of activities associated with the project.

Further, the proposed expansion will be located in a previously disturbed site within an industrialized area and is adjacent to an airport. (Town of Stephenville, 2010). As such, the proposed expansion site is not likely to offer suitable habitat for most of the species listed above.

The Indian Head Hatchery is immediately adjacent to the proposed expansion site. The hatchery was release from environmental review in 2011 and little has changed in the area, in regard to wildlife, since then. For more information see Appendix A: Indian Head Hatchery 2011 Environmental Review and Release.

### 3.2.7 Aquaculture

The closest licensed aquaculture site in proximity of the Indian Head Hatchery is a blue mussel farm which belongs to Plastik Industries of Canada and is located approximately 120km west of the Project in Piccadilly Bay.

## 3.3 Project Components and Technical Descriptions

The following sections discuss the project components and various activities associated with the Project. See Appendix G: Project Design Drawings for system layouts and integration.

### 3.3.1 Expansion Site Preparation

The Project includes preparation of the site property adjacent to the existing hatchery prior to the construction of the Modular RAS Production units.  The site requires some drainage to stabilize the area for facilities and activities. Some leveling of the property is also required as is excavation for buildings and the large production tanks that are placed at depth in the ground. A 3-D groundwater flow model has been constructed and will be used to design an efficient groundwater drainage system, see Appendix F: Expansion Site Environmental Assessment. The groundwater that is intercepted by this drainage network will be channeled to seepage zones constructed just outside the 15 m buffer zone at the shoreline and parallel to the shoreline. With the groundwater channeled and released in this system, there will be no direct release of groundwater from the drainage network to the harbour waters.

The groundwater that is directed to those released or seepage areas will approximate the normal groundwater discharge to the harbour shoreline in the littoral zone and will have seeped through approximately 15 to 20 m of sand before discharging into the harbour. This lowering of the groundwater table, through the construction of a well-designed and carefully placed drainage channels, will 1) allow the full vertical column of the site to be utilized for the fish tanks and foundations, 2) it will protect the building foundations and also prevent the fish tanks from floating as they are being drained as part of the normal fish transfer operations, and 3) in addition, this proposed approach will not change the overall groundwater flux to the harbour ecosystem.

Opportunities for improvements to the environmental conditions at the proposed expansion site include the following.

- Systematic location and removal of large scrap and waste disposal deposits directly attributable to the 1940’s US military activities in the region;
- Removal of derelict fuel lines from the same military activities, originally installed to supply the airport from nearby storage tanks;
- Inspection and remediation of hydrocarbon impacted soils along the route of the fuel lines (as they are located, excavated and removed);
- Relocation of the municipal potable water supply line that currently runs through the property. Relocation to the road side will provide for more secure and accessible pipeline maintenance.
- The beneficial re-use of treated fresh-water aquaculture process effluent by the local golf course (for seasonal irrigation purposes) is expected to be a significant

benefit to the Town of Stephenville as this will eliminate a large demand for potable water use and reduce the seasonal fluctuations in water demand.

- The potential use of treated effluent by a proposed hydroponics business would remove or reduce a potential additional demand for potable water from the Town's water supply.
- Potential re-use of solids produced by the effluent treatment system is being considered and may be directed to a new hydroponics operation or other composting operations.

### 3.3.2 Modular RAS Production

The Project includes the construction of a Modular RAS Production unit to increase production, enhance biosecurity and produce more robust smolt. The system has been designed specifically for this project with the culture parameters as shown in the table below.

Table 7: Modular RAS Production Design Criteria

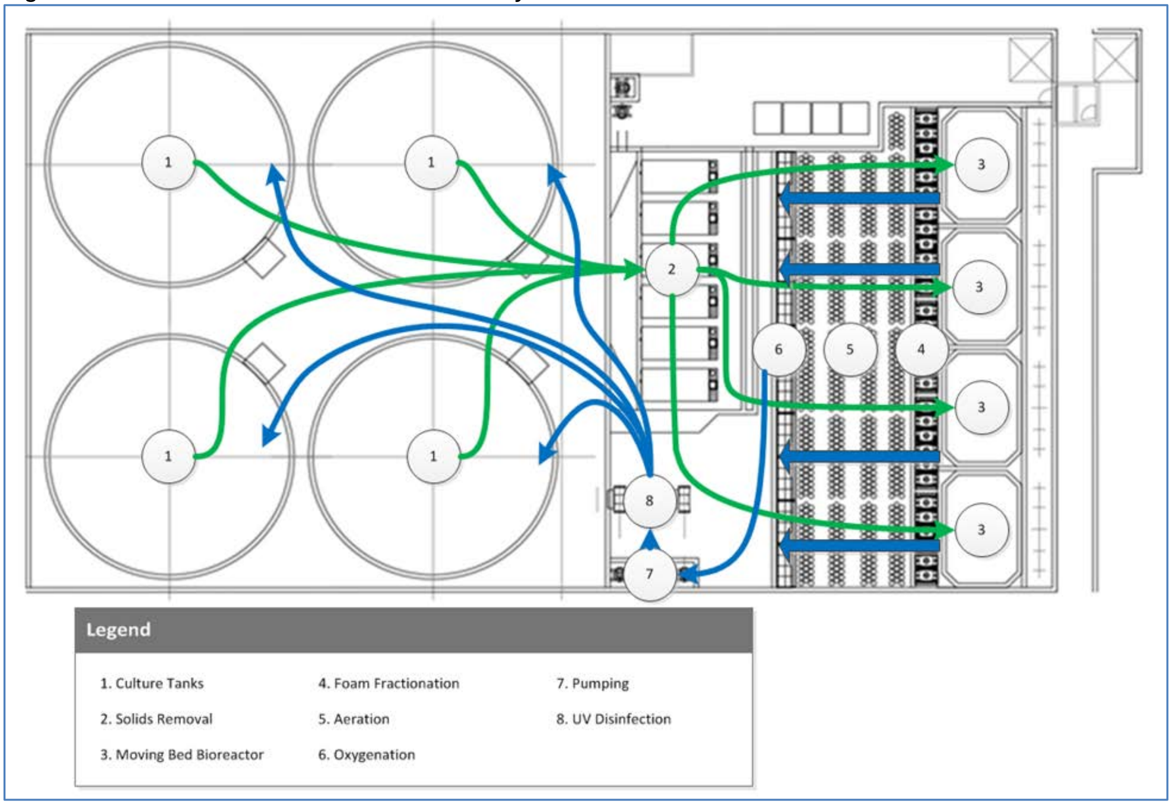
| Parameter | Units | RAS Module |
|---|---|---|
| Bio-plan Criteria | | |
| Species | - | Atlantic Salmon |
| Maximum rearing density | kg/m$^3$ | 75 |
| Maximum biomass | kg | 240,000 |
| System culture volume | m$^3$ | 3,200 |
| Unit culture tank volume | m$^3$ | 800 |
| Rearing tanks | m | Ø18 x 3.5 |
| Water Quality Criteria | | |
| Minimum temperature | ºC | 10 |
| Maximum temperature | ºC | 15 |
| Salinity | g/L | 0-15 |
| Minimum allowable DO concentration | % saturation | 80% |
| Maximum allowable CO2 concentration | mg/L | 15 |
| Max allowable $NH_3$-N concentration | mg/L | 0.0125 |
| Max allowable NO3-N concentration | mg/L | 100 |
| Design Values/Assumptions | | |
| Oxygen demand rate wrt feed (average) | g $O_2$ / kg feed | 400 |
| Culture tank CO2 to O2 ratio | gCO2/gO2 | 0.9 |

| Parameters continued | Units | RAS Module |
|---|---|---|
| Max protein content of feed | % | 50% |
| TAN conversion rate | g TAN / kg feed | 46 |
| TAN production rate | g TAN / hr | 5750 |
| Nitrate production rate | mg/min | 95833 |
| System Flow Rates | | |
| Culture Tank turnover (maximum) | 1/h | 1.7 |
| Culture Tank HRT (maximum) | min | 35.3 |
| Culture flow rate (max, total of all tanks) | lpm | 90,667 |
| Influent Flow Rate | lpm | 958 |
| Recirculation Rate (by flow) | % | 98.94% |
| Daily water exchange (of culture volume) | % | 43.13% |
| Influent Flow Rate wrt Feed | L/kg feed | 460 |

The Modular RAS Production system will have four units each with four culture tanks and a Recirculating Aquaculture System (RAS) for treatment and circulation of water, see figure below. It is expected that 97% of the production water will be reused. This state-of-the-art technology is more efficient and will provide improved conservation of the water resources.

Water from fish production tanks is filtered to remove solids by drum filters, has toxic nitrogen compounds removed or converted to less toxic substances in a moving bed bioreactor and flows through a fractionation unit to remove foam and proteins. From there, the cleaned water is aerated to reduce carbon dioxide, oxygenated and disinfected with UV prior to being re-introduced into the fish production tanks. Each unit (four tanks) will have a separate treatment system for heightened biosecurity, see figure below.

Figure 10: Modular RAS Production Unit Layout with Water Treatment Flow




### *3.3.2.1 Culture Tanks*

The self-cleaning and efficient mixing properties of a properly designed culture tank are critical to the overall water quality performance of the system. Water will be injected to the tanks using directional inlet pipes to develop a rotational flow pattern which aids in tank self-cleaning and provides a range of safe swimming speeds to promote good fish heath and stamina.

Dissolved oxygen will be monitored and provided to each tank individually. In the event that dissolved oxygen cannot be maintained in the tank, or if a power failure interrupts the supply of water to the culture tank, a solenoid will automatically open to supply back-up diffusers in the culture tanks.

### *3.3.2.2 Solids Removal*

The rapid removal of solids from the water is critical to the success of any recirculating aquaculture system as solids will settle within culture systems, fouling tanks, valves and piping and organic solids can biodegrade and contaminate the culture water and consume available oxygen.  Four 37-micron drum filters will be used to remove particles from the culture tank discharge water.  The drum filters will be elevated to minimize system operating energy requirements and to maximize water depth through the treatment system. Each micro-screen drum filter will include a fully automated backwash and control system.

#### *3.3.2.3 Moving Bed Bioreactor*

In a RAS, a bioreactor prevents the accumulation of ammonia nitrogen, a toxic waste product of fish metabolism using cultured bacteria to convert toxic ammonia-nitrogen to less toxic forms using a process called nitrification. A Moving Bed Bioreactor (MBBR) is uniquely suited to aquaculture applications where there may be significant variance in feed load or flow rate. Air will be injected into upwelling tubes located within the media bed providing oxygen to the bacteria and agitating and circulating the media. This aeration will also remove some carbon dioxide.

#### *3.3.2.4 Foam Fractionation*

A Full-flow Foam Fractionation system will be used to remove proteins and other organics in the water prior to aeration. The use of the foam fractionation system will reduce the fine suspended solids and loads on other processes while also improving water clarity and helping to balance dissolved gases (removing $CO_2$ and adding oxygen).

#### *3.3.2.5 Aeration*

The treated water flows from the MBBR into the hydraulically-linked aeration basin used to balance the dissolved gases by bubbling air through the water. This will strip carbon dioxide and add oxygen until near saturation concentrations are reached.

#### *3.3.2.6 Oxygenation*

The aerated water will flow by gravity to Low Head Oxygenators (LHO) where oxygen is transferred into the water. The LHO, which operates at less than 0.9 m of hydraulic head, is a cost-effective method of setting a baseline dissolved oxygen concentration for all culture tanks. The LHO has the added advantage of reducing the level of nitrogen dissolved in the water while it adds oxygen, providing protection against nitrogen supersaturation from the upstream aeration process. The LHO have been assumed to operate at up to 160% saturation DO at outlet to maximize the oxygen transfer efficiency

#### *3.3.2.7 Ultraviolet Disinfection*

A full-flow UV unit will provide disinfection. The UV reactor is typically designed to provide a dosage of 60mJ/cm$^2$ EOLL with an assumed water transmissivity of 85%UVT. See section 3.3.9 Effluent Treatment for more information on common waterborne pathogens and recommended UV dose.

### 3.3.3 Upgrades to Existing Production Systems

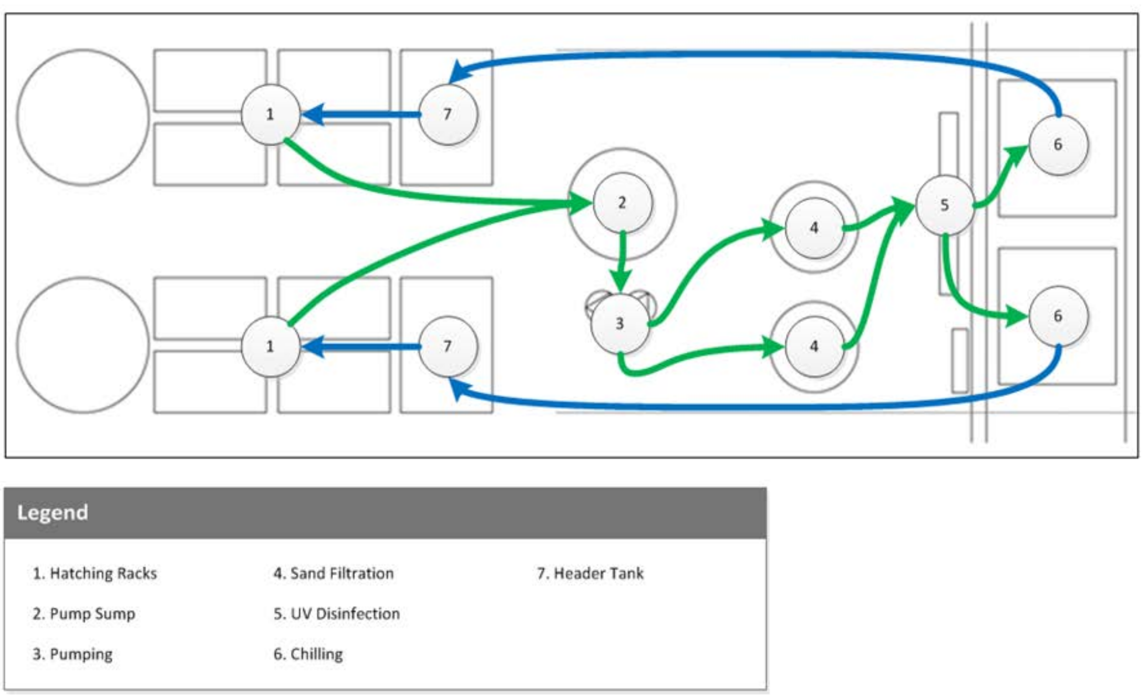
The existing Indian Head Hatchery production systems will be improved to increase egg hatch capacity, improve the vaccination and grading process and enhance biosecurity. Throughout the hatchery, processes and where possible the functioning of existing equipment will be improved. Overall the Project will result in the existing facility systems being more efficient resulting in improved production and conservation of the water resource.

#### *3.3.3.1 Incubation*

The existing incubation system will be improved with new substrate and chilling capacity to allow batching of production. Eyed eggs will be brought into the facility and held in a modular incubation system until hatch.

Four independent modules will each have own recirculating water treatment system and will incorporate eight (8) Comp Hatch racks, 8 trays per rack. Water will flow by gravity from a raised header tank to the hatching racks and then to a pump sump. The water will be pumped through sand filtration, UV disinfection and temperature control before discharging back into the raised header tank, see figure below for general layout of the incubation modules and flow of water. Each module will flow at up to 320 Lpm (5 Lpm per tray, 8 trays per rack, 8 racks per module) for a total recirculation flow of 1280 Lpm (four modules) and each tray holds up to 45,000 eggs.

Figure 11: Incubation System Layout and Water Flow



#### *3.3.3.2 Vaccination/Grading*

The Project will include installation of a centralized grading and vaccination system integrated into the existing hatchery systems to increase efficiency and reduce stress to the fish and thereby improving overall performance. Grading will ensure a cohost is growing consistently as per the production plan and will ensure the health of the fish through to harvest. If not done efficiently and effectively, the grading and/or vaccination processes can create stress which leads to poor performance and fish welfare, either immediate or later. The new automated vaccination system will have a double/twin line for efficiency and will anesthetize and orient the fish with minimum stress for proper vaccination. An Apollo Grader will be situated so the fish are graded prior to vaccination. The modern technology can be adjusted for fish 30-170 grams in size and the fish are gently lifted onto rollers and slide through gaps into specific sizes. For more information see: https://en.skalamaskon.no/aquaculture2/vaccination, https://www.w-m-t.com/apollo-fish-graders/

### 3.3.4 Fresh Water Supply

The Project includes expansion of the existing facility to include a Modular RAS Production unit which will require additional fresh water supply. The freshwater will be sourced from three wells located inland of the main facility. See figure below for the location of the proposed fresh water wells.

The company has performed extensive testing and modeling of the freshwater aquifer and has demonstrated the aquifer has the capacity to supply the requirements of expansion. See Appendix B: Freshwater Aquifer Testing, for the results of the water testing and aquifer modelling.


Figure 12: Fresh Water Wells

#### *3.3.4.1 Aquifer Capacity*

A test well (MHPW1) was sited and drilled for MHAC to evaluate the aquifer potential and water chemistry as a source water for a proposed fish hatchery expansion. Figure below shows the location of test well MHPW1.

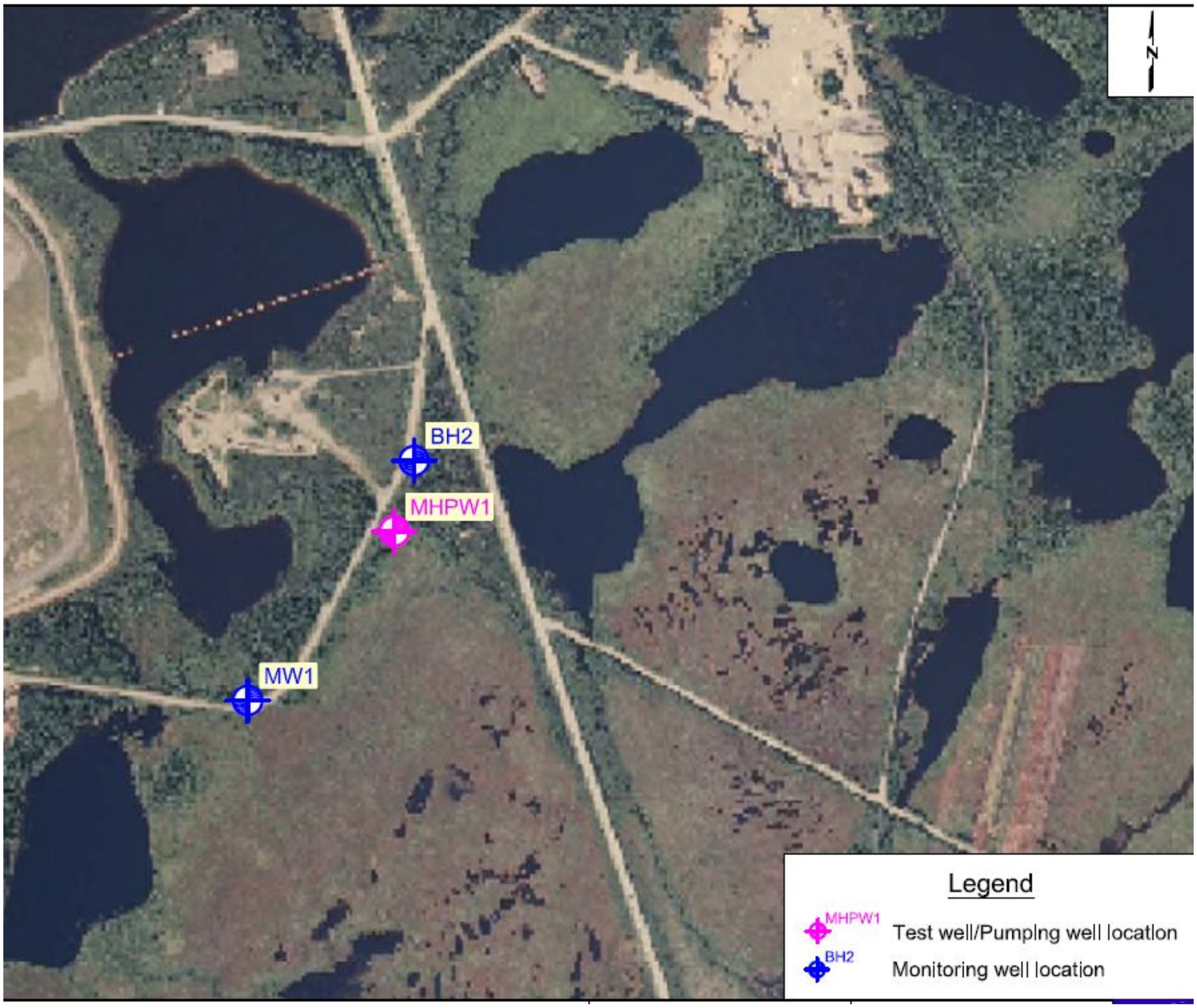



Figure 13: Test Well MHPW1

The test well was drilled between February 8 and 11, 2018. Aquifer tests, consisting of a step-drawdown test, a 72-hour constant discharge test followed by monitoring of the recovery of the water level in the Test Well and monitoring wells, were completed between March 19 and 22, 2018. Five potable water samples, three fish health samples, (tested for bacteria, viruses, parasites and fungi that could adversely affect the fish) and additional water samples for low-level BTEX/TPH hydrocarbon analysis, were collected during the 72-hour aquifer test. The scope of work, field methods, data collected, and the aquifer test results are presented in Appendix B: Freshwater Aquifer Testing.

The aquifer at the location of the test well consists primarily of medium sand with some gravel and scattered boulders or cobbles to approximately 67 m bgs, followed by a thin clay layer, that overlies a 6 m thick layer of fine sand that grades into a conglomeratic bedrock or a layer of gravel embedded in a clay matrix to the end of the borehole at 80 m bgs. The computed hydraulic conductivities varied from 5.52 E-05 m/s to 8.51E-04 m/s with the hydraulic conductivities that were computed from the grain size data falling within this range.

The aquifer test data indicates the aquifer is responding as an unconfined aquifer or a very leaky confined aquifer. A 3-D model has to be used to match the measured drawdowns and screened sections in the monitoring well and the pumping well within the aquifer to the computed drawdowns at the same locations within at the model.

The safe yield of this well is controlled in part by the size of the well screen and with a specific capacity of approximately 400 litres per metre of drawdown and an available drawdown of 22 m for the pump configuration used in this aquifer test, the estimated safe yield of this well is 2,300 Lpm.

### *3.3.4.2 Aquifer Water Quality*

AGAT Laboratories analyzed of two water samples obtained from the fresh water source. In the table below, water chemistry requirements for culture of salmonid are compared to the water analysis.

Table 8:Water Chemistry Requirements for Salmonid Health Compared to Water Analysis

| Parameter | Units | Application | Recommended Minimum | Recommended Maximum | Chronic Toxic Limit | Acute Toxic Limit | Pump1 | Pump2 |
|---|---|---|---|---|---|---|---|---|
| Ammonia | mg/LTAN | | | 1[1] | 1 | | | |
| Cadmium | mg/LCd | Hard Alk>100 mg/L | | 0.003[4] | | 0.08 to 0.42[2] | <.000017 | <.000017 |
| Chlorine | mg/LCl | | | 0.003 to 0.005[3] | 0.05[3] | 0.1 to 0.3[3] | | |
| Chromium | mg/LCr | | | 0.03[4] | | 2 to 20[2] | 0.001 | 0.001 |
| Copper | mg/LCu | Alk>100 mg/L | | 0.01[3] | 0.03[3] | 0.1[3] | <0.001 | <0.001 |
| Hydrogen Cyanide | mg/LHCN | | | 0.005[1] | | | | |
| Iron | mg/LFe | | | 0.1[3] | | | <0.05 | <0.05 |
| Lead | mg/LPb | | | 0.02[1] | | 1 to 40[2] | <0.0005 | <0.0005 |
| Mercury | mg/LHg | | | 0.0002[3] | | 0.01 to 0.04[2] | | |
| Nickel | mg/LNi | | | 0.1[1] | | | <0.002 | <0.002 |
| Nitrate | mg/L$NO_3$ | | 0[1] | 400+[1] | 1000+[1] | 1310[2] | 0.21 | 0.38 |
| Oxygen, dissolved | mg/LDO | | 6[2] | | | | | |
| pH | | | 6.5[2] | 8[2] | | | | |
| Phosphorus | mg/LP | | 0.01[1] | 3[1] | | | 0.02 | 0.02 |
| Selenium | mg/LSe | | | 0.01[1] | | | | |
| Silver | mg/LAg | | | 0.003[1] | | | <0.0001 | <0.0001 |
| total dissolved solids | mg/LTDS | | | 200[3] | | | 190 | 179 |
| total suspended solids | mg/LTSS | | | 80[1] | | | | |
| turbidity | NTU over ambient | | | 20[3] | | | 0.6 | 0.8 |
| Uranium | mg/LU | | | 0.1[1] | | | 0.0003 | 0.0003 |
| Vanadium | mg/LV | | | 0.1[1] | | | <0.002 | <0.002 |
| Zinc | mg/LZn | | | 0.005[1] | | 1 to 10[2] | <0.005 | <0.005 |

The general chemistry, total metals and dissolved metals laboratory data indicate that the water tested is suitable for aquaculture usage. Also, the low-level BTEX/TPH laboratory data for the two water samples collected show no evidence of hydrocarbon impacts in the immediate area of the test well.

Based on the yield obtained from this test well, it is recommended that future production wells be constructed using a 250 mm (10 inch) diameter well screen with a straight well assembly. In addition, each well design should be adapted to the aquifer materials that are encountered during the borehole drilling. To further evaluate the aquifer system and to provide additional data for aquifer test evaluation of future production wells, a 15 cm diameter casing should be driven within 30 m of the production well location to approximately 90 m of depth, into obvious bedrock, and the borehole instrumented with three 50 mm diameter monitoring wells, with screens at 85 m to 90 m, 55 m to 65 m and at 30 m to 35 m of depth, as the casing is withdrawn. This multi-level piezometer or monitoring well will enable collection of water samples from the bedrock, and the measured hydraulic heads will show the direction of groundwater movement during aquifer tests. See Section 3.3.8 for Monitoring Program details.

### 3.3.5 Saltwater Supply

Saltwater will be used to acclimatize the fish to the marine environment prior to transporting to the saltwater farms. To determine the potential for obtaining saltwater, monitoring wells were constructed and evaluated. The data was used to develop a design with preferred production well location, potential water flow and well construction considerations, see Appendix H: Saltwater Supply and Lines.

Two monitoring wells (FHS 1 and FHS2) were drilled between the paved highway and the southern edge of the golf course to determine if the overburden and water chemistry were suitable to supply saline water, by inducing sea water intrusion, for the Project.

The two boreholes were augered to approximately 20 m of depth with the collection of split spoon soil samples and then DCPTs were driven out the bottom of the augers to determine the soil type or soil properties at depth. Once the DCPTs were completed, piezometers were installed in the boreholes - one piezometer at approximately 20 m of depth and the second piezometer at approximately 3 m of depth. Water samples were collected from each piezometer with the deeper piezometers being sampled a second time after a more aggressive purging of the well. Augering, DCPTs and water sampling were completed between March and May 2018.

Appendix H: Saltwater Supply and Lines, provides the well logs, the soil descriptions, the water chemistry data and the permeability values that were computed from the grain size data.

From the data collected during the monitoring, a saltwater production well system was designed with the saltwater supply extracted from two or three wells drilled in close proximity to the ocean. The figure below shows the proposed locations of the saltwater wells in relation to the Modular RAS Production expansion site.


Figure 14: Saltwater Well Locations

From the wells, the water will be pumped across the Port of Stephenville to a treatment system and reservoir co-located with that of the freshwater influent supply, at the top of the bluff above the proposed expansion site.

Solids filtration will not likely be required due to the natural filtration inherent to the well location. However, there is a risk of naturally occurring pathogens therefore, the water will pass through a two-stage UV disinfection system, arranged in series. At each stage, there will be two parallel UV reactors, each with the capacity to dose at 100 $mJ/cm^2$ at the design max flow rate and end of lamp life. Therefore, during normal operations, the saltwater influent will receive a UV dose of 100 $mJ/cm^2$ twice. In the event that one UV reactors fail, a minimum UV dosage of 100 $mJ/cm^2$ will be delivered at all times.

After UV disinfection, saltwater influent will be stored in an 800 $m^3$ reservoir. The reservoir will ensure on-demand availability of high flow rates of treated saltwater and will buffer the flow from the wells. From the reservoir the saltwater supply will flow by gravity to the Modular RAS

Production units. In the figure below, the red arrows indicate the proposed routing of the saltwater lines from the well across the harbour to the water treatment building. The following figure shows the proposed flow from the water treatment building to the Modular RAS Production units.

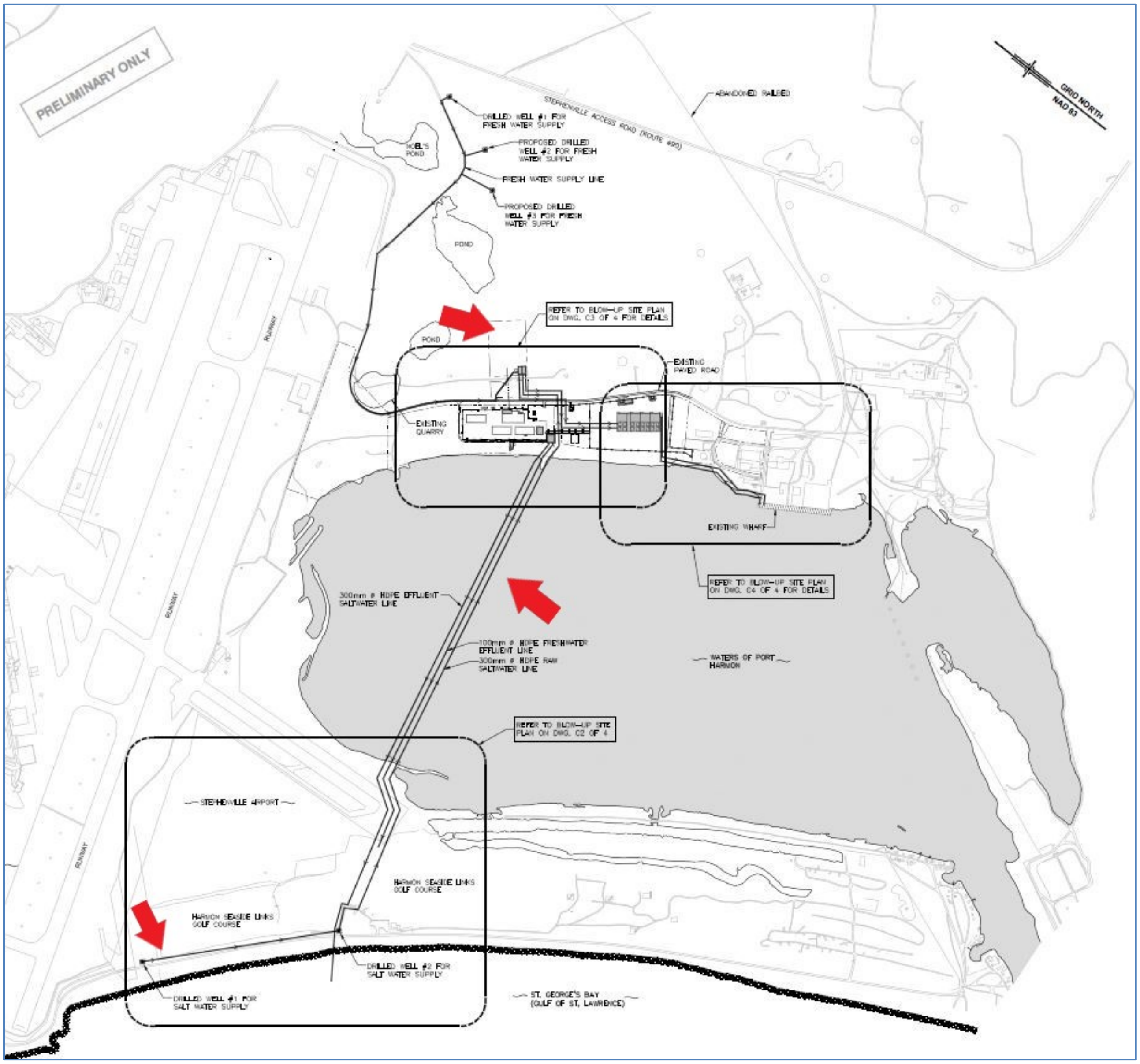



Figure 15: Location of Proposed Saltwater Lines from Wells to the Water Treatment Building

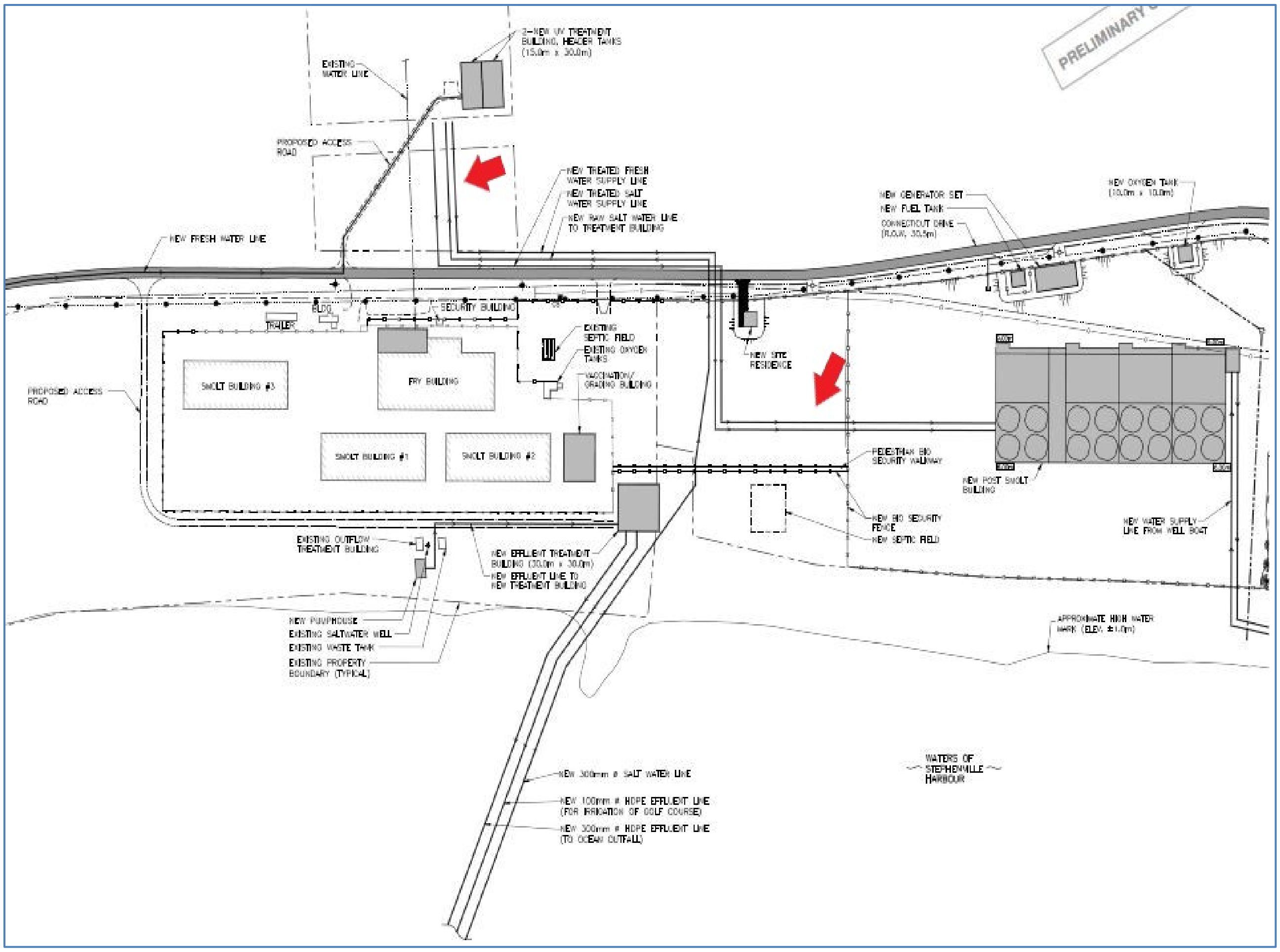



Figure 16: Proposed Saltwater Flow from the Treatment Building to Modular RAS Production Units

### 3.3.6 Water Monitoring

A combined groundwater monitoring program is in development and will encompass the existing requirements of the Indian Head Hatchery and the proposed Project expansion for the new water supply for the Modular RAS Production facility. The following program will be finalized in consultation with MAE Water Resources Division.

#### *3.3.6.1 Well Fields*

The well fields that provide water to the existing fish hatchery and the proposed Modular RAS Production expansion fall into three areas, see figure below for location.

1. Area one: Three wells in the existing water supply production well field that currently supply water to the Indian Head hatchery.
2. Area two: Three or four wells at depths of 70 to 80 m below ground surface in a new well field constructed to supply the proposed Project Modular RAS Production units.

3. Area Three: Three saltwater wells in a new well field located between the golf course and the ocean. An application is being prepared to construct one or more full size water supply/test wells at this location to determine if water is in sufficient quantities and with the required salinity and quality can be obtained by inducing sea water intrusion at each well location.

The new production wells in area two will include the test well that was constructed in February 2018 to survey the aquifer and a request will be submitted to reconfigure this test well to serve as one of the required water supply wells. A request will also be submitted to construct two additional water supply wells between the location of the test well and the existing Indian Head hatchery well field. If a fourth well is required, a request will be made to construct 200 m immediately east of the test well.

Note that water withdrawal permit applications will be submitted for each well field and applications to construct each well will also be submitted for approval by MAE Water Resources Division. The recommended final location of those additional productions wells at both proposed well fields will be determined by 3D model simulations and by discussions with MAE as part of the normal non-domestic well permit application process.

#### *3.3.6.2 Monitoring Program*

The three well fields will be controlled by a common wireless three node system with the control and real time monitoring of the water level and flowrate/pump discharge from each production well at a control center in the fish hatchery. In each well field, each production well will have an individual flow meter and an individual water level sensor.

The sensors will be hardwired into the wireless node for each well field and the data recorded in real time on a set time basis. The water supply pumps in each well will be equipped with variable frequency drives and these variable frequency drives will be controlled from the fish hatchery control room through each well field wireless node. The flow meters will be calibrated against a calibrated turbine flow meter on an annual basis. The water level sensors in each well will be calibrated by direct measurement of water levels using a standard water level meter.

The pump discharge pipe at each new well head will be designed to allow the collection of water samples under pressure for water quality monitoring on a periodic basis - quarterly for the first year and then every six months after the first year of operation. The existing Indian Head production wells will be sampled individually at the well field pump house. Laboratory analysis on the collected water samples from each production well will include the standard potable water analysis as provided by the MAE guidelines, including both total metals and dissolved metals as well as low-level BTEX/TPH.

Real time monitoring of water chemistry from each production well is not feasible due to the need to frequently calibrate the sensors and the limited range of parameters that the available sensors can measure accurately. However, water quality for the combined freshwater supply and the saline water supply will be monitored on a real time basis as required to ensure fish health and reported on a pre-determined schedule.

A number potential sources of contamination exist that could impact water quality in the three well fields. Aquifer wide water level and water quality monitoring will be completed using both single level and multi-level piezometers. Two piezometers already exist at the Indian Head Hatchery well field in area one. Two piezometers have been constructed in the area two test well for the proposed project. Two additional piezometers have been constructed, one up-gradient and one trans-gradient of the proposed project test well. The capture areas and the travel times for the proposed project area two well field have been computed using the 3D flow and transport model and confirm that those piezometers are well located to monitor changes in water levels and water quality within the recharge area and within the aquifer.

As an added precaution, a multi-level, deep, piezometer is scheduled to be constructed at the existing Indian Head Hatchery well field in area one at a location between the nearest Ministry of Transport property and the existing production wells.

A second multi-level deep piezometer will be constructed close to the area two test well. A third aquifer monitoring well will be constructed along the existing road between the Town's sludge disposal pits on the edge of the airport and the area one well field. Real time monitoring of water quality and water levels in those piezometers is not feasible and is not warranted based on the 3D model simulations and the difficulty in maintaining water quality sensors.

Continuous monitoring of the aquifer water levels is both feasible and practical using self-contained data loggers (Leveloggers) that will record water levels and temperatures on any desired time basis. We propose that data be recorded every 15 minutes or every 30 minutes and that each sensor be equipped with a direct reading cable to allow for regular downloading of the recorded data.

Based on the computed travel times, periodic water sampling in those piezometers will provide a clear indication of any changes over the long term. These piezometers will serve as sentry wells. It is recommended that quarterly sampling during the first year of well field operation followed by sampling every six months after the first year of operation. This periodic water sampling, with the same analytical program as that designed for the water supply wells along with near-continuous recording of water levels will provide the data needed to achieve real time monitoring of the aquifer performance and water quality.

#### *3.3.6.3 Reporting*

Both water level, water quality and well field production rates will be tabulated and provided to the regulator on an annual basis or on a more frequent basis if required by the regulator.

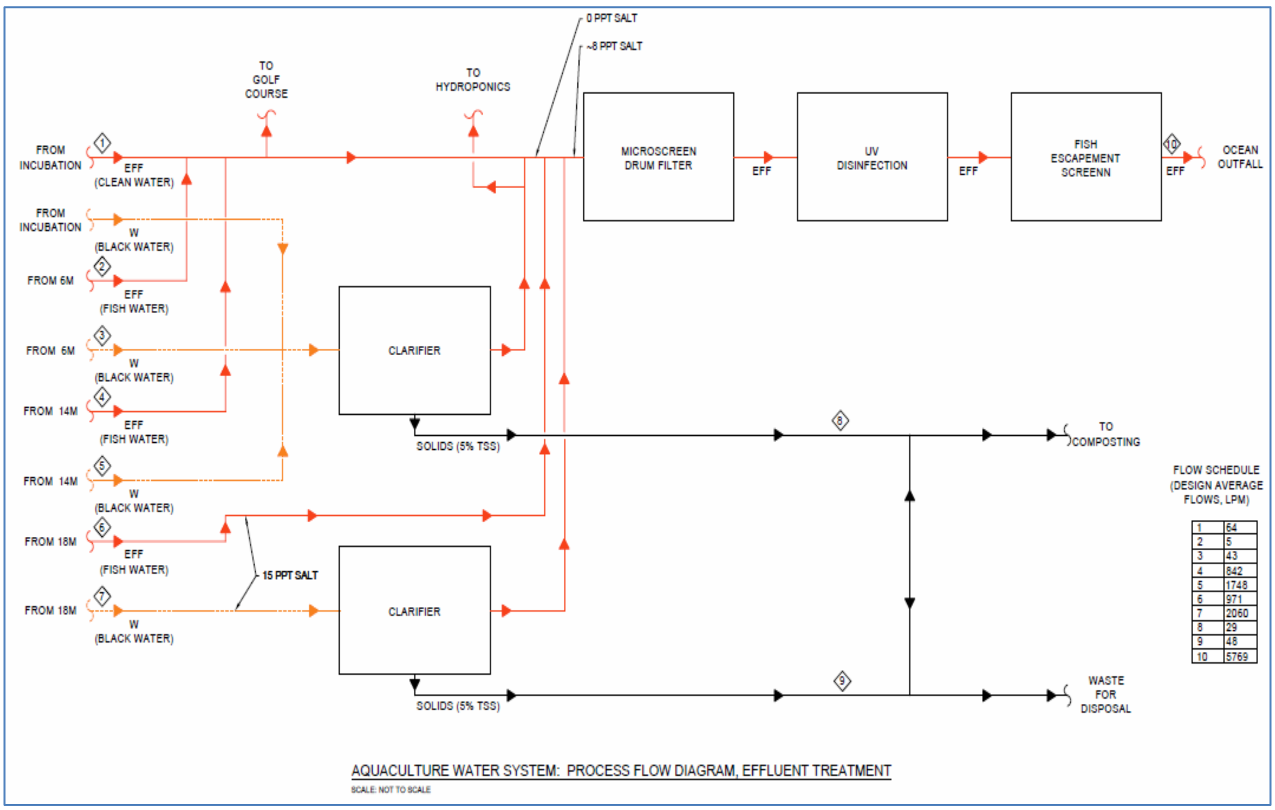
The system will be designed to allow ready access by the regulator to the full monitoring system and its real-time data base to confirm that the groundwater monitoring program is being executed as outlined. Reports will be compiled and submitted to MAE Water Resources Management Division for review and approved on a schedule as determined by MAE.

### 3.3.7 Effluent Treatment System

Wastewater from the production tanks will have solids removed, disinfection and passed through screens to ensure no fish escape prior to being pumped to discharge to the marine environment.

Solids will be settled out and the liquid effluent will have smaller particles removed by a 37-micron drum filter. After removal of particulate, the effluent will pass through a second stage drum filter and a UV reactor and through triple screening to ensure no fish escape.

Figure 17: Effluent Treatment System and Flow Diagram



#### *3.3.7.1 Effluent Disinfection*

Ultraviolet germicidal irradiation is a disinfection method that uses short-wavelength ultraviolet (UV-C) light to kill or inactivate microorganisms by destroying nucleic acids and disrupting their DNA, leaving them unable to perform vital cellular functions.

A UV dosage of 100 mJ/cm2 which has been proven effective for waterborne pathogens commonly associated with aquatic recirculating systems, see table below.

Table 9: Waterborne Pathogens and UV Dose

| BACTERIA | UV Dose |
|---|---|
| Aeromonas salmonicida | 3.6 mJ/cm2 (log-3) |
| Pseudomonas fluorescens (fin rot) | 11 mJ/cm2 (log-3) |
| Listeria monocytogenes | 16 mJ/cm2 (log-5) |
| Streptococcus sp. (seawater) | 20 mJ/cm2 |
| Bacillus subtilis (spores) | 22 mJ/cm2 (log-3) |
| Vibrio anguillarum | 30 mJ/cm2 |
| Yersinia ruckeri | 30 mJ/cm2 |
| BKD (Bacterial Kidney Disease) | 60 mJ/cm2 (estimate) |
| PROTOZOA | |
| Sarcina lutea (Micrococcus luteus) | 26 mJ/cm2 (log-3) |
| Ceratomyxa shasta | 30 mJ/cm2 (log-3) |
| Perkinsus marinus (dermo disease) | 30 mJ/cm2 |
| Trichodina sp. | 35 mJ/cm2 (log-3) |
| Myxobolus cerebralis (TAMs, Whirling Disease) | 40 mJ/cm2 |
| VIRUS | |
| ISA (Infectious Salmon Anemia) | 8 mJ/cm2 |
| CCV (Channel Catfish Virus) | 20 mJ/cm2 |
| IHNV (Infectious Hematopoietic Necrosis/CHAB) | 20 mJ/cm2 |
| IHNV (Infectious Hematopoietic Necrosis/RTTO) | 30 mJ/cm2 |
| VHS (Viral Hemorrhagic septicemia) | 32 mJ/cm2 |

From https://pentairaes.com

A benefit of using UV is that the disinfection takes place only inside the UV vessel (exposure chamber) and leaves no residue in the water. Therefore, it is harmless to animals downstream. In contrast, chlorine/bromine leaves a residual in the water that can irritate the skin and eye tissue of mammals, reptiles, and birds. Ozone, if not measured and controlled properly, is capable of causing severe tissue damage even death in fish and invertebrates.

#### *3.3.7.2 Effluent Discharge*

The effluent will be pumped via an underwater 400mm HDPE forcemain across the Port of Stephenville and across the golf course before discharging to an ocean outfall. The forcemain will be installed in the same trench as the raw saltwater line to minimize damage to the golf course. Proper separation distances between the effluent and saltwater line will be followed.

Saltwater effluent and freshwater effluent will be piped across the harbour as separate streams in order for the freshwater to be made available to the golf course for irrigation. Prior to discharge into St. George's Bay, the effluent will be combined. See section 3.2.1 for schematic of the pipeline location and supporting infrastructure

The ocean outfall will be designed in accordance with the MAE Guidelines. The outfall will be located 20m below low tide which is approximately 800m from the shoreline. A second smaller 100mm HDPE effluent line is proposed to be installed across the Port of Stephenville to provide irrigation to the golf course.

### 3.3.8 Fish Transport System

Fish will be transferred between the existing hatchery and the Modular RAS Production units, between production systems and ultimately transferred via a discharge line to well-boats using dedicated permanent fish transfer lines.

Conveyance of the fish will be facilitated using centrifugal type fish pumps or by use of gravity where appropriate. Fish will be de-watered leaving the sending module and move via an airgap into a hopper flooded with water from the receiving module. This air gap minimizes the potential risk of cross contamination from one production module to another and from the production area to the well-boat. Specially designed well-boats will be used for transport to saltwater farms.

The smolt transport building will be located upland from the wharf as an extension to the Modular RAS Production building. The 250mm above ground transport discharge line has been sized to fill the well-boat with a full load of 70-75 tonnes of fish (not including water) in approximately two hours. The figures below show the layout of the building and the transport technology as well as the discharge line location. The discharge line will run from the smolt transfer building to the existing wharf where the fish will enter the well-boat. The water from the discharge line will be held in the well-boat along with the fish.

Figure 18: Smolt Transport Building Layout

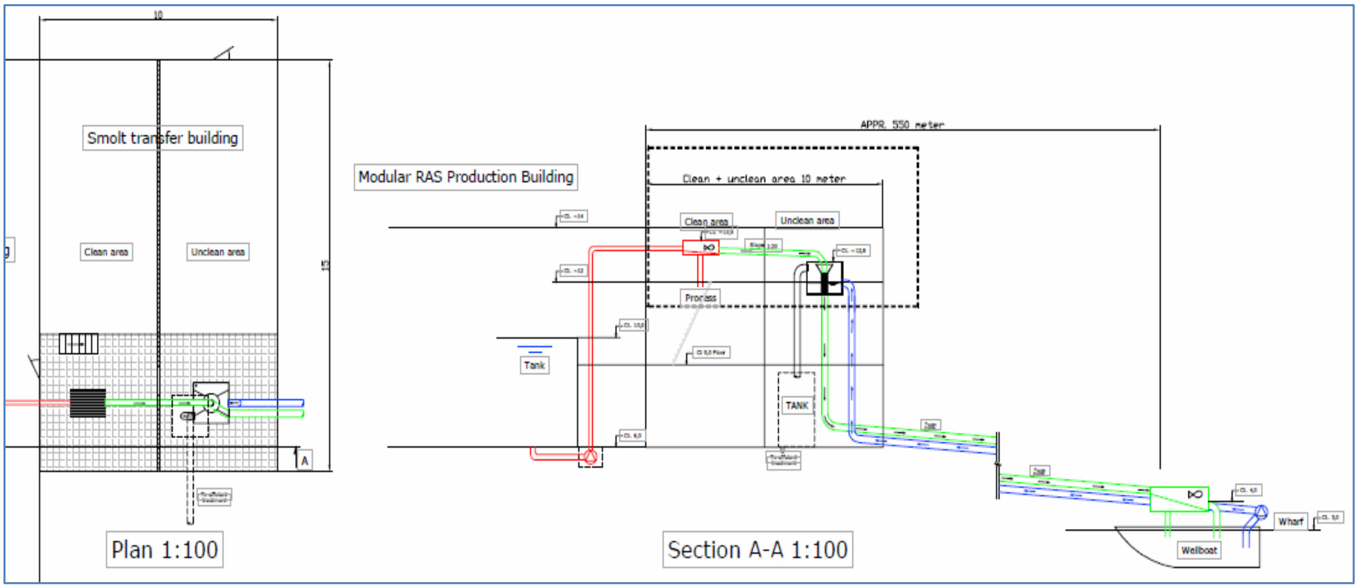
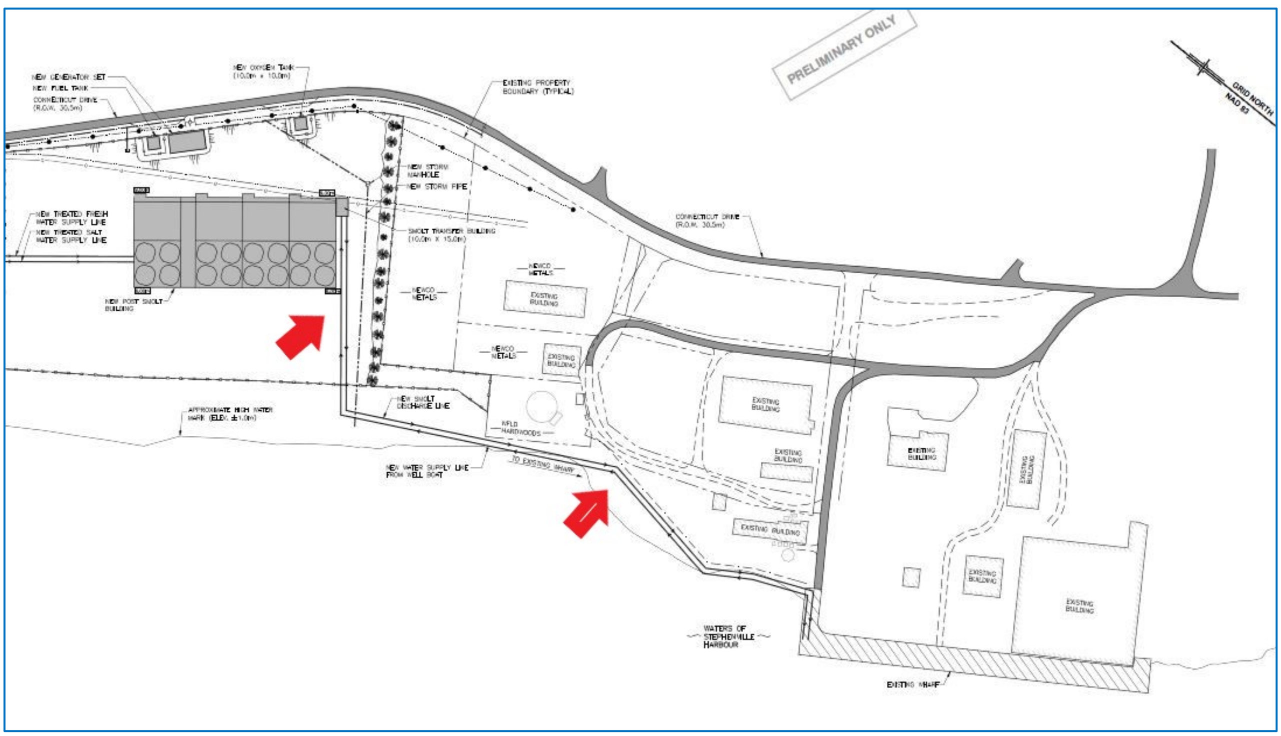



Figure 19: Smolt Transport Discharge Line




Well-boats have become a common method of fish transfer either from the hatchery to the saltwater farms and from the farms to processing plants. They provide a less stressful and more bio-secure method of transfer and fish can be transported over longer distances while maintaining the quality and consistency of the product being delivered (Bernoulli System AB, 2018). A typical well-boat is pictured below.


Figure 20: Typical Well-boat Configuration

### 3.3.9 Marine Infrastructure

The only new marine infrastructure associated with the Project are the saltwater influent lines and the effluent discharge line that cross the Port of Stephenville and the effluent discharge into St. George's Bay. See sections 3.3.8 and 3.3.9 of this report. The fish transportation system will make use of an existing wharf facility where well boats will dock to receive fish from the production building and transfer them to the sea sites for further development.

### 3.3.10 Related Municipal Infrastructure

The following sections discuss the existing municipal infrastructure and proposed upgrades or modifications.

#### *3.3.10.1 Municipal Water System*

The potable water supply and fire-fighting support for the facility will come from the Town water system. Currently, the Town water main crosses through the northerly portion of the proposed expansion property and it is the understanding of the company that the Town of Stephenville will be responsible for re-locating the water main to the shoulder of Connecticut Drive. The proponent proposes to supply potable water to the facility via a 150mm PVC line with smaller branch lines going to the individual buildings as required. A 150mm gate valve will be installed just off the connection point on Connecticut Drive, thereby minimizing disruptions to the town system during installation. The new water service will be installed in accordance with the most current edition of the standards of the Municipal Water, Sewer and Roads Master Construction Specifications, as published by the MAE, Government of Newfoundland and Labrador.

#### *3.3.10.2 Municipal Sewer System*

The proponent proposes to install a private sewage disposal system on site for sanitary sewage. The proposed sewage disposal system will be comprised of a septic tank, distribution box, and disposal field. The location of the proposed septic field can be seen in the figure below. Using Daily Sewage Flows for Various Types of Commercial Establishments, as published by Government Services Center, Government of Newfoundland and Labrador, it was determined that a daily flow rate of 340 liters per person per day would be used for the site. The proponent employment of a total of 24 people therefore the anticipated sewage flow would be in the order of 14.2 liters per minute.

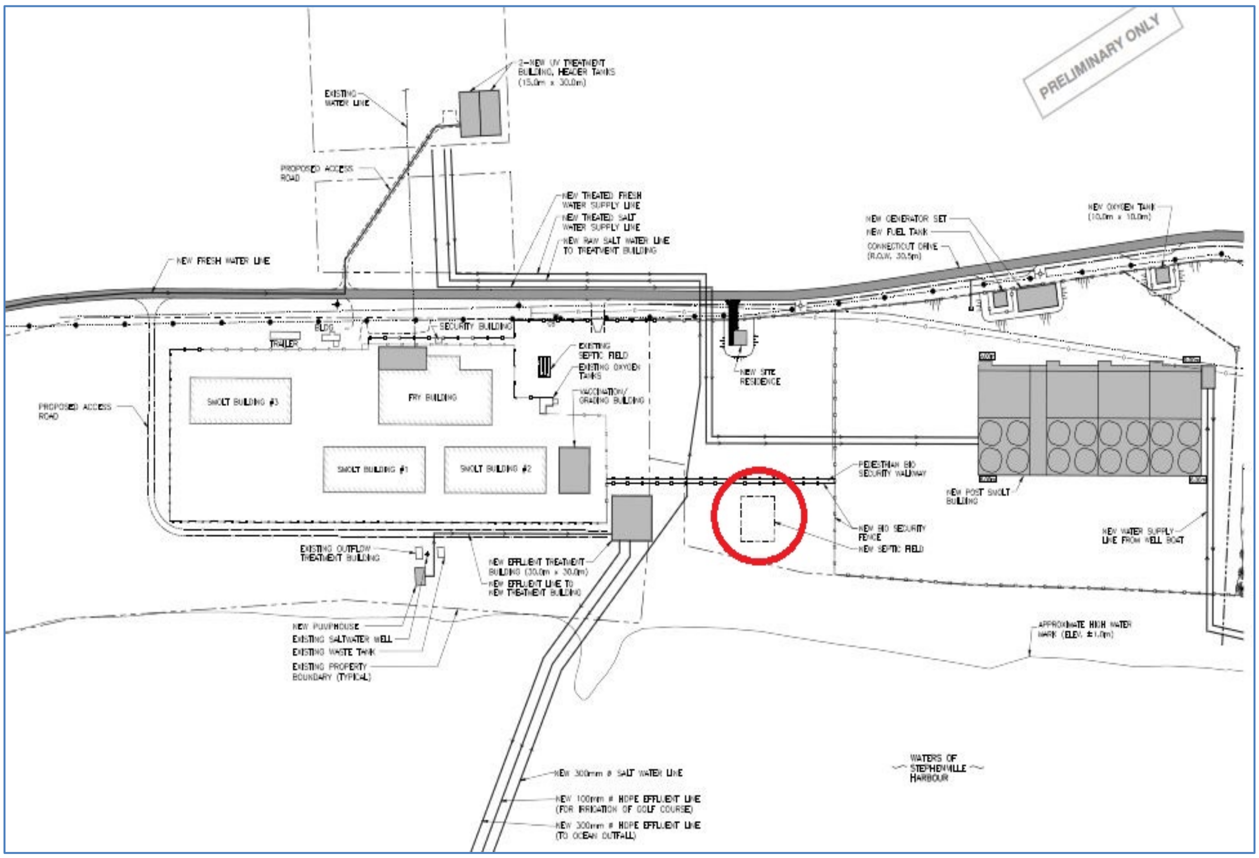



Figure 21: Proposed Septic Field Location

The proposed sewage disposal system will be installed in accordance with the most current edition of the Private Sewage Disposal and Water Supply Standards, as published by Government Services, Government of Newfoundland and Labrador.

#### *3.3.10.3 Municipal Road System*

The proponent proposes to access the expansion site from Connecticut Drive, a paved municipal street owned by the Town of Stephenville. The main entrance will come from the northwest limit of Connecticut Drive and lead a parking area for employees. The access roads and parking areas will be paved once construction activities are completed, thereby eliminating any environmental concerns in relation to dust control.

The new roads and parking areas will be installed in accordance with the most current edition of the standards of the Municipal Water, Sewer and Roads Master Construction Specifications, as published by the Department of Municipal Affairs and Environment, Government of Newfoundland and Labrador.

### 3.3.11 Electrical Services

The proponent proposes to connect to the existing power distribution system installed in the Town of Stephenville which runs along the northeasterly limit of Connecticut Drive. A series of taps will be taken from various sections along this line to supply three phase power to the various buildings. The new power lines will run along the proposed access points for the site to allow for street lighting and increased lighting in the parking areas. A diesel generator located on the site will supply the emergency backup power in the event of a power outage. The generators will be sized to ensure that the site has 100 percent backup power and enough fuel storage for continuous operations up to 72 hours. Both the generator and fuel storage tanks will be located inside the property fence but outside of the biosecurity fence.

## 3.4 Environmental Protection During Construction

The proponent is proud of its environmental record in relation to aquaculture activities. This sense of environmental stewardship will be maintained throughout the Project. As always, the proponent is committed to minimizing the environmental footprint throughout the entire construction period.

Potential effects from land development and construction of the new facilities have been anticipated and best practicable technology and methods will be used to minimize the effects of construction on the environment. The bio-physical effects on the environment may stem from one of several activities of construction; land clearing, excavation, building and install of infrastructure, as well as vehicular travel

### 3.4.1 Construction Duration and Period

Site preparation and construction for the Project are scheduled to start mid-August 2018 upon receiving release from the environmental review process and receiving all applicable permits and licenses. The scheduled completion date is December 31, 2020.

### 3.4.2 Potential Sources of Pollutants during Construction

Throughout the construction phase of the Project it is anticipated that there will be several potential sources of pollutants, however, it is also anticipated that there will be no long term environmental effects. Bio-physical effects on the environment may stem from one of several activities related to the construction including, but not limited to clearing of the land, excavation, building and install of infrastructure, as well as, vehicular travel and loading / off-loading of construction materials. Best practicable technology and methods will be used to minimize the effects of construction on the environment. Some of these methods include the following but are not limited to these items.

- All work will be completed in the dry; that is, no heavy equipment will be permitted to operate in any streams or brook crossing.
- Inlets and outlets of all culverts will receive erosion control such as rip-rap sodded protection or concrete head walls.
- Hydro poles installed on the site will meet all environmental regulations in relation to wood preservatives, location in wet areas, etc.
- Silt fences will be erected along the downward slope of the construction area to prevent silt infiltration to local brooks, streams or into Port Harmon.
- The area cleared for proposed expansion site will be controlled to minimize the footprint and care will be exercised to ensure that activities near any wetlands or bog areas are kept to a minimum.

### 3.4.3 Airborne / Noise Emissions

Construction activities such as land clearing, excavating, and operation of heavy equipment can potentially generate various types of air pollutants such as particulate emissions, chemical releases, noise, and odours. Sources of emissions may include the following.

- Mobile machinery for construction and transportation (e.g. earth-moving equipment, trucks, personal vehicles) generating noise, emissions of particulate matter from roadways, and combustion emissions including carbon dioxide, nitrogen oxides, carbon monoxide, and volatile organic compounds (VOCs).
- Stationary equipment (e.g. generators, drill rigs, wood chippers, pumps, heaters, transfer conveyors, etc.) generating noise, particulate matter, combustion emissions, and visible emissions.
- Chemicals used during construction (e.g. cleaners, adhesives, thinners, paint, lubricants, etc.) generating fugitive emissions of VOCs and possibly other specific chemical compounds.
- Excavated material (e.g. contaminated soil, tanks and fuel lines with residual contents, other buried objects), generating VOCs and possibly other specific chemical compounds.

Construction activities will be managed using best practicable technology and methods to reduce air emissions, such as the following.

- Vehicles and equipment will be adequately maintained for operation, maintenance will to be conducted off-site.
- Vehicles and equipment will be operated when required only, i.e. minimal idling.
- Transportation of goods will be conducted using a cover when required to minimize dust entrainment.
- Traffic is to be restricted to existing roads and to project related access routes to protect surrounding ecosystems.
- Travel routes will be adequately maintained to control dust emissions through the use of gravel and water applications.
- Piles of aggregate will be covered or watered to reduce dust emissions.
- Storage and handling of chemicals will be minimized.
- Preferential use of chemicals with low levels of Hazardous Air Pollutants (HAPs) and VOCs.
- Adequate drying time allowed before occupying the building.
- Proper ventilation provided.
- Disposal of chemicals in designated containers and removed from site using approved procedures.
- Sources of noise including motors, engines, fans, etc. will be minimized to the extent possible. Hours of construction will be established when possible to minimize noise during the early morning, evening, and night.

There is potential for the perception of odours through the use of chemicals, operation of heavy machinery, and general construction activities; however, the facility location is far from sensitive receptors and off-site impacts would reasonably be expected to be minimal.

### 3.4.4 Liquid Effluents

Construction activities generate various sources of potential environmental impacts related to water such as solids discharge, chemical discharge, and erosion. Sources of emissions may include:

- Mobile machinery for construction and transportation (e.g. earth-moving equipment, trucks, personal vehicles) generating emissions of solids more easily entrained in storm water, and potentially being the source of spilled / leaked fuel or oil.
- Stationary equipment (e.g. generators, drill rigs, wood chippers, pumps, heaters, transfer conveyors, etc.) potentially generating emissions to storm water via spills.
- Chemicals used during construction (e.g. cleaners, adhesives, thinners, paint, lubricants, etc.) potentially generating emissions to storm water via spills;
- Excavated material (e.g. contaminated soil, tanks and fuel lines with residual contents, other buried objects) potentially generating emissions to storm water via spills.
- Run-on to the site from the roadway and surrounding land, generating salts and potentially spilled material.

- Groundwater dewatering of excavation.
- Sanitary waste from construction personnel.

The preparation of the land, excavation and general travel to and from, as well as throughout the property can contribute to liquid effluents. Soil erosion is possible with the flow of water that occurs during a rain event, or simple watering which can result in surface runoff. Runoff has the potential to not only move pollutants offsite, but infiltrate waterways, groundwater and soil. As the facility is near-shore, best management practices are used to prevent and/or minimize liquid effluent.

### 3.4.5 Solid Waste Materials

Construction activities generate various types of solid waste which may include the following.

- Excess and scrap building materials (e.g. steel, concrete, wood, adhesives, solvents, etc.).
- Excavated material from grading cuts and foundation excavation (e.g. soil, rocks, etc.).
- Buried items and infrastructure excavated from the site (e.g. fuel pipelines, underground tanks, etc.).

Minimizing construction waste destined for landfill disposal is a priority. This waste includes building materials such as insulation, steel, concrete, and wood as well as those listed above.

### 3.4.6 Sediment Erosion Control and Natural Drainage

Consideration will also be given to storm water management throughout the construction as construction activities can sometimes alter drainage patterns and add pollutants to the rainwater and snow melting which ends up in the surrounding rivers, lakes and water ways. Construction activities, such as those listed below, will be managed using best practicable methods to reduce liquid effluent.

- Alterations to existing drainage patterns will be avoided, if possible.
- Perimeter controls and sediment barriers built, as needed.
- Phased construction activity, controlling duration of exposed surfaces.
- Land disturbance will be kept to a minimum as a method to implement sediment control.
- Ditches will be constructed to intercept surface water that would enter the site as well as constructed from low to high elevations to avoid water ponding.
- Ditches constructed will have short, shallow, protected slopes to avoid erosion, if possible.
- Culverts will be installed to prevent ponding, as necessary.
- Storm drain inlets will be protected with technology, e.g. check dams and catch basins where applicable.

- Method to limit soil exposure include: covering excess soil to reduce contact, removing excess soil, as necessary, as well as maintaining surrounding vegetation and other shelters to divert excess water or wind flow.
- Retain sediment on-site with sediment control measures (barriers, silt fence, etc.) and control dewatering practices.
- Regular inspection and repair of sediment/erosion control techniques.

Groundwater dewatering activities may be required at the site. The details of this activity (if required) will follow accepted provincial construction industry practices defined for transportation and building systems developments.

Appropriate washroom facilities will be provided for construction personnel. All sanitary waste generated during construction will be removed from the site and managed at an off-site location by a licensed operator of temporary sanitary systems.

### 3.4.7 Waste Management

Construction waste will be managed using best practicable technology and methods to prevent release of waste into the environment. Solid waste is categorized by hazardous and non-hazardous classes, and must be documented, maintained and either salvaged, recycled or disposed of as required.

The following practices will minimize environmental impacts caused by non-hazardous waste.

- The site will be kept tidy at all times by establishing staging areas.
- Construction waste and sewage will be collected for proper disposal.
- Recyclable waste will be separated from other waste materials, trash and debris.
- Waste will be collected and stored in containers that are off ground and covered.
- Waste will be removed regularly to an approved landfill or recycling facility.
- Salvaged waste will be removed from the site.

The practices that will be followed to minimize environmental impacts caused by hazardous waste are listed below.

- An inventory of controlled products, including hazardous waste will be maintained on site and updated as needed. These products will be documented in an on-site MSDS document.
- Non-hazardous products will be used in place of hazardous products, if possible.
- WHMIS requirements will be followed, i.e. properly containerized, marked, etc.
- Each individual on the project will be trained to recognize hazardous wastes on the project and to respond appropriately.
- Hazardous waste will be treated and disposed of at a facility permitted or licensed for this purpose. Transportation of said hazardous waste will be per law, regulation and/or standard.

- If a leak or spill should occur, spill cleanup kits will be maintained on site at the storage location.

### 3.4.8 Potential Causes of Resource Conflicts

No potential causes of resource conflicts have been identified for the construction of the proposed hatchery at this time.

## 3.5 Operations and Operational Impacts

The Project provides significant improvements and benefits to the existing operations. The following sections provide information on operations and operational impacts expected from the Project.

#### *3.5.1.1 Fish Culture Operations*

The Project will provide positive impact to production with increased production, improved biosecurity, and more robust smolt for the saltwater farms. The current bio-plan is to produce two cohorts of fish each year.

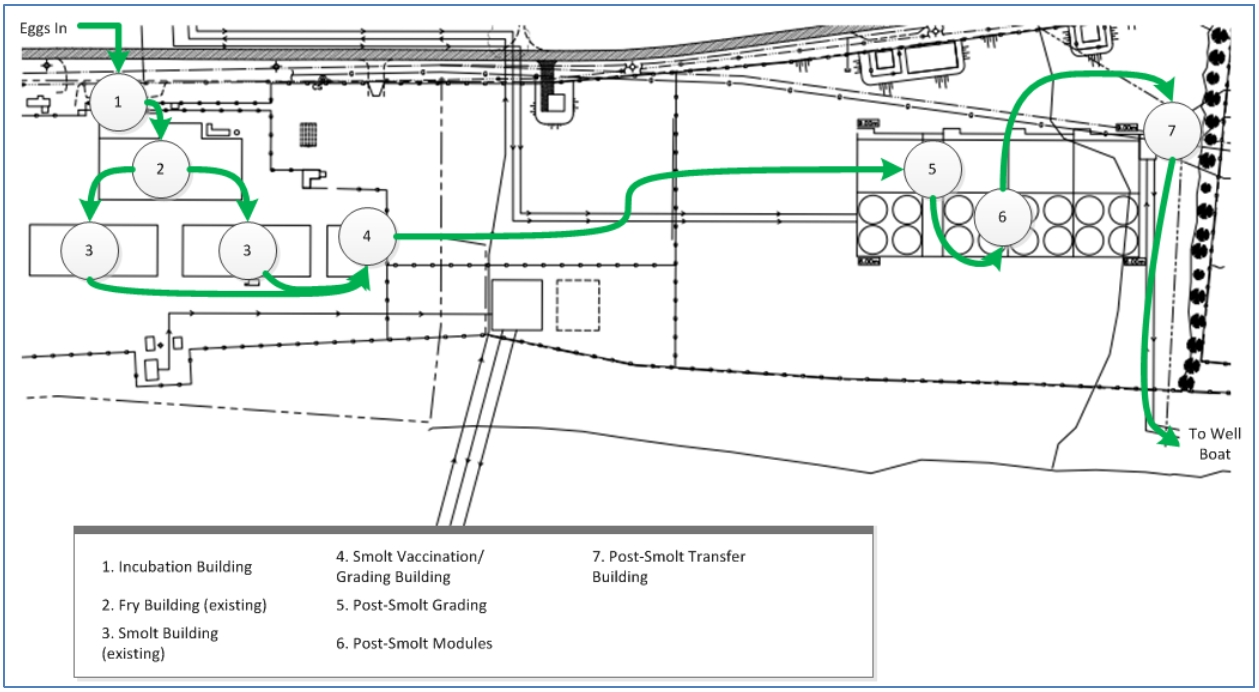
Eggs are introduced to the existing facility in Dec-Feb annually. Eggs introduces in December are incubated until May, fry are graded at 0.6 gram in size and again at 43 grams in size, rearing will take place in the production systems in the existing hatchery and the new Modular RAS Production units.

The first cohort begins with about 7.5 million eyed eggs place into the incubation system in December. After hatching in May, the fish are ponded into 6 metre and 7 metre tanks for about 2 months (July) before they are graded and transferred to 12 metre tanks. After four months (December), fish are moved to the Modular RAS Production tanks for additional on-growing. About two million 250+ gram fish are discharged after 7 months (May) to saltwater farms. Approximately one million fish are reared for an additional four months to 400+ grams and acclimatized to saltwater before they are discharged in September.

The second cohort begins with about 4 million eyed eggs entering the incubation system in February. After hatching in July, the fish are ponded into 7 metre tanks for 2 months (Sept) before they are transferred to 12 metre tanks. After 10 months (June) in the 12 metre tanks, the 2.75 million 250+ gram fish are discharged to saltwater farms.

The Project includes the development of saltwater wells to be able to acclimatize the smolt to seawater prior to being transported. It has been shown the salmon acclimatized to seawater have better survival at sea and grow to harvest size in a shorter period of time.

Figure 22: Fish Rearing and Flow Through Production Systems




### 3.5.1.2 Biosecurity

The biosecurity of the existing production system will be enhanced. The proximity to other sites can sometimes lead to the possible transfer of pathogens, however the existing hatchery is not near other aquaculture sites and the proposed expansion is a Modular RAS Production facility has dedicated and treated water from known sources which eliminates the potential for pathogen transfer. The site biosecurity measures such as designated bio-secure areas, foot baths and dedicated work wear for specific areas, hand wash stations, and disinfection of personnel and equipment, are designed to reduce disease transfer. All visitors, contractors, and staff will receive a biosecurity orientation prior to entering the facility. Permanent employees and staff will part take in monthly safety meetings and continued training to ensure the highest level of biosecurity is maintained within the facility.

- The supply of fresh water required will be from 4 or 5 wells to be located and constructed near the edge of the marsh, east of the site. Pipelines will be constructed to convey the water produced by these wells following the alignment of the roadways to the site.
- Saltwater supply will be from 2 or 3 wells located at the shore to the west of the municipal golf course. A pipeline will be constructed crossing the harbour to bring this supply of saltwater to the site. All fresh and saltwater supply will be treated at a small treatment facility to be located across the road to the east of the site.
- Treated liquid effluent will be discharged to the ocean through a system of pipelines that will cross the harbour. These lines will be located near the incoming saltwater pipelines.

Construction of the Modular RAS Production unit will be undertaken while the existing hatchery continues operations.

#### 3.5.1.3 Estimated Period of Operation

NHS is the provider of smolt for the 33 saltwater farms owned by the company. The Project will create greater security and greater numbers of smolt for these sites. The company is investing approximately $51 million to complete the Project. It is anticipated that the Indian Head Hatchery will be producing smolt for a minimum of 15 years.

#### 3.5.1.4 Potential Sources of Pollutants during Operations

The development of the proposed facility and its operation present an opportunity for significant environmental improvements and benefits to the site compared to as it exists today. However, there are potential sources of pollution during operations.

##### 3.5.1.4.1 Airborne Emissions

Air borne emissions from the operation, while expected to be slightly increased from the current site, will be very minor. Sources of airborne emissions, such as odours etc., will be isolated and controlled with containment and ventilation systems designed for the specific sources to be controlled. The primary source of odour is solids handling and storage at the final effluent treatment facility. Based on previous experience and with the intended containment and ventilation systems in place, no odour impacts from the operations are expected.

##### 3.5.1.4.2 Liquid and Solid Hatchery Effluents

Three sets of criteria have been identified as standards for the quality of water discharged from this facility:

- NLR 65/03 Environmental Control Water and Sewage Regulations, 2003
- Best Aquaculture Practices Certification Standards, Guidelines: Finfish, Crustacean and Mollusk Hatcheries and Nurseries, Appendix A.
- Aquaculture Stewardship Council Salmon Standard V.1.1 – April 2017. Section 8, Indicators and Requirements for Smolt Production.

The table below summarizes the standards. In all cases, the criteria to be applied for each water quality parameter in the design of the facility are the most stringent from the three sources.

Table 10: Quality of Discharged Water

| | | NLR 65/03 | BAP | | ASC | Typical MHC Facility* - Blended effluent before treatment | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter** | **Units** | **Body of water** | **< 5 yrs** | **+ 5 yrs** | | **average** | **max** | **min** |
| **Ammonia** | mg/L TAN | 2 | 5 | 3 | | 0.86 | 2.02 | |
| **BOD** | mg/L | 20 | 50 | 30 | | 11.91 | 40.6 | |
| **Cadmium** | mg/L Cd | 0.05 | | | | | | |
| **Chlorine** | mg/L Cl | 1 | | | | | | |
| **Chromium** | mg/L Cr | 0.05 | | | | | | |
| **Copper** | mg/L Cu | 0.3 | | | | | | |
| **Copper** | mg/L Cu | 0.3 | | | | | | |
| **Hydrogen Cyanide** | mg/L HCN | 0.025 | | | | | | |
| **Iron** | mg/L Fe | 10 | | | | | | |
| **Lead** | mg/L Pb | 0.2 | | | | | | |
| **Mercury** | mg/L Hg | 0.005 | | | | | | |
| **Nickel** | mg/L Ni | 0.5 | | | | | | |
| **Nitrate** | mg/L $NO_3$ | 10 | | | | 2.64 | 5.26 | |
| **Oxygen, dissolved** | mg/L DO | | 4 | 5 | | | | |
| **pH** | | 5.5-9.0 | | 6.0-9.0 | | 6.74 | 7.6 | 6.1 |
| **Phosphorus** | mg/L P | 1 | | | 4 kg per tonne of fish produced | | | |
| **Phosphorus (soluble)** | mg/L P | | 0.5 | 0.3 | | 0.51 | 0.884 | |
| **Selenium** | mg/L Se | 0.01 | | | | | | |
| **Silver** | mg/L Ag | 0.05 | | | | | | |
| **total dissolved solids** | mg/L TDS | 1000 | | | | | | |
| **total suspended solids** | mg/L TSS | 30 | 50 | 25 | | 13.65 | 69 | |
| **Zinc** | mg/L Zn | 0.5 | | | | | | |

Two types of fish culture effluent are produced: black water containing high concentrations of waste solids, and effluent which typically has very little TSS or BOD.

The quality of water from existing British Columbia hatcheries of similar design to the proposed project was compared to the criteria summarized in table above. The only parameters of particular concern are the TSS and BOD5 measurements. This is particularly of concern for the black water samples where TSS concentrations above 700 mg/L are possible. Removal of the suspended solids will also result in reduction in BOD5 measurements to within acceptable limits. Therefore, the high TSS laden drum filter backwash water will discharge to clarifiers. It has yet to be identified if the brackish water settled solids are suitable for composting.

After the solids have been extracted, the remaining water will pass through a microscreen drum filter. The microscreen drum filter will intercept any large particulates that float plus any settleable solids which could be discharged in an upset from the clarifiers. A redundant microscreen drum filter will permit continuous operation even if one filter requires servicing.

After removal of particulate, the combined flow will pass through an ozone contact chamber followed by an UV reactor that can deliver a UV dosage of 100 mJ/cm2. This UV reactor will ensure that no live pathogen will leave the facility in the effluent discharge.

Each component in the treatment process will be sized to treat approximately 6000 Lpm as it is expected that the four Modular RAS Production units will each generate about 960 Lpm maximum, this represents spare capacity of approximately 50%. After treatment, the fresh water effluent will be discharged to a sump which can be used to pump irrigation water to the Harmon Seaside Links golf course. Water not used for irrigation will be combined with the discharge from the Modular RAS Production facility in a 400 mm pipe which will be pumped to an ocean outfall beyond the Harmon Seaside Links.

Estimates have been made of waste and effluent flows based on target fish production rates within each of the culture modules. Starting with fish size, a very conservative estimate was made of feed consumption rate. Influent of 460 L/kg of feed was used to estimate influent requirements based on those feed rates. Waste solids production of 25% of the feed consumed was used to estimate waste production. Most waste solids are extracted from the fish culture water using drum filters. At an assumed 800 mg/L TSS concentration in the drum filter backwash, an estimate of the drum filter backwash flows can be made.

Based on the assumptions identified, the following flow estimate can be made for the Modular RAS Production facility.

- Peak Biomass: 878,635 kg
- Peak Feed: 14153 kg/d
- Peak Waste production: 3538 kg/d
- Peak Drum Filter Backwash flow at 800 mg/L TSS: 2922 Lpm
- Peak Clean Effluent (at an estimated 15 mg/L TSS): 1600 Lpm
- Peak total influent flow: 4521 Lpm

Total Suspended Solids and Total Phosphorus in the discharge water can be identified in similar discharges from RAS modules at other facilities. At a Marine Harvest Canada facility in British Columbia, before treatment, drum filter backwash water contains approximately 260 mg/L TSS and 9 mg/L total phosphorus including approximately 0.75 mg/L orthophosphates. After treatment, it is anticipated that TSS will be reduced to below 30 mg/L and TP will be reduced to below 1 mg/L. Therefore, the total TSS discharged will be up to 195 kg/d while the total Phosphorus discharged will be less than 6.5 kg/d.

A comparable flow through facility would flow at 90,667 Lpm per module for a total of 362,668 Lpm. The BAP standard requires flow through facilities to discharge at TSS concentrations less than 25 mg/l and TP at less than 0.3 mg/L. Therefore, the comparable discharge would be 13,056 kg/d TSS and 156.67 kg/d TP.

##### *3.5.1.4.3 Noise Pollution*

Noise emissions from the operation, while expected to be slightly increased from the current site, will be very minor. Sources of noise such as motors, engines, fans, etc are expected to generate little significant noise at the hatchery.

#### *3.5.1.5 Waste Management*

The proponent has a comprehensive waste management plan which reduces the type, volume and disposition of waste and effluents. The Materials Storage, Handling and Waste Disposal Plan (MSHWDP) is developed for fish production and affiliated activities and responds to the requirements of Aquaculture Stewardship Council and Best Aquaculture Practices certification standards, as well as, all provincial and federal regulations and requirements. The MSHWDP ensures that all waste materials are handled in a responsible manner that prioritizes recycling over landfill dumping whenever possible. All facilities shall ensure that non-biological material is not dumped into marine or freshwater environments.

As with any workplace or human activity, control of hazardous materials is important to ensure the health of staff and other persons, as well as, to safeguard the environment. For aquaculture facilities, a healthy production environment translates into healthy fish which provides additional incentive to ensure that best practices guide hazardous materials use and management.

The first step in controlling hazardous substances is recognition of their presence on site. The Hazardous Materials Inventory Form developed by NHS allows staff to track which items are on site and becomes a reference for ensuring that Safety Data Sheets (SDS) sheets are available for all identified hazardous substances. The form includes all substances that may be commonly found on site and for which SDS are required. Additionally, the form includes space for other hazardous materials that may not be normally found on site. Finally, the form has space for identifying and providing information on waste hazardous materials that may be stored on site prior to disposal.

All staff are required to receive training regarding waste management practices relevant to their time on the job, work experience and duties.

#### *3.5.1.6 Escape Management*

The Project proposed to build a land-based closed system with 97% water re-use.

The existing Indian Head Hatchery is a land-based facility with all systems enclosed within buildings. The proposed expansion is a closed loop recirculating aquaculture system and effluent is triple screened. No freshwater lakes or rivers will be used for rearing.

Fish will be transported between systems within the facility and from the hatchery to the well boats via enclosed permanent pipelines. An also enclosed permanent pipeline will be used to transport fish from the hatchery to the enclosed well boat for transport to the saltwater farms. Though the opportunity for escapes is extremely low, the company takes escape prevention seriously and a full Escape Prevention and Mitigation program will be developed.

Escape prevention includes system design to eliminate escapes, management plans and procedures to reduce opportunity for human error and equipment malfunction, training and reporting.

> *Standards:* The facility will be built to the Norwegian technical standards NS9416 that are focussed on escape prevention for new land-based aquaculture facilities for fish.
> *Design:* The expansion project has been fully designed and meets all regulatory requirements, ASC standards and environmental protocols.
> *Operations:* Detailed SOPs will be developed using production protocols, technology user manuals and company and regulatory standards and other requirements.
> *Inspections:* All equipment used in rearing fish will be inspected daily and if needed repairs made as soon as a deficiency is discovered. Inspection observations and repairs is recorded with records kept onsite. Materials used for repairs meet or exceed original material. Effluent screens are inspected daily with inspections and repairs recorded in the site.

It is company policy that fish culture and fish transport are done in a manner that reduces the risk of escapes and the following will be part of the standard procedures.

- All staff and contractors will follow best practices with regards to escape prevention.
- For both fish culture and transport, staff training programs will ensure all staff and contractors can carry out their responsibilities for both escape prevention and inventory practices.
- All fish culture tanks and vaccination/grading systems will be inside buildings and enclosed areas.
- If a dip net is used it will be of the appropriate mesh size and in good repair. Fish will not be crowded in the tank more than necessary.
- Effluent from fish production tanks will be triple screened with mesh sized according to the smallest size of fish.
- Fish transfer lines will be permanent structures with flexible line at the end to facilitate fish handling with pipe joins connected using cam-lock fittings.
- Transfer pipes will be inspected for holes/splits, sharp edges, and integrity prior to each use and pipe joins will be inspected for proper fitting and support prior to transferring.

- Escape incidents or near misses during transport will be reported to the Freshwater Transport Manager.

Though unlikely that an escape will occur, an Escape Response Plan will be developed to minimize the escape and the potential effect on the environment and will include the following.

- Escape Response Kit – list of equipment, location, instructions for use.
- Suspected escape response actions documented and available onsite.
- Known escape response actions documented and available onsite.
- Training for all staff and contractors on site.

Record keeping will include detailed accurate records of events leading up to the discovery, response, reporting and all communications related to the event.

- Escape Event record
- Fish production information – origin, transfer date, introduction of fish
- Mortalities
- Training
- Internal Escape and Investigation Report

### 3.5.2 Hatchery Effluent Monitoring

Both fresh water and saltwater effluent will be monitored at the treatment facility before being discharged into St. George's Bay. The effluent discharged will meet all provincial and federal standards, as well as Best Aquaculture Practices certification requirements.

## 3.6 Employment and Human Resources

The hatchery expansion project will make a positive and significant contribution to the local economy in the following ways.

- Estimated employment for more than 112 people during construction.
- Once the project is completed, an estimated twenty-four full time permanent employment positions.
- Long-term relationships with local and provincial companies for ongoing required services and supplies.
- Opportunities for local businesses to provide amenities and services for management and employees, contractors, service suppliers and others associated with the company and the hatchery.

NHS is committed to being part of the local community and will preferentially hire locally for both employment and contracts. Discussions have been initiated with the local colleges to provide training for specific technical positions.

A team of provincial, national and international experts have been collaborating for 6 months to design the systems for this project and assess the proposed site and the aquifer. Once the site development and construction are initiated, there will be opportunities for local companies to be involved such as for land clearing and development, foundation and building construction, electrical and mechanical engineering and installation, providing materials etc. Additionally, services will be required for the management team that include hotel accommodation and food, car rentals, meetings rooms and business services.

### 3.6.1 Enumeration and Breakdown for Construction

Site development and construction will begin August 2018 and be completed in December 2020. All site development and construction work will be contracted using local companies as much as possible. The design and environmental review team consists of Edwards and Associates Ltd, Meridian Engineering and Consulting, and Fracflow Consultants Inc from the Province of Newfoundland, GenCoast Construction Ltd from BC and international companies Pentair Aquatic Ecosystems Inc and Ramboll Group A/S.

Using local companies provides the added benefit of employment opportunities locally. It is estimated that over 150 people could have employment related to the Project development and construction, though not all will be fulltime permanent positions. The table below provides the number of workers expected through the three years of site development and construction.

Table 8: Estimated Number of Workers for Project Site Development and Construction with National Occupational Classification (NOC)

| Work | Potential Number of Workers[1] | National Occupational Clasification[2] |
|---|---|---|
| Project Management, Supervision | 5 | 0211 engineering manager/supervisor<br>0711 construction managers |
| Site Development | 35 | 7217 heavy duty equipment operators<br>0711construction manager<br>7611 construction trades |
| Construction Buildings and Production Systems | 85 | 0711 construction manager/supervisor<br>7213 pipe fitters<br>7215 carpenters<br>7216 mechanical engineers<br>7219 installers<br>7611 construction trades |
| Construction Wells and Pipelines | 55 | 7217 contractor/supervisor<br>7373 well driller<br>2212 geotech technicians<br>2231 civil engineer<br>2113 geologist/ coordinator |
| Total | 180 | |

[1]not all positions are fulltime permanent employment

[2]For more information on the National Occupation Classifications, please see http://noc.esdc.gc.ca/English/noc/QuickSearch.aspx?ver=06&val65=*

### 3.6.2 Enumeration and Breakdown for Operations

The current Indian Head hatchery employs approximately 16 people in full and part-time positions. The operations of the upgraded hatchery and proposed expansion systems, when fully operational, will have the potential for additional eight positions bringing the total to 24 positions will full-time permanent employment, as indicated below.

Table 11: Potential Employment – Positions, Potential Number of Employees and National Occupational Classification

| Position | Potential Full Time Employment | National Occupational Classification[1] |
|---|---|---|
| Manager | 1 | 8257 |
| Assistant Manager | 1 | 8257 |
| Fish Culture Technicians | 12 | 2221 |
| Water Quality Technician | 1 | 2131 |
| Vaccination, grading | 3 | 8613 |
| Fish Health Technician, Fish Health Program Manager, Veterinarian[2] | 2 | 2221, 3213 |
| Administration | 2 | 1411 |
| Security | 1 | 6651 |
| Facility Maintenance | 1 | 0721 |
| Total Employment | 24 | |

[1]For more information on the National Occupation Classifications, please see http://noc.esdc.gc.ca/English/noc/QuickSearch.aspx?ver=06&val65=*

[2]This position may be shared with other divisions within the company.

### 3.6.3 Workforce, Contractor and Spin-Off Activities

The hatchery has the potential to generate approximately 112 jobs for site development and construction from August 2018 through December 31, 2020. During ongoing operations, a staff of 24 full-time permanent positions are expected with likely more than 4x the number in spin-off employment opportunities within the community as part of supply and services required for the hatchery and company management and for employees.

For hatchery operations, local companies will be contracted preferentially for services such as transport of feed and chemicals, road maintenance and repair, electrical servicing, site maintenance and new development, waste disposal and recycling, environmental monitoring and reporting, accounting and business services, office supplies etc.

### 3.6.4 Employment Equity

NHS, as a MH company, will align itself with the principles and goals that MH has committed to world wide. MH acknowledges that to be successful, it must maintain good relationships with its employees and local communities. MH farms in many countries and cultures worldwide. In

2017, MH employed 13,233 people, 58.2 % were male and 41.8 % were female. Page 103 of the Annual Report 2017 describes MH efforts and commitment to providing meaningful jobs

MH supports the UN Sustainability Development Goals that guide governments, civil society and the private sector in collaborative efforts for change towards sustainable development. MH actively implements many of these goals, including Goal Number 8 – Decent Work and Economic Growth. Please see page 28 of the 2017 MH Annual Report 2017 (http://hugin.info/209/R/2177429/840178.pdf) for more information on how the company applies these goals. MH operations contribute to the development of local communities providing safe and meaningful jobs and has developed global key performance indicators that contribute to Goal 8.

MH also supports the UN Global Compact, a strategic policy initiative for businesses that are committed to aligning their operations and strategies with ten universally accepted principles in the area of human and labor rights, the environment, and anticorruption.

MH employees are its most valued assets and corporate success depends on the ability to attract new and retain existing staff. To do this, the company must be a trusted and professional employer, with a reputation for ensuring people are protected and rewarded. A competitive advantage is the ability to offer meaningful and challenging employment in a positive work environment.

MH is committed to fair employment practices, a commitment embodied in the Code of Conduct and in company values. Activities are conducted without discrimination and each employee is treated as an individual. Fair compensation, striving to attract a diverse workforce, providing equal opportunities, conducting our activities without discrimination and valuing everyone as individuals are cornerstones of the business.

### 3.6.5 Education and Training

This project will install new high-tech equipment and systems and employees will need skills not currently present in the industry. The company is committed to local communities benefitting and preferentially hires local people to fill positions. Many of the position are highly technical and require specific training such as fish culture expertise currently provided by Memorial University. The company will also work collaboratively with educational institutes to ensure additional training is available where required and will consult when recruiting skilled labour such as Memorial University and local colleges, College of the North Atlantic and Western College in Stephenville. In addition, specific technical training is provided through the company's Global R&D network and through learning exchanges with other business units around the world.

### 3.6.6 Employee Health and Safety

NHS, as a MH company, will align employee health and safety with the established principles and practises of MH by implementing the MH global safety approaches with both NHS and NHSF. The aim is to have zero workplace injuries or lost time. Employee safety will never be compromised. MH has implements a global safety program called Brain safe. Brain safe is a behaviour-based safety process designed to empower employees to take control of their own safety. MH encourages and fosters a strong safety culture where employees take responsibility for the safety of themselves and their colleagues. Please see page 106-107 of the annual report (http://hugin.info/209/R/2177429/840178.pdf).

Newly hired staff participate in a safety orientation session prior to starting work and workplace safety sessions regularly during employment at least once per year. Employees are encouraged to use established processes to report unsafe work situations to supervisors and management. Ongoing improvement of workplace safety is addressed at regular site meetings.

### 3.6.7 Alternatives Considered

The Project is necessary to improve quantity and quality of salmon smolt produced for NHSF saltwater farms and the company production. The company has decided to expand the established salmonid hatchery at Indian Head for the following reasons.

1. Producing smolt in the same province as the saltwater farms is the most bio-secure and sustainable option for the industry and for the company.
2. The Indian Head hatchery is currently producing smolt, no delay is expected in having smolt ready for sea sites.
3. The proposed expansion and upgrades will enhance the Indian Head hatchery production and make it more secure.
4. The Modular RAS Production facility will be housed in a new stand-alone building on a site adjacent to the existing Indian Head Hatchery and will be linked to the equipment and process upgrades at the existing facility. Site development and construction will not adversely affect the current hatchery operations.
5. The security of the Indian Head hatchery freshwater supply and the efficacy of the effluent treatment and discharge will be improved with the in the proposed project.

Several other alternatives were considered and rejected before the decision was made to expand the Indian Head hatchery.

### 3.6.8 Alternative One

Alternative one would consist of not expanding the current hatchery. NHS can continue to operate as it has been, but aquaculture production will not grow. The owners of NHS, Marine Harvest Atlantic Canada Inc (MHAC), purchased the company with plans of expanding production. If the facility is not expanded and improved upon, smolt production and smolt size will be limited to current levels and salmon production potential on licensed sea cages site will not be fully realized. The aquaculture growth targets set in the provincial Way Forward initiative will likely not be met through smolt produced in this province.

### 3.6.9 Alternative Two

Alternative two would be for MHAC to construct a hatchery in another province and ship or transport smolts to Newfoundland and Labrador. This practice occurs regularly in the aquaculture industry in Newfoundland to make up shortfalls in smolt production for sea cage sites. It is known that in-province smolt production is more bio-secure and fish welfare is improved when the fish produced are near the sea sites. Accessing smolt outside of the province may compromise the current high level of biosecurity in the province. While this is an approved practice and has been successful, it is not a best practice for overall production and biosecurity of both the farm and the industry. Shorter transport times from provincially located hatcheries to NL sea sites minimizes stress on the fish and increases their ability to acclimate to the marine environment providing a higher level of fish welfare and greater production security.

# 4 SOCIO-ECONOMIC DEVELOPMENT

## 4.1 Demography

The Town of Stephenville, formerly named ‘Indian Head’, is located on the west coast of Newfoundland and has a population, as of 2006, of 6,588. Stephenville is a major service centre for the southwestern part of Newfoundland (Town of Stephenville, 2018). The town was founded in 1844 by two English families, William Hunt and James Penny, of Margaree, Cape Breton.

The name ‘Stephenville’ first appeared in 1874 when the population had reached 268. Farming was the main occupation but by the early 1900’s, people had turned to lobster and herring fishing. By 1935, the population of the town of Stephenville had reached 1,000 with many being employed in the pulp-wood industry and at saw mills. In 1941, Stephenville became the site of the Ernest Harmon Air Force Base – the largest U.S. Air Force Base outside of the Continental United States. Construction of the base impacted Stephenville significantly increasing the population to 7000, almost overnight. In 1966, the base closed, leaving considerable economic devastation in the region. In the 1970’s the Abitibi-Consolidated Pulp and Paper Mill opened. The College of the North Atlantic also established its main campus in Stephenville at this time.

(Town of Stephenville, 2018). The Abitibi-Consolidated Pulp and Paper Mill also closed its doors, again leaving considerable economic devastation in the region. Stephenville, survived, however, and is continuing to grow economically (Town of Stephenville, 2018).

### 4.2 Socio Economic Benefits

Newfoundland and Labrador's aquaculture industry creates 2,500 direct and indirect jobs and has a total market value of $276 million (Newfoundland Aquaculture Industry Association, 2018).

Newfoundlanders have embraced the aquaculture development opportunity and have seen the value of the industry rise over 500% in the last ten years from $38 million in 2007 to $209 million in 2017. Aquaculture is an important economic driver for this province which is helping to bring prosperity to rural, coastal communities (Newfoundland Aquaculture Industry Association, 2018).

In addition to the direct jobs created on the farms, hatcheries and processing plants, the industry has generated indirect jobs in feed manufacturing, packaging, transportation, the supply and service sectors as well as spin off jobs in retail and tourism (Newfoundland Aquaculture Industry Association, 2018). Farmers are building an industry that will help keep young people at home by offering them challenging, full-time work in their own communities (Newfoundland Aquaculture Industry Association, 2018). Over 90 per cent of the jobs in the salmon farming industry are full-time; seven per cent are part-time and only three per cent are seasonal (Newfoundland Aquaculture Industry Association, 2018).

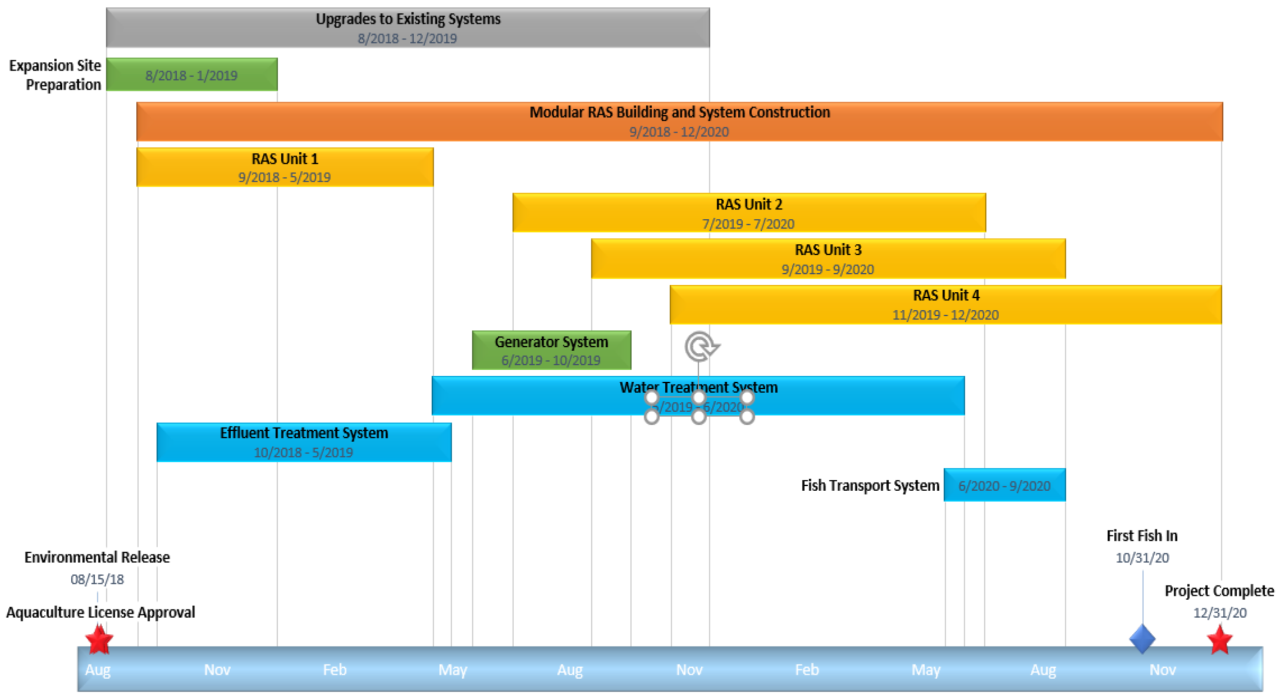
The Project will have a positive contribution to the local economy by providing an estimated employment for more than 120 people during the 2-3 years of construction, an estimated twenty-four fulltime permanent employment positions for ongoing operations, as well as, opportunities for local companies for ongoing services and supplies.

# 5 SCHEDULE

The Project is scheduled to start immediately upon release from the Environmental Review process and receiving the required licenses and permits. The planned start date is August 15, 2018 in order to have the site developed and the building constructed for Modular RAS Production units prior to winter. This will allow work to continue during the winter months.

With this start date, the Project will be completed by December 31, 2020 with Modular RAS Production facility taking the majority of the time from site preparation through construction and commissioning of the Modular RAS Production units and supporting systems, see figure below.

Figure 23: Indian Head Hatchery Expansion Project Timeline




# 6 FUNDING

This project is entirely financed by Marine Harvest, owner of Northern Harvest Sea Farms and Northern Harvest Smolt. The Marine Harvest annual report found at http://hugin.info/209/R/2177429/840178.pdf contains the most recent financial statements of the global company. These clearly indicate the financial strength of the company and its ability to fund this project in its entirety.

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## APPENDIX A: INDIAN HEAD HATCHERY 2011 ENVIRONMENTAL REGISTRATION AND RELEASE

## APPENDIX B: FRESHWATER AQUIFER TESTING

Please note that these reports were commissioned by MHAC prior to the purchase of NHS.

1. Assessing the Capacity of the Local Groundwater Aquifers 3113-003
2. Aquifer Well Testing 3113-006

## APPENDIX C: LEGAL SURVEYS AND DESCRIPTIONS

## APPENDIX D: AERIAL PHOTOS

1. 1:50:000 map of the area
2. Arial photos of the proposed expansion site over time

## APPENDIX E: ZONING AND LAND OWNERSHIP

## APPENDIX F: EXPANSION SITE ENVIRONMENTAL ASSESSMENT AND ANALYSES

Please note that these reports were commissioned by MHAC prior to the purchase of NHS.

1. Phase I and II Environmental Assessment 3113-011
2. Soil Analysis and Classification Update

## APPENDIX G: PROJECT DESIGN DRAWINGS

## APPENDIX H: SALTWATER SUPPLY AND LINES

Please note that these reports were commissioned by MHAC prior to the purchase of NHS.

1. Saltwater Monitoring Well Report 3113-010
2. Sonar-DCPTs, Port of Stephenville 3113-008

# APPENDIX I: SURVEYS FOR LAND PURCHASES AND EASEMENTS

Land Acquisitions or Easements Required for the Project, from Sections 3.1.4 and 3.1.5

| OWNER | AGREEMENT TYPE | PURPOSE | DRAWING NUMBER[1] |
|---|---|---|---|
| Town of Stephenville | PURCHASE | Modular RAS Production Site | SV-CD-MARINE-1A |
| Town of Stephenville | PURCHASE | Water Treatment Facility | SV-CD-MARINE-1 |
| Town of Stephenville | EASEMENT | Freshwater Wells | MHAC-6 |
| Town of Stephenville | EASEMENT | Freshwater Lines | MHAC-2 |
| Town of Stephenville | EASEMENT | Modular RAS Production Site | SV-CD-FFLOW-B |
| Town of Stephenville | EASEMENT | Modular RAS Production Site | SV-CD-FFLOW-A |
| Port of Stephenville | LEASE | Fish Transport Line | MHAC-3 |
| Port of Stephenville | LEASE | Saltwater Influent Line, Effluent Lines | MHAC-1 |
| Port of Stephenville | LEASE | Saltwater Influent Line, Effluent Lines | SV-CD-FFLOW-1 |
| Stephenville Airport Authority | EASEMENT | Effluent Lines | MHAC-5 |
| Seaside Links Golf Course | EASEMENT ON LEASE | Saltwater Influent Line, Effluent Lines | MHAC-4 |

[1]Refers to drawing number in Appendix I: Surveys for Land Purchases and Easements