PLACENTIA BAY ATLANTIC SALMON AQUACULTURE PROJECT
ENVIRONMENTAL EFFECTS MONITORING PLAN (EEMP):
SEA CAGE PERFORMANCE

GRIEG NL

June 2019

Placentia Bay Atlantic Salmon Aquaculture Project
Environmental Effects Monitoring Plan:

Sea Cage Performance

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Table of Contents

Page

List of Figures

Page

List of Tables

Page

1.0 Introduction

As part of the environmental assessment process for the proposed Placentia Bay Atlantic Salmon Aquaculture Project, Grieg NL was required to prepare and submit Environmental Effects Monitoring Plans (EEMPs) subsequent to the completion of the Environmental Impact Statement (EIS) but prior to initiation of Project construction (see Section 7.4 in EIS Guidelines, Department of Municipal Affairs and Environment [DMAE] 2018). Additionally, the release of the Placentia Bay Atlantic Salmon Aquaculture Project from further environmental assessment by DMAE on 5 September 2018 was subject to Grieg NL meeting a series of terms and conditions including the preparation of eight EEMPs for various aspects of the Project. This document is the EEMP for 'Sea Cage Performance'. It describes the inspection, maintenance and part replacement methodologies, including scheduling, for the various parts of the sea cage system. This EEMP is largely based on recommendations provided by Aqualine in its user manuals (Aqualine 2018a,b,c) and the Provincial *Code of Containment* (DFA 2014).

Grieg NL considers the implementation of this EEMP an essential aspect of its Placentia Bay Atlantic Salmon Aquaculture Project. The organization of this document closely follows the requirements outlined in Section 7.4 of the EIS Guidelines (DMAE 2018). This EEMP will be reviewed annually and updated as needed throughout the life of the Project.

2.0 Objectives and Scheduling of Monitoring

The objective of this EEMP is to describe the required monitoring of sea cage systems through inspection, maintenance and part replacement. All inspections, which will be conducted by both Grieg NL personnel and trained third-party inspectors such as DNV GL and Aqualine, will meet the standards outlined in the *Code of Containment* (DFA 2014) as well as the relevant Norwegian standards (NS9415), where applicable. Inspections, maintenance and part replacement monitoring will provide information on how deployed sea cage systems withstand pressures applied by both physical (e.g., oceanographic and weather-driven factors) and biological (i.e., biofouling)[1] factors in the field. Based on this collected information, improvements, adjustments or replacements for parts or the system can be determined.

Once the sea cages are installed, it will be important to perform both scheduled and non-scheduled (e.g., after extreme weather event) inspections and any subsequent maintenance and part replacement to ensure that the integrity of the sea cage system is maintained, and that workplace safety is optimized. Monitoring inspections will check for signs of surface damage, ruptures, corrosion, fouling, deformities and any other issues that can compromise the system or the safety of personnel. Inspection frequency will vary, depending on the sea cage system component. Details of monitoring scheduling are provided in Section 3.0.

The following sea cage system components will be monitored to determine the performance of the Aqualine Midgard sea cage system in Placentia Bay.

[1] Note that monitoring of the sea cage systems with respect to marine wildlife (large fishes, sea turtles, marine mammals, river otters and seabirds) is included in Grieg NL's Fish, Sea Turtles, Marine Mammals, and Seabirds EEMP.

- Moorings
- Floating collar
- Sinker ring
- Net, including winch system

3.0 Monitoring Design/Methodology

Individuals who perform the monitoring inspections, maintenance and part replacements will have successfully completed Aqualine's internal training and will be very familiar with the product and the Aqualine user manuals.

Four general types of monitoring will be employed: (1) general visual inspection (GVI); (2) close visual inspection (CVI); (3) dimensions inspection (DK); and (4) modification/replacement (MU). Brief descriptions of each method are provided below.

- GVI: visual inspection at some distance from target using either a remotely operated vehicle (ROV) or a diver with a camera;
- CVI: close visual inspection using either a camera or some other inspection tool (e.g., ultrasound);
- DK: dimension checks using measuring tools; and
- MU: modification and/or replacement of compromised parts.

Visual inspections will include human observations on the condition of sea cage system components occurring out of water, and ROV-mediated observations on the condition of system components occurring below the water's surface. Inspections will be conducted immediately after installation, routinely after prescribed intervals, immediately after extreme weather events (when nearing the design limits of the system), and immediately after any unforeseen events (e.g., vandalism, vessel collisions with fish farm).

Note that Grieg NL will conduct daily general visual inspections to check system component parts that occur above the water's surface (e.g., ropes, bridles, connections, etc.).

This EEMP also describes how Grieg NL will provide results of the various types of monitoring of the sea cage system to the regulators and the public.

The following subsections provide details on the monitoring inspection methodology for the various sea cage components. Figure 1 provides some perspective on the connections between the various sea cage system components.

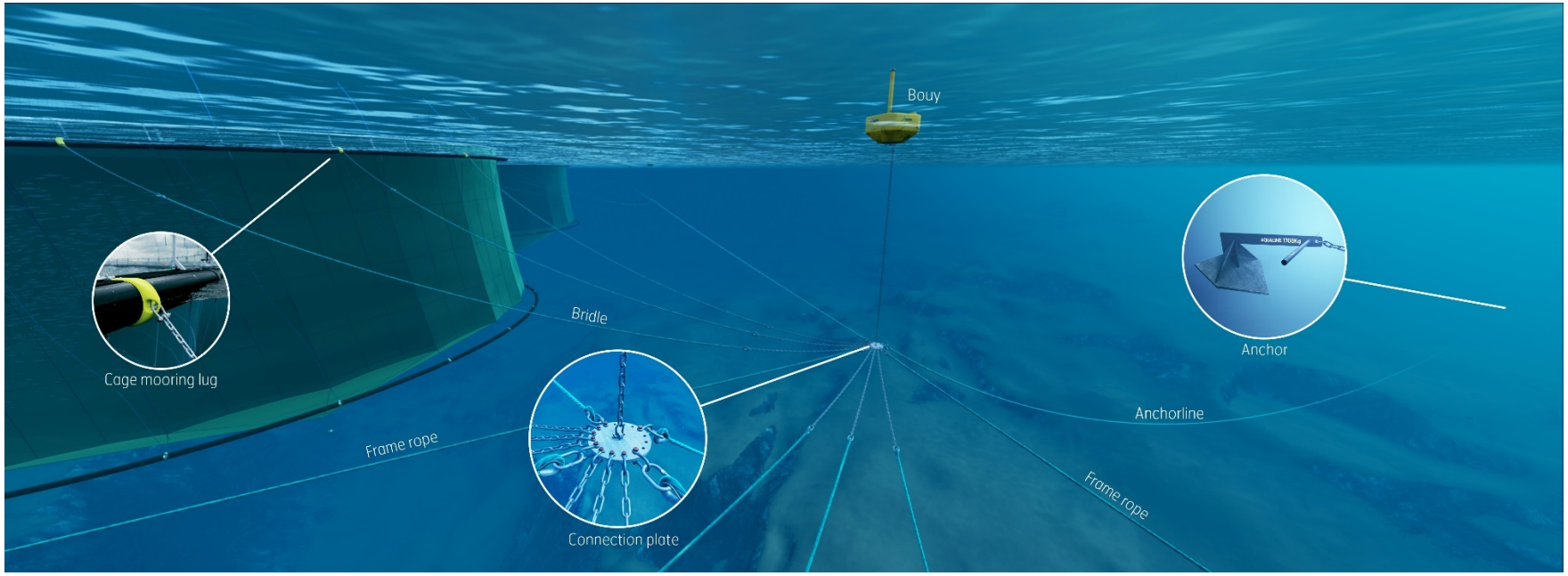

Figure 1. Schematic showing connections between sea cage system components.

3.1 Mooring Component

The mooring system for the Aqualine Midgard System is an integral component of the system that is designed and constructed according to the Norwegian Standard (NS9415) and custom-made for each sea cage site based on various physical and oceanographic characteristics of each sea cage site location. The mooring system, which consists of a grid mooring with anchor lines and bridles, is pre-tensioned with buoys to avoid shock loads and not affect the cage system. Mooring system parts, such as anchors, shackles, buoys and ropes, will be inspected, maintained and replaced, if necessary, on both a routine and a non-routine (e.g., after an extreme weather event) basis to ensure the system performs as designed. Personnel responsible for inspection of the mooring component of the sea cage system will have at least two years of relevant experience.

The mooring component of the sea cage system consists of the following parts:

- Rope/chain combination bridles extending from cage to a connecting plate;
- Rope frame to support each cage;
- Mooring lines to hold cages and frames in place;
- Connecting plate, connecting bridles, frame ropes and mooring lines;
- Rope/chain combination anchor lines;
- Mooring buoys to keep rope and chain connection point above the seabed; and
- Anchors.

An independent third-party such as DNV GL will be contracted to conduct inspections after initial installation of the mooring system and routinely on an annual basis. DNV GL will utilize an ROV to inspect the mooring system immediately after installation to confirm that the approved mooring analysis is reflected in the installed layout. As part of the DNV GL inspection process, a 5-year site certificate will be issued after the initial inspection after installation. If alterations are made to the mooring system, Grieg NL will advise DNV GL at which time another survey inspection may be required along with a new 5-year site certificate. Follow up audits of the mooring system by DNV GL will occur annually.

Grieg NL will submit to Aqualine a “Mooring Maintenance/Replacement Plan” annually for each lease site stocked with fish, detailing mooring component procedures, frequency and schedules. Aqualine will review these reports to assess if any possible actions are required.

Tables 1–4 provide details regarding the monitoring of the mooring component immediately after installation, daily/monthly, biannually, and before/after extreme weather events and after unforeseen events (e.g., vessel strike), respectively.

The results of monitoring inspections of the mooring component will sometimes require part replacement. Spare parts that will be immediately available to Grieg NL include the following:

- Shackles (5% of the total number in use);
- Thimbles (5% of the total number in use);
- Grid line rope (sufficient quantity to replace 3 grid lines);
- Bridle rope (sufficient quantity to replace a complete set of bridles);

- Anchor line rope (sufficient quantity to replace the longest anchor line);
- Galvanized link (5% of the total number in use);
- Connection plate (3 pieces); and
- Buoys (3 of the largest buoys).

Table 1. Post-installation monitoring of mooring component.

Component	Focus of Inspection	Method	Description of Inspection	Specification
Mooring lines (frame and barge)	General technical status	GVI	Check that no mooring lines are floating on the sea surface.	All mooring lines, frame lines and bridles
Bridles	Connection to floating collar	CVI	Check that all bridles occur at the floating collar connections and that there is no damage to either the bridles or connections.	All bridles
Bridles	Tension control	GVI	Visually check that all bridles are properly tensioned (i.e., floating collar not being pulled downwards, and bridles not floating at sea surface).	All bridles
Buoys	Position and load	GVI CVI	Visually check that buoys are in proper alignment, are evenly submerged, and are not damaged.	All buoys
Marking lights	Function	GVI CVI	Visually check that all lights are operative and not damaged.	All marking lights

GVI denotes 'general visual inspection'.
CVI denotes 'close visual inspection'.

Table 2. Daily and monthly monitoring of mooring component.

Component	Focus of Inspection	Method	Description of Inspection	Specification	Frequency of Methods of Inspection	
					Daily	Monthly
Mooring lines (frame and barge)	Control of pre-tension	GVI	Check that no mooring lines are floating on the sea surface.	All mooring lines, frame lines and bridles	GVI	GVI
Bridles	Connection to floating collar	CVI	Check that all bridles occur at the floating collar connections and that there is no damage to either the bridles or connections.	All bridles	GVI	CVI
Buoys	Position and load	GVI CVI	Visually check that buoys are in proper alignment, are evenly submerged, and are not damaged.	All buoys	GVI	CVI
Marking lights	Function	GVI CVI	Visually check that all lights are operative and not damaged.	All marking lights	GVI	CVI

GVI denotes 'general visual inspection'.
CVI denotes 'close visual inspection'.
If nonconformities in tension control, attachments, positions and/or loads are observed, then supplier must be notified, and a closer inspection of the mooring system is required.

Table 3. Biannual inspection of mooring component.

Component	Focus of Inspection	Method	Description of Inspection	Specification
Mooring lines (frame and barge)	Damages/deformation	CVI	Use of ROV to check for any damages and/or deformations that exceed supplier requirements.	All mooring lines must be controlled. If anchor is buried and shackle is not accessible, then inspection status will be based on other shackles on the same mooring line. If rock bolt not accessible, attempt to remove marine growth. Contact supplier regarding critical rock bolts that require inspection.
Mooring coupling locations	Wear and tear/deformation at bridles, frame lines and buoy lines	CVI DK	Check all parts at coupling locations for deformations and/or wear and tear that exceeds supplier requirements. Check that all nuts are present, including safety pins for shackle bolts.	Wear and tear of all parts at all connection points. If tolerances exceeded, then part replacement is required.
Mooring coupling/bridles	Bridle and buoy line chain corrosion	CVI DK	Check for damage to long link chain at bridles and buoy lines, including chain galvanization. Measure wear and tear on long link chains.	Damage to galvanization coating of and/or wear and tear to bridle and buoy chains. If tolerances exceeded, then chain replacement is required.
Barge mooring	Connection to barge	CVI DK	Check that mooring line shackles are intact and for any damage that exceeds supplier requirements.	Wear and tear to all shackles and thimbles. If tolerances exceeded, then part replacement is required.
Frame mooring	Top chain	CVI DK	Check that top chain against barge is intact, and that damage and/or wear and tear does not exceed supplier requirements.	Wear and tear to chain. If tolerances exceeded, then chain replacement is required.

GVI denotes ‘general visual inspection’.
CVI denotes ‘close visual inspection’.
DK denotes ‘dimension checks’.

Table 4. Monitoring of mooring component before and after extreme weather events, and after unforeseen events.

Component	Focus of Inspection	Inspection Method	Description of Inspection	Specification
Mooring lines (frame and barge)	General technical status	GVI	Check that no mooring lines are floating on the sea surface.	All mooring lines, frame lines and bridles
Bridles	Connection to floating collar	CVI	Check that all bridles occur at the floating collar connections and that there is no damage to either the bridles or connections.	All bridles
Bridles	Tension control	GVI	Visually check that all bridles are properly pre-tensioned (i.e., floating collar not being pulled downwards, and bridles not floating at sea surface).	All bridles
Buoys	Position and load	GVI CVI	Visually check that buoys are in proper alignment, are evenly submerged, and are not damaged.	All buoys
Marking lights	Function	GVI CVI	Visually check that all lights are operative and not damaged.	All marking lights

GVI denotes 'general visual inspection'.
CVI denotes 'close visual inspection'.

3.2 Floating Collar Component

The functions of the floating collar of the Aqualine Midgard sea cage system include maintenance of the shape of the net and service as a working platform. The floating collar consists of floater tubes and railing tubes, as well as clamps for moorings and trusses, bolts, chains and ropes. Each of these parts must be inspected on a routine basis to ensure the integrity of the floating collar. As with the mooring component, general visual inspections of the floating collar component will also be necessary immediately after installation, before and after extreme weather events, and after any unforeseen events such as a vessel strike.

The floating collar component of the sea cage system consists of the following parts:

- Floating pipes;
- Handrail pipes;
- Steel brackets to hold the pipes and construction together (12 with mooring points);
- Plastic gaskets to prevent chafing between steel brackets and pipes;
- Loadbearing system consisting of steel rods connected to all brackets;
- Downlet tubes in the brackets holding the suspension from the net/sinker ring;
- Bolts to fasten and secure the suspension from the net/sinker ring;

- Walkways; and
- Plastic fenders on the inside and outside of each bracket.

Each part of the floating collar component has a designated inspection schedule. Tables 5–7 provide details regarding the monitoring of the floating collar component monthly, quarterly and annually, respectively.

Table 5. Weekly and monthly monitoring of floating collar component.

Component	Focus of Inspection	Method	Description of Inspection	Specification
Collar tubes Cage support struts Jump net rail	Potential defects and/or damage	GVI (Weekly)	Check for cuts, local buckling and ruptures as well as kinks, cracks or wear.	All collar tubes, support struts and jump net rails
Mooring bracket with mooring eye	Integrity of bracket	GVI (Monthly)	Check for bowing or cracks in the mooring eye.	All brackets with a mooring eye
Tendons, chains and ropes	Integrity of main load-bearing system	GVI (Monthly) MU (Monthly)	Check to ensure that tendons, chains, and ropes of main load-bearing system are taut and without deformation or rupture.	Entire main load-bearing system

GVI denotes 'general visual inspection'.
MU denotes 'modification/replacement'.

Table 6. Quarterly monitoring of floating collar component.

Component	Focus of Inspection	Method	Description of Inspection	Specification
Tendons, chains and ropes	Integrity of main load-bearing system	GVI MU	Retighten main load-bearing system after 3 months of operation and during annual inspection, if necessary.	Entire main load-bearing system

GVI denotes 'general visual inspection'.
MU denotes 'modification/replacement'.

Spare parts of items associated with the floating collar that could cause 'high risk' situations if non-functional will be immediately available to ensure quick repair.

3.3 Sinker Ring Component

The sinker ring functions to maintain the shape, tension and rearing capacity of the net. It is attached to the cage net base rope located at the bottom of the net. During harvesting, the sinker ring is important in the raising of the net with the winches.

Table 7. Annual monitoring of floating collar component.

Component	Focus of Inspection	Method	Description of Inspection	Specification
Mooring bracket with mooring eye	Integrity of bracket	GVI CVI	Check mooring bracket with liner for any deformation and/or cracks.	All brackets with a mooring eye
Mooring bracket with steel pipe	Integrity of bracket	GVI CVI	Check mooring bracket with liner for any deformation and/or cracks.	All relevant brackets
Steel and plastic brackets	Integrity of bracket	GVI CVI	Check mooring bracket with liner for any deformation and/or cracks.	All relevant brackets
Handrail tube and supports	Potential defects and/or damage	GVI CVI	Check for rupture in handrail tube. Check handrail supports for damage.	All handrail tubes and supports
Bolted connections and plug joints	Potential defects and/or damage	GVI CVI	Check integrity of bolts and plugs in the main load-bearing system.	All bolts and plugs

GVI denotes 'general visual inspection'.
MU denotes 'modification/replacement'.

The Aqualine sinker ring component of the sea cage system consists of the following parts:

- Sinker ring pipe;
- Sinker ring steel brackets;
- Sinker ring steel bracket adapter;
- Sinker ring steel bracket Dyneema cape; and
- Sinker ring suspension, combination of Aquaneema ropes and chain.

Table 8 provides details regarding the monitoring of the sinker ring component monthly, quarterly and annually, respectively. As with the mooring and floating collar components, general visual inspections of the sinker ring component will also be necessary immediately after installation, before and after extreme weather events, and after any unforeseen events such as a vessel strike.

Monitoring inspections of the sinker ring component will sometimes result in the necessity of replacing parts of the system. Spare parts that will be stored and immediately available to Grieg NL include the following:

- Dyneema capes; and
- Bolts for suspension adaptors.

Table 8. Monthly, quarterly and annual monitoring of the sinker ring component.

Component Part	Inspection Specifics	Frequency of Inspection		
		Monthly	Quarterly	Annually
Sinker ring suspension and net	Check that sinker ring is in operating position. Check for signs of gnawing between the sinker ring suspension and the net. Check fastenings between the sinker ring and the net.	X		
Sinker ring suspension	Check fastenings between the sinker ring and the net. Check for damage at the bottom suspension.		X	
Sinker ring chain	Check for corrosion and roughness. Check that all surfaces remain smooth.			X
Sinker ring clamps	Check fastening between the sinker ring suspension and the sinker ring. Check staples, bolt, chain and plastic protection.			X
Y-strap	Check for wear and cuts, and that all plastic cases are in place and intact.			X
Fibre rope	Check for fraying/wear and replace all damaged ropes.			X

3.4 Net Component

Aqualine nets are designed to effectively reduce the risk of fish escape while maintaining the best possible growing conditions. Aqualine uses only hand-sewn nets for its system to ensure precise apportionment of netting material to framing rope. Appendix 1 of the *Code of Containment* (DFA 2014) outlines equipment standards for nets and net testing. In addition, Aqualine has developed recommended routines for net inspection, washing and repair. Grieg NL will follow an inspection routine that meets the recommendations outlined by both the Aqualine user manuals (Aqualine 2018a,b,c) and the provincial *Code of Containment* (DFA 2014).

A net testing agent approved by Aqualine and DNV GL will conduct the initial net stress tests at the laboratory associated with the net factory in either China or Vietnam. Stress tests will adhere to the procedures and requirements outlined in the *Code of Containment* (DFA 2014). All inspections, both *in situ* ones and those conducted by a net testing agent, will be properly documented, logged and retained.

In situ inspections of a sea cage net will be conducted in the following scenarios:

- Immediately after the installation of either a new net or associated accessories such as the LiftUp system, camera system and feed system;
- Immediately after the reinstallation of a net;
- Immediately after the reinstallation of associated accessories such as the LiftUp system, camera system and feed system;

- After routine net cleaning;
- At regular weekly and quarterly intervals, depending on the part of the net component;
- Before and after extreme weather events that exert extreme loads on the net; and
- Immediately after any unforeseen event that may have caused damage to the net (e.g., vessel strike, presence of predatory marine mammals and/or large fishes).

Note that planned inspections every 3–4 weeks of the portion of the net that occurs underwater will occur at a minimum between June-September. This inspection schedule exceeds the frequency requirements of Condition 'p' stipulated by the Government of Newfoundland and Labrador in its Letter of Release. Condition 'p' states that the portion of a sea cage net that occurs below the water's surface must be inspected every 30 days during June–September, and every 90 days for the remainder of the year, weather permitting. As per Condition 'p', inspections will occur for the remainder of the year at a minimum every 90 days if weather permits.

In situ inspections, maintenance and repair of the portion of the net that occurs underwater will utilize ROVs equipped with various attachments, including cameras and knitting machines. The time required to properly inspect a single net is approximately 4 hours; therefore, three nets could be inspected over the course of a 12-hour day. Based on these numbers, inspections of all nets in a single 12-sea cage lease site will require 4–5 days to complete.

As per the *Code of Containment* (DFA 2014), a net that has been in use for three years will require follow-up stress testing every 18-months (i.e., after each production cycle) at the Net Service Station using a handheld unit (e.g., DYNA 300 DP dynamometer). Stress tests will also be required prior to any restocking of cages with fish. This testing schedule also corresponds to requirements by DNV GL. DNV GL requires that nets exceeding 2-years of age be inspected by a certified Net Testing Agent approved by DNV GL every 12–24 months. Based on both these requirements, Grieg NL will test nets after each production cycle which typically lasts for 17–19 months.

Grieg NL is currently in discussions with a supply company and an academic institute regarding the development of camera software to recognize damaged net mesh. This software would enable early detection of any single mesh tears during operations such as cleaning and inspections providing an early warning for any integrity issues of the net.

Tables 9–12 provide details regarding the monitoring of the net component immediately after installation, weekly, quarterly, and before/after extreme weather events and after unforeseen events, respectively.

Table 9. Post-installation monitoring of net component.

Component Part	Inspection Specifics
Sinker ring ropes should have 70 cm of slack	Pull on sinker ring rope to ensure that slack is at least 70 cm.
All Midgard suspensions are taut	Verify good tension in the chain to the Midgard suspension.
Sufficient slack in the netting between 5 m waistband and main rope	Ensure all loops on main rope can be pulled into the base of the support by hand.

Table 10. Weekly monitoring of net component.

Component Part	Inspection Specifics
Main point of attachment for net – floating collar	Ensure that net is correctly attached to floating collar. Ensure that corners of net are positioned correctly in relation to shape of floating collar. Ensure that net is attached in accordance with user manual. Check for abrasion and wear on attachment rope and at main point of attachment on net.
Top rope/jump fence	Ensure that top of the net is attached with enough slack to reduce excess strain. Ensure that parts of the net visible both above and below water surface are evenly suspended and stretched, free of any visible damage to netting and ropes.
Hauling rope and collector rope	Ensure that all hauling and collector ropes have been securely attached to floating collar, with no tension.
Secondary point of attachment for net to floating collar	Check for any abrasion/wear on main rope and netting.
Feedthroughs in jump fence	Ensure that feedthroughs in the jump fence have been securely fastened in accordance with user manual so that they aren't abraded or worn.
Fouling	Assess the degree of fouling on the net and make decision as to whether cleaning or net replacement is warranted.
Hauling rope and collector rope	Check that all hauling and collector ropes have been securely attached to floating collar with no tension.
Additional equipment on and near floating collar	Ensure that all additional equipment on and near floating collar has been securely fastened so that it cannot fall into the net or damage the net in other ways.
Predators	Check for any visible damage to net that could have been caused by predators.
Miscellaneous	Check for any flotsam or other debris that could cause damage to net.

Table 11. Quarterly monitoring of net component.

Component Part	Inspection Specifics
Net	Check that net is evenly expanded along all sides and the bottom. Check for holes/damage to netting and ropes.
Attachment of weighting system	Check for sufficient distance between weighting system and net to prevent contact between the two. Check for abrasion/wear at point of attachment for weighting system.
Weight ropes/weighting system suspension	Check for abrasion/wear in weight ropes.
Dead fish removal	Check for any abrasion/wear in area near the dead fish removal system. Check that dead fish removal system is functioning properly.

Table 12. Monitoring of net component before and after extreme weather events, and after unforeseen events.

Component Part	Inspection Specifics
Main point of attachment for net – floating collar	Ensure that net is correctly attached to floating collar. Ensure that corners of net are positioned correctly in relation to shape of floating collar. Ensure that net is attached in accordance with user manual.
Top rope/jump fence	Ensure that top of the net is attached with enough slack to reduce excess strain. Ensure that parts of the net visible both above and below water surface are evenly suspended and stretched, free of any visible damage to netting and ropes.
Hauling rope and collector rope	Ensure that all hauling and collector ropes have been securely attached to floating collar, with no tension.
Secondary attachment of net to floats	Ensure that secondary point of attachment for the net has a lower tensile strength than the main rope. Ensure slack/no tension on secondary point of attachment. Check for abrasion/wear on main rope and netting.
Feedthroughs in jump fence	Ensure that feedthroughs in the jump fence have been securely fastened in accordance with user manual.
Additional equipment on and near floating collar	Ensure that all additional equipment on and near floating collar has been securely fastened so that it cannot fall into the net or damage the net in other ways.
Attachment of weighting system	Ensure that weighting system has been correctly attached to the point of attachment on the baseline rope (i.e., where lifting rope and baseline rope meet). Ensure sufficient distance between the weighting system and the net so as to prevent the system from contacting the net.
Net	Ensure that net is evenly expanded along all sides and the bottom.
Hauling ropes	Ensure that hauling rope is correctly attached and threaded. Ensure that hauling rope has sufficient slack and has been securely fastened so as not to abrade or damage the net.
Dead fish removal	Ensure proper installation, including sufficient weighting, of dead fish removal system.
Suspension for weighting system/sinker ring rope	Ensure that suspension for and the weighting system have been correctly installed in accordance with user manual so that it does not cause wear on net through excessive movement.

4.0 Frequency, Duration and Geographic Extent of Monitoring

The frequency, duration and geographic extent of performance of sea cage monitoring are determined based on recommendations provided by Aqualine in its user manuals (Aqualine 2018a,b,c) and the *Code of Containment* (DFA 2014).

4.1 Frequency

The frequency of monitoring (i.e., inspection, maintenance, part replacement) of the performance of sea cages will vary by component of the sea cage system. See Sections 3.1–3.4 for frequency of monitoring associated with each sea cage system component. In addition to the inspection of all components immediately after installation, before/after storm events, and after unforeseen events (e.g., vessel strike) (see Tables 1, 4, 9 and 12), the following sections indicate the frequency of routine scheduled inspections of each component.

4.1.1 Mooring Component

Routine scheduled inspections of the mooring component will be conducted daily, monthly and biannually. Both GVI and CVI will be conducted during daily and monthly inspections, while CVI and DK will be conducted during biannual inspections. As indicated in Tables 2 and 3, mooring component parts being inspected will vary by timing and type of inspection.

4.1.2 Floating Collar

Routine scheduled inspections of the floating collar component will be conducted weekly, monthly, quarterly and annually. Weekly inspections will be by GVI, monthly and quarterly inspections by GVI and MU, and annual inspections by GVI and CVI. As indicated in Tables 5–7, floating collar component parts being inspected will vary by timing and type of inspection.

4.1.3 Sinker Ring

Routine scheduled inspections of the sinker ring component will be conducted monthly, quarterly and annually. All inspections of the sinker ring component parts will be conducted using CVI. As indicated in Table 8, sinker ring component parts being inspected will vary by timing of inspection.

4.1.4 Net

Routine scheduled inspections of the net component will be conducted based on the above schedules (Tables 9–12) using both GVI and CVI. As indicated in Tables 10 and 11, net component parts being inspected will vary by timing and type of inspection.

The frequency of net cleaning will vary by time of year. During the early-December to mid-April period, net cleaning will not likely be necessary given the low level of biofouling during this time of year. The other consideration related to net cleaning during low water temperature periods is the health of the fish in terms of induced stress caused by the cleaning activity. The potential net cleaning frequencies during various periods of the year are as follow:

- Early-December to mid-April: Likely no cleaning required
- Mid-April to late-September: Biweekly cleaning
- Late-September to early-December: Biweekly or monthly cleaning

4.2 Duration

The estimated time required to complete the daily GVI on parts of these cages visible from surface is 1–2 hours. A full inspection of the net will require approximately 2 hours to complete but will depend on weather conditions visibility and fouling. Cleaning of a single net will require four to six hours.

4.3 Geographic Extent

The geographic extent of the monitoring of the performance of sea cages will remain within the footprint of each sea cage system which extends out to the positions of the mooring anchors.

5.0 Reporting and Response Mechanisms

All inspections, maintenance and/or part replacements will be recorded in logbooks which will include information on the following:

- Action performed;
- Date of action performed;
- Result of action performed;
- Follow-up repairs or maintenance, if required; and
- Name of individual or institution that conducted the action.

Monitoring inspection response mechanisms include maintenance and/or component part replacement. All replacements of system component parts will be reported to Aqualine. Any modification to the sea cage system will require immediate inspection of the change, either by ROV or through visual observation when the modification is applied to infrastructure occurring out of the water. Grieg NL personnel will clearly document repairs/modifications to the sea cage systems, which may be required after an extreme weather event. Details on these extreme weather events will be recorded (as outlined in Grieg NL's Climate and Weather EEMP) to allow Grieg NL to analyze the performance of the sea cage system in harsh conditions.

Also, an adaptive management approach will be taken for biofouling. For example, net cleaning frequency may be increased if biofouling levels require further control.

5.1 Mooring System

Based on the recommendations of Aqualine and the *Code of Containment* (DFA 2014), Grieg NL will adopt the following record keeping forms associated with the inspections and maintenance performed on mooring component.

- Form 1a – Logbook;
- Form 1b – Daily maintenance and inspection;
- Form 1c – 3-month maintenance and inspection;
- Form 1d – Quarterly maintenance and inspection;
- Form 1e – Semi-annual maintenance and inspection;

- Form 1f – Annual maintenance and inspection;
- Form 1g – Severe weather maintenance and inspection;
- Form 1h – Unforeseen incident maintenance and inspection;
- Form 1i – Repair and discrepancies;
- Form A2 – Mooring maintenance/replacement plan (*Code of Containment*); and
- Form A4 – NL site surface inspection checklist (*Code of Containment*).

5.2 Floating Collar

Based on the recommendations of Aqualine and the *Code of Containment* (DFA 2014), Grieg NL will adopt the following record keeping forms associated with the inspections and maintenance performed on the floating collar component.

- Form 2a – Logbook;
- Form 2b – Daily inspections and maintenance;
- Form 2c – Weekly inspections and maintenance;
- Form 2d – Monthly inspections and maintenance;
- Form 2e – Quarterly inspections and maintenance;
- Form 2f – Annual inspections and maintenance; and
- Form A4 – NL site surface inspection checklist (*Code of Containment*).

5.3 Sinker Ring

Based on the recommendations of Aqualine, Grieg NL will adopt the following record keeping forms associated with the inspections and maintenance performed on the sinker ring component.

- Form 3a – Logbook;
- Form 3b – Monthly inspection and maintenance;
- Form 3c – Every 6 to 8-week inspections and maintenance;
- Form 3d – Annual inspection and maintenance; and
- Form 3e – Repairs and discrepancies.

5.4 Net

Based on the recommendations of Aqualine and the *Code of Containment* (DFA 2014), Grieg NL will adopt the following record keeping forms associated with the inspections and maintenance performed on the net component.

- Form 4a – Logbook;
- Form 4b – Initial inspection and maintenance;
- Form 4c – Weekly inspections and maintenance;
- Form 4d – Quarterly inspections and maintenance;
- Form 4e – Event-initiated inspections and maintenance;
- Form 4f – Repairs and discrepancies;

- Form 4g – Mesh size; and
- Form A4 – NL site surface inspection checklist (*Code of Containment*).

6.0 Approach to Monitor Cumulative Effects

Monitoring of the performance of sea cages will be regularly conducted at all sea cage sites during the life of the Project, thereby resulting in the monitoring of any cumulative effects associated with sea cage performance (e.g., escape of farmed fish).

7.0 Procedures to Assess Effectiveness of Monitoring and Follow-up Programs, Mitigation Measures, and Recovery Programs

The effectiveness of the monitoring of sea cage systems through inspection, maintenance and/or part replacement will be determined by the incidence of events that could occur should the sea cage system integrity be compromised. For example, should a farmed fish escape occur during routine operations (i.e., not following an extreme weather event or any unforeseen event such as a vessel strike), then changes to the inspection protocols may be required. Changes will be made in consultation with DFO and DFLR.

8.0 Communication Plan to Describe the Results

The record keeping forms listed for each sea cage system component in Sections 5.1–5.4 will be completed as required. As per Condition 'c' in the Government of Newfoundland and Labrador's Project Release Letter, Grieg NL will include the results of the sea cage performance monitoring in its annual report on EEMPs.[2] This report will be publicly available on the Grieg NL website.

9.0 Literature Cited

Aqualine. 2018a. User Manual Aqualine Mooring. 50 p. + appendices.

Aqualine. 2018b. User Manual Aqualine FrøyaRing Cage. 51 p. + appendices.

Aqualine. 2018c. User Manual Aqualine Nets. 43 p. + appendices.

DFA (Department of Fisheries and Aquaculture). 2014. Code of containment for the culture of salmonids in Newfoundland and Labrador. Department of Fisheries and aquaculture, Aquaculture Branch. 46 p.

DMAE (Department of Municipal Affairs and Environment). 2018. Environmental impact statement guidelines for the Placentia Bay Atlantic salmon aquaculture project. Prepared by the Newfoundland and Labrador Department of Municipal Affairs and Environment. March 8, 2018. 35 p. + appendices.

[2] In addition, Grieg NL will publicly release all confirmed reports of disease and fish escapes within 24 hours and the use of chemotherapeutants (i.e., antibiotics, vaccinations, and anesthetics) and pesticides on an annual basis.