

FINFISH AQUACULTURE SITE AQUACULTURE STEWARDSHIP COUNCIL REPORT LUTES CREEK, ESPERANZA INLET, BC

*SITE LICENSE: AQ1078
SURVEY TYPE: ASC
SURVEY DATE: APRIL 10 AND 11, 2023
REPORT DATE: MAY 20, 2023*

PREPARED FOR:
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CAMPBELL RIVER, BC
V9W 5P7



Summary

This document presents the qualitative and quantitative assessment of sediment obtained during the survey completed at the Lutes Creek finfish aquaculture site operated by Grieg Seafood BC Ltd in Esperanza Inlet, BC, on April 10 and 11, 2023. Sediment was collected and the data analyzed according to the *Aquaculture Activities Regulations* (AAR) and adapted to address Criterion 2.1 and 5.2 of the Aquaculture Stewardship Council (ASC) Salmon Standard.

Sediment could not be successfully collected at any of the ASC sampling stations located on Transect A or Transect B.

The measured and observed characteristics of the sediment collected during the sampling confirmed that the station outside the Allowable Zone of Effect (AZE) on Transect C had mean sulphide levels less than the ASC Salmon Standard acceptable limit of 1500 µm. Redox potential measured in sediment obtained outside the AZE on Transect C was greater than the ASC Salmon Standard acceptable lower limit of 0 mV.

As required by Criterion 5.2 of the ASC monitoring for parasiticide residue was completed at the station outside the AZE on Transect C and at two reference stations. Emamectin benzoate was below detectable limits in all collected samples.

An assessment and identification of the benthic organisms present in the sediment was not completed to evaluate for potential impacts to habitat, as BC salmon farms have been granted a variance to Indicators 2.1.2 and 2.1.3 and instead rely on the scientifically proven and federally regulated sulfide surrogates (ASC VR224)¹.

¹ <http://variance-requests.asc-aqua.org/questions/vr-224-benthic-biodiversity-and-benthic-effects-salmon-v1-0-2-1-2-2-1-3/>

Table of Contents

Summary	ii
Table of Contents	iii
1.0 Introduction	1
2.0 Methods	3
2.1 Field Sampling.....	3
2.2 Data Analysis.....	6
3.0 Results and Discussion	7
3.1 Redox Potential and Sulphide Levels.....	7
3.2 Parasiticide Residue	8
4.0 References	10
Appendix 1 – Sample Photographs	I
Appendix 2 – Lutes Creek Field Data	VI
Appendix 3 – Lutes Creek ASC Survey Summary	VII

1.0 Introduction

This document presents the marine sediment data collected as part of a benthic study completed at the Lutes Creek finfish aquaculture site operated by Greig Seafood BC Ltd (Campbell River, BC). The Lutes Creek site is located in the Esperanza Inlet, BC (Figure 1).

The study was completed by adapting the methodology required for operational monitoring of waste dispersion required under *Aquaculture Activities Regulations* (AAR) and comparing the results with the indicators listed in Criterion 2.1 of the Aquaculture Stewardship Council (ASC) Salmon Standard. Additional analysis of the collected sediment was also completed to address Criterion 5.2 of the ASC.

The purpose of the ASC Salmon Standard is to evaluate concerns of potential environmental impact related to salmon farming. The Standard is based on a combination of requirements and performance levels that must be reached to determine if potential impacts are being addressed. Principle 2 of the Standard addresses the “*potential impacts from salmon farms on natural habitat, local biodiversity and ecosystem function*” (ASC, 2012).

This survey was specifically designed to address Criterion 2.1 within Principle 2 of the ASC Salmon Standard which involved the collection of sediment within and outside of the Allowable Zone of Effect (AZE). Sediment was analyzed for redox potential and sulphide levels to evaluate benthic habitat conditions. In addition, testing for parasiticide residue in sediment collected at the two reference stations and at the stations outside the AZE was completed to address Criterion 5.2.1 of the ASC.

An assessment and identification of the benthic organisms present in the sediment was not completed to evaluate for potential impacts to habitat, biodiversity and ecosystem function, as BC salmon farms have been granted a variance to Indicators 2.1.2 and 2.1.3 and instead rely on the scientifically proven and federally regulated sulfide surrogates (ASC VR224).

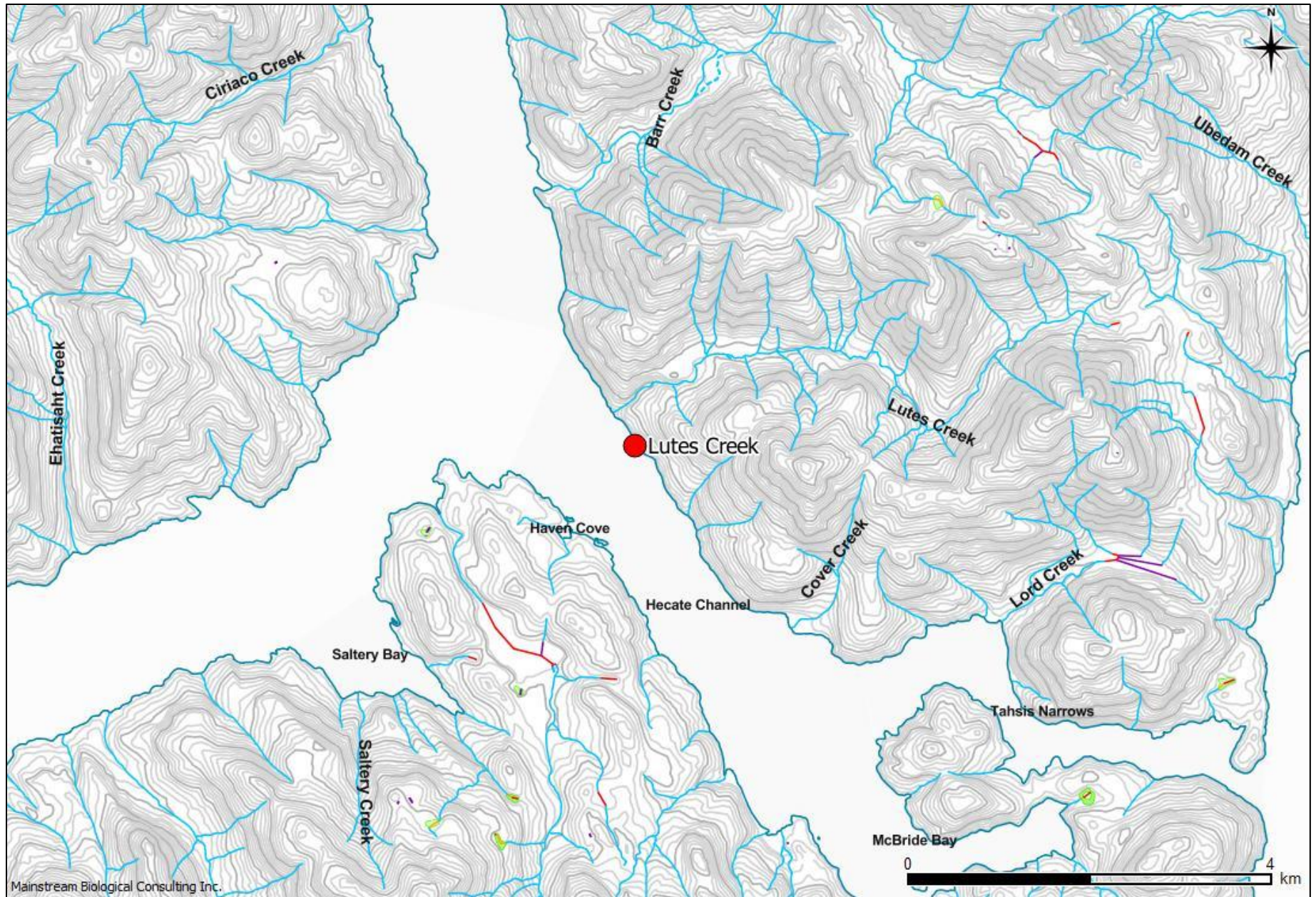


Figure 1: An overview map (1:50,000) showing the approximate location of the Lutes Creek finfish aquaculture farm site (red dot) in Esperanza Inlet, BC.

2.0 Methods

The substrate at the designated sampling locations at the Lutes Creek finfish aquaculture site had not been previously identified to consist of “soft” sediment. Therefore, the field activities involved the attempted collection of sediment samples for physical and chemical analysis at all proposed ASC sampling stations.

2.1 Field Sampling

The locations of sediment sampling stations were provided by Grieg Seafood BC Ltd. Individual sediment sampling stations were located along three Transects A, B, and C. Stations within the AZE were located 5 m inside the 1 g DEPOMOD contour (Figure 2) for all three transects and at the perimeter of the containment system for Transects A and B. Stations outside the AZE were located 25 m outside of the 1 g DEPOMOD contour. Additional stations were established at two or three reference sites within the range of 500 m to 1000 m from the aquaculture containment system as outlined in the ASC Salmon Standard (Figure 3). However, reference sites from the Aquaculture Activities Regulation (AAR) and the associated Monitoring Standard (Annex 7 and Annex 8)² were utilized for sample collection in which Reference 1 was greater than 1000 m from the containment system.

Sediment was collected using a Petite Ponar and a Van Veen sampler. Two sediment samples were collected at each station if possible.

The coordinates of the sample locations were recorded using a Trimble GeoExplorer GeoXT (Firmware v1.05) using TerraSync 3.30 software and equipped with an external Hurricane antenna.

Data filters were set to standards recommended by the Resource Inventory Standards Committee (RISC)³, with at least 15 fixes taken per location, using satellites greater than 15 % above the horizon with signal to noise ratios (SNR) greater than 40 and a horizontal dilution of precision (HDOP) of five. The GPS data was corrected post-mission with Pathfinder Office v5.40 software using data from the PABH (Pacific Beach, WA) base station.

The Trimble antenna was attached to the grab davit and positional fixes were obtained while the grab was completing the estimated bottom third of its descent. Positional fixes were completed when the grab was on the bottom and the drop line was as close vertical as possible.

² <http://www.gazette.gc.ca/rp-pr/p2/2015/2015-07-15/html/sor-dors177-eng.php>

³ Integrated Land Management Bureau. 2008. Province of British Columbia Standards, Specifications and Guidelines for Resource Surveys Using Global Positioning System (GPS) Technology. Release 4.0d.

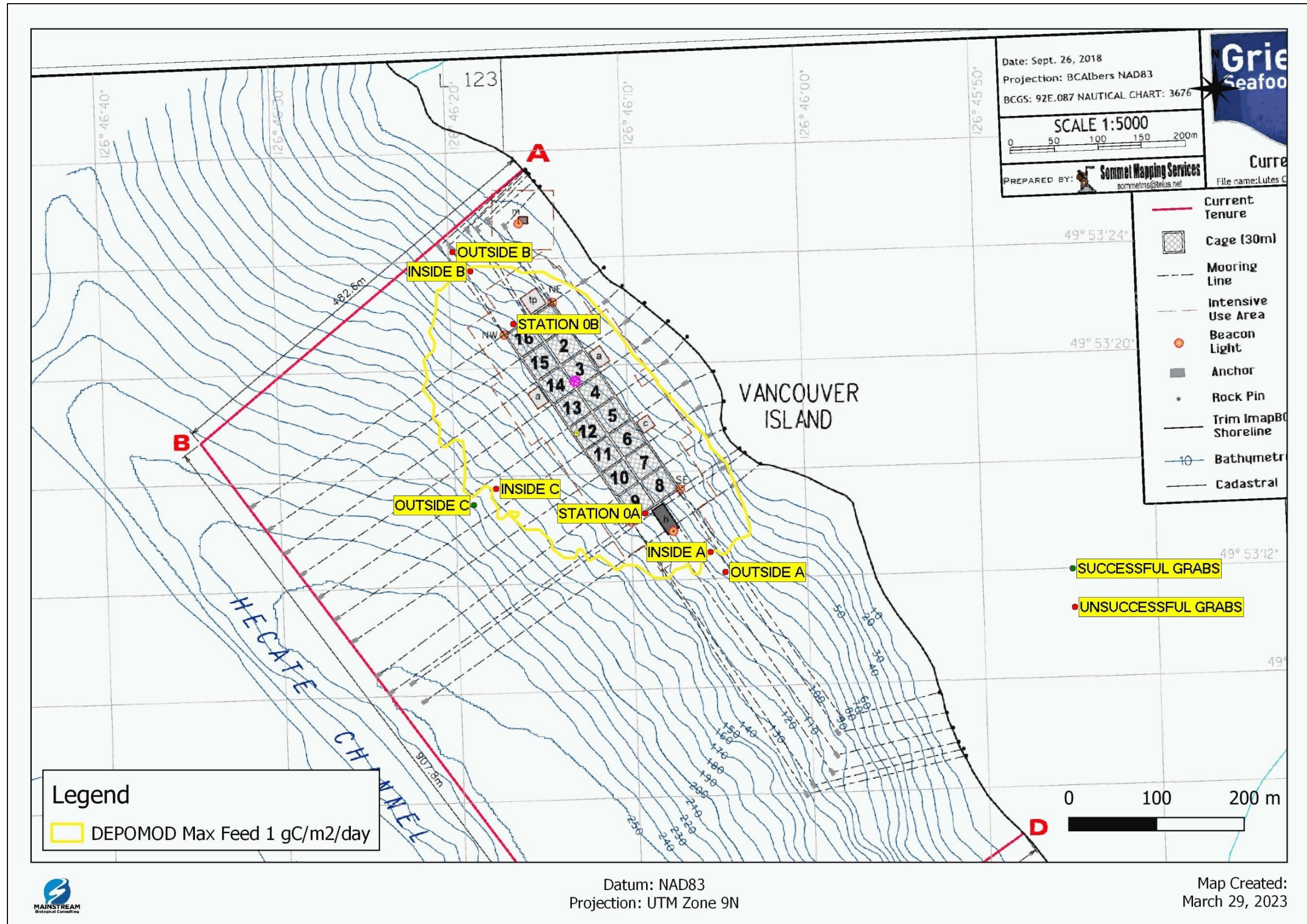


Figure 2: The locations of the sampling stations for the ASC survey at the Lutes Creek fish aquaculture site in relation to the pen system and surrounding area on April 10 and 11, 2023.

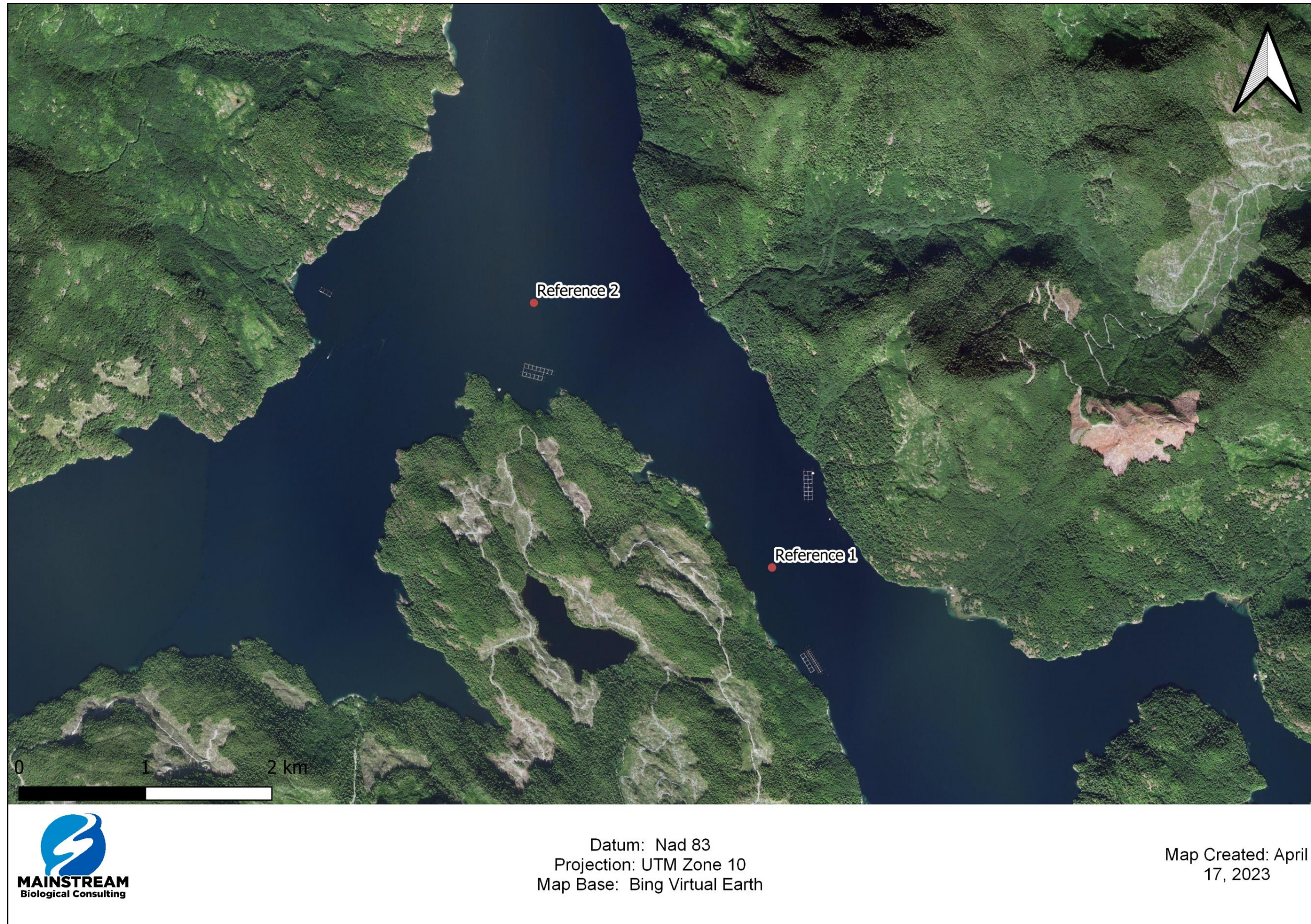


Figure 3: The locations of the reference stations for the ASC survey at the Lutes Creek finfish aquaculture site in relation to the site and surrounding area on April 10 and 11, 2023.

The time at which each sample was successfully obtained, and physical characteristics of the collected sediment were recorded. A digital photograph of each sample was also taken. As per Indicator 2.1.1, levels of free sulphides and redox potential of each sediment sample were measured in the field using an Orion A324 meter and the appropriate ISE probes. A digital thermometer was used to measure the temperature of the sediment.

As per Indicator 5.2.1, portions of the grab samples collected at the stations outside the AZE on Transects A, B and C as well as the reference stations were retained for analysis. Retained samples were stored at 4° Celsius and transported to SGS Canada Inc for analysis for emamectin benzoate.

2.2 Data Analysis

To evaluate if the benthic conditions at and near the Lutes Creek site met the requirements of Criterion 2.1 of the ASC Salmon Standard, the data collected was compared to required levels for indicators of potential finfish farm impacts. These indicators represent a combination of chemical and biodiversity measurements to evaluate the status of benthic health, biodiversity and ecosystem function and to detect potential impacts related to the salmon farm operation. The indicators considered for this assessment are summarized below in Table 1.

Additional analysis of parasiticide residue was completed to fulfill the requirement for monitoring of these chemicals but there is no required level presented in the ASC to compare these results with.

Table 1: Summary of indicators of benthic health, biodiversity and ecosystem function that were considered during the evaluation of the Lutes Creek finfish aquaculture site. The indicators have been adopted from Criterion 2.1 of the ASC Salmon Standard.

Criterion Number	Indicator	ASC Salmon Standard Requirement
2.1.1	Redox potential in sediment outside the AZE ¹ .	>0 millivolts (mV)
2.1.1	Sulphide levels in sediment outside the AZE.	≤1500 microMoles / L (µM)

1: AZE = Allowable Zone of Effect

3.0 Results and Discussion

Representative photographs of sediment obtained at each sampling station are presented in Appendix 1. Raw data obtained from sediment sampled in the field is presented in Appendix 2 and the summarized data is presented in Appendix 3.

The sediment successfully collected at the Lutes Creek Outside C sampling station consisted of sandy mud with no sulphide odor.

Sediment could not be successfully collected at any of the ASC sampling stations located Transect A or Transect B and could not be successfully obtained from the inside AZE station on Transect C. The results of each unsuccessful grab attempt are presented in Table 2.

3.1 Redox Potential and Sulphide Levels

Following Criterion 2.1.1 of the ASC Salmon Standard, the results of redox potential and sulphide testing at the station outside the AZE on Transect C was analyzed to help evaluate if the Lutes Creek facility was meeting the certification requirements (Appendix 3).

The mean sulphide level in sediment collected at the station outside the AZE on Transect C (45.2 μM) on April 10, 2023, was less than the ASC Salmon Standard sulphide upper limit of 1500 μM .

Mean redox potential in sediment collected at the station outside the AZE on Transect C (105.3 mV) was greater than the 0 mV minimum requirement cited in Criterion 2.1.1 of the ASC Salmon Standard.

Table 2: The location and results of each unsuccessful grab attempt at the Lutes Creek finfish aquaculture site on April 10 and 11, 2023.

Station	Latitude	Longitude	Distance from Pens (m)	Sampling Device	Comments
Station 0B	49 53.3599	126 46.2728	0	Ponar	Skiff of sediment, flecks shell hash
Station 0B	49 53.3599	126 46.2728	0	Ponar	Skiff of sediment
Station 0B	49 53.3599	126 46.2725	0	Ponar	Skiff of sand
Station 0B	49 53.3586	126 46.2734	0	Ponar	
Inside B	49 53.3926	126 46.3120	81	Ponar	Skiff of sand
Inside B	49 53.3916	126 46.3136	81	Ponar	Some sticks and cedar needles
Inside B	49 53.3915	126 46.3136	81	Ponar	3 small gravel pieces
Inside B	49 53.3922	126 46.3124	81	Ponar	Skiff of sand
Outside B	49 53.4049	126 46.3286	111	Ponar	Skiff of sand
Outside B	49 53.4044	126 46.3299	111	Ponar	
Outside B	49 53.4048	126 46.3292	111	Ponar	
Outside B	49 53.4047	126 46.3296	111	Ponar	
Inside C	49 53.2586	126 46.2940	109	Van Veen	Skiff of sand
Inside C	49 53.2598	126 46.2953	109	Van Veen	
Inside C	49 53.2595	126 46.2949	109	Van Veen	Skiff of sediment
Inside C	49 53.2589	126 46.2944	109	Van Veen	
Station 0A	49 53.2417	126 46.1524	0.0	Ponar	
Station 0A	49 53.2416	126 46.1525	0.0	Ponar	Skiff of sand
Station 0A	49 53.2416	126 46.1526	0.0	Ponar	Some pieces of shell hash
Station 0A	49 53.2416	126 46.1527	0.0	Ponar	Sandy mud with shell hash
Inside A	49 53.2173	126 46.0912	80	Ponar	Mud, shell hash
Inside A	49 53.2172	126 46.0912	80	Ponar	
Inside A	49 53.2178	126 46.0900	80	Ponar	
Inside A	49 53.2180	126 46.0896	80	Ponar	
Outside A	49 53.2046	126 46.0777	109	Ponar	Shell hash, brown mud, macrophytes
Outside A	49 53.2040	126 46.0788	109	Ponar	Skiff shell hash
Outside A	49 53.2044	126 46.0780	109	Ponar	
Outside A	49 53.2044	126 46.0781	109	Ponar	

3.2 Parasiticide Residue

Analysis of the sediment collected from the station outside the AZE on Transects C and the two reference stations for emamectin benzoate are shown in Table 3. The analysis was completed to fulfill the requirement of the ASC Salmon Standard Criterion number 5.2.1. All of the collected sediment samples analyzed had parasiticide residue concentrations less than the laboratory detectable limit.

Table 3: The parasiticide residue concentration of collected sediment at the stations outside the AZE on Transect C and the two reference stations at the Lutes Creek finfish aquaculture site on April 10 and 11, 2023.

Station Name	Sample Number	Emamectin Benzoate (ppm)
	Detection Limit	1.0
Outside AZE C	1	<1.0
Outside AZE C	2	<1.0
Reference 1	1	<1.0
Reference 1	2	<1.0
Reference 2	1	<1.0
Reference 2	2	<1.0

4.0 References

- Aquaculture Stewardship Council. 2012. ASC Salmon Standard Version 1.3. Available online: www.asc-aqua.org.
- Salas, F., Patrício, J. and Marques, J.C. 2006. Ecological Indicators in Coastal and Estuarine Environmental Quality Assessment - A user friendly guide for practitioners. Imprensa da Universidade de Coimbra.

Appendix 1 – Sample Photographs



Photo 1

Unsuccessful grab attempt at the 0m station on Transect A at the Lutes Creek site on April 11, 2023.



Photo 2

Unsuccessful grab attempt at the station inside the AZE on Transect A at the Lutes Creek site on April 11, 2023.



Photo 3

Unsuccessful grab attempt at the station outside the AZE on Transect A at the Lutes Creek site on April 11, 2023.



Photo 4

Unsuccessful grab attempt at the 0m station on Transect B at the Lutes Creek site on April 10, 2023.



Photo 5

Unsuccessful grab attempt at the station inside the AZE on Transect B at the Lutes Creek site on April 10, 2023.



Photo 6

Unsuccessful grab attempt at the station outside the AZE on Transect B at the Lutes Creek site on April 10, 2023.

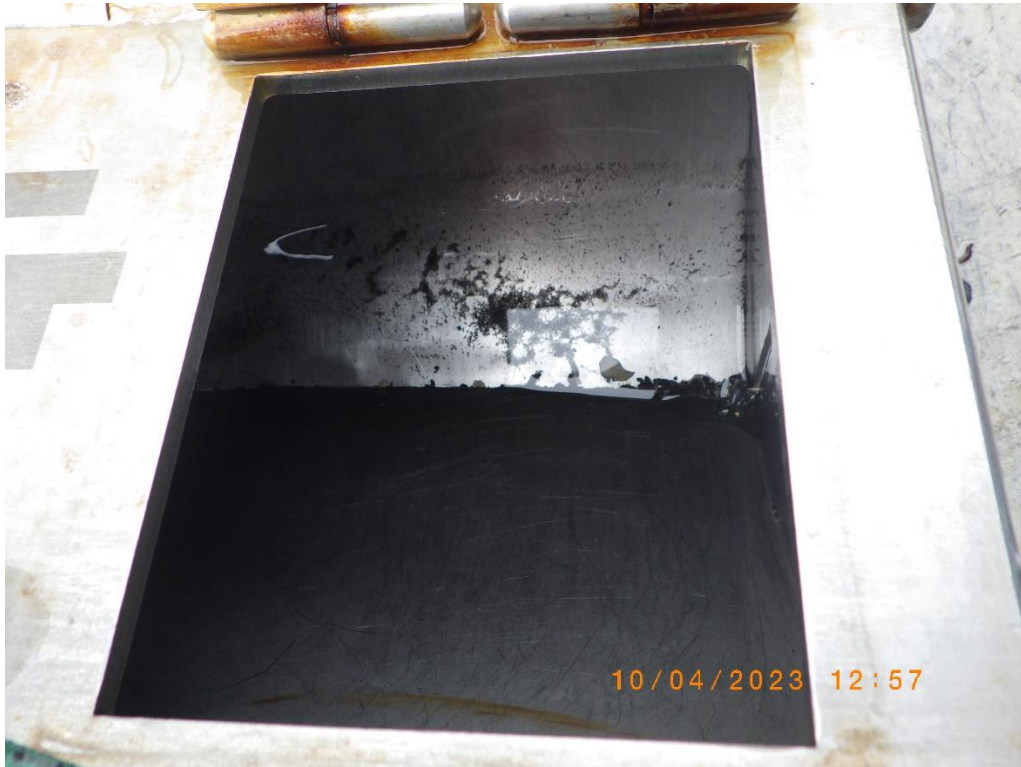


Photo 7

Unsuccessful grab attempt at the station inside the AZE on Transect C at the Lutes Creek site on April 10, 2023.



Photo 8

Sediment sample collected at the station outside the AZE on Transect C at the Lutes Creek site on April 10, 2023.



Photo 9

Sediment sample collected at the Reference 1 at the Lutes Creek site on April 11, 2023.



Photo 10

Sediment sample collected at the Reference 2 at the Lutes Creek site on April 11, 2023.

Appendix 2 – Lutes Creek Field Data

Reference Information:

Farm site: Lutes Creek	Field Crew: M. Haswell, E. Jarry, M. Twocock
Aquaculture Company: Grieg Seafood Ltd	Field Investigator: Mainstream Biological Consulting Inc.
Site Reference #: AQ1078	Laboratory: SGS Canada Inc
Geographic Region: Esperanza Inlet, BC	

Transect A, B, C Name	Sampling Station Name	Replicate Number	Transect A, B, C Bearing (Magnetic)	Reference Station (Y/N)	Distance from Pens (m)	Sampling Device Type	Sampling Device Capacity (m2)	Quality Control Replicate (Y/N)	Replicate Analysis Type	Sample Date (YYYY-MM-DD)	Sample Time (24HH:MM)	Sample Latitude (Degrees)	Sample Latitude (Minutes)	Sample Longitude (Degrees)	Sample Longitude (Minutes)	GPS Correction Status	Ocean Depth (m)	Sample Depth (cm)
C	OUT	1	42	N	140	Ponar	0.02	N		2023-04-10	14:06:37	49	53.2483	126	46.3149	Post-process corrected	223.0	5
C	OUT	2	42	N	140	Ponar	0.02	N		2023-04-10	14:22:44	49	53.2485	126	46.3153	Post-process corrected	223.0	7
C	OUT	2	42	N	140	Ponar	0.02	Y	Duplicate	2023-04-10	14:22:44	49	53.2485	126	46.3153	Post-process corrected	223.0	7
C	OUT	2	42	N	140	Ponar	0.02	Y	Triplicate	2023-04-10	14:22:44	49	53.2485	126	46.3153	Post-process corrected	223.0	7
Ref 1	Ref 1	1		Y	1658	Ponar	0.02	N		2023-04-11	10:17:59	49	52.4255	126	45.8537	Post-process corrected	125.0	5
Ref 1	Ref 1	2		Y	1658	Ponar	0.02	N		2023-04-11	10:30:20	49	52.4257	126	45.8519	Post-process corrected	124.0	5
Ref 2	Ref 2	1		Y	1605	Van Veen	0.10	N		2023-04-11	11:39:45	49	53.5026	126	47.5145	Post-process corrected	150.0	18
Ref 2	Ref 2	2		Y	1605	Van Veen	0.10	N		2023-04-11	11:48:34	49	53.5028	126	47.5114	Post-process corrected	149.0	18

Transect A, B, C Name	Sampling Station Name	Replicate Number	Free Sulphide (micromolar)	Sediment Temperature (deg C)	Eh Uncorrected (mV)	Eh Corrected (mV)	Cu (micro-g/g)	Zn (micro-g/g)	Li (micro-g/g)	Gravel Percent	Sand Percent	Mud Percent	TVS Percent	Beggiatoa Observed (Y/N)	OPC Observed (Y/N)	Fish Feed Observed (Y/N)	Fish Feces Observed (Y/N)	Odour Rating	Black Sediment Observed (Y/N)	Gas Bubbles Observed (Y/N)
C	OUT	1	30.5	8.0	-79.2	136.8								N	N	N	N	0	N	N
C	OUT	2	59.8	8.1	-142.3	73.7								N	N	N	N	0	N	N
C	OUT	2	63.6	8.1	-178.2	37.8								N	N	N	N	0	N	N
C	OUT	2		8.1	-179.8	36.2								N	N	N	N	0	N	N
Ref 1	Ref 1	1	14.2	8.0	242.2									N	N	N	N	0	N	N
Ref 1	Ref 1	2	92.0	7.6	-71.9	144.1								N	N	N	N	0	N	N
Ref 2	Ref 2	1	19.1	8.4	-104.9	111.1								N	N	N	N	0	N	N
Ref 2	Ref 2	2	10.3	8.4	-109.2	106.8								N	N	N	N	0	N	N

Table note:

- Odour rating: ranked on a scale of 0 (no odour) to 4 (very strong sulphide odour)

Transect A, B, C Name	Sampling Station Name	Replicate Number	Flocculent Organic Material Observed (Y/N)	Shell Hash Observed (Y/N)	Terrigenous Material Observed (Y/N)	Farm Litter Observed (Y/N)	Macrophytes Observed (Y/N)	Megafauna Observed (Y/N)	Sediment Colour Observations	Sediment Texture Observations	Other Sample Observations (Comments)
C	OUT	1	N	Y	N	N	N	N	Grey	Sandy mud	
C	OUT	2	N	Y	N	N	N	N	Grey	Sandy mud	
C	OUT	2	N	Y	N	N	N	N	Grey	Sandy mud	
C	OUT	2	N	Y	N	N	N	N	Grey	Sandy mud	
Ref 1	Ref 1	1	N	Y	N	N	N	N	Brown	Mud	Fleck SH
Ref 1	Ref 1	2	N	Y	N	N	N	N	Grey	Mud	Fleck SH
Ref 2	Ref 2	1	N	Y	N	N	Y	N	Brown	Mud	Fleck SH + trace seaweed
Ref 2	Ref 2	2	N	Y	N	N	N	N	Brown	Mud	Fleck SH

Appendix 3 – Lutes Creek ASC Survey Summary

Company:	Greig Seafood Ltd.	Sample date:	April 10 and 11, 2023
Farm Site:	Lutes Creek	Field crew:	M. Haswell, E. Jarry, M. Twocock
Site License #:	AQ1078	Analytical:	SGS Canada Inc
Site Location	Esperanza Inlet, BC		

SULPHIDES Indicator 2.1.1 Requirement ≤ 1500 (μm)					
Station	Rep 1	Rep 2	n	Mean	ASC Criteria Met
Outside AZE C	30.5	59.8	2	45.2	Yes
Reference 1	14.2	92.0	2	53.1	
Reference 2	19.1	10.3	2	14.7	

REDOX POTENTIAL Indicator 2.1.1 Requirement > 0 mV					
Station	Rep 2	Rep 2	N	Mean	ASC Criteria Met
Outside AZE C	136.8	73.7	2	105.3	Yes
Reference 1	242.2	144.1	2	193.2	
Reference 2	111.1	106.8	2	109.0	