

FINFISH AQUACULTURE SITE AQUACULTURE STEWARDSHIP COUNCIL REPORT ATREVIDA POINT, MUCHALAT INLET, BC

SITE LICENSE: AQ1738

SURVEY TYPE: ASC

SURVEY DATE: FEBRUARY 23 AND 24 2022

REPORT DATE: MARCH 22, 2022

PREPARED FOR:

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Summary

This document presents the qualitative and quantitative assessment of sediment obtained during the survey completed at the Atrevida Point finfish aquaculture site operated by Grieg Seafood BC Ltd in Muchalat Inlet, BC, on February 23 and 24, 2022. 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.

The measured and observed characteristics of the sediment collected during the sampling confirmed that the stations outside the Allowable Zone of Effect (AZE) on Transects A and 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 A was less than the ASC Salmon Standard acceptable lower limit of 0 mV. 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 Transects A and 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/>

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1.0 Introduction

This document presents the marine sediment data collected as part of a benthic study completed at the Atrevida Point finfish aquaculture site operated by Grieg Seafood BC Ltd (Campbell River, BC). The Atrevida Point site is located in Muchalat, 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).

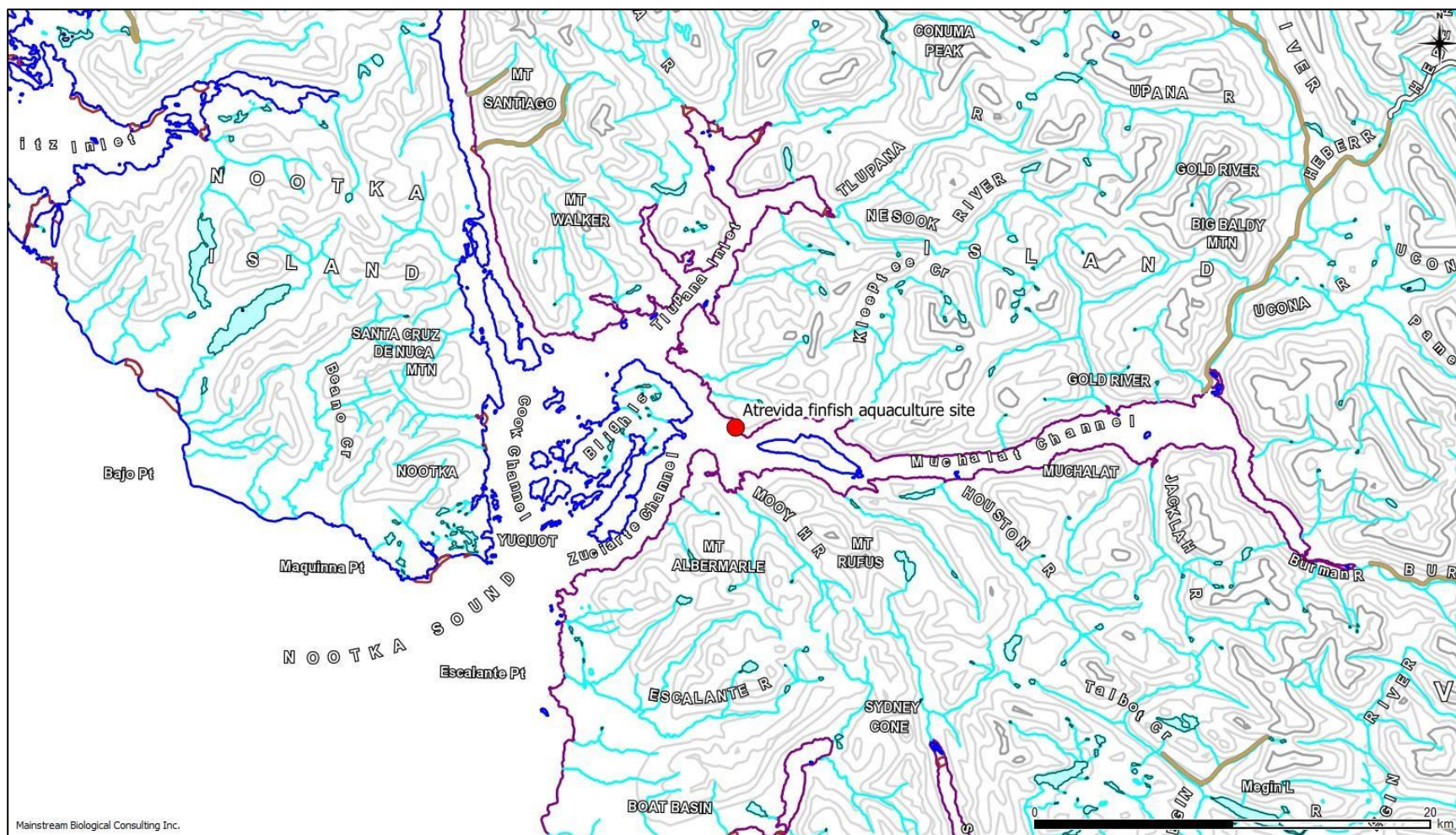


Figure 1: An overview map showing the approximate location of the Atrevida Point finfish aquaculture farm site (red dot) in Muchalat Inlet, BC.

2.0 Methods

The substrate at the some of the designated sampling locations at the Atrevida Point finfish aquaculture site had been previously identified to consist of “soft” sediment. Therefore, the field activities involved the collection of sediment samples for physical and chemical analysis at stations where sediment had been successfully collected during previous ASC surveys.

2.1 Field Sampling

The locations of sediment sampling stations were provided by Greig Seafood BC Ltd.

Individual sediment sampling stations were located along two transects (Transects A and C). Stations within the AZE were located 5 m inside the 1 g DEPOMOD contour (Figure 2) for both transects and also at the perimeter of the containment system. Stations outside the AZE were located 25 m outside of the 1 g DEPOMOD contour. Additional stations were established at two 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).

Transect A stations were repositioned due to an addition of a fifth cage at the north end of the system prior to the survey. The Transect B sampling locations on the south side of the system remained unchanged. Sediment could not be successfully obtained from these stations during the March 2020 ASC survey², and therefore were not attempted during this survey.

Sediment was collected using a Petite Ponar sampler. Two sediment samples were collected at each station.

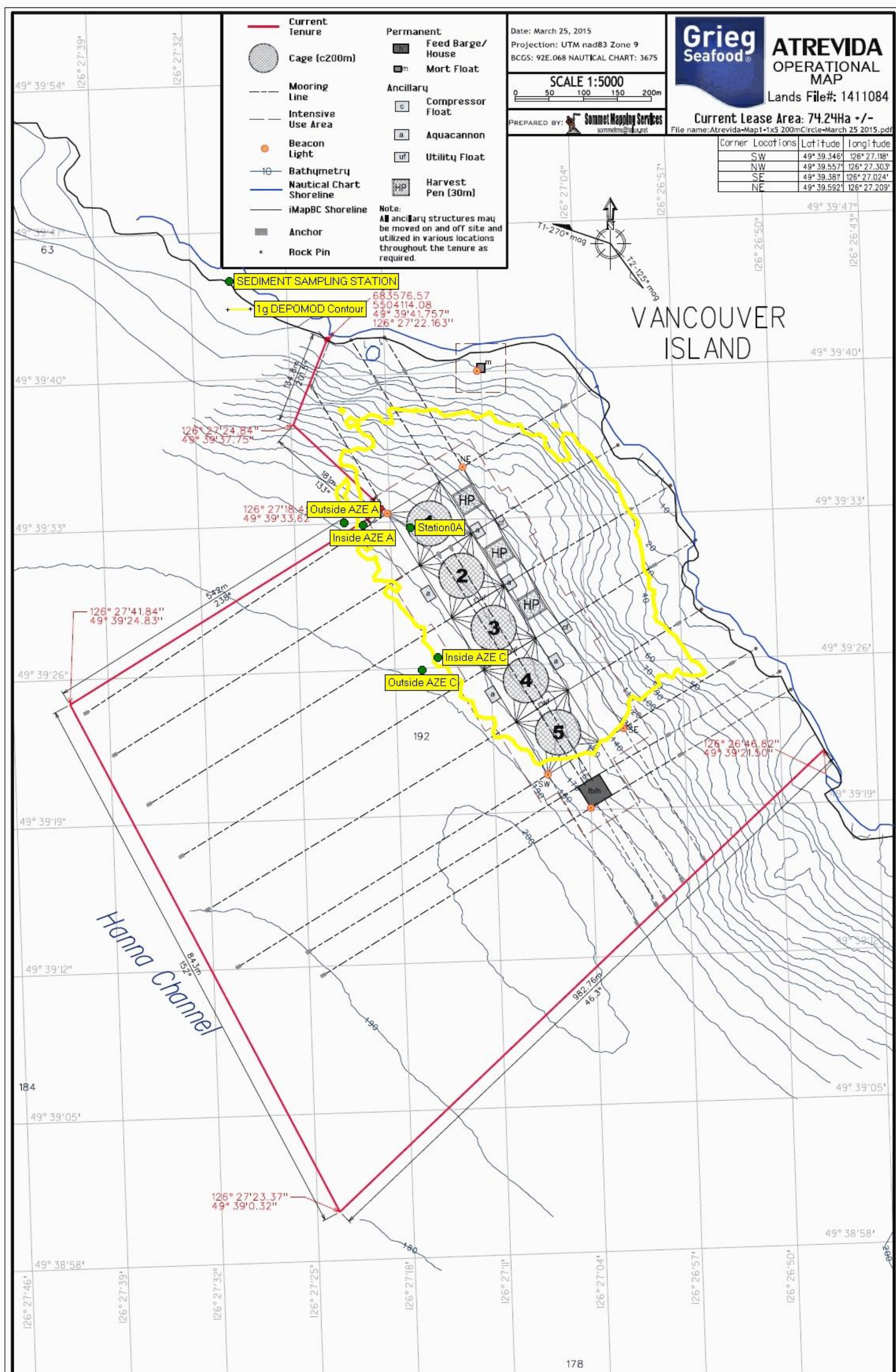
The coordinates of the sample locations were recorded using a Trimble GeoExplorer GeoXT (Firmware v1.05) using TerraSync 3.30 software and equipped with an external Hurricane antenna.

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 Ucluelet base station (UCLA).

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 Mainstream Biological Consulting. March 2020. Finfish Aquaculture Site Aquaculture Stewardship Council Report, Atrevida Point, Muchalat Inlet, BC. An unpublished report prepared for Greig Seafood BC Ltd.

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.



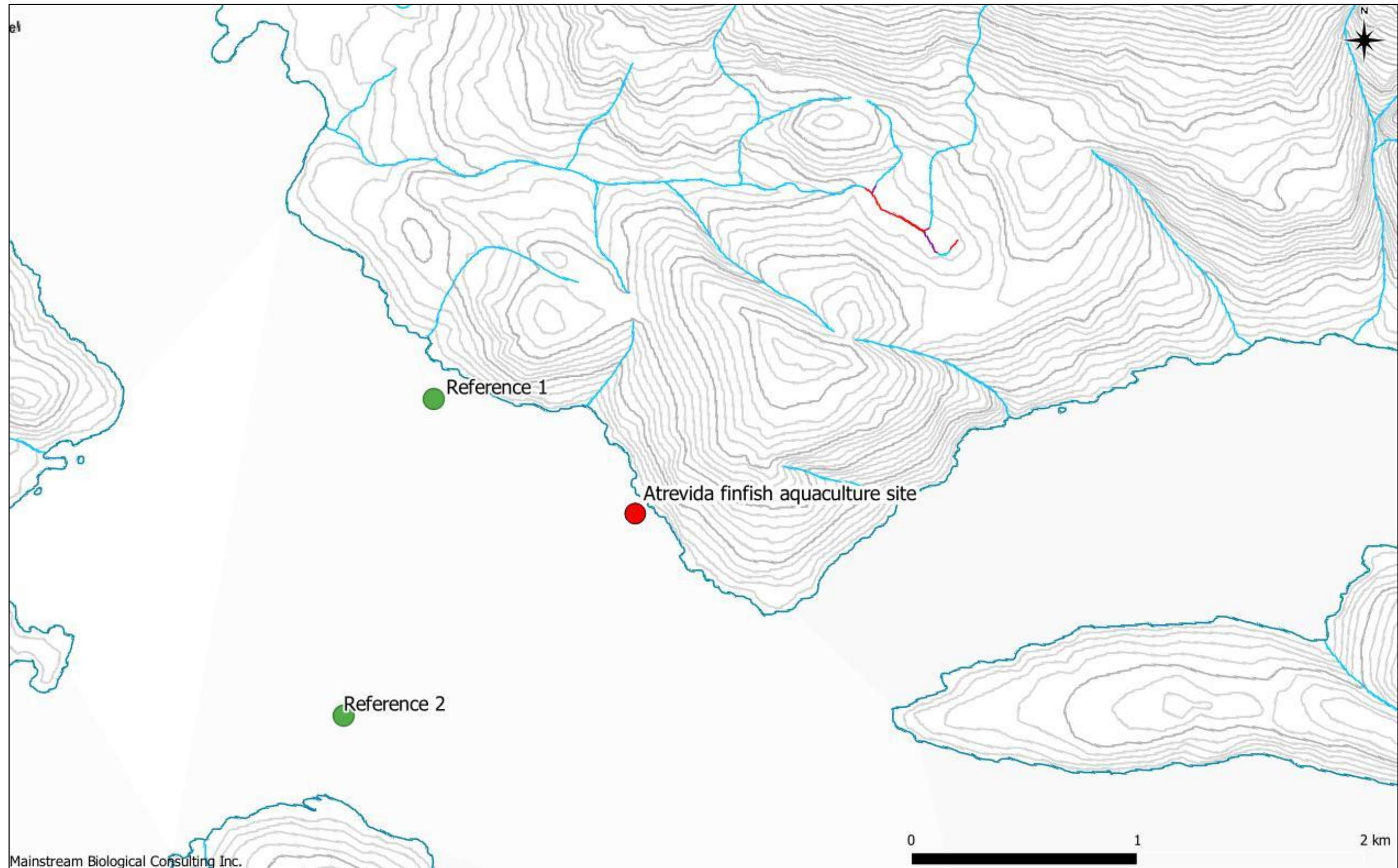


Figure 3: The locations of the reference stations for the ASC survey at the Atrevida Point finfish aquaculture site in relation to the site and surrounding area on February 24, 2022.

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 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 Atrevida Point 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 to.

Table 1: Summary of indicators of benthic health, biodiversity and ecosystem function that were considered during the evaluation of the Atrevida Point 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 Atrevida Point sampling stations typically consisted of green mud.

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 stations outside the AZE were analyzed to help evaluate if the Atrevida Point facility was meeting the certification requirements (Appendix 3).

The mean sulphide level in sediment collected at the stations outside AZE on Transects A and C (936 μM and 508 μM respectively) on February 23 and 24, 2022, were less than the ASC Salmon Standard sulphide upper limit of 1500 μM .

Mean redox potential in sediment collected at the stations outside the AZE on Transect A (-74.1 mV) was less than the 0 mV minimum requirement cited in Criterion 2.1.1 of the ASC Salmon Standard. Mean redox potential in sediment collected at the stations outside the AZE on Transect C (56.0 mV) was greater than the 0 mV minimum requirement cited in Criterion 2.1.1 of the ASC Salmon Standard.

3.2 Parasiticide Residue

Analysis of the sediment collected from the stations outside the AZE on Transects A and 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. Unfortunately, a single sample from each of the reference stations was reportedly “compromised” at the laboratory and neither sample could be processed. Both single reference station samples and all of the other analyzed sediment samples 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 Transects A, C and the two reference stations at the Atrevida Point finfish aquaculture site on February 23 and 24, 2022.

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

Sediment sample collected at the 0m station on Transect A at the Atrevida Point site on February 23, 2022.



Photo 2

Sediment sample collected at the station inside the AZE on Transect A at the Atrevida Point site on February 23, 2022.



Photo 3

Sediment sample collected at the station outside the AZE on Transect A at the Atrevida Point site on February 23, 2022.



Photo 4

Sediment sample collected at the station inside the AZE on Transect C at the Atrevida Point site on February 24, 2022.



Photo 5

Sediment sample collected at the station outside the AZE on Transect C at the Atrevida Point site on February 24, 2022.



Photo 6

Sediment sample collected at the Reference 1 at the Atrevida Point site on February 24, 2022.



Photo 7

Sediment sample collected at the Reference 2 at the Atrevida Point site on February 24, 2022.

Appendix 2 – Atrevida Point Field Data

Reference Information:			
Farm site:	Atrevida Point	Field Crew:	M. Haswell & E. Weiss
Aquaculture Company:	Grieg Seafood BC Ltd	Field Investigator:	Mainstream Biological Consulting Inc.
Site Reference #:	AQ1738	Laboratory:	
Geographic Region:	Muchalat Inlet, BC		

<i>Transect A, B, C Name</i>	<i>Sampling Station Name</i>	<i>Replicate Number</i>	<i>Transect A, B, C Bearing (Magnetic)</i>	<i>Reference Station (Y/N)</i>	<i>Distance from Pens (m)</i>	<i>Sampling Device Type</i>	<i>Sampling Device Capacity (m2)</i>	<i>Quality Control Replicate (Y/N)</i>	<i>Replicate Analysis Type</i>	<i>Sample Date (YYYY-MM-DD)</i>	<i>Sample Time (24HH:MM)</i>	<i>Sample Latitude (Degrees)</i>	<i>Sample Latitude (Minutes)</i>	<i>Sample Longitude (Degrees)</i>	<i>Sample Longitude (Minutes)</i>	<i>GPS Correction Status</i>	<i>Ocean Depth (m)</i>	<i>Sample Depth (cm)</i>
A	0m	1	258	N	0	Petite Ponar	0.02	N		2022-02-23	12:46	49	39.5453	-126	27.2754	Post-process Corrected	130	10
A	0m	2	258	N	0	Petite Ponar	0.02	N		2022-02-23	12:53	49	39.5455	-126	27.2753	Post-process Corrected	130	10
A	5m	1	258	N	70	Petite Ponar	0.02	N		2022-02-23	15:30	49	39.5351	-126	27.3391	Post-process Corrected	181	10
A	5m	2	258	N	70	Petite Ponar	0.02	N		2022-02-23	15:37	49	39.5350	-126	27.3388	Post-process Corrected	181	10
A	25m	1	258	N	97	Petite Ponar	0.02	N		2022-02-23	14:48	49	39.5506	-126	27.3595	Post-process Corrected	179	10
A	25m	2	258	N	97	Petite Ponar	0.02	N		2022-02-23	14:59	49	39.5505	-126	27.3595	Post-process Corrected	179	10
C	5m	1	221	N	58	Petite Ponar	0.02	N		2022-02-24	10:56	49	39.4292	-126	27.2789	Post-process Corrected	180	10
C	5m	2	221	N	58	Petite Ponar	0.02	N		2022-02-24	11:08	49	39.4300	-126	27.2775	Post-process Corrected	180	9
C	25m	1	221	N	87	Petite Ponar	0.02	N		2022-02-24	11:25	49	39.4158	-126	27.3017	Post-process Corrected	190	10
C	25m	2	221	N	87	Petite Ponar	0.02	N		2022-02-24	11:47	49	39.4127	-126	27.3016	Post-process Corrected	190	10
REF	Ref 1	1		Y	570	Petite Ponar	0.02	N		2022-02-24	12:02	49	39.7230	-126	27.6725	Post-process Corrected	153	10
REF	Ref 1	2		Y	570	Petite Ponar	0.02	N		2022-02-24	12:20	49	39.7191	-126	27.6680	Post-process Corrected	151	10
REF	Ref 2	1		Y	1400	Petite Ponar	0.02	N		2022-02-24	12:43	49	38.9761	-126	28.0255	Post-process Corrected	152	10
REF	Ref 2	2		Y	1400	Petite Ponar	0.02	N		2022-02-24	12:54	49	38.9710	-126	28.0356	Post-process Corrected	154	10

<i>Transect A, B, C Name</i>	<i>Sampling Station Name</i>	<i>Replicate Number</i>	<i>Free Sulphide (micromolar)</i>	<i>Sediment Temperature (deg C)</i>	<i>Eh Uncorrected (mV)</i>	<i>Eh Corrected (mV)</i>	<i>Cu (micro-g/g)</i>	<i>Zn (micro-g/g)</i>	<i>Li (micro-g/g)</i>	<i>Gravel Percent</i>	<i>Sand Percent</i>	<i>Mud Percent</i>	<i>TVS Percent</i>	<i>Beggiatoa Observed (Y/N)</i>	<i>OPC Observed (Y/N)</i>	<i>Fish Feed Observed (Y/N)</i>	<i>Fish Feces Observed (Y/N)</i>	<i>Odour Rating</i>	<i>Black Sediment Observed (Y/N)</i>	<i>Gas Bubbles Observed (Y/N)</i>
A	0m	1	11800	7.7	-362.5	-146.5								N	N	N	N	4	N	N
A	0m	2	7780	7.3	-359.9	-142.9								N	N	N	Y	4	N	N
A	5m	1	644	7.9	-78.3	137.7								N	N	N	N	1	Y	N
A	5m	2	2180	7.9	-322.8	-106.8								N	N	N	N	2	N	N
A	25m	1	761	7.7	-281.2	-65.2								N	N	N	N	1	Y	N
A	25m	2	1110	7.9	-299.0	-83.0								N	N	N	N	2	Y	N
C	5m	1	617	7.6	-166.0	50.0								N	N	N	N	1	N	N
C	5m	2	741	7.4	-212.5	4.5								N	N	N	N	1	N	N
C	25m	1	343	7.6	-95.2	120.8								N	N	N	N	1	Y	N
C	25m	2	672	7.7	-224.8	-8.8								N	N	N	N	1	N	N
REF	Ref 1	1	226	7.5	85.0	301.0								N	N	N	N	1	Y	N
REF	Ref 1	2	162	7.6	-123.8	92.2								N	N	N	N	0	Y	N
REF	Ref 2	1	56.2	8.2	-53.2	162.8								N	N	N	N	0	N	N
REF	Ref 2	2	56.3	8.3	-63.9	152.1								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)

<i>Transect A, B, C Name</i>	<i>Sampling Station Name</i>	<i>Replicate Number</i>	<i>Flocculent Organic Material Observed (Y/N)</i>	<i>Shell Hash Observed (Y/N)</i>	<i>Terrigenous Material Observed (Y/N)</i>	<i>Farm Litter Observed (Y/N)</i>	<i>Macrophytes Observed (Y/N)</i>	<i>Megafauna Observed (Y/N)</i>	<i>Sediment Colour Observations</i>	<i>Sediment Texture Observations</i>	<i>Other Sample Observations (Comments)</i>
A	0m	1	N	Y	N	N	N	N	Green	Mud	
A	0m	2	N	Y	N	N	N	N	Green	Mud	
A	5m	1	N	Y	N	N	N	N	Green	Mud	Shell hash, cedar needle
A	5m	2	N	Y	N	N	N	N	Green	Mud	Shell hash
A	25m	1	N	Y	N	N	N	N	Green	Mud	Stick, shell hash
A	25m	2	N	Y	N	N	N	N	Green	Mud	Trace shell hash
C	5m	1	N	N	N	N	N	Y	Green	Mud	Tubeworms
C	5m	2	N	N	N	N	N	Y	Green	Mud	Tubeworms
C	25m	1	N	Y	N	N	N	N	Green	Mud	Conifer needle, shell hash
C	25m	2	N	N	N	N	N	N	Green	Mud	
REF	Ref 1	1	N	N	N	N	N	N	Green	Mud	
REF	Ref 1	2	N	N	N	N	N	N	Green	Mud	
REF	Ref 2	1	N	N	N	N	N	N	Green	Mud	
REF	Ref 2	2	N	N	N	N	N	N	Green	Mud	

Appendix 3 – Atrevida Point ASC Survey Summary

Company:	Grieg Seafood BC Ltd	Sample date:	February 23 and 24, 2022
Farm Site:	Atrevida Point	Field crew:	M. Haswell & E. Weiss
Site License #:	AQ1738	Analytical:	SGS Canada Inc
Site Location	Muchalat Inlet, BC		

SULPHIDES Indicator 2.1.1 Requirement ≤ 1500 (μm)					
Station	Rep 1	Rep 2	n	Mean	ASC Criteria Met
0m A	11800	7780	2	9790	
Inside AZE A	644	2180	2	1410	
Outside AZE A	761	1110	2	936	Yes
Inside AZE C	617	741	2	679	
Outside AZE C	343	672	2	508	Yes
Reference 1	226	162	2	194	
Reference 2	56.2	56.3	2	56.3	

REDOX POTENTIAL Indicator 2.1.1 Requirement > 0 mV					
Station	Rep 1	Rep 2	N	Mean	ASC Criteria Met
0m A	-146.5	-142.9	2	-144.7	
Inside AZE A	137.7	-106.8	2	15.5	
Outside AZE A	-65.2	-83.0	2	-74.1	No
Inside AZE C	50	4.5	2	27.3	
Outside AZE C	120.8	-8.8	2	56.0	Yes
Reference 1	301.0	92.2	2	196.6	
Reference 2	162.8	152.1	2	157.5	