

# FINFISH AQUACULTURE SITE AQUACULTURE STEWARDSHIP COUNCIL REPORT WA-KWA, CLIO CHANNEL, BC

*SITE LICENSE: AQ1839*

*SURVEY TYPE: ASC*

*SURVEY DATE: JULY 27, 2021*

*REPORT DATE: AUGUST 21, 2021*

***PREPARED FOR:***

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## Summary

This document presents the qualitative and quantitative assessment of sediment obtained during the survey completed at the Wa-Kwa finfish aquaculture site operated by Greig Seafood Ltd in Clio Channel, BC, on July 27, 2021. 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 B had mean sulphide levels less than the ASC Salmon Standard acceptable limit of 1500 µm. Sediment collection was not successful at the outside station on Transect C. Redox potential measured in sediment obtained outside the AZE on Transect A and B 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 B and at two reference stations. Emamectin benzoate and florfenicol 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)<sup>1</sup>.

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<sup>1</sup> <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 Wa-Kwa finfish aquaculture site operated by Greig Seafood Ltd (Campbell River, BC). The Wa-Kwa site is located in Clio Channel, 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 in order 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).

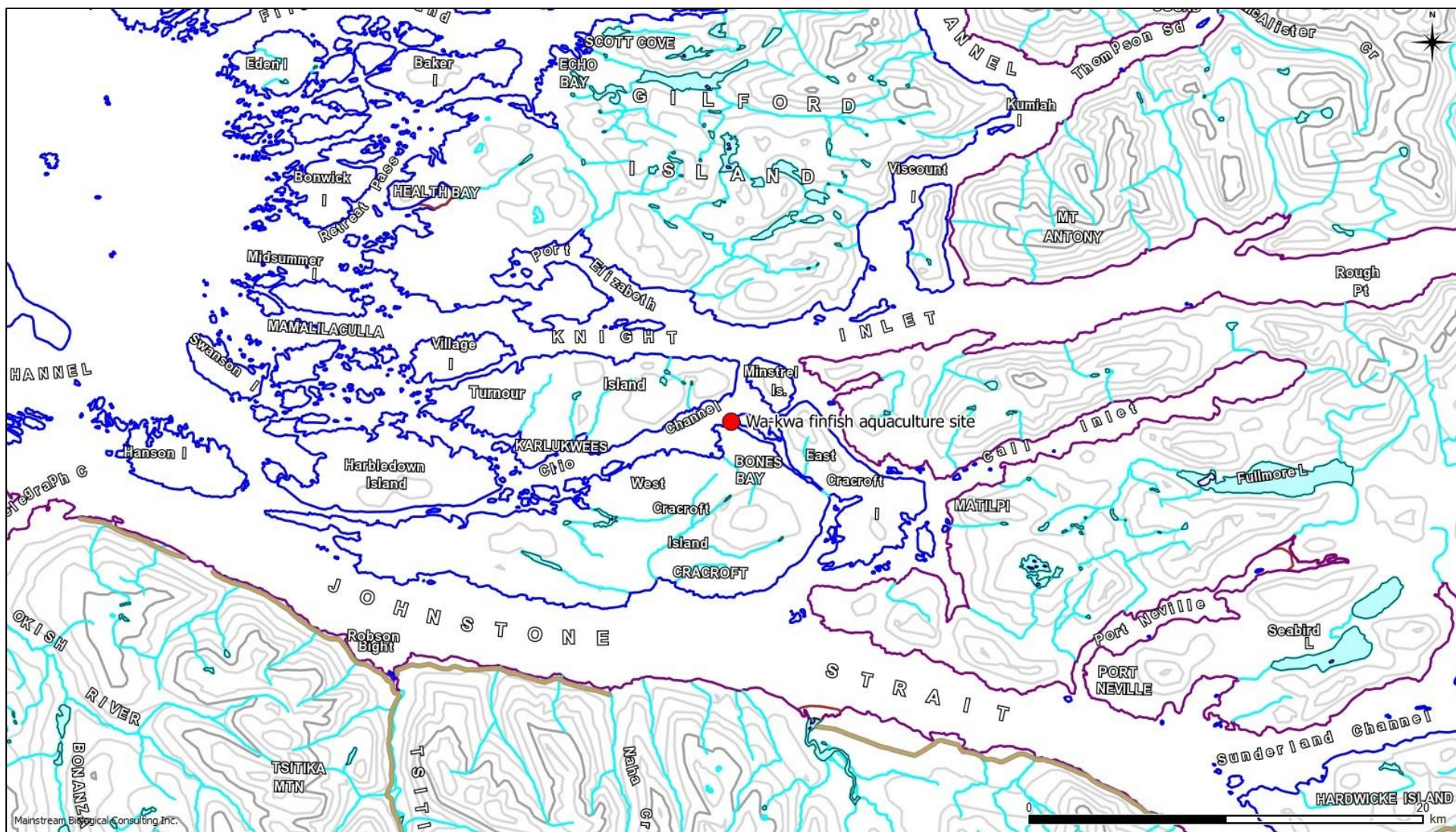


Figure 1: An overview map showing the approximate location of the Wa-Kwa finfish aquaculture farm site (red dot) in Clio Channel, BC.

## 2.0 Methods

The substrate at the sampling locations at the Wa-Kwa finfish aquaculture site had been previously identified to consist of “soft” sediment. Therefore, the field activities involved the attempted collection of sediment samples for physical and chemical analysis.

### 2.1 Field Sampling

The locations of sediment sampling stations were provided by Greig Seafood 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 also 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 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).

Sediment collection was attempted using a Petite Ponar sampler. Two sediment samples were collected at each successful 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)<sup>2</sup>, 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 Beaver Cove base station (BCOV).

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.

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<sup>2</sup> 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.



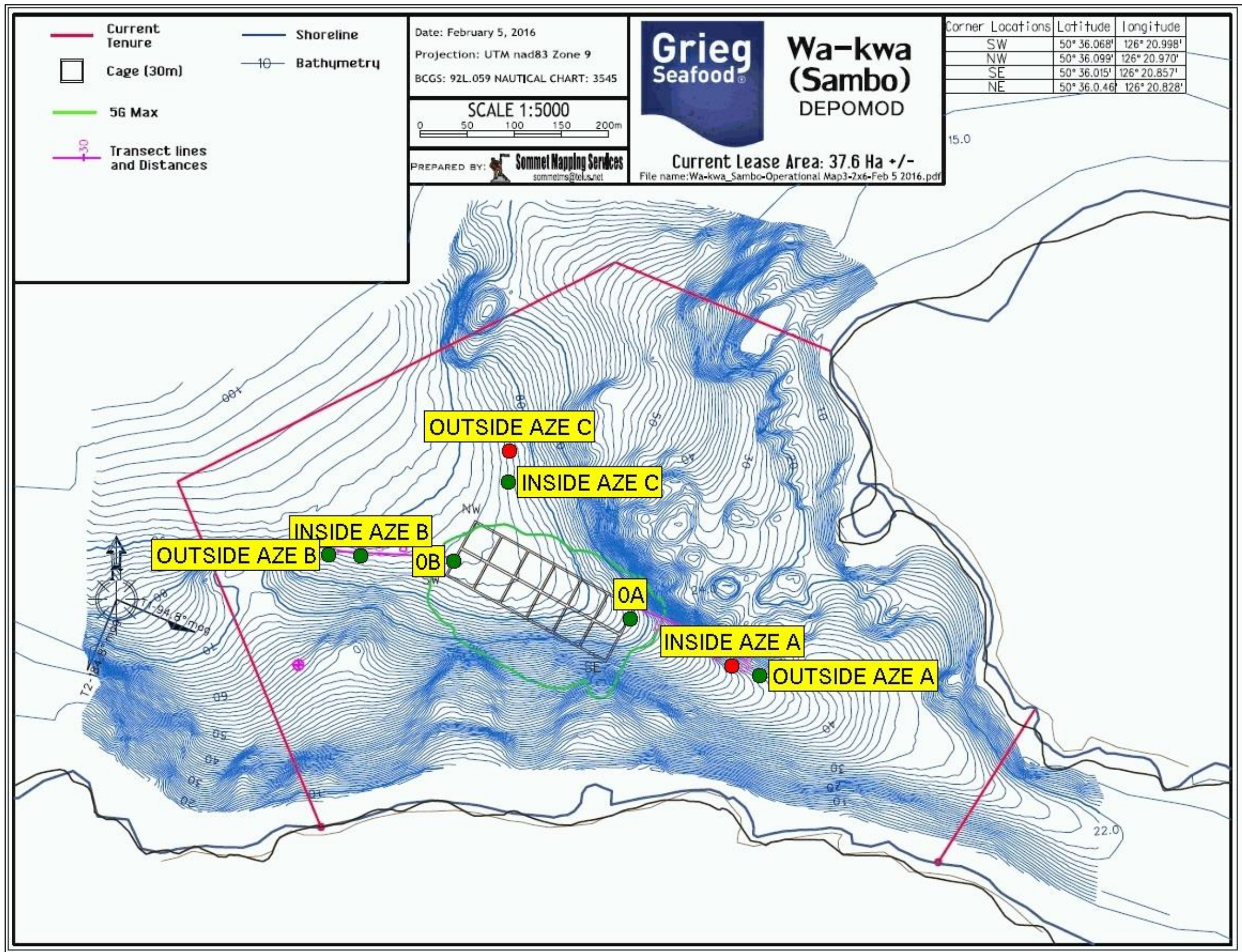


Figure 2: The locations of the sampling stations for the ASC survey at the Wa-Kwa finfish aquaculture site in relation to the pen system and surrounding area on July 27, 2021. Stations that had successful collection of sediment are marked with green circles; unsuccessful stations are marked with red circles.



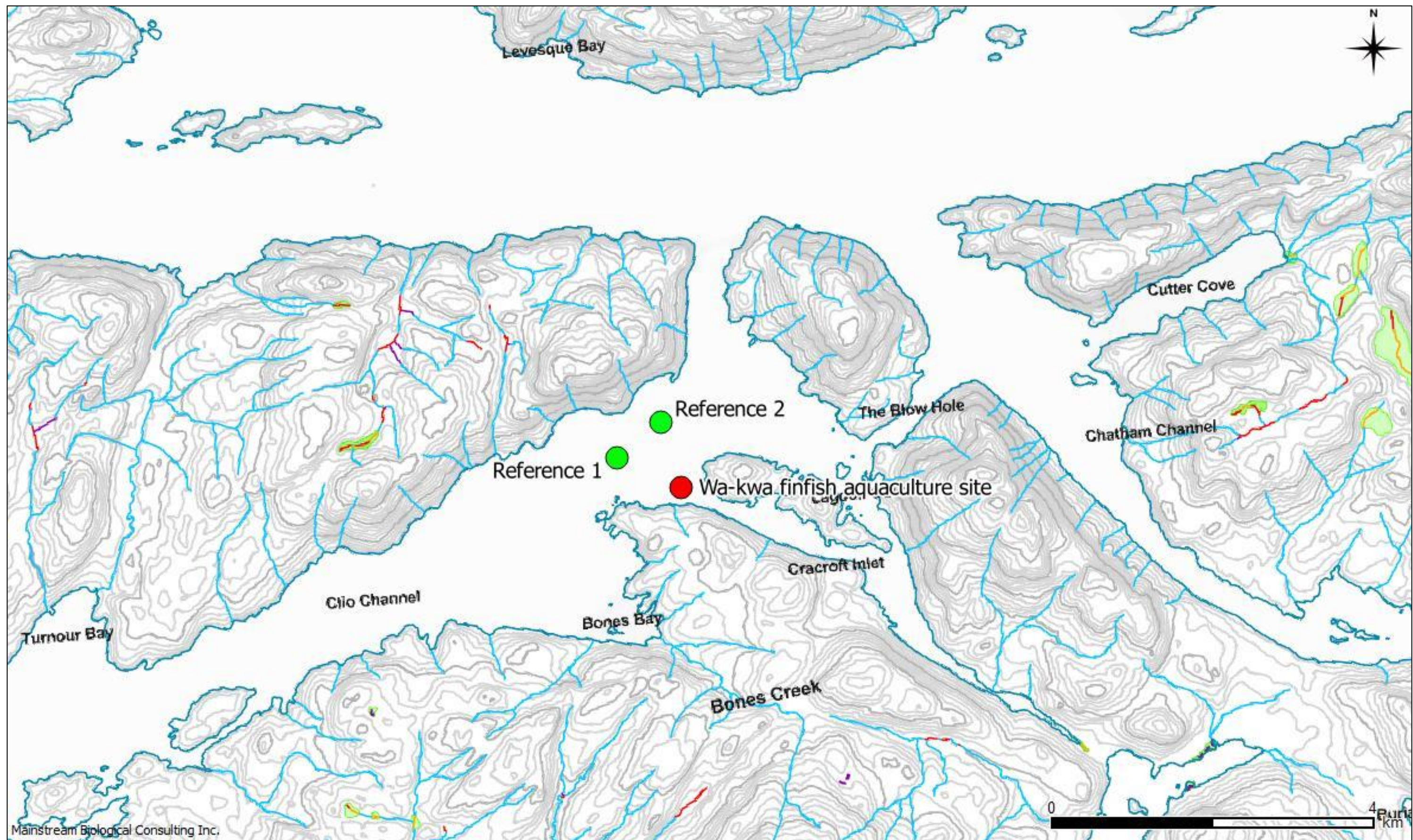


Figure 3: The locations of the reference stations for the ASC survey at the Wa-Kwa finfish aquaculture site in relation to the site and surrounding area on July 27, 2021



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 successful 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 and florfenicol.

## **2.2 Data Analysis**

In order to evaluate if the benthic conditions at and near the Wa-Kwa 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 Wa-Kwa 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 <sup>1</sup> .	>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 Wa-Kwa sampling stations typically consisted of brown mud with some grabs containing a mixture of sand and mud.

Sediment could not be successfully collected inside the AZE on Transect A and outside the AZE on Transect C. The results and location of each unsuccessful grab attempt are presented in Table 2.

Table 2: The location and results of each unsuccessful grab attempt at the Wa-Kwa finfish aquaculture site on July 27, 2021.

Station	Latitude	Longitude	Distance from Pens (m)	Sampling Device	Comments
Inside AZE A	50 36.0042	126 20.7313	120	Petite Ponar	Skiff of sand
Inside AZE A	50 36.0052	126 20.7301	120	Petite Ponar	Skiff of sand
Inside AZE A	50 36.0040	126 20.7313	120	Petite Ponar	Skiff of sand
Inside AZE A	50 36.0074	126 20.7288	120	Van Veen	Skiff of sediment
Outside AZE C	50 36.1397	126 20.9221	85.9	Petite Ponar	Empty
Outside AZE C	50 36.1393	126 20.9199	85.9	Petite Ponar	Empty
Outside AZE C	50 36.1386	126 20.9169	85.9	Petite Ponar	Empty
Outside AZE C	50 36.1392	126 20.9187	85.9	Van Veen	Skiff of sediment

#### 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 were analyzed to help evaluate if the Wa-Kwa facility was meeting the certification requirements (Appendix 3).

The mean sulphide level in sediment collected at the stations outside AZE on Transects A and B (40.7  $\mu\text{M}$  and 33.7  $\mu\text{M}$  respectively) on July 27, 2021, were less than the ASC Salmon Standard sulphide upper limit of 1500  $\mu\text{M}$ .

Mean redox potential in sediment collected at the stations outside the AZE on Transect A and B (267.5 mV and 195.1 mV respectively) were 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 B and the two reference stations for emamectin benzoate and florfenicol 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 Transects A, B and the two reference stations at the Wa-Kwa finfish aquaculture site on July 27, 2021.

Station Name	Sample Number	Emamectin Benzoate (ppm)	Florfenicol (ng/g)	Florfenicol Amine (ng/g)
Detection Limit		1.0	2.00	5.00
Outside AZE A	1	<1.0	<2.00	<5.00
Outside AZE A	2	<1.0	<2.00	<5.00
Outside AZE B	1	<1.0	<2.00	<5.00
Outside AZE B	2	<1.0	<2.00	<5.00
Reference 1	1	<1.0	<2.00	<5.00
Reference 1	2	<1.0	<2.00	<5.00
Reference 2	1	<1.0	<2.00	<5.00
Reference 2	2	<1.0	<2.00	<5.00



## 4.0 References

- Aquaculture Stewardship Council. 2012. ASC Salmon Standard Version 1.3. Available online: [www.asc-aqua.org](http://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**

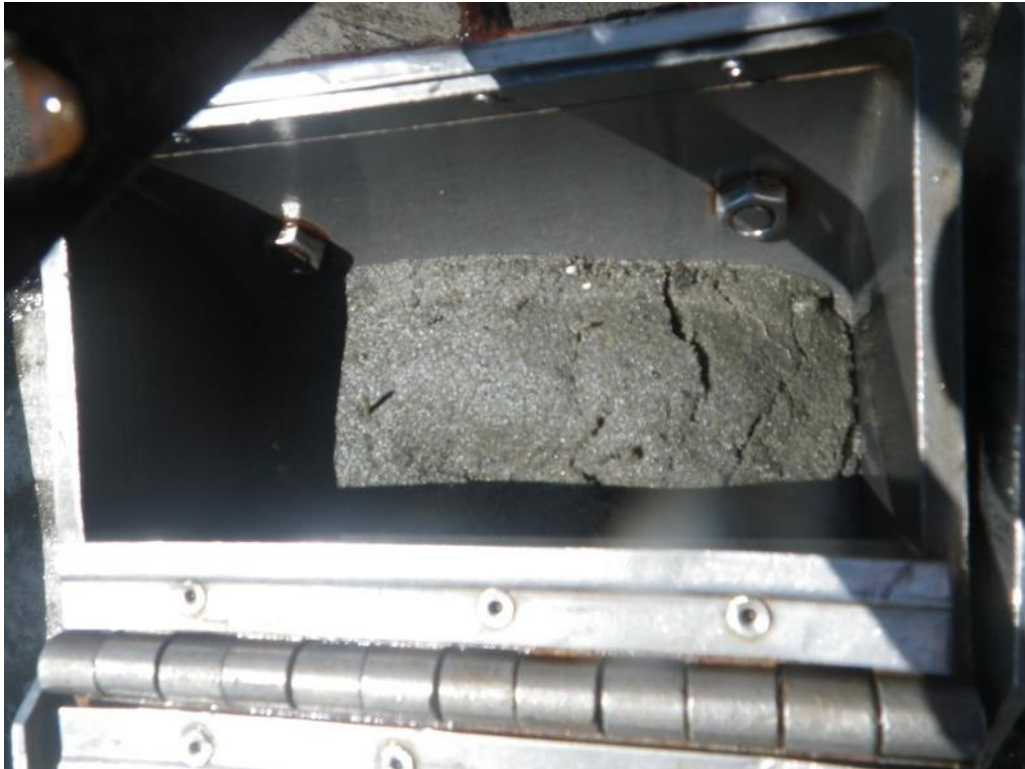
Sediment sample collected at the 0m station on Transect A at the Wa-Kwa site on July 27, 2021.



**Photo 2**

A typical missed grab at the station inside the AZE on Transect A at the Wa-Kwa site on July 27, 2021.





**Photo 3**

Sediment sample collected at the station outside the AZE on Transect A at the Wa-Kwa site on July 27, 2021.



**Photo 4**

Sediment sample collected at the 0B station at the Wa-Kwa site on July 27, 2021.



**Photo 5**

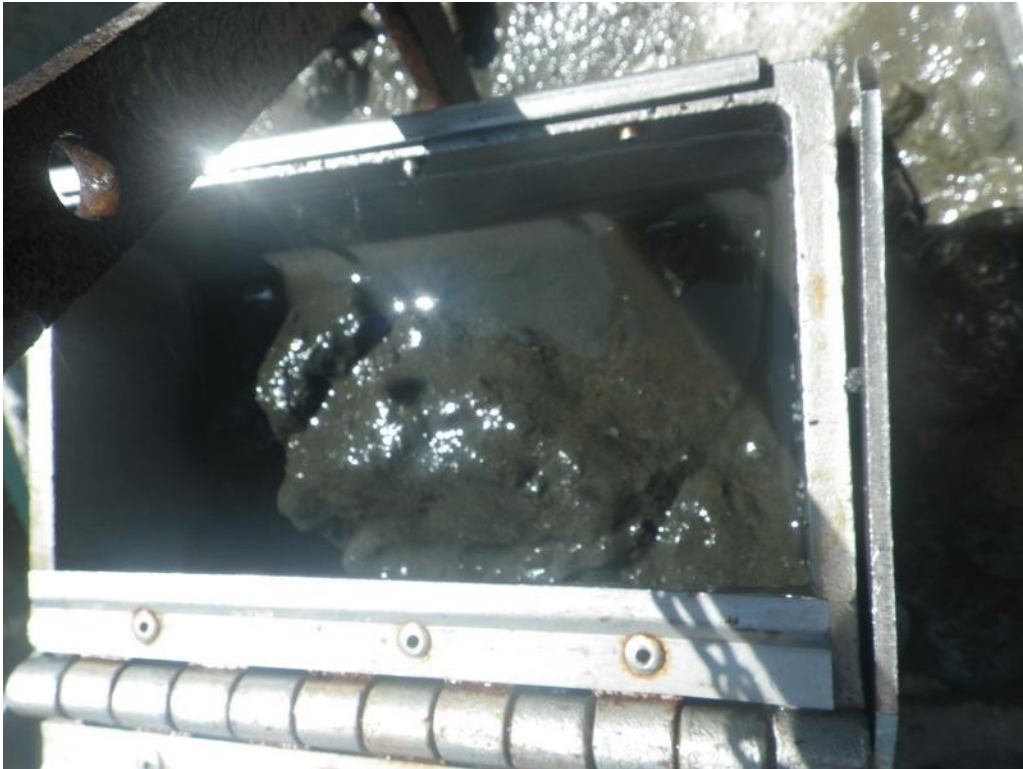
Sediment sample collected at the station inside the AZE on Transect B at the Wa-Kwa site on July 27, 2021.



**Photo 6**

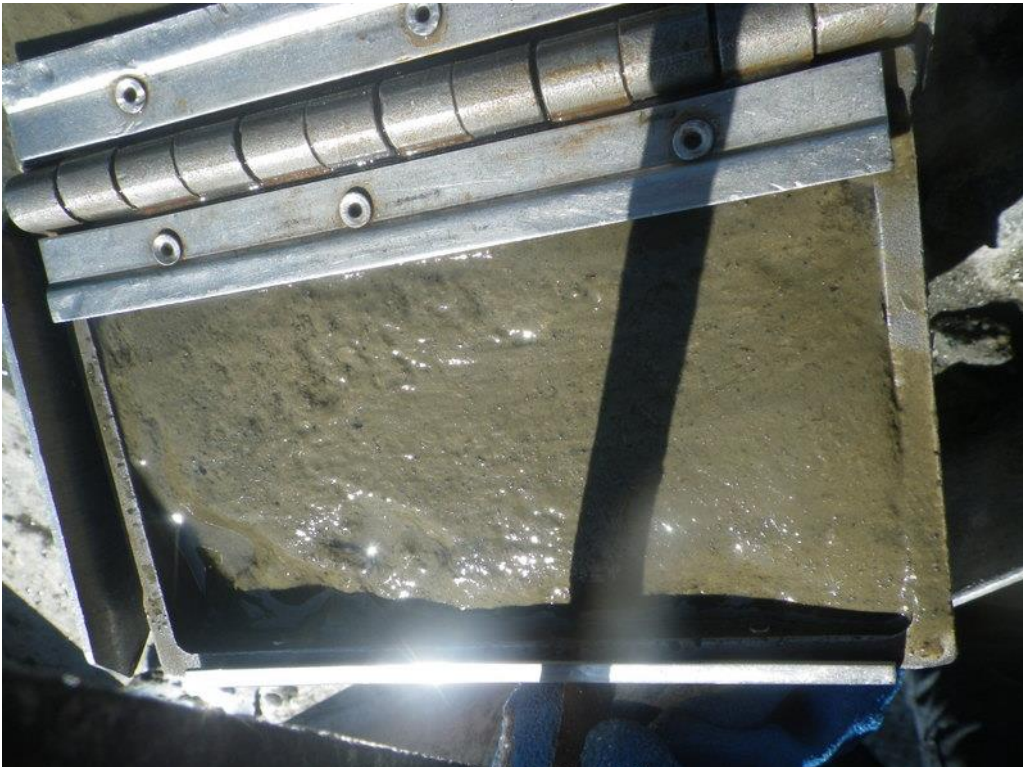
Sediment sample collected at the station outside the AZE on Transect B at the Wa-Kwa site on July 27, 2021.





**Photo 7**

Sediment sample collected at the station inside the AZE on Transect C at the Wa-Kwa site on July 27, 2021.



**Photo 8**

Sediment sample collected at the Reference 1 at the Wa-Kwa site on July 27, 2021.





**Photo 9**

Sediment sample collected at the Reference 2 at the Wa-Kwa site on July 27, 2021.

Appendix 2 – Site name Field Data

Reference Information:	
<b>Farm site:</b>	Wa-Kwa
<b>Aquaculture Company:</b>	Greig Seafood Ltd
<b>Site Reference #:</b>	AQ1839
<b>Geographic Region:</b>	Clio Channel, BC
<b>Field Crew:</b>	E. Weiss, M. Haswell
<b>Field Investigator:</b>	Mainstream Biological Consulting Inc.
<b>Laboratory:</b>	SGS Canada Inc

<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	100	N	0	Petite Ponar	0.02	N		2021-07-27	12:57	50	36.0356	126	20.8203	Post Process Corrected	52.6	5
A	0m	2	100	N	0	Petite Ponar	0.02	N		2021-07-27	13:06	50	36.0359	126	20.8197	Post Process Corrected	52.8	6
A	25m	1	100	N	120	Petite Ponar	0.02	N		2021-07-27	14:37	50	35.9975	126	20.7064	Post Process Corrected	43.5	5
A	25m	2	100	N	120	Petite Ponar	0.02	N		2021-07-27	14:41	50	35.9972	126	20.7068	Post Process Corrected	44.6	5
B	0m	1	260	N	0	Petite Ponar	0.02	Y		2021-07-27	09:56	50	36.0770	126	20.9780	Post Process Corrected	84.7	5
B	0m	1	260	N	0	Petite Ponar	0.02	Y	Duplicate	2021-07-27	09:56	50	36.0770	126	20.9780	Post Process Corrected	84.7	5
B	0m	1	260	N	0	Petite Ponar	0.02	Y	Triplicate	2021-07-27	09:56	50	36.0770	126	20.9780	Post Process Corrected	84.7	5
B	0m	2	260	N	0	Petite Ponar	0.02	N		2021-07-27	10:05	50	36.0770	126	20.9779	Post Process Corrected	84.7	5
B	5m	1	260	N	94.2	Petite Ponar	0.02	N		2021-07-27	10:45	50	36.0838	126	21.0626	Post Process Corrected	86.3	5
B	5m	2	260	N	94.2	Petite Ponar	0.02	N		2021-07-27	10:55	50	36.0833	126	21.0629	Post Process Corrected	85.1	5
B	25m	1	260	N	130	Petite Ponar	0.02	N		2021-07-27	11:31	50	36.0859	126	21.0922	Post Process Corrected	85.2	5
B	25m	2	260	N	130	Petite Ponar	0.02	N		2021-07-27	11:39	50	36.0862	126	21.0921	Post Process Corrected	85.9	5
C	5m	1	351	N	53.5	Petite Ponar	0.02	N		2021-07-27	12:03	50	36.1208	126	20.9224	Post Process Corrected	78.7	6
C	5m	2	351	N	53.5	Petite Ponar	0.02	N		2021-07-27	12:08	50	36.1200	126	20.9198	Post Process Corrected	78.9	6
REF	1	1		Y	590	Petite Ponar	0.02	N		2021-07-27	15:02	50	36.1639	126	21.4478	Post Process Corrected	105	10
REF	1	2		Y	590	Petite Ponar	0.02	N		2021-07-27	15:21	50	36.1646	126	21.4558	Post Process Corrected	105	10
REF	2	1		Y	580	Petite Ponar	0.02	N		2021-07-27	15:32	50	36.3895	126	20.9675	Post Process Corrected	109	5
REF	2	2		Y	580	Petite Ponar	0.02	N		2021-07-27	15:42	50	36.3898	126	20.9632	Post Process Corrected	110	5

<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	1240	13.4	-355.8	-144.8								N	N	N	N	4	N	N
A	0m	2	134	12.4	-42.4	169.6								Y	N	N	N	2	N	N
A	25m	1	49.9	14.5	14.8	223.8								N	N	N	N	0	N	N
A	25m	2	31.5	13.5	101.2	311.2								N	N	N	N	0	N	N
B	0m	1	2010	11.2	-268.2	-55.2								Y	N	N	N	3	N	N
B	0m	1	1890	11.2	-279.8	-66.8								Y	N	N	N	3	N	N
B	0m	1		11.2	-281.9	-68.9								Y	N	N	N	3	N	N
B	0m	2	862	10.0	-279.7	-65.7								N	N	N	N	3	N	N
B	5m	1	15.3	10.0	-59.1	154.9								N	N	N	N	0	N	N
B	5m	2	52.3	9.2	-148.7	66.3								N	N	N	N	0	N	N
B	25m	1	1.43	10.2	-17.7	196.3								N	N	N	N	0	N	N
B	25m	2	4.05	10.2	-20.1	193.9								N	N	N	N	0	N	N
C	5m	1	151	10.4	-273.2	-59.2								Y	N	N	N	2	N	N
C	5m	2	247	9.8	-276.8	-62.8								Y	N	N	N	3	N	N
REF	1	1	9.77	10.3	-90.7	123.3								N	N	N	N	0	N	N
REF	1	2	7.60	10.7	-67.3	145.7								N	N	N	N	0	N	N
REF	2	1	9.80	10.6	-21.0	192.0								N	N	N	N	0	N	N
REF	2	2	4.56	11.1	30.9	243.9								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><b>Transect A, B, C Name</b></i>	<i><b>Sampling Station Name</b></i>	<i><b>Replicate Number</b></i>	<i><b>Flocculent Organic Material Observed (Y/N)</b></i>	<i><b>Shell Hash Observed (Y/N)</b></i>	<i><b>Terrigenous Material Observed (Y/N)</b></i>	<i><b>Farm Litter Observed (Y/N)</b></i>	<i><b>Macrophytes Observed (Y/N)</b></i>	<i><b>Megafauna Observed (Y/N)</b></i>	<i><b>Sediment Colour Observations</b></i>	<i><b>Sediment Texture Observations</b></i>	<i><b>Other Sample Observations (Comments)</b></i>
A	0m	1	N	Y	Y	N	N	N	green	mud	twigs
A	0m	2	N	Y	Y	N	N	N	green	mud	leaves, needles
A	25m	1	N	N	N	N	N	Y	grey	sandy mud	tubeworms
A	25m	2	N	Y	N	N	N	N	grey	sandy mud	
B	0m	1	N	Y	Y	N	N	N	grey	mud	twigs
B	0m	1	N	Y	Y	N	N	N	grey	mud	twigs
B	0m	1	N	Y	Y	N	N	N	grey	mud	twigs
B	0m	2	N	Y	Y	N	N	N	grey	mud	needles
B	5m	1	N	Y	Y	N	N	N	brown	mud/sand	needles
B	5m	2	N	N	Y	N	N	N	brown	mud	twigs
B	25m	1	N	Y	N	N	N	Y	brown	mud	tubeworms
B	25m	2	N	Y	Y	N	N	Y	brown	mud	tubeworms, twigs
C	5m	1	N	Y	Y	N	N	N	grey	mud	wood debris
C	5m	2	N	N	N	N	N	N	brown	mud	
REF	1	1	N	N	N	N	N	N	green	mud	
REF	1	2	N	N	N	N	N	Y	green	mud	tubeworm
REF	2	1	N	Y	N	N	N	Y	brown	mud	tubeworms
REF	2	2	N	Y	N	N	N	Y	brown	mud	tubeworms



## Appendix 3 – Wa-Kwa ASC Survey Summary

<b>Company:</b>	Greig Seafood Ltd	<b>Sample date:</b>	July 27, 2021
<b>Farm Site:</b>	Wa-Kwa	<b>Field crew:</b>	E. Weiss, M. Haswell
<b>Site License #:</b>	AQ1839	<b>Analytical:</b>	SGS Canada Inc
<b>Site Location</b>	Clio Channel, BC		

SULPHIDES Indicator 2.1.1 Requirement $\leq 1500$ ( $\mu\text{m}$ )					
Station	Rep 1	Rep 2	n	Mean	ASC Criteria Met
0m A	1240	134	2	687	
Inside AZE A	-	-	2	-	
Outside AZE A	49.9	31.5	2	40.7	Yes
0m B	2010	862	2	1436	
Inside AZE B	15.3	52.3	2	33.8	
Outside AZE B	1.43	4.05	2	2.74	Yes
Inside AZE C	151	247	2	199	
Outside AZE C	-	-	2	-	-
Reference 1	9.77	7.60	2	8.69	
Reference 2	9.80	4.56	2	7.18	

REDOX POTENTIAL Indicator 2.1.1 Requirement $> 0$ mV					
Station	Rep 1	Rep 2	N	Mean	ASC Criteria Met
0m A	-144.8	169.6	2	12.4	
Inside AZE A	-	-	2	-	
Outside AZE A	223.8	311.2	2	267.5	Yes
0m B	-55.2	-65.7	2	-60.5	
Inside AZE B	154.9	66.3	2	110.6	
Outside AZE B	196.3	193.9	2	195.1	Yes
Inside AZE C	-59.2	-62.8	2	-61.0	
Outside AZE C	-	-	2	-	-
Reference 1	123.3	145.7	2	134.5	
Reference 2	192.0	243.9	2	218.0	
Reference 3			2		