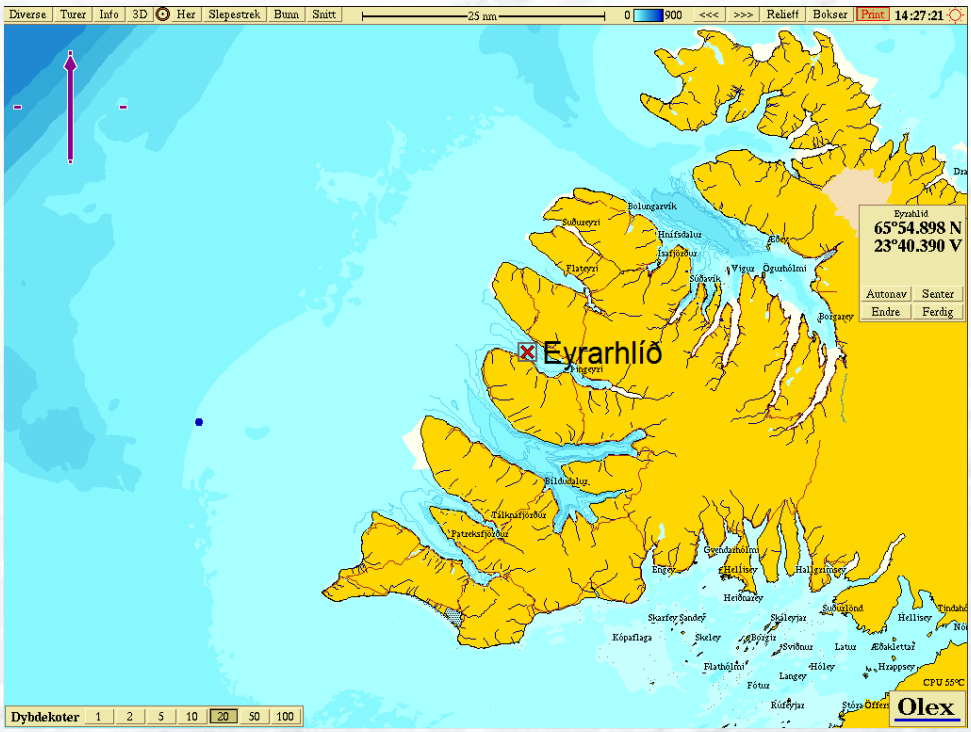
Akvaplan niva

Rapport Report

Arctic Sea Farm,
B-survey local impact zone, Eyrarhlíð
January 2020



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Akvaplan-niva AS: APN report 61859.B01

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Information client			
Titel	Arctic Sea Farm. B-survey local impact zone, Eyrarhlíð January 2020		
Report number	APN report 61859.B01		
Site name	Eyrarhlíð	Coordinates site	65°54.898 N 24°40.390 V
County	Ísafjarðarsýsla	Municipality	Ísafjarðarbær
MTB-or estimated max biomass	6800 ton	Site manager/contact	Egill Ólafsson
Client name	Arctic Sea Farm		

Biomass/production/status at date of survey			
Biomass at date of survey	4.083 ton	Feed use	6.984 ton
Fish type	Salmon	Amount produced	5.178 ton

Type/time of survey	Mark with X	Comments
At maximal biomass see kap 7.9	☐	Extra B-survey upon initiative from Arctic Sea Farm.
A follow up survey	☐	
Half maximal biomass	☒	
Survey prior to putting out smolt	☐	
A pre-survey new site	☐	
Other	☐	
Last fallowing period:		

Results from B-survey iht. NS 9410:2016 (main results)			
Parameters and indexes		**Parameters and site status**	
Gr. II. pH/Eh	0,10	Gr. II. pH/Eh	1
Gr. III. Sensory	0,48	Gr. III. Sensory	1
GR. II + III	0,29	GR. II+ III	1
Date field work	30.01 2020	**Date report**	17.02.20
Site status (NS 9410:2016):			**1**

Report writing	Snorri Gunnarsson	Signature	Snorri Gunnarsson
Quality control	Arnþór Gústavsson	Signature	Arnþór Gústavsson

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Preface

The survey is carried out according to guidelines in NS 9410:2016 which includes evaluation of sediment, faunal investigation and bottom topography. The environmental survey is regulated by § 35 in the Norwegian «akvakulturdriftsforskriften. The survey also fulfills the requirements regarding bottom surveys in the standard ISO 12878.

The primary objective of a B-survey is to fulfil the requirements regarding bottom surveys as they are defined in NS9410:2016. As this is an extra bottom survey decided upon by Arctic Sea Farm i.e. additional to the requirements from the Icelandic authorities the number of sampling stations was set to 10 within the mooring lines of the fish farm. The estimated standing biomass at the date of sampling at the site Eyrarhlíð was 4.083 MTB ton. The methods applied in this survey follow otherwise guidelines in chapter 5 (NS6410:216) and the requirements described in ISO 12878.

The following have participated in the survey:

Snorri Gunnarsson	Akvaplan-niva AS	Prosjektleder. Report
Arnþór Gústavsson	Akvaplan-niva AS	Fieldwork. Mapping (Olex).

The date for sampling at the Eyrarhlíð was done 30.01 2020.

Accredited survey:

The following parts of the survey are done in accordance to accreditation methods:

Sampling and treatment of sediment samples, analysis of samples and evaluations of the results. It should be pointed out that as Icelandic officials have not set standards regarding different parameters based on samplings at Icelandic conditions so the site characters in this report should be interpreted with that disclaimer in mind.

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Akvaplan-niva AS thanks Arctic Sea Farm their personnel for the cooperation during the conductance of this site survey.

Kópavogi 17. februar 2020

Snorri Gunnarsson
Project manager

1 Introduction

The sampling date for the present site survey was the 30.01 2020 and done by Akvaplan-niva AS contracted by Arctic Sea Farm in relation to the company's fish farming activity at the site Eyrarhlíð in Dýrafjörður, Ísafjarðabæ.

The objective of the B-survey is to document the environmental condition of the local impact zone of the fish farm according to NS 9410:2016 (and ISO 12878) which includes condition of the seabed, faunal evaluation and bottom topography registration.

The survey gives an estimate and evaluation of the site condition with regard to organic load and suitability assessment of the site for fish farming activity.

Figure 1 shows map of the fjord system Vestfirðir where the site Eyrarhlíð is placed.

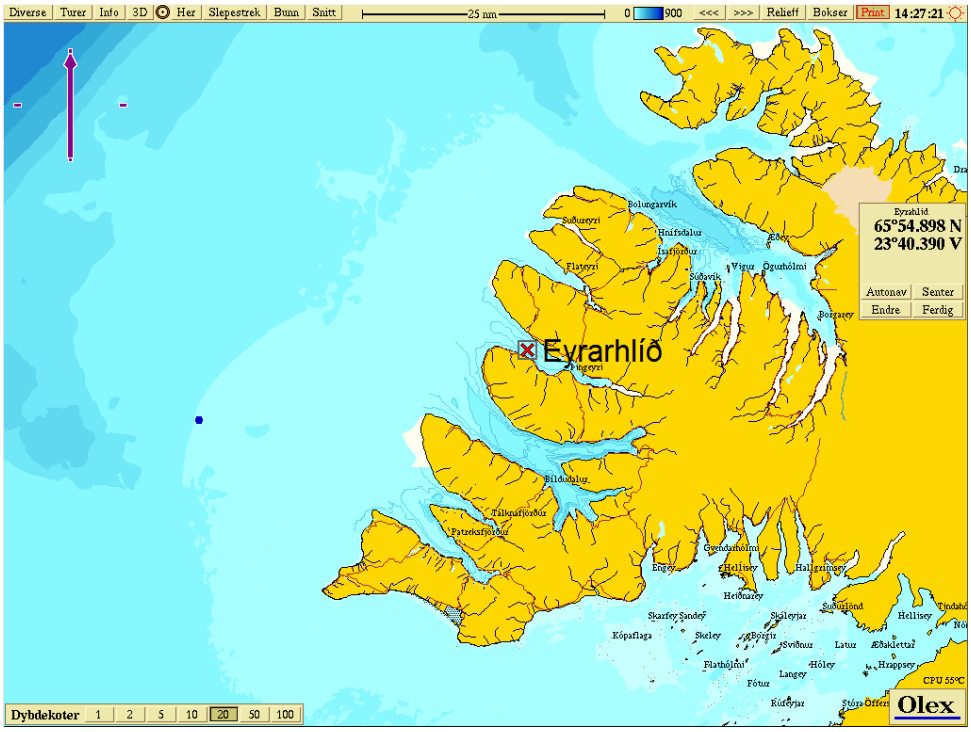

Figure 1. An overview map with the Eyrarhlíð site market by it´s name.

2 Professional program and methods

Environmental monitoring of the impact from the fish farming activities on the seabed is a standardised system. All fish farming sites in the sea are to be regularly assessed. The methods for monitoring in Iceland are to follow guidelines based on description in the ISO 12878 standard and we also follow the methodology described in the NS 9410:2016. The Icelandic Umhverfisstofnun can also set forward specific requirements regarding frequency of samplings for different fish farming sites that can overrule the requirements in the above mentioned standards. This B-survey is undertaken upon the initiative from Arctic Sea farm and is additional to the required frequency set by the standards and Icelandic officials.

The B-survey is a trend study of the benthic conditions at or in close proximity to the fish farming site (local impact zone). Sediment is collected by use of grab (min 250 cm^2). Each grab sample is investigated with regard to three observation types of benthic characters; faunal parameters, chemical parameters (pH and redox-potential) and a sensory evaluation (gas bubbles, smell, texture, colour and the thickness of the precipitated slam layer in the sediment. The different benthic parameters are given a character on the scale from 1 to 4, according to the scale of the impact on the benthic conditions from organic load, see criteria in table 1 and that score sets the follow up sampling frequency according to NS 9410:2016. The weighted average score for the different parameters for all the sampling stations gives the sites condition.

Table 1. The frequency for B-surveys in the local impact zone related to the site condition in previous survey.

Site condition at the time of sampling	Frequency for B-surveys (NS 9410:2016)
1-very good	At next max biomass
2-good	Prior to putting nex generation into sea and again at next max biomass.
3-bad	Prior to putting next generataion into sea. Based on the site condition prior to putting next generation into sea: - Condition 1 – next site survey at next max biomass - Condition 2 – next site survey at next halv max biomass and at max biomass - Condition 3 – next site survey at next halv max biomass and at max biomass. Some conditions should apply for farming of next generation at the site If any of the samples result in character 4 it is a sign of overload.
4-very bad	Overload

2.1 Field equipment

The following field equipment was used during the site survey:
Grab: Van Veen grab (0,025 m^2)
Sieve 1 mm: Akvaplan-niva
pH meter: Electrode, YSI Professional Plus
Redox-meter: Electrode, YSI Professional Plus
Position determination– Garmin GPS mapping tool.
Digital camera

3 Site description and bottom topography

3.1 Info site operation

The Eyrahlíð site is a new site where there has not been any prior fish farming activity until the present generation. The fish farm at the site is a two-frame mooring system, each frame having 6 cages total 12 cages each with 160 m circumference. The present generation was put into sea (smolts) in June to September 2018.

Table 2 shows the production and feed usage for the present and past generations.

Table 2. Production and feed usage at the site Eyrarhlíð, data is based on info given from the fish farmer.

Generation of fish (G)	Production (ton)	Feed usage (ton)
Present generation	5.178 ton	6.984 ton

3.2 Present and past site surveys

There has not been done a previous B-survey at the site Eyrarhlíð. There was done a base line study (C-survey) at the site prior to putting fish into sea (Gallo, 2019) with sampling date 5.06 2018. Bottom was described as muddy and visual and chemical parameters did not show any signs of organic load at the site. Redox potential was positive at all eight sampling stations.

The present B-survey is a half-max biomass survey done upon the initiative from Arctic Sea Farm. The date for the sampling was somewhat delayed due to unusual and prolonged bad weather conditions in December 2019 through January 2020.

3.3 Dispersing current

Measurement of dispersing current was done at the site in August – September 2019 measurements at 39 m depth (unpublished data). Dominating current (39 m) is in direction south-east (130 degrees) with a smaller counter current in north-west direction. Average current speed is measured to be 5.9 cm/s. Highest current speed is measured to be 26.7 cm/s and 3.4 % of the measurements are < 1 cm/s.

3.4 Position of sampling stations

Description of the stations in the survey is given in figure 2 and table 3. Positioning of the stations was chosen based on guidance and perimeters described in NS 9410:2016 and spread around the periphery of the cages. At the site the typical depth in the local impact zone is in the range from 40 – 42 m, with a slightly deeper area into the fjord (NNV). The placement of sampling stations was chosen to give a good picture of the condition of the whole local impact zone. It is important to evaluate the status in both the deeper and shallower parts of the local impact zone of the fish farm. The sampling stations had a depth varying from 40 m (st. 10) to 42 m. The placement of the sampling stations is regarded to be in accordance with the descriptions for survey of local impact zone given in NS 9410:2016.

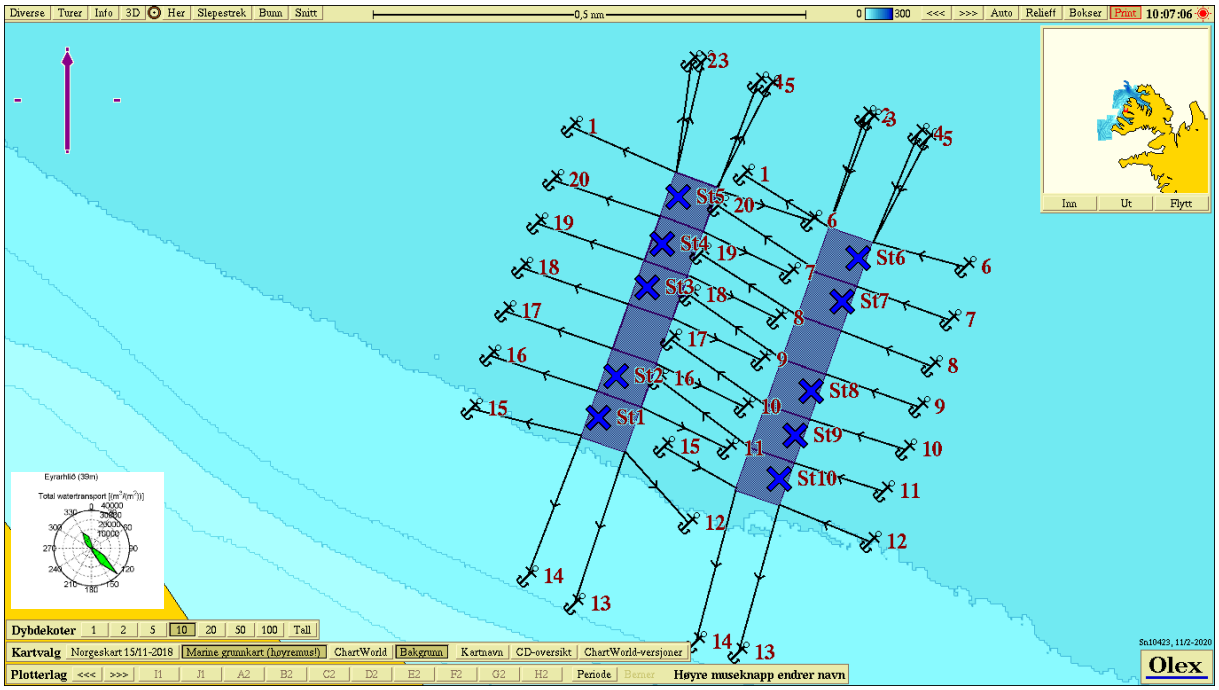

Figure 2. Chart showing depths at the site Eyrarhlíð. Sampling stations st. 1 – 10 are marked with color codes that describe the condition according to NS 9410:2016, chapter 7.11. Color codes: Blue =very good condition, green = good condition, yellow = bad condition, red = very bad condition. (Current rose unpublished data, 2019)

Table 3. Placement and depth of the sampling stations in the B-survey.

Station number	North	Vest	Depth (m)
St 1	65°54,806	23°40,754	41
St 2	65°54,854	23°40,705	41
St 3	65°54,957	23°40,617	41
St 4	65°55,007	23°40,574	42
St 5	65°55,061	23°40,529	42
St 6	65°54,991	23°40,019	42
St 7	65°54,940	23°40,064	41
St 8	65°54,837	23°40,152	41
St 9	65°54,786	23°40,198	41
St 10	65°54,736	23°40,242	40

4 Results

Results for the different parameters are given in Table 4. A complete filled sampling sheet with calculations for each parameter is attached in appendix.

Table 4. Results from the classifications of the local impact zone of the fish farm.

Parameter	Condition
Group II - parameters (pH/Eh)	1
Group III – parameters, (sensory)	1
Group II + III – parameters (mean value)	1
Site condition	1

There were collected valid sediment samples at all stations in the first grab taken except for stations 4, 6 and 10 (2 grabs needed). This indicates that in general there is soft bottom in the whole local impact zone. The sediment type consisted mainly of clay and sand. For the group II parameters (redox and pH), all ten stations had status 1 «very good». For sensory parameters (group III) all stations had status 1 «very good». Animals where present in all samples. For combined parameters II and III (pH/redox and sensory) all stations had condition 1 «very good». Overall evaluation site condition is 1 «very good».

5 Conclusion

Based on the criteria given in NS 9410:2016 the fish farming site has been assigned a site condition 1 «Very Good» at the date of sampling. A total of 10 samples were taken with Van Veen grab (0,025 m^2), divided on 10 stations placed around the twelve cages that present at the site.

Measurement of dispersing current was done at the site in August – September 2019 measurements at 39 m depth (unpublished data). Dominating current (39 m) is in direction south-east (130 degrees) with a smaller counter current in north-west direction. Average current speed is measured to be 5.9 cm/s. Highest current speed is measured to be 26.7 cm/s and 3.4 % of the measurements are < 1 cm/s.

The present B-survey is done at half-max biomass and is done upon the initiative from Arctic Sea Farm as a supplementary survey (additional to required surveillance set by Icelandic officials). For this first farmed generation at Eyrarhlíð site, smolts were put into sea June through September 2018.

The site is assigned a condition factor 1 "Very good" according to calculations based on methodology described in NS 9410:2016 and sample sheet Table B.1 and B.2 (se chapter 7 Appendix).

6 References

Forskrift om drift av akvakulturanlegg (akvakulturdriftsforskriften) §§ 35 og 36.

Gallo, C., 2019. Base line monitoring for salmon farming site in Eyrarhlíð, Dýrafjörður. NV nr. 13-19.

Heggem, T. 2017. Arctic Sea Farm hf, lokalitetsrapport Eyrarhlíð. Akvaplan-niva AS rapport nr. 9179.01. 15 s.

ISO 5667-19:2004. Guidance on sampling of marine sediments.

ISO 12878:2012. Environmental monitoring of the impacts from marine finfish farms on soft bottom..

Norsk Standard NS 9410:2016. Miljøovervåking av bunnpåvirkning fra marine akvakultur-anlegg.

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7 Appendix:

7.1 Sheet (B.1 og B.2) NS 9410:2016

Sample scheme B.1

Company:	**Arctic Sea Farm hf**	**Date:**	**30.1.2020**
Site:	**Eyrarhlíð**	**Site no.:**	
Fieldworker:	**Arnþór Gústavsson**		

Gr	Parameter	Point	Sample number 1	2	3	4	5	6	7	8	9	10	Index S%	H%
	Bottom type: S (soft) or H (hard)		S	S	S	S	S	S	S	S	S	S	100	0
I	Animals > 1mm	Yes (0) No (1)	0	0	0	0	0	0	0	0	0	0		
II	pH	value	7,6	7,6	7,6	7,7	7,7	7,8	7,7	7,7	7,8	7,7		
	Eh (mV)	ORP	110	50	-180	40	67	-60	-40	30	-60	-90		
		plus ref. value	310	250	20	240	267	140	160	230	140	110		
	pH/Eh	from figure	0	0	1	0	0	0	0	0	0	0	0,10	
		Status station	1	1	1	1	1	1	1	1	1	1		
		Status group II	1	Buffer temp	C		Sea temp	C		Sediment temp	C			
		pH sea	ORP sea	mV		Eh sea	mV		Reference electrode		200 mV			
III	Gas bubbles	Yes (4) No (0)	0	0	0	0	0	0	0	0	0	0		
	Colour	Light/grey (0)	0	0	0	0	0		2	2	2	2		
		Brown/black (2)						2						
	Smell	None (0)		0	0	0	0	0	0	0	0	0		
		Light (2)	2											
		Strong (4)												
	Consistency	Solid (0)	0	0	0	0	0	0	0	0	0	0		
		Soft (2)												
		Aqueous (4)												
	Grab - volume (v)	v < 1/4 (0)												
		1/4 < v < 3/4 (1)	1	1	1	1	1	1	1	1	1	1		
		v > 3/4 (2)												
	Thickness of sludge (t)	t < 2 cm (0)	0	0	0	0	0	0	0	0	0	0		
		2 < t < 8 cm (1)												
		t > 8 cm (2)												
		Sum	3,0	1,0	1,0	1,0	1,0	3,0	3,0	3,0	3,0	3,0		
		Corrected (*0,22)	0,7	0,2	0,2	0,2	0,2	0,7	0,7	0,7	0,7	0,7	0,48	
		Status station	1	1	1	1	1	1	1	1	1	1		
		Status group III	1											
		Average group II & III	0,3	0,1	0,6	0,1	0,1	0,3	0,3	0,3	0,3	0,3	0,29	
		Status station	1	1	1	1	1	1	1	1	1	1		
		Status group II & III	1											

pH/Eh Corr.sum Index Average	**Status**
< 1,1	1
1,1 - <2,1	2
2,1 - <3,1	3
≥3,1	4

Status site: 1

Grabb ID	K-22
pH / Eh ID	YSi Professional Plus

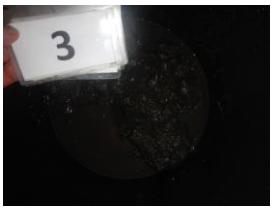
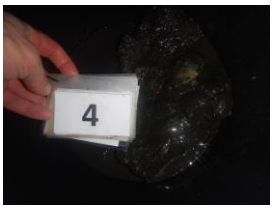
page 1 of 2 pages

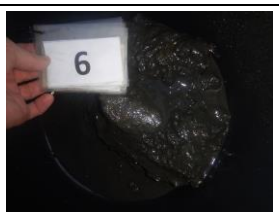
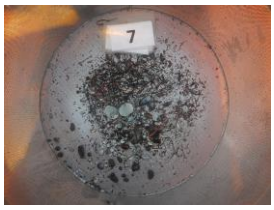
Sample Scheme B.2

Company:	**Arctic Sea Farm hf**		**Date:**	**30.1.2020**
Site:	**Eyrarhlíð**		**Site no.:**	**0**
Fieldworker:	**Arnþór Gústavsson**			

Sample number		1	2	3	4	5	6	7	8	9	10
Depth (m)		41	41	41	42	42	42	41	41	41	40
Number of trials		1	1	1	2	1	2	1	1	1	2
Gas bubbles (in sample)											
Sediment type	**Clay**	X	X	X	X	X	X	X	X	X	X
	Silt										
	Sand	X	X	X	X	X	X	X	X	X	X
	Gravel										
	Shellsand										
Reef											
Rocky bottom (cobbles, boulders)											
Echinodermata, count											
Crustaceans, count											
Molluscs, count			1								
Polychaetes, count		>100	>50	>100	>100	>100	>100	>100	>100	>100	>100
Other animals, count											
Beggiatoa											
Feed											
Faeces											
Comments											
Grab	**Area [m^2]**			**Grab ID**		K-22					
Signature fieldworker:	Arnþór Gústavsson										

7.2 Pictures of samples at Eyrarhlíð

St 1		
St 2		
St 3		
St 4		
St 5		

St 6		
St 7		
St 8		
St 9		
St 10		

7.3 Bottom topography and 3D view

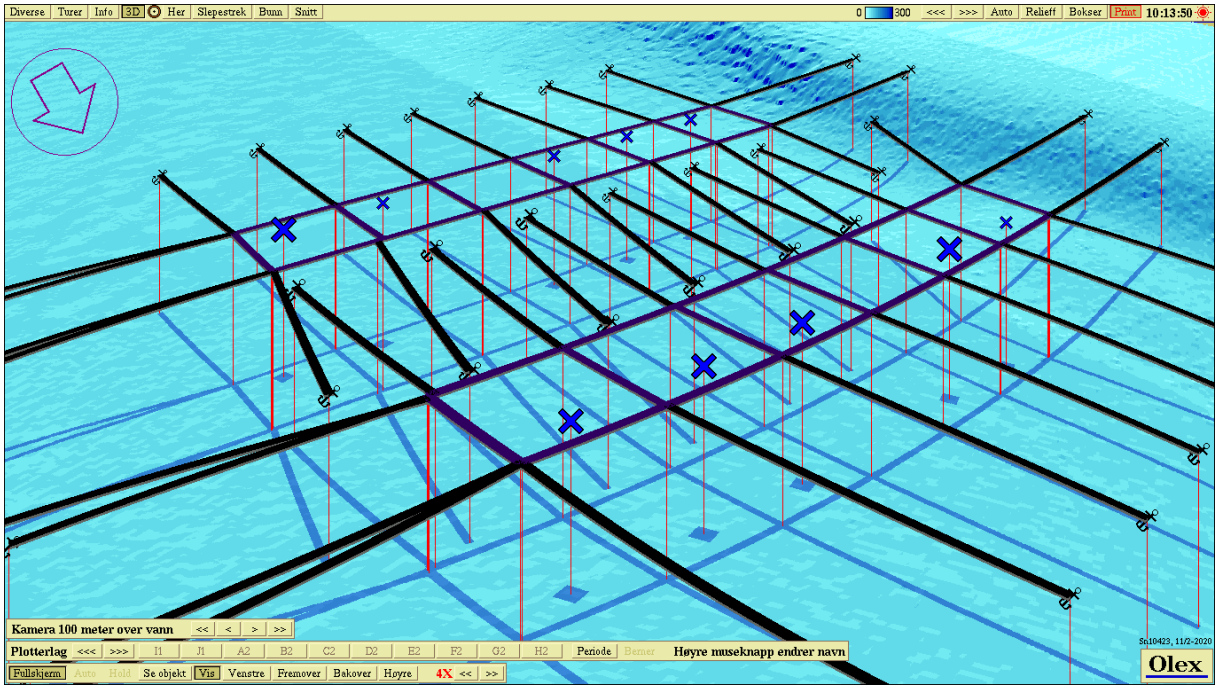


Figure 3. Showing bottom topography 3D at Eyrarhlíð with each station numbered according to info in figure 2 and Table 4.