Fair Isle Harbour Improvement Works

Appendix 04 Fair Isle BPEO

On behalf of **Shetland Isle Council (SIC)**

Shetland Islands Council

Project Ref: 11168 | Rev: Version 1.0 | Date: April 2023

Registered Office: Buckingham Court Kingsmead Business Park, London Road, High Wycombe, Buckinghamshire, HP11 1JU
Office Address: 10 Queen Square, Bristol, BS1 4NT
T: +44 (0)117 332 7840 E: bristol@stantec.com

Note

Fair Isle Best Practicable Environmental Option

Introduction

Proposals for the replacement of the existing ferry between Fair Isle and Grutness will require the harbour at North Haven, Fair Isle, to be upgraded to facilitate the new roll-on roll-off (Ro-Ro) vessel. This includes navigational dredging to -4.5 m Chart Datum (CD) to provide a sufficient water depth for the new vessel around the proposed quay extension and at the end of the pier which is used to winch up the vessel into the noust in adverse weather conditions. Additionally, construction dredging to -4.0mCD will be required as part of seabed preparation within the proposed quay extension and linkspan areas. The total volume of dredge material will be approximately 2,730 m^3 (including a 10% contingency) or 5,340 wet tonnes. A marine licence is required for the dredging operations. To support the marine licence application there is a need for a Best Practicable Environmental Option (BPEO) assessment. The following sections provide this BPEO assessment.

Dredge Material Characterisation

Sediment sampling has been carried out to support this marine licence application. Samples were obtained during the geotechnical investigations undertaken for the proposed works between 28 February and 09 March 2023, from five locations across the proposed dredge areas as shown in Figure 1. The pre-dredge sampling plan (submitted on 03 February 2023) was agreed with the Marine Scotland Licensing and Operations Team (MS-LOT) prior to the surveys and subsequent sample analysis. Samples were either collected using a Van Veen grab or sub-sampled from the cores collected at each location. Table 1 details the percentage of each material type for the different samples obtained.

Table 1 Sediment sample characteristics

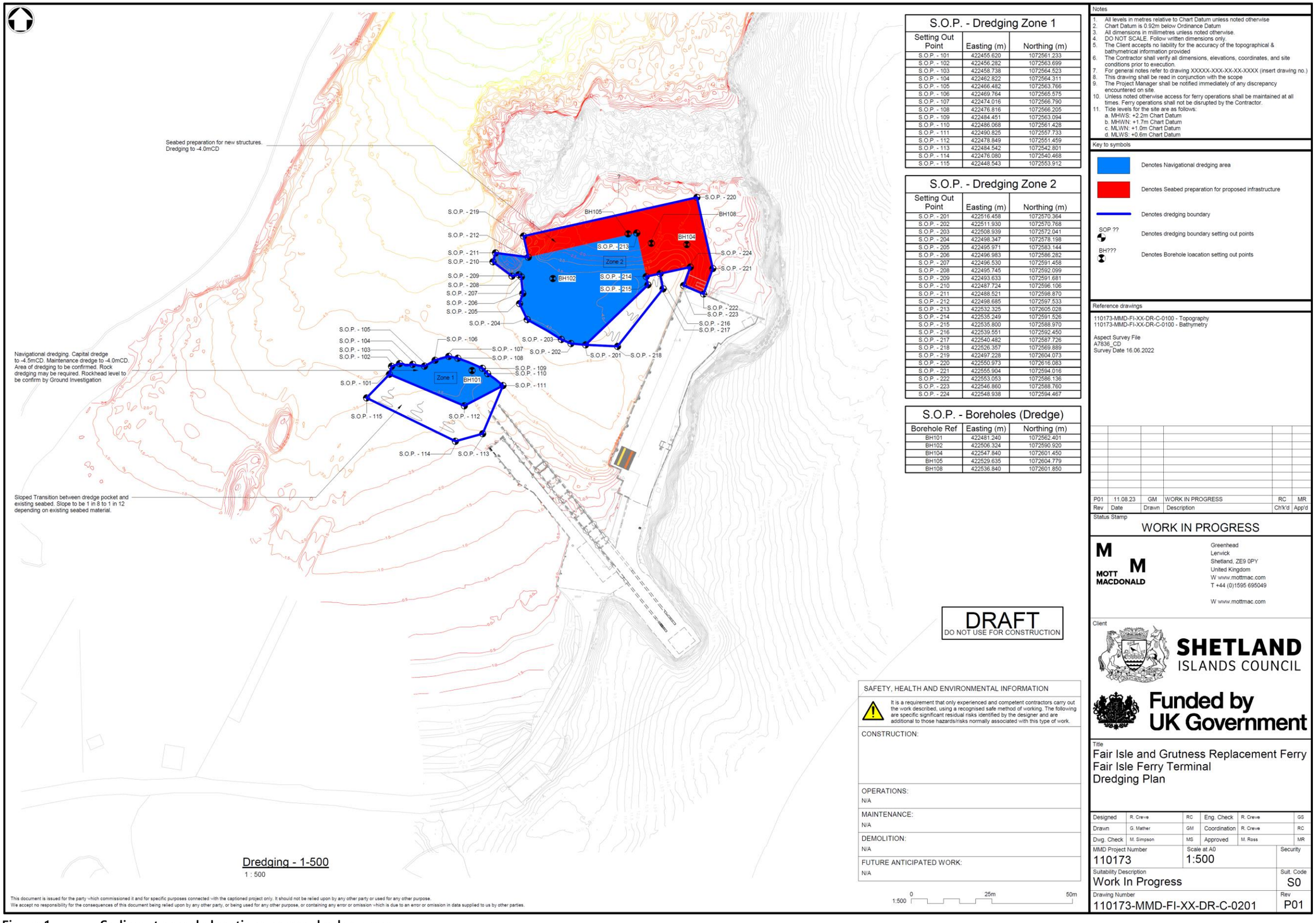
Sample ID	Type of sample	Sample depth (m)	Gravel (>2 mm) (%)	Sand (63-2000 µm) (%)	Silt (<63 µm) (%)
Navigational dredge area at end of pier (Zone 1)					
BH101SeaBedA	Grab	0	0	91.73	8.29
Navigational and construction dredge area adjacent to extended quay (Zone 2)					
BH102SeaBedA	Grab	0	0.16	42.69	57.32
BH104SeaBedA	Grab	0	0.39	49.79	49.83
BH105SeaBed	Grab	0	1.43	42.33	56.31
BH105@0.2-0.9	Core	0.2-0.9	0.26	43.13	56.54
BH108SeaBed	Grab	0	0.36	40.58	59.17
BH108@0-0.80	Core	0.0-0.8	1.17	46.47	52.42

Sediment within the navigational dredge area (sample BH101) at the end of the pier comprises predominantly sand. Sediments within the navigational and construction dredge pockets (sample BH102 and samples BH104, BH105 and BH108, respectively) comprise roughly equal parts sand and silt. Geotechnical investigations showed that sediment was no more than 1 m in thickness across the dredge footprint of the proposed dredge areas, with an average of 0.5 m thickness across both

dredge areas. As such it is anticipated that the total volume of the dredged material will comprise 47% sediment and 53% rock. The dredge material characteristics for the two dredge areas, accounting for the bedrock within the >2mm fraction, are shown in Table 2.

Table 2 Dredge material characteristics

Dredge area	Pebbles, cobbles and boulders (including bedrock) (>2 mm) (%)	Sand (63-2000 µm) (%)	Silt (<63 µm) (%)
Navigational dredge area at end of pier (Zone 1)	53%	43%	4%
Navigational and construction dredge area adjacent to extended quay (Zone 2)	53%	21%	26%



S.O.P. - Dredging Zone 1		
Setting Out Point	Easting (m)	Northing (m)
S.O.P. - 101	422455.620	1072561.233
S.O.P. - 102	422456.282	1072563.699
S.O.P. - 103	422458.738	1072564.523
S.O.P. - 104	422462.822	1072564.311
S.O.P. - 105	422466.482	1072563.766
S.O.P. - 106	422469.764	1072565.575
S.O.P. - 107	422474.016	1072566.790
S.O.P. - 108	422476.816	1072566.205
S.O.P. - 109	422484.451	1072563.094
S.O.P. - 110	422486.068	1072561.428
S.O.P. - 111	422490.825	1072557.733
S.O.P. - 112	422478.849	1072551.459
S.O.P. - 113	422484.542	1072542.801
S.O.P. - 114	422476.080	1072540.468
S.O.P. - 115	422448.543	1072553.912

S.O.P. - Dredging Zone 2		
Setting Out Point	Easting (m)	Northing (m)
S.O.P. - 201	422516.458	1072570.364
S.O.P. - 202	422511.930	1072570.768
S.O.P. - 203	422508.939	1072572.041
S.O.P. - 204	422498.347	1072578.198
S.O.P. - 205	422495.971	1072583.144
S.O.P. - 206	422496.983	1072586.282
S.O.P. - 207	422496.530	1072591.458
S.O.P. - 208	422495.745	1072592.099
S.O.P. - 209	422493.633	1072591.681
S.O.P. - 210	422487.724	1072596.106
S.O.P. - 211	422488.521	1072598.870
S.O.P. - 212	422498.685	1072597.533
S.O.P. - 213	422532.325	1072605.028
S.O.P. - 214	422535.249	1072591.526
S.O.P. - 215	422535.800	1072588.970
S.O.P. - 216	422539.551	1072592.450
S.O.P. - 217	422540.482	1072587.726
S.O.P. - 218	422526.357	1072569.889
S.O.P. - 219	422497.228	1072604.073
S.O.P. - 220	422550.973	1072616.083
S.O.P. - 221	422555.904	1072594.016
S.O.P. - 222	422553.053	1072586.136
S.O.P. - 223	422546.860	1072588.760
S.O.P. - 224	422548.938	1072594.467

S.O.P. - Boreholes (Dredge)		
Borehole Ref	Easting (m)	Northing (m)
BH101	422481.240	1072562.401
BH102	422506.324	1072590.920
BH104	422547.840	1072601.450
BH105	422529.635	1072604.779
BH108	422536.840	1072601.850

DRAFT
DO NOT USE FOR CONSTRUCTION

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

It is a requirement that only experienced and competent contractors carry out the work described, using a recognised safe method of working. The following are specific significant residual risks identified by the designer and are additional to those hazards/risks normally associated with this type of work.

CONSTRUCTION:

OPERATIONS:
N/A

MAINTENANCE:
N/A

DEMOLITION:
N/A

FUTURE ANTICIPATED WORK:
N/A

0 25m 50m
1:500

Notes

1. All levels in metres relative to Chart Datum unless noted otherwise
2. Chart Datum is 0.92m below Ordinance Datum
3. All dimensions in millimetres unless noted otherwise.
4. DO NOT SCALE. Follow written dimensions only.
5. The Client accepts no liability for the accuracy of the topographical & bathymetrical information provided
6. The Contractor shall verify all dimensions, elevations, coordinates, and site conditions prior to execution.
7. For general notes refer to drawing XXXXX-XXX-XX-XX-XXXX (insert drawing no.)
8. This drawing shall be read in conjunction with the scope
9. The Project Manager shall be notified immediately of any discrepancy encountered on site.
10. Unless noted otherwise access for ferry operations shall be maintained at all times. Ferry operations shall not be disrupted by the Contractor.
11. Tide levels for the site are as follows:
    a. MHWS: +2.2m Chart Datum
    b. MHWN: +1.7m Chart Datum
    c. MLWN: +1.0m Chart Datum
    d. MLWS: +0.6m Chart Datum

Key to symbols

Denotes Navigational dredging area

Denotes Seabed preparation for proposed infrastructure

Denotes dredging boundary

SOP ?? Denotes dredging boundary setting out points

BH??? Denotes Borehole loacation setting out points

Reference drawings

110173-MMD-FI-XX-DR-C-0100 - Topography
110173-MMD-FI-XX-DR-C-0100 - Bathymetry

Aspect Survey File
A7836_CD
Survey Date 16.06.2022

Rev	Date	Drawn	Description	Ch'k'd	App'd
P01	11.08.23	GM	WORK IN PROGRESS	RC	MR

Status Stamp
WORK IN PROGRESS

MOTT MACDONALD
Greenhead
Lerwick
Shetland, ZE9 0PY
United Kingdom
W www.mottmac.com
T +44 (0)1595 695049
W www.mottmac.com

Client
SHETLAND ISLANDS COUNCIL
Funded by UK Government

Title
Fair Isle and Grutness Replacement Ferry
Fair Isle Ferry Terminal
Dredging Plan

Designed	R. Crewe	RC	Eng. Check	R. Crewe	GS
Drawn	G. Mather	GM	Coordination	R. Crewe	RC
Dwg. Check	M. Simpson	MS	Approved	M. Ross	MR

MMD Project Number: 110173
Scale at A0: 1:500
Security:
Suitability Description: Work In Progress
Suit. Code: S0
Drawing Number: 110173-MMD-FI-XX-DR-C-0201
Rev: P01

Figure 1 **Sediment sample locations across dredge areas**

Samples exceeding Action Levels

Analysis of sediment collected during sampling in 2023, indicated the below contaminant exceedances in a number of samples:

- Chromium and cadmium exceeded the respective Action Level (AL) 1 in one sample each;
- Mercury exceeded AL2 in one of the samples; and
- Four of the Polyaromatic Hydrocarbons (PAHs) marginally exceeded the respective AL1 in one of the samples; these were Benz(a)anthracene; Benzo(a)pyrene; Chrysene; and Diben(ah)anthracene.

All other contaminants analysed were below their respective ALs (Marine Scotland, 2017).

Figure 2, Figure 3 and Figure 4 show the levels of cadmium, chromium and mercury identified in the sediment samples in 2023 against AL1 and AL2.

It can be seen from Figure 2 that although there is cadmium exceedance of AL1 in one of the samples, all remaining samples have very low concentrations well below AL1.

Figure 3 shows that the elevated chromium concentration is exactly 50 ppm, i.e. the AL1 for chromium with all remaining samples having very low concentrations well below AL1.

Figure 4 shows a single sample containing concentrations of mercury above AL2. This exceedance is only present within the depth integrated sample with no contamination detected within the surface sample. This is considered to be a very localised hot spot of contamination as mercury concentrations are extremely low and well below AL1 in all other samples.

The presence of AL1 exceedances of cadmium and chromium in the sediment from surface samples could potentially indicate that elevated concentrations of these metals are from a recent source. However, AL2 exceedance of mercury was only present within the depth integrated sample with no contamination detected within the surface sample at BH108. This could indicate historic contamination at this location.

The presence of Benz(a)anthracene; Benzo(a)pyrene; Chrysene; and Diben(ah)anthracene at concentrations marginally higher than their respective AL1 were recorded at one location (BH105) also located close to the floating pontoon. PAHs can enter the marine environment through atmospheric deposition, run-off, industrial discharges and as a result of oil spills.

Location BH108 where two of the metal exceedances were recorded was located immediately in front of a floating pontoon at the north end of the existing quay. Location BH101 where one of the metal exceedances was recorded is off the end of the pier where the existing ferry is winched from the water on its cradle.

It is possible that historic pollution incidents have contributed to elevated contamination levels at these three locations.

It should be noted that the average concentrations of all contaminants across all sediment samples are well below the respective AL1. Recent communication with the Marine Scotland Licensing Operations Team (MS-LOT) (Teams meeting on 03 August 2023) confirmed that if the average across all samples did not exceed the respective AL1 then the dredge material would be suitable for disposal at sea as the contaminants across the whole dredge volume would be low.

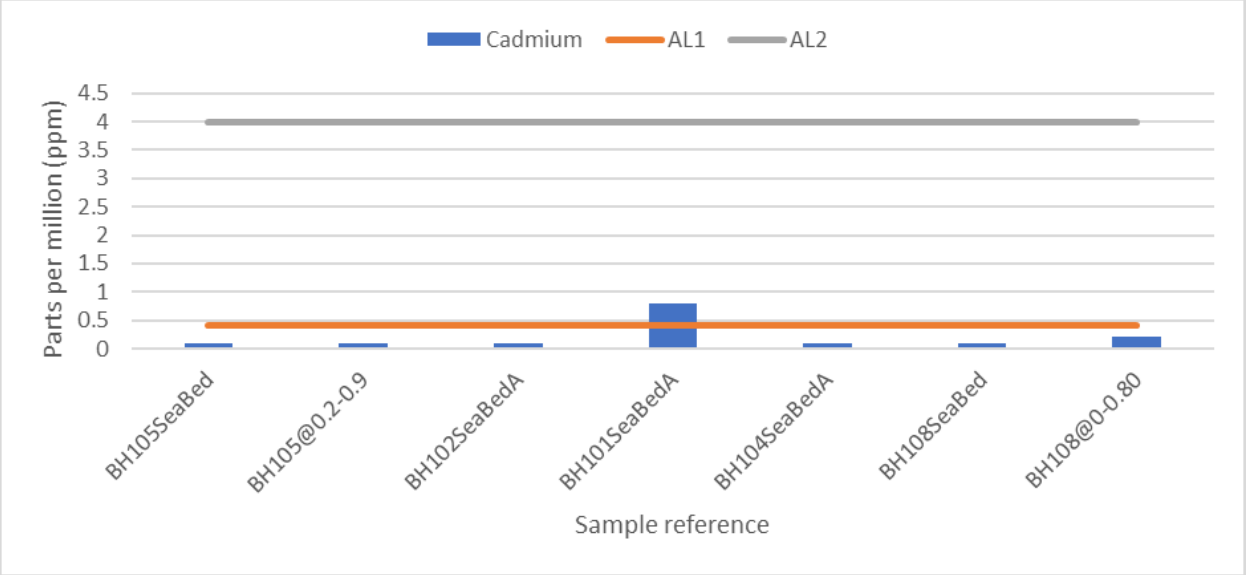


Figure 2 **Cadmium levels in samples in 2023**

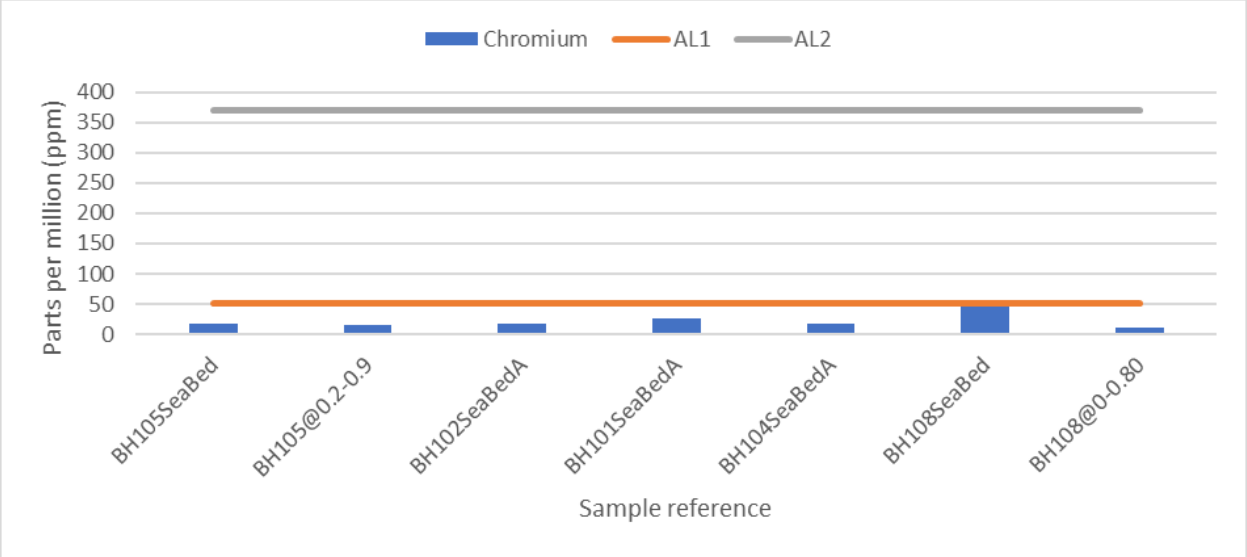


Figure 3 **Chromium levels in samples in 2023**

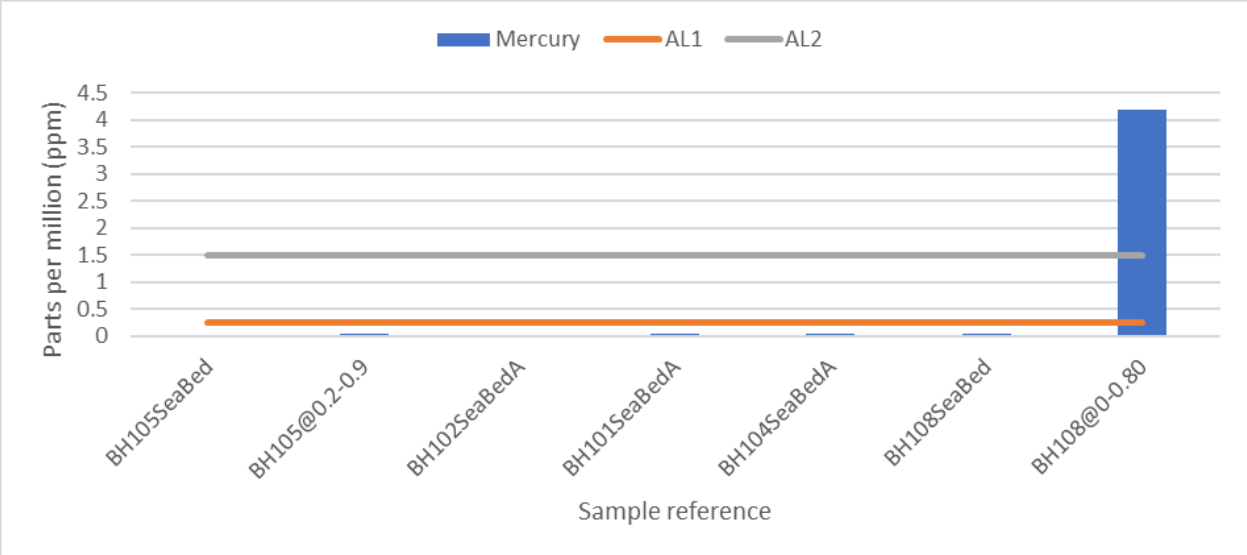


Figure 4 **Mercury levels in samples in 2023**

Prevention

There are three main alternatives for the prevention of generating waste material, including:

- Do Nothing (i.e. do not undertake capital dredging);
- Reduce the dredging requirement; and
- Reduce the disposal requirement.

The main approach to avoiding the generation of waste would be to not undertake the proposed capital dredging. Without capital dredging there would not be sufficient depth to accommodate the new vessel which is essential to replace the existing vessel, as this is approaching the end of its life and does not meet modern standards. The 'do nothing' scenario is therefore not appropriate.

The design minimises the volume of sediment to be dredged, only dredging the necessary volume to prepare the seabed for construction and to accommodate the proposed vessel draft. Detailed bathymetric surveys have informed the selection of the dredge area.

In summary, all measures to prevent and/or reduce the volume of waste generated by the dredging activities have been fully considered.

Re-use, recycling and other recovery

Few cost-effective re-use and/or recycling options have been identified due to the nature of much of the material arising from capital dredging at North Haven. The surface layer of the largest dredge area which is adjacent to the extended quay predominantly comprises of mixed sand and silts (Table 1). As shown in Table 2, approximately 53% of the total dredge volume will comprise of the rock underlying the top layer of sediment. It is considered that this material could represent a good resource for general fill material that could be used as backfill in the local area. However, the material does not meet the standards for beach nourishment purposes or good quality aggregate.

Consideration has been given to use the dredge material as backfill for the quay extension. However, the rock material arising from expansion of the noust is already planned to be used as backfill. It is estimated that the volume required for backfill is too small to require both the rock material from the noust and the dredge material. There are not currently any other planned developments in the local area which would be able to use the material from North Haven. Future road improvements on Fair Isle could potentially use some of the material. However, plans for such improvements are still in the very early stages and it is unlikely that the dredge material would be reused for this in the short term. Shetland Island Council will continually look to re-use a proportion of this material wherever possible to minimise the dredging requirement and also reduce the need of using a more valuable natural aggregate resource in any future developments. No other practical methods for cost effective recovery of the material have been identified at this time, given the type of material and the known developments in the area.

Beach Nourishment/Recharge

The beach at North Haven is the only sandy beach on Fair Isle and is not currently experiencing any erosion. As such there are no local beaches that could reuse the material for nourishment or recharge.

Disposal

The above assessment has considered the options available for management of the capital dredge arisings from North Haven. No beneficial use options have been identified and therefore the BPEO for

the material is considered to be disposal. However, the context in which disposal is achieved has been further considered in the following sections.

Disposal on shore

The nature of the dredged material (a mixture of sand, silt and rock) is unsuitable for sacrificial landfill without involving an extensive transport and treatment process. Disposal to landfill would involve a complicated material handling operation involving sea to land transfer, de-watering, loading to trucks and transport to site. In addition, there would need to be a change in dredger type, for example from a vessel designed for maintenance dredging to one designed for aggregate recovery or a change to a mechanical form of dredger, unless a settling lagoon could be constructed.

Each existing dredger load would produce *circa* 1,000 m^3 of 'semi- wet' material after water has been 'weired-off' from the dredger or de-watered in a settling lagoon on land. This volume equates to *circa* 50-60 lorry loads of material produced at the quayside in a time of 1 – 2 hours to several hours depending on the method of de-watering the dredge arisings. This transport requirement is impractical and very costly as a significant fleet of lorries would be required to prevent significant delays in dredging operations.

Disposal at sea

The identified deposit ground FI095 (Scalloway) is located 65 km away and is the nearest to the area where dredging will take place; thus, relocation in terms of distance is minimised. The main effects of the disposal are all short term and transient in nature. Disposal of the material at this site will not result in any significant impacts on the hydrodynamics, water and sediment quality, marine habitats and ecology of the disposal area. A detailed assessment of the dredge disposal is provided within the Environmental Impacts Assessment Report submitted in support of the construction works (including dredging) marine licence application for the Fair Isle Harbour Improvement Works (Ref no. 00010439).

Summary

The BPEO assessment has not identified any immediate opportunities for the re-use of the dredge material. Without any suitable uses available at the present time, disposal in the marine environment at a licenced disposal ground is considered the BPEO. The optimum disposal location is determined through consideration of practical, environmental and economic parameters. The site has been selected to be as close as practical to the dredge site. This minimises transport time to each site and reduces the carbon footprint whilst minimising transportation cost. The disposal site had no current exclusions that would preclude the deposition of the dredge material, including dredged rock.

Reference

Marine Scotland, 2017. Pre-disposal Sampling Guidance. Version 2 – November 2017.