REPORT

Lochaline Ferry Berth Redevelopment Works

BPEO Report

Client: Caledonian Maritime Assets Limited

Reference: I&BPB4151R001F0.1

Revision: 0.1/Final

Date: 01 August 2018

Royal HaskoningDHV

Enhancing Society Together

HASKONINGDHV UK LTD.

2 Abbey Gardens
Great College Street
London
SW1P 3NL
Industry & Buildings
VAT registration number: 792428892

+44 207 2222115 **T**
info.london@uk.rhdhv.com **E**
royalhaskoningdhv.com **W**

Document title: Lochaline Ferry Berth Redevelopment Works

Document short title:
Reference: I&BPB4151R001F0.1
Revision: 0.1/Final
Date: 01 August 2018
Project name: Lochaline Ferry Berth Redevelopment
Project number: PB4151
Author(s): [Redacted]

Drafted by: [Redacted]

Checked by: [Redacted]

Date / initials: 3/8/18 /[Re

Approved by: [Redacted]

Date / initials: 3/8/18 / [Red

Classification
Project related

Table of Contents

Table of Tables

Table of Figures

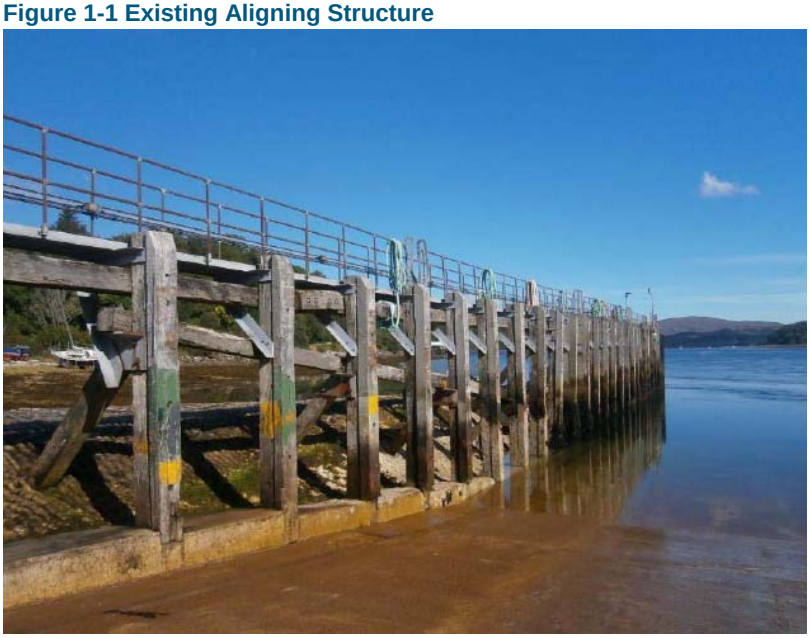
Appendices

1 Introduction

1.1 Background

Lochaline Ferry Terminal is located within the Morvern area on the Ardnamurchan peninsula on the West coast of Scotland. Lochaline Ferry Terminal is owned by Caledonian Maritime Assets Limited (CMAL) and accommodates a regular ferry service operating between the slipway at Lochaline and Fishnish on the Isle of Mull. The existing aligning structure at Lochaline is believed to have originally been constructed in the early 1970s. The structure comprises a series of timber piles at 2.1m centres with longitudinal walings and raking timber struts to the rear of every other pile.

Figure 1-1 Existing Aligning Structure



The structure has been upgraded several times in the past including the addition of a sheet piled inner dolphin circa 1980, the construction of the outer mooring dolphin in 1998 and a crew access walkway in 2016.

The vessels operating on this route have increased in size considerably since the structure was first built which has increased the strain on the structure itself and as a consequence the structure is now continuously being damaged through ‘normal use’. It is therefore considered to have reached the end of its serviceable design life and upgrading works are required to maintain the lifeline ferry service between Lochaline and Fishnish, which is important to the local community and economy.

1.2 Site and works description

1.2.1 Site

Lochaline Ferry Terminal is located within the Morvern area on the Ardnamurchan peninsula on the west coast of Scotland at Grid Ref. NM 679447 (O.S. Landranger Map 49). The ferry terminal is located at the end of a small access road which joins onto the A884 road running north to Strontian (**Figure 1.2**).

Figure 1-2 Site location

1.2.2 Works

The project will consist of the replacement of the existing timber alignment structure with a new continuous twin wall sheet pile alignment structure with a single layer of tie rods. The existing alignment structure will be demolished in 14.5m long sections commencing from the landward end, taking guidance from the Institution of Civil Engineers (ICE): Demolition Protocol 2008. Temporary braced piles will be driven at the seaward end of each cell to protect the works from the ferry during construction of the new facility. The new structure will be built some 2.0m behind the existing berthing line and will consist of 8 adjoining sheet piled cells with internal cellular sheet pile walls between. The new alignment structure will be protected by QME 600 CO element type fenders (or similar). The access walkway linking the current inner dolphin to the outer dolphin will be demolished to accommodate a new, independent, open, piled infill structure which will link the new alignment structure with the outer dolphin whilst accommodating the crew access gangway. Drawings showing the proposed marine works are contained in **Appendix 1.**

Other works included within the scope of the upgrading works are:

a) Upgrading and extension of slipway;
b) Provision of a power supply for a hybrid ferry charging point;
c) Upgrading of the lighting throughout the site (includes marshalling area etc);
d) Increasing the size of the marshalling area; and
e) New through road including passenger drop off and parking.

To facilitate the construction works, as well as to create the required operational water depth, capital dredging of the seabed is required. The depth of material to be removed from proposed dredge footprint is a maximum of -2.23m below chart datum (CD). It is understood that this would equate to approximately 500m^3 of material. The type of dredger used and the associated dredging methodology will be dependent

on which contractor is successful in securing the contract to construct the works and on availability of equipment and will be confirmed in the Marine Licence application for the works.

1.3 Sediment sampling and analysis

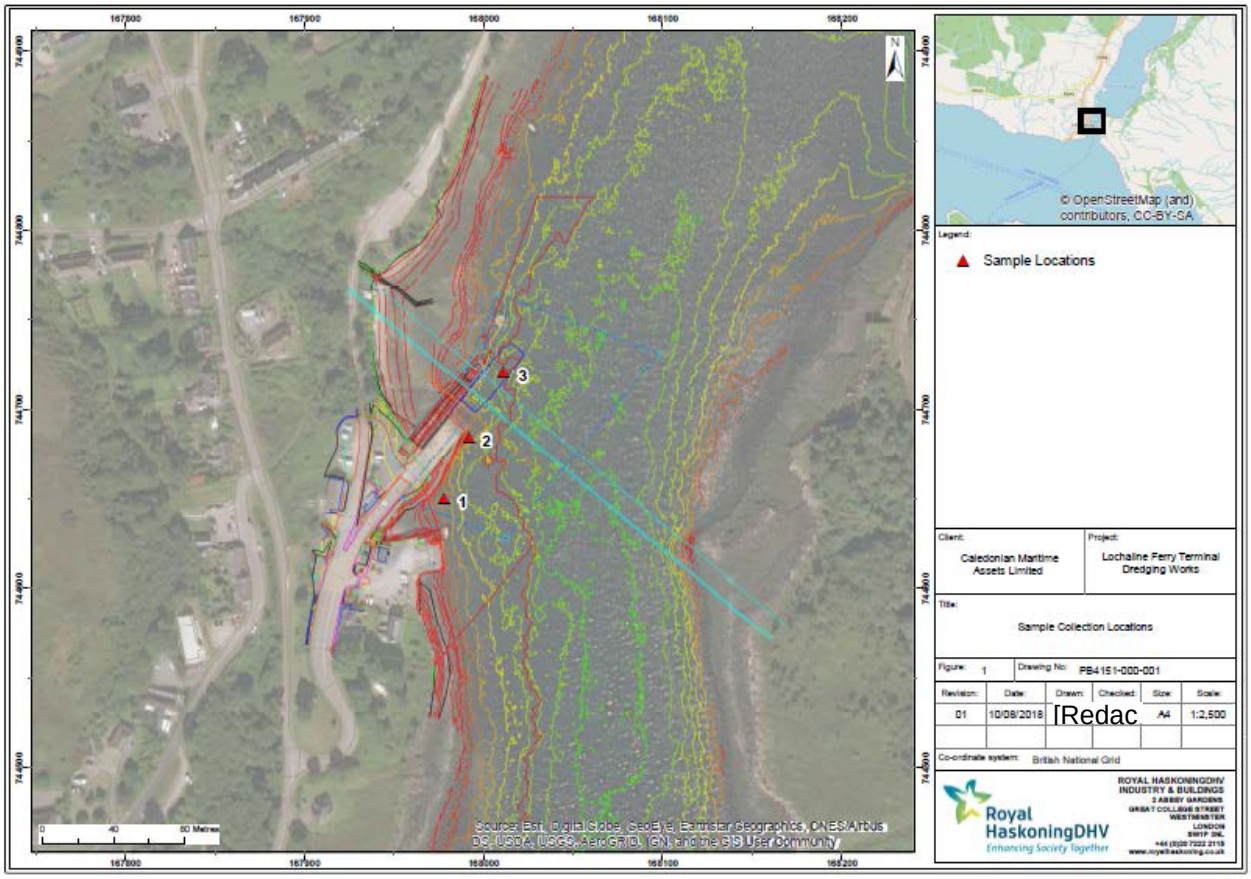
In support of this study, sediment samples were collected from the proposed dredge area and analysed for their physical characteristics (Particle Size Analysis – PSA), metals, organotins, organohalogens and polycyclic aromatic hydrocarbons (PAH's). The sample locations are listed in **Table 1.1** and marked on **Figure 1.3.**

Table 1-1 Lochaline sediment sampling locations

Sample ID	Easting	Northing
Lochaline 1	167978E	744650N
Lochaline 2	167992E	744684N
Lochaline 3	168011E	744721N

The full data set is contained in **Appendix 2**, individual results/data sets are discussed in the relevant sections of this report.

Figure 1-3 Sample Collection Locations



1.4 Report structure

The purpose of this document is to review the available techniques for disposal of the dredged material, to assess the practicality of those methods and to determine the Best Practicable Environmental Option (BPEO). Methods will be considered against their environmental suitability, strategic benefit, health and safety and cost. The report will be structured as below:

Section number	Title	Content
Section 2	Screening of Available Options	Identification and high-level suitability of disposal options.
Section 3	Viable options under consideration	Assessment of viable options identified in Section 2.
Section 4	Conclusion and BPEO	Identification of preferred disposal option.

2 Screening of Available Options

This section outlines the methods that will be considered as part of the BPEO assessment. It is a high-level screening of available options to identify which options are technically viable. Where a method is deemed impractical, either through not being technically feasible, or through having no practical benefit, justification for this is provided and the method is not being investigated further. Methods that are deemed to be viable have been considered in more detail in Section 3.

2.1 Landfill disposal

Disposal to landfill would require dredged material to be transported from the dredge site to an appropriate onshore commercial waste facility. To make the sediment suitable for landfill disposal, several processes would need to be undertaken.

Dredged material would require offloading to shore for treatment prior to disposal. Irrespective of which dredging technique is selected, the dredged sediment is likely to have a high volume of water and would need to be dewatered for some sediment disposal or treatment options to be used. Return of this water to the marine environment once separated from the sediment is not permitted under the Marine (Scotland) Act 2010 so specialised dewatering options (either onsite or offsite) would be required. It is unlikely that the ferry terminal would have sufficient space available to undertake the dewatering processes on site. However, adjacent agricultural land could potentially be used for siting a temporary dewatering facility (with permission from the landowner). Additional transport costs would require consideration of whether offsite dewatering was considered a viable option.

The water removed from the sediment, through either on or off-site dewatering would require sampling. This would be required to ensure the effluent complied with levels set by parameters described in the Trade Effluent Agreement/Consent that is set by the relevant Sewerage Company prior to discharge to a foul sewer.

The dredged material could be transported to a waste disposal and/or treatment facility from site by either land or sea.

Whilst complicated, land disposal is a technically feasible option, therefore the practicality of this option is considered further in Section 3.

2.2 Land incineration and disposal

Samples collected as part of this study indicate that the sediment within the proposed dredge area is mainly coarse sediment (sand and gravels). The bulk of this material would not be combustible and would not result in an appreciable loss of volume prior to disposal, therefore this approach is not considered to be practical and will **not be considered further**.

2.3 Spreading on agricultural land

Based on sediment samples collected as part of this study, the dredged material has a minimum volume of organic material. Therefore, it is considered of limited use for spreading on agricultural land. As the sediment is marine in origin it would need to be dewatered prior to use to prevent saline water polluting terrestrial environments. Dewatering typically does not remove all water content from sediment, although, with the expected sediment type being coarse, drainage of in-water would be expected to be relatively complete.

In addition, the land that is adjacent to the ferry terminal appears to be a mix of grazing pasture and woodland which would not be expected to benefit from the addition of coarse sediment.

Sediment from a marine source would be expected to be high in salt content which has the potential to have deleterious impacts on vegetation and terrestrial surface and ground water environments as the salt leeches out of the sediment.

Given these factors, it is not considered a viable option to spread the dredged material on agricultural land and this option is **not considered further.**

2.4 Reclamation

PSA of sediment samples show that the sediment at Lochaline is dominated by gravel and sand. The PSA has been undertaken with a view to potentially reuse the dredged material and it is possible that it could be used to fill the structure. The use of the material in landscaping is not considered viable due to the risk associated with contaminant levels or saline material contaminating terrestrial environments.

Marine sand and gravel constitute important raw materials for the construction industry, primarily for use as aggregates in the manufacture of concrete. Salt is generally not acceptable in aggregate to be used for reinforced or other structural concrete so the material may require washing before use (Burt, 1997). Once the material is in the form of clean sand / or gravel it may require screening to achieve the desired grading for a specific purpose. Washed and graded marine sand and gravel are normally combined in the proportion of 50:50 to produce concrete and concrete products.

National institutes responsible for the testing of construction material and specification have established that the use of marine sand and gravel is no less appropriate than the terrestrial equivalent (ICES, 2016). In certain cases, marine-sourced material can offer benefits through superior workability resulting from the more rounded nature of individual grains and clasts, and the lack of contamination from soft materials (fine sands, silts, and clays) compared to land-won resources.

As well as the benefits of reducing the volume of disposed waste, avoiding the transport of large quantities of materials by road is also a significant advantage of using material from marine sources. The current proposal is to stockpile dredged material on the end of the partially filled pier. The material would then be segregated with suitable material used to fill the structure. This is considered a viable option and is discussed further in Section 3.

2.5 Disposal to sea

Due to the small scale of the works and the relatively shallow depths indicated at Lochaline, further investigations will be needed to determine the type of dredger that will be able to access the area. Due to possible site access restrictions, it may be the case that material would be removed via a backhoe dredge, long arm excavator or grab. The dredged material could then be transferred to a separate vessel for transport to a suitable disposal site.

There are several potential disposal sites which could be suitable for sea disposal of 500m^3 of sediment, Port Ellen (MA30, approx. 96nm) is the closest site to Lochaline and Cambeltown (MA060, approx.135nm) would be the next closest suitable site. In addition, there are four additional sites that may be viable; Girvan (MA025, approx. 138nm), Ayr Bay (MA050, approx. 152nm), Rothesay Bay (MA016 approx. 170nm) and Cloch Point (MA021 approx. 175 nm)[1].

[1] *Please note that distances are estimates and may change when suitable vessel routes are planned.*

Disposal at sea is a recognised and common method of disposing of marine sediment and suitable facilities are located nearby, it is therefore considered a viable method and is discussed further in Section 3.

2.6 Shoreline disposal

This method would require the removal of dredged material and transportation to an identified disposal site by road and would be considered with the framework of a soft engineering solution to a coastal protection and/or flooding issue. The shoreline around the Isle of Mull and the southern region of the Ardnamurchan peninsula is a mix of low lying rocky coast, coarse sediment (gravel) beaches and small sandy beach inlets. No evidence of beach nourishment in this area is available, the nearest sites to Lochaline that have required beach nourishment since 2000 are at Kirkcaldy (170km from Lochaline) and a number of sites on the Hebrides islands (120km to 130km from Lochaline)[1].

Given the complex logistics of road and sea transport that would be required to transport the sediment to one of these sites and the lack of suitable locations nearer Lochaline, this option is not considered a viable method and is **not considered further**.

2.7 Other beneficial uses

Currently no viable recipient for the material has been identified. It is assumed the material will have a limited capacity for reuse beyond those identified in relation to reuse in reclamation as outlined in Section 2.4, therefore other beneficial uses **are not considered further**.

2.8 Do nothing approach

The current condition of the slipway and maintained depth of the surrounding water is such that a purely 'do nothing' option would not allow the future safe operation of the ferry service and would result in tidal restrictions being placed upon the timetable. The existing aligning structure is believed to have originally been constructed in the early 1970's. The structure has been upgraded several times, but upgrade works have not been sufficient to prevent damage to the structures through increased pressures as a result of the larger vessels that now use the facilities. The existing structure is continuously being damaged through 'normal operation' and is therefore deemed to be at the end of its serviceable design life.

Dredging of the seabed surrounding the slipway is important to ensure that there is a safe, unrestricted operational depth for the ferry. Removal of sediment to -2.23m CD will allow the ferry to access the slipway safely during the lowest tidal conditions.

It is considered that without maintenance/upgrading the structural integrity of the slipway is such that its continued use would represent a health and safety risk to passengers and personnel using the ferry in the near future. The ferry route is deemed to be of importance to the local community and local economy and the option of 'do nothing' is not considered viable for the operation of the ferry and is **not considered further in this document**.

3 Viable options under consideration

3.1 Disposal to landfill

3.1.1 Overview

Disposal to landfill is a viable option in so far as it is technically feasible to remove material from the dredged site to shore, dewater dredged sediment on-site or at a waste management facility and then treat and/or dispose of the sediment.

If dewatering was considered an option on-site, a mobile facility would be needed, which would require transporting to Lochaline and set up at a pre-determined laydown area. Ideally, the facility would be set-up near to point of extraction, with minimal need for transportation between the dredging vessel and the facility. Excess water within sediment prior to dewatering will increase the volume of waste material and therefore would increase the number of HGV trips required to transport sediment to a dewatering facility. Once water is removed, the volume of waste material will decrease, reducing the number of HGV trips required. It is estimated that once de-watered, the sediment would require approximately 25 return HGV trips (based on an assumption of a 20 tonne capacity per-HGV) to transport 500m^3 of sediment to landfill.

In order to determine the most cost-effective method of dewatering, it will be necessary to carry out an analysis of the difference between on-site dewatering costs and transporting dewatered sediment against off-site dewatering and transporting both sediment and water.

Waste water removed during the dewatering process would also need to be disposed of in an appropriate manner regardless of whether dewatering was undertaken on or off-site. The water would require testing prior to being permitted for disposal to foul sewer.

3.1.2 Sediment quality considerations

It is noted that the site at Lochaline is relatively pristine and other than the ferry operations, no historical industrial use at the ferry terminal site or surrounding area has been identified.

Under the Criteria and Procedures for the Acceptance of Waste at Landfills (Scotland) Direction 2005 the general principles for the acceptance of waste at all kinds of landfill are as follows:

Waste may only be accepted at a landfill where its acceptance would not:

- Result in unacceptable emissions to groundwater, surface water or the surrounding environment;
- Jeopardise environmental protection systems (such as liners, leachate and gas collection and treatment systems) at the landfill
- Put at risk waste stabilisation processes (such as degradation or wash out) within the landfill; or
- Endanger human health.

Disposing of marine sediment onshore has the potential to leech saline water into the surrounding area. The dewatering process would need to be undertaken prior to final disposal, however, even after this process, saline water would remain within the sediment. Once buried, this saline water has the potential to leach into surrounding ground overtime potentially causing negative impacts to soils, vegetation and ground water adjacent to the disposal site. To prevent this, material for disposal would need to be placed within a bund to prevent leaching.

Waste water, other than potentially being silt laden, would be expected to be suitable for release back to a foul sewer if it met the standards set by the relevant Sewerage Company. Disposal directly back to sea would not be permitted. Additionally, due to its saline nature, it would not be permissible to release waste water into freshwater or brackish water systems.

Prior to release of waste water, it is likely that silt within the waste water would need to be removed or allowed to settle to prevent silt laden water being released and increasing turbidity in the immediate vicinity of release point. However, due to the low percentage of fines present in tested sediment samples and the mobile nature of the Ardnamurchan peninsula, silt laden water would disperse quickly and would not be expected to result in smothering of the seabed in the immediate vicinity to the release point.

3.1.3 Public health and safety

Tested samples shows that sediment in the dredge area is not likely to be contaminated to levels of regulatory concern, therefore there is a low risk to public health related to sediment quality.

Under this option, approximately 25, 20 tonne HGVs would be required to transport sediment to a dewatering facility (this distance would vary depending on whether the dewatering site was on or off-site) and onwards to the waste disposal facility. Plant movement associated with handling, processing, drying and transporting of the spoil using excavators and HGVs would result in an increase in minor increases in emissions and traffic numbers, although these would not be significant

3.1.4 General ecological implications

The material would be disposed of in an existing facility and it is not anticipated that there would be any deleterious impacts on ecology (flora and fauna).

Potential impacts may arise if seepage of saline water or sediment occurs from the dredged material or and water that is removed. Depending on the extent and location of any seepage this may have impacts on ecological receptors within the vicinity of the seepage. Further investigation would be required to determine the impact of any seepage.

3.1.5 Interference with existing activities

The ferry trip between Lochaline and Fishnish is approximately 18 minutes in duration and a full return journey takes the ferry approximately 45 minutes. Sailings are continuous between the hours of 07:00 and 18:30 although a reduced service runs between October and March.

Given the short periods between ferry landings there is a risk that there will be some disturbance to the ferry during the dredging works, although the construction programme has been designed to minimise disruption during construction. The risk of disruption is likely to be greatest if dredged sediment needs to be offloaded from the dredging vessel to shore for disposal via the slipway as it is unlikely that offloading operations would be fewer than 45 minutes. To reduce impacts on the ferry service any offloading of dredged material would need to be undertaken away from the slipway. This would be technically challenging as pumping spoil onshore may not be technically feasible.

3.1.6 Amenity/aesthetic implications

As the dredged material would be disposed of in an existing facility, it is not considered that there will be any permanent negative or positive aesthetic implications. It is likely that there would be some minor, negative but temporary impacts during handling and transport; however, these would be for the duration of the transport and handling phase.

There would be no further impacts to amenities beyond a temporary disruption to the ferry service.

3.1.7 Environmental summary

If saline water or dredged material seeps out of the dredged material either in the dewatering, transit or transfer processes, there is a risk that flora and/or fauna may be affected. However, this is not considered to be a significant risk if standard procedures and mitigation measures to manage processes are adhered to. Further investigations would be required to determine the extent of any impacts. There are not anticipated to be any other impacts to ecological receptors through this method.

If a dewatering facility is required on-site, careful consideration would need to be given to the placement and requirements of such a facility.

The requirement for transporting material via HGV (approximately 25 return journeys) may result in localised air, dust and noise emissions although these would not be significant.

The offloading and transport of sediment may result in temporary disruption to road users and the ferry; however, these would only be during the transportation and handling phase of the disposal operation.

The disposal of marine sediment to a land disposal site would require management to mitigate the risks discussed in this section.

3.1.8 Strategic considerations

Availability of suitable sites/facilities

Dredged material will need to be removed from site and dewatered prior to being disposed of at an approved landfill facility. Transport to land could either be undertaken by the dredging vessel or separate vessel depending on the methodology of the contractor and the location of the preferred landfill site. Sites with the potential to receive the material according to data provided by the Scottish Environmental Protection Agency (SEPA) include the following:

- Site PPC/A/1022141 at Tobermory on the Isle of Mull (approximately 23km/13nm from Lochaline). The dredged material would likely require transfer by vessel to this site.
- Site PPC/N/0050031 located approximately 10 kilometres to the west of Fort William (approximately 47km direct/40nm by sea from Lochaline). Transport may be possible by road or vessel to this site depending on road capacity, vessel draught, vessel availability and costs.
- Site PPC/A/1008888 located on the Isle of Tiree (approximately 84km/45nm from Lochaline). The dredged material would require transfer by vessel to this site.

Please note that these distances are estimates and may not be completely accurate with road/vessel routes. It is unclear whether these sites have the capacity to dewater, or whether an on-site dewatering facility would be required at Lochaline.

Public acceptability

The potential for disruption to the ferry service and impacts on the transport network required for this option are likely to cause some concern with local residents as there would be temporary visual, noise and traffic disruption at the ferry terminal. The volume of HGVs and presence of onshore dewatering facility may cause concern to local residents and may not be widely accepted.

This may also impact on tourism in the area and cause some visual and access disruptions to tourists travelling using the ferry service, both from the presence of HGVs and a temporary de-watering facility. The degree of disruption will largely be dependent on the time of year the works are undertaken, with the summer months being most sensitive in terms of disruption to tourists.

Disruption to the ferry services would also have the potential to result in disruption to workers and local businesses which are either dependant on or regularly use the ferry to travel.

Residents are unlikely to look favourably on this option in comparison to others due to the potential for disturbance (visual, noise, traffic, real or perceived health and safety concerns, disruption to tourism).

Legislative implications

Dredged material is considered a controlled waste material for the purposes of transport. The Scottish Government have had a Zero Waste Plan in place since 2010 which is aimed at achieving zero waste to landfill.

3.1.9 Strategic summary

Disposal to land would be logistically complex and there are likely to be concerns from the public in relation to the amount of disruption caused by road transport of the material to the disposal site. This method of disposal is likely to be the least favourable in terms of public perception and legislative acceptance. Additionally, it is the method likely to result in the greatest level of disruption to the road network.

3.2 Disposal to sea

3.2.1 Overview

Disposal to sea would require the transportation of dredged disposal material from the dredged site to an identified disposal site. The disposal operation could be undertaken by the dredge vessel or by a separate supporting vessel depending on the type of dredge vessel used and the location of the disposal site.

3.2.2 Sediment quality considerations

The Centre for Environment, Fisheries and Aquaculture Science (Cefas) has set guideline action levels (AL) for the disposal of dredged material. They are not statutory contaminant concentrations for dredged material but are used as part of a weight of evidence approach to decision-making on the disposal of dredged material to sea.

The AL values are may be used in conjunction with a range of other assessment methods, for example, bioassays, as well as historical data and knowledge regarding the dredging site, the material's physical characteristics, the disposal site characteristics and other relevant data, to make management decisions regarding the fate of dredged material.

The AL's are not 'pass/fail' criteria but triggers for further assessment. In general, contaminant levels in dredged material below AL1 are of no concern and are unlikely to influence any licensing decision for disposal. However, dredged material with contaminant levels above AL2 is generally considered unsuitable for sea disposal. Dredged material with contaminant levels between AL1 and AL2 may require further consideration and testing before a decision can be made. Typically, this may require further investigations into historical information, disposal site characteristics and physical characteristics of the material. The details of any required investigation would be confirmed on a case-by-case basis.

The action levels are presented in **Table 3.1** below.

Table 3-1 Cefas Action Levels

Contaminant/Compound	Action Level 1	Action Level 2
mg/kg dry Weight (ppm)		
Arsenic	20	100
Cadmium	0.4	5
Chromium	40	400
Copper	40	400
DBT (dibutyltin)	0.1	1
DDT (dichlorodiphenyltrichloroethane)	0.001	No AL2
Dieldrin	0.005	No AL2
Lead	50	500
MBT (mono-butyltin)	0.1	1
Mercury	0.3	3
Nickel	20	200
PAHs (individual compounds)	0.1	No AL2
PCB's, sum of 25 congeners	0.02	0.2
PCB's, sum of ICES 7	0.01	No AL2
Total hydrocarbons	100	No AL2
TBT (tributyltin)	0.1	1
Zinc	130	800

The results from the sediment analysis at Lochaline are displayed below in **Tables 3.2** to **3.5**. Concentrations above AL1 are highlighted in yellow. None were above AL2.

Table 3-2 Lochaline metals and tins results

Parameter	Lochaline 1 (mg/kg)	Lochaline 2 (mg/kg)	Lochaline 3 (mg/kg)
Arsenic (As)	8.24	3.13	6.46
Cadmium (Cd)	0.17	<0.1	0.15
Chromium (Cr)	42.7	29.6	37.1
Copper (Cu)	40.7	21	29.6
Mercury (Hg)	0.21	0.04	0.04
Nickel (Ni)	24.6	13.1	20.8
Lead (Pb)	217	22.9	28.9
Zinc (Zn)	132	38.4	115
Dibutyltin (DBT)	0.044	0.008	0.016
Tributyltin (TBT)	0.132	0.023	0.055

Table 3-3 Lochaline PAH results

Parameter	Lochaline 1 (mg/kg)	Lochaline 2 (mg/kg)	Lochaline 3 (mg/kg)
Acenaphthene	0.08	0.05	0.15
Acenaphthylene	0.04	0.01	0.11
Anthracene	0.14	0.09	0.14
Benz(a)anthracene	0.21	0.15	0.31
Benzo(a)pyrene	0.23	0.15	0.31
Benzo(b)fluoranthene	0.35	0.26	0.74
Benzo(ghi)perylene	0.17	0.12	0.36
Benzo(K)fluoranthene	0.10	0.07	0.21
Chrysene	0.20	0.15	0.36

Diben(ah)anthracene	0.03	0.05	0.06
Fluoranthene	0.38	0.35	0.69
Fluorene	0.27	0.13	0.59
Indeno(1,2,3-cd)pyrene	0.14	0.10	0.33
Naphthalene	0.39	0.20	1.01
Phenanthrene	0.58	0.33	0.65
Pyrene	0.28	0.22	0.41
Total Hydrocarbon Content*	29.20	28.50	39.50

*No AL's available

Table 3-4 Lochaline organohalogens (PCB) results (sum of ICES7)

Parameter	Lochaline 1 (mg/kg)	Lochaline 2 (mg/kg)	Lochaline 3 (mg/kg)
PCB28	0.0001	0.0001	0.0076
PCB52	0.0002	0.0002	0.0034
PCB101	0.0002	0.0002	0.0028
PCB118	0.0002	0.0002	0.0028
PCB138	0.0002	0.0002	0.005
PCB153	0.0002	0.0002	0.0045
PCB180	0.0002	0.0002	0.0043

Table 3-5 Lochaline PSA results

Parameter	Lochaline 1	Lochaline 2	Lochaline 3
Total solids (%)	75.8	79.9	82.1
Gravel (%)	46.5	13.8	71.1
Sand (%)	50.7	83.1	28.1
Silt (%)	2.87	3.15	0.87
TOC (%)	1.5	0.9	0.6

The data indicates that no levels of any contaminants analysed from the three sample points are above AL2. Site 1 has the highest levels of contamination with concentrations of TBT, zinc, lead, nickel, copper and chromium all in excess of AL1. Nickel concentrations are also in excess of AL1 at Site 3.

A number of PAH's exceed AL1 at all three data collection points, however the greatest number of individual PAH's exceeding AL1 is found at Site 3.

All data for PCB's (Sum of ICES7) were lower than AL1.

The Particle Size Analysis (PSA) data indicates that the sediment is heavily dominated by gravels and sands. This material would settle quickly once deposited into the marine environment from a dredger and result in a highly short-lived, localised increase in turbidity. Silt particles would not settle as quickly and would create a sediment plume during disposal, although the small percentage of fines would result in a relatively small plume which could last up to several hours.

The complex geography of the coastline around the Sound of Mull and Loch Linnhe create a dynamic environment as tidal flows are confined within narrow straits. It is assumed that the Port Ellen disposal site would be the most appropriate site for disposal as it is the closest to Lochaline. If this were to be the case, the fine sediment would be expected to disperse rapidly under natural currents. There would be a temporary increase in turbidity but this would be expected to last no more than several hours (assuming a worst case where all sediment is disposed of in a single operation).

3.2.3 Public health and safety implications

The Port Ellen (MA30, approx. 96nm from Lochaline) disposal site is located at the southern end of the Isle of Islay. Assuming this is the final disposal site, this would require a return journey of approximately 192 nm.

Depending on the contractors' preferred dredging method and available vessel capacity, one trip may be sufficient to transport the full quota of dredged material. On this basis, there would be limited vessel presence which would be in line with background vessel numbers and should therefore not increase safety risk to other sea users.

Any air pollution (either gas or dust emissions) that will be generated by the vessels activities will be out at sea and not near built up areas, there would be no public health or safety implications.

3.2.4 General environmental implications

Due to it being the closest disposal site to Lochaline, disposal at Port Ellen would be the preferred option. Disposal already occurs at this site and any sediment plumes generated during disposal are expected to be limited but likely to result in a temporary increase in turbidity. However, given the location of the disposal site, it would be expected that natural tide and current activities would disperse fines widely and quickly. This would also prevent smothering of seabed habitats adjacent to the disposal site.

There is the potential for transfer of species from the dredge site to the disposal site, although given the proximity and nature of coastal habitats, similar habitat and species composition are likely to present at both dredge and disposal sites.

The journey by vessel to and from the disposal site is not expected to result in ecological impacts unless there is an accidental spillage. The following of standard pollution prevention guidelines will ensure that this risk is reduced to As Low As Reasonably Possible (ALARP).

3.2.5 Interface with existing activities

This method of disposal is not expected to result in significant disruption to the ferry service. Dredged material will be placed directly onto a vessel for transport to the disposal site or be transported by the dredging vessel itself. This would help to minimise disruption to the ferry services and transport networks as there is no need for onward transportation by HGV.

Once at sea the disposal vessel (either dredger or separate transport vessel) will be mobile and use established navigational routes, the disposal vessel is therefore unlikely to present a navigational obstruction to other marine users. The vessel will adhere to standard navigational safety protocols (IMO COLREGS, 1972) minimising the risk of obstruction to other users.

There is a possibility of commercial or recreational vessels being active in Port Ellen during disposal, a Notice to Mariners would be issued to notify other vessels of the disposal works.

3.2.6 Amenity/aesthetic implications

Given the general visual disruption to receptors using the ferry, including tourist and local residents from the works, this method of disposal is not expected to result in added disruption. As this disposal method would not require the landing or transport of dredged material, the visual impact and disruption to the traffic network would be minimal and restricted to the works themselves.

Disposal at Port Ellen would be a relatively short duration operation (24-36 hours return) and would not be anticipated to cause significant visual or noise disturbance to coastal receptors.

It is considered that there will be no significant amenity or aesthetic implications from this method.

3.2.7 Environmental summary

Levels of contaminants within the sediment are below that which would exclude disposal at sea from a regulatory perspective. However, as a number of results indicate concentrations of variables between AL1 and AL2, regulators may request that further investigations are carried out prior to permitting at sea disposal for the dredged material. Sediment and smothering caused by sediment plumes are anticipated to be minimal and there is not expected to be any significant impacts or risks from the loading or transportation phases of the operation.

3.2.8 Strategic considerations

Availability of suitable sites/facilities
The Port Ellen disposal site would be most suitable as it is the closet to Lochaline, however there are several alternative sites within the area that may be suitable options. Given that no samples indicate contaminants above AL2 and the small volume of sediment requiring disposal, all of the sites identified in this document may be suitable options.

Public acceptability
All identified sites are existing disposal facilities and therefore likely to be acceptable from a public acceptability perspective. Additionally, this method would result in minimal or no disruption to public transport or roads and at sea disposal would not add significantly to the disruption of the ferry service.

Legislative implications
Disposal of dredged (marine) material at sea is common practice but requires a Marine Licence. As part of the Marine Licence application all other available options must be considered to determine that disposal at sea is the most suitable method. This is the purpose of this document.

Due to the presence of contaminants in excess of AL1, further studies may be required to assess the suitability of the material for at-sea disposal.

Section 13 of the National Marine Plan requires consideration is given to marine users and activities highlighted within the NMP. It is considered that this dredging activity is essential for continued use of the Lochaline ferry and there would be limited or no disruption to other marine users.

Strategic summary
This method is unlikely to result in disruption to the public or be perceived negatively as the task will be undertaken at sea and away from the public. Other marine users are unlikely to be affected and the level of shipping activity will be in line with baseline conditions. As the proposed disposal site is currently an active disposal site, disposal of dredged material to this site is unlikely to be contentious.

3.3 Reclamation

3.3.1 Overview

PSA of sediment samples indicate that the material to be dredged has good potential to be reused on site as infill for the proposed structure. The depth of material to be removed from proposed dredge footprint is up to -2.23m CD. It is understood that this would equate to approximately 500m^3 of material.

The volume of suitable dredged material relative to the required volume of infill material is currently unknown. Should the volume of dredged material exceed what is required for the structure it may be necessary to consider disposal to landfill or disposal to sea, the implications of which are discussed in Sections 3.1 and 3.2 of this report, respectively. For the purposes of this section of the report it is assumed that all dredged arising's would be reused on site.

It is currently proposed that dredging arisings will be stockpiled on the end of the partially filled pier. From here the arisings will be segregated with suitable material used to fill the structure and the remainder used in identified landscaping areas.

3.3.2 Sediment quality considerations

Tested samples indicate that several variables in the data indicated levels of contamination in excess of AL1. Stabilisation and subsequent reuse of the material as infill for the proposed structure would inhibit exposure of local/ecological receptors to any contaminants contained within the material.

Sediment quality is likely to be of greater consideration if material is used for landscaping areas. It is recommended that the dredged material is not used in landscaping due to concerns about contaminant levels and the potential for saline sediment leaching into the terrestrial environment

It is likely that either solidification and/or stabilisation will be required to pre-treat the sediment prior to any reclamation occurring. The solidification process binds the sediment into a less mobile form through altering the physical characteristics of the material. Stabilisation involves chemical treatment and binders and binds substances into a stable matrix. These processes would enable the sediment to be pre-treated to a state that is suitable for reclamation and that would not pose any environmental risks.

3.3.3 Public health and safety implications

As previously noted, tested samples indicate that sediment in the dredge area is not likely to be contaminated to levels of regulatory concern, therefore based on current understanding there is no risk to public health due to sediment quality.

Under this option it is assumed that all dredged material would be reused on site, either as infill for the structure itself or as landscaping material. As well as resulting zero waste, a major benefit of this option is that it would avoid the transport of dredged material offsite by road, requiring multiple HGV movements (refer to Section 3.1.3).

Sources of air quality contaminants, notably NOx and airborne particulate matter, would be limited to vessel activity and on-site plant movement associated with the handling and segregation of the material. This level of activity would have a negligible effect on air quality at the site.

Disruption to users of the local road network caused by HGV movements would also be avoided. Most importantly there would be no public health or safety implications associated with the movement of HGVs on the local road network.

3.3.4 General environmental implications

Run-off of seawater containing elevated suspended sediment levels is a possible risk associated with the stockpiling of dredged arisings. This has the potential to cause increased sediment loads and turbidity in the adjacent surface water. However, the PSA data indicates that there is a low level of fine sediment in the material and therefore potential impacts of suspended sediment in water would be limited.

Depending on the extent and location of any seepage this may have minor impacts on ecological receptors within the vicinity of the pier. Further investigation would be required to determine the impact of any seepage.

To minimise the risk of sediment laden run off entering into the adjacent water, stockpiled arisings shall be fully bunded to 110% of the volume stored and maintained securely on an impermeable surface. It would not be feasible to store sediment prior to dewatering in a bunded area due to the practicalities of managing the volume of material, the type of storage facility required (tanks) and potentially higher risks of seepage/releases. On this basis, the sediment would require dewatering prior to being stored, this process is also necessary as one phase of stabilisation/solidification.

In the event that any fines did enter the water, it would be expected that natural tide and current activities would disperse them during the transfer of material from the dredging vessel to the storage area.

3.3.5 Interface with existing activities

Given the short periods between ferry landings there is a risk that there will be some disturbance to the ferry during the dredging works, although the construction programme has been designed to minimise disruption during construction. The risk of disruption is likely to be greatest during the offloading of material from the dredging vessel to the specified storage location as it is unlikely that offloading operations would be less than 45 minutes.

To reduce impacts on the ferry service any offloading of dredged material would need to be undertaken away from the slipway. This would be technically challenging as pumping spoil onshore may not be technically feasible. Stockpiling material for reuse on the end of the partially filled pier (as currently proposed) may help to reduce inference with the operational slipway however this requires further investigation.

3.3.6 Amenity/aesthetic implications

As the dredged material would be used as infill for the proposed structure, it is not considered that there will be any permanent negative aesthetic implications. The use of material not suitable for use as reclamation infill for landscaping areas may have positive implications on visual amenity, particularly if landscaping can be used to screen infrastructure associated with the ferry terminal (i.e. through the introduction of landscape planting).

It is likely that there would be some minor, negative but temporary impacts during handling and storage of the material; however, these would be for the construction phase only.

There would be no further impacts to amenities beyond a temporary disruption to the ferry service.

3.3.7 Environmental Summary

Overall there is minimal environmental risk associated with the reuse of dredged material on site. Potential effects associated with sediment run off from stockpiled material would be managed through best practice site management measures.

Nuisance due to sound, vibrations and dust during the handling of dredged material has the potential to cause disturbance to local receptors. However, any such impacts would be localised and temporary during the construction phase only.

Should the option of reclamation be progressed, further investigations would be required to determine the full extent of potential environmental impacts.

3.3.8 Strategic considerations

The reuse of material on site is likely to the most acceptable option from a public acceptability perspective as this option would result in minimal or no disruption to public transport or roads. It is also the option that is most aligned with Scottish Governments Zero Waste policy.

The detail on how and where marine sourced material will be stored on site is not currently available but it is likely to have some implications on existing site operations. Further investigation is required to determine the level of disruption of the ferry service.

Importantly, this option adheres with objectives set out in Scottish planning policy to minimise and seek alternatives to seabed and landfill disposal.

4 Summary of options

Table 4.1 below outlines all options considered within this study.

Table 4-1 – Summary of options

Option	Viability	Justification
Landfill disposal	Viable	Although technically viable, offloading of material onto shore would be potentially challenging and transportation would require the 25 return journeys by 20 tonne HGVs. The use of HGVs would increase air and noise pollution and is unlikely to be considered favourable from a public perspective. With a high volume of HGVs on the road there is likely to be some disturbance to the road network and an increased risk of collision. Disposal to landfill is also non-compatible with the Scottish Government's Zero Waste Plan which is aimed at achieving zero waste to landfill.
Land incineration and disposal	Not viable	The dredged material is non-combustible and therefore there is little or no benefit to combustion, this option is therefore not viable.
Spreading on agricultural land	Not viable	It is unlikely that material, being saline in nature, would be suitable for agricultural disposal. Sediment treatment similar to that required for land disposal would be required, plus additional measures to reduce salinity would need to be undertaken. This option is not considered viable.
Reclamation	Viable	Marine sand and gravel are important raw materials for the construction industry. This option would avoid transport of large quantities of land materials by road is a significant advantage of using material from marine sources. Additionally, re-use of material is a favourable option within the waste hierarchy and this option is compatible with the Scottish Government's pledge to reduce the volume of material being sent to landfill to zero. **This option is considered the preferred method.**
Disposal to sea	Viable	Disposal to sea would require the transportation of dredged material to the disposal site. No environmental or strategic impacts have been identified that would cause this method to result in damage to the environment or contention with local residence. On this basis, this option is considered feasible.
Shoreline disposal	Not viable	Currently there is no identified site suitable for shoreline disposal. The nearest locations to Lochaline that have requited beach nourishment through disposal of material are situated a minimum of 120km away. The transport required would result in localised air pollution and noise disturbance as well as disruption to the road network. This option is therefore not considered viable.
Other beneficial uses	Not viable	There are no other uses that have been identified at this stage; therefore, this is not considered a viable option.
Do nothing approach	Not viable	To do nothing would result in tidal restrictions being placed on the existing lifeline ferry service. This option is not considered feasible.

5 Conclusions - Best Practicable Environmental Option

Table 5-1- ranking of available options

Option	Practicability	Strategic	Environment	Cost	Total	Option Rank
Landfill	3	3	3	3	12	**3**
Sea	2	1	2	2	7	**2**
Reclamation	1	2	1	1	5	**1**

A more detailed justification for the ranking in **Table 4.1** is provided below;

Rank 1: Reclamation was ranked 1st due to the following reasons;

- This option would largely minimise disruption beyond the immediate site footprint, beyond plant required for material extraction, construction and associated activities;
- Transport of material by land or sea for disposal would not be required;
- Re-use of material is a favourable option within the waste hierarchy and this option is compatible with the Scottish Governments pledge to reduce the volume of material being sent to landfill to zero;
- Impacts on local communities in relation to disruption and potential nuisances such as increased noise and emissions would be largely avoided, however some impacts on ferry movement would be expected during the works.

Rank 2; Disposal to sea was ranked 2nd due to the following reasons;

- 500m^3 is a relatively small volume of sediment and is unlikely to result in significant smothering or levels of suspended sediment at the disposal site;
- The method is considered more environmentally acceptable than disposal to landfill;
- The method is least likely to result in disruption to the public or road users and is least likely to cause public concern;
- Sediment would not require extensive treatment of sediment prior to disposal

Rank 3: Disposal to landfill was ranked 3rd due to the following reasons;

- This option has the potential to result in negative environmental impacts through the introduction of saline water (and sediment) to terrestrial ground and water habitats.
- Waste water from dewatering would be saline and silt laden and would likely need to be disposed of to sea with the potential of causing sediment plumes.
- Transport off material off-site would be required. Although, not significant impacts these would not occur with the other options.
- This option is likely to generate the most public concern due to the level of traffic movement required.
- The amount of transportation and processing required would be expected to make this the most technically challenging and therefore the most expensive option.

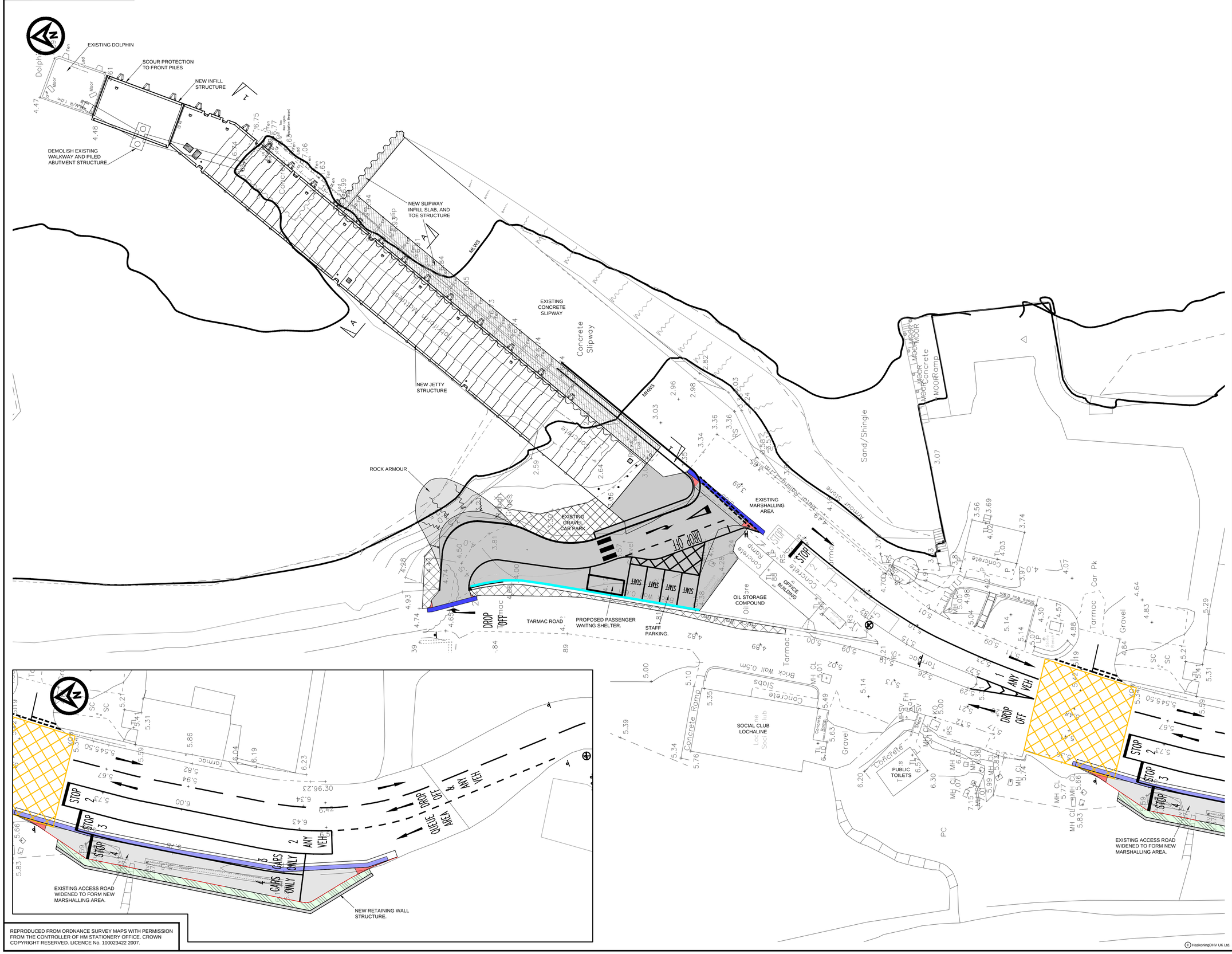
6 Best Practicable and Environmental Option

Based on the discussion provided above, we consider that reclamation represents the most viable option in terms of minimal ecological, environmental and strategic considerations.

A1 Proposed works drawings

DRAWING No.
PB4151-XXX-GA-DR-0002

DO NOT SCALE



NOTES

1. ALL LEVELS ARE GIVEN IN METRES RELATIVE TO ORDNANCE DATUM (OD).
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. ORDNANCE DATUM (OD) = +2.10m CHART DATUM (CD).

REV	DATE	DESCRIPTION	BY	CHK	APP
T1	25.05.18	TENDER ISSUE	YH	SCH	JGF

REVISIONS

CLIENT

CMAL
Caledonian Maritime Assets Ltd
Stòras Mara Cailleannach Eta

PROJECT

LOCHALINE
FERRY TERMINAL WORKS

TITLE

PROPOSED GENERAL
ARRANGEMENT PLAN

Royal HaskoningDHV
Enhancing Society Together

HASKONINGDHV UK LTD
MARITIME & AVIATION
74/2 Commercial Quay, Commercial Street
Leith, Edinburgh
EH6 6LX
Tel +44 (0) 131 555 0506
Fax +44 (0) 131 555 0502
info.edinburgh@rhdhv.com
www.royalhaskoningdhv.com

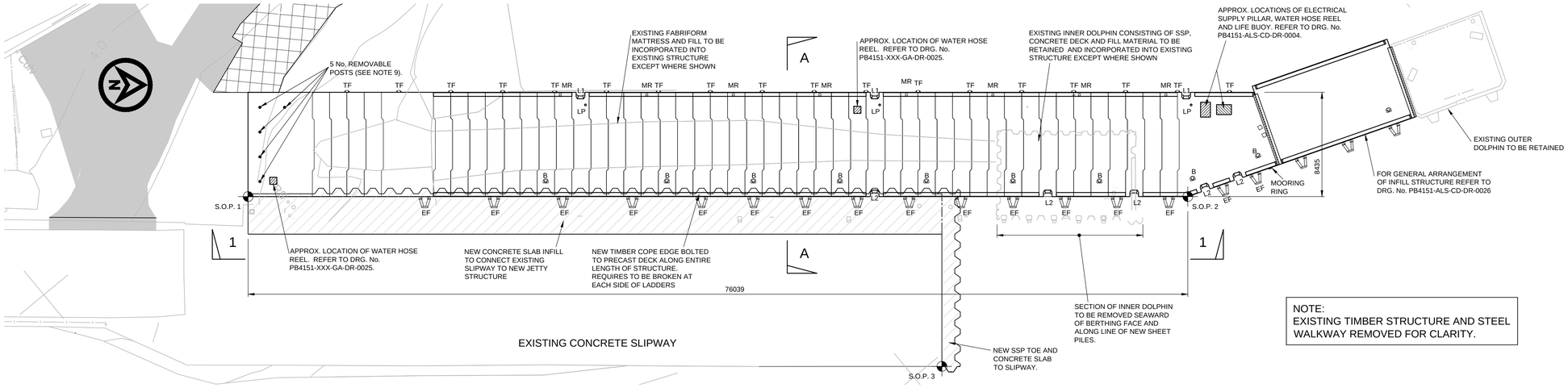
DRAWN	CHECKED	APPROVED
[Re	[Re	[Re
DATE SEPT. '17	SCALE AT A1 1:250	[Reda

DRAWING No. PB4151-XXX-GA-DR-0002

REVISION T1

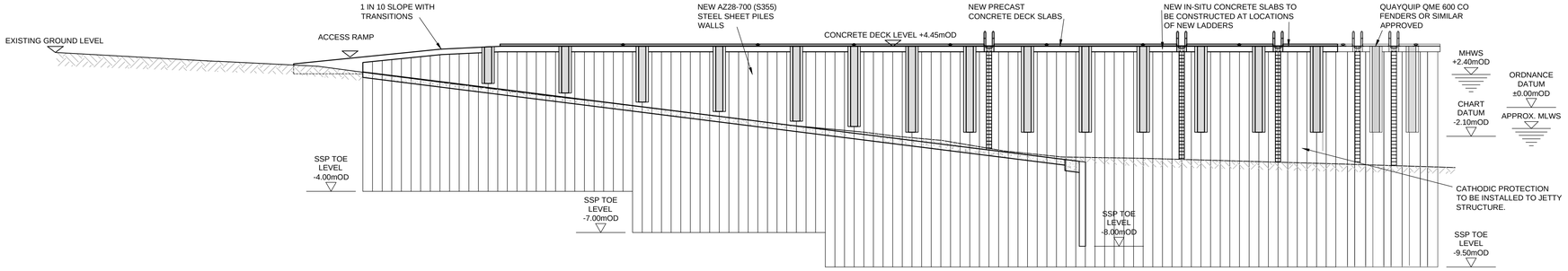
DRAWING No.
PB4151-ALS-GA-DR-0003

DO NOT SCALE

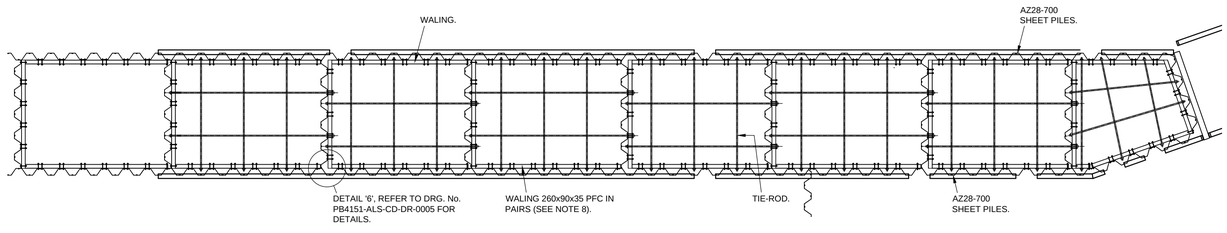


NOTE:
EXISTING TIMBER STRUCTURE AND STEEL WALKWAY REMOVED FOR CLARITY.

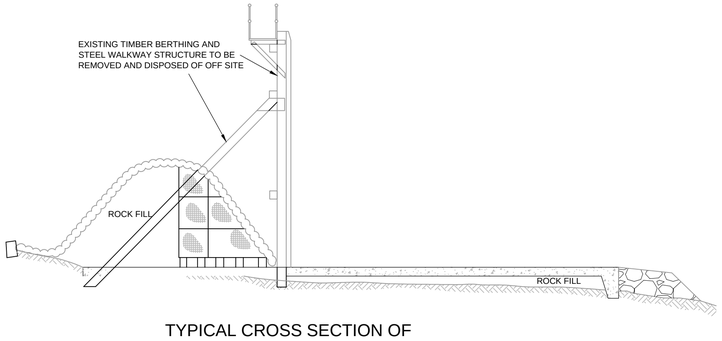
PLAN ON STRUCTURE AT DECK LEVEL (1:200)



ELEVATION 1-1 (1:200)

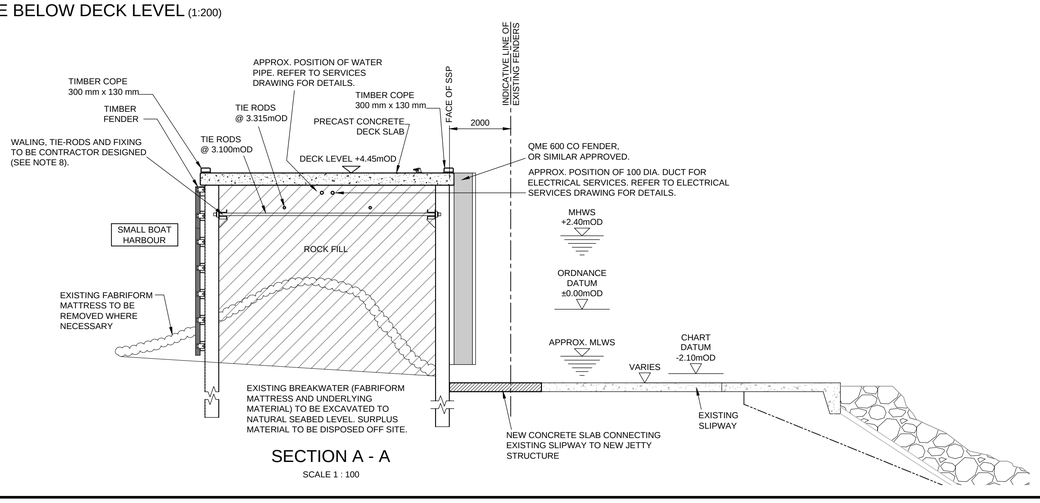


PLAN ON STRUCTURE BELOW DECK LEVEL (1:200)



TYPICAL CROSS SECTION OF EXISTING STRUCTURE

SCALE 1 : 100



SECTION A - A

SCALE 1 : 100

NOTES

1. ALL LEVELS ARE GIVEN IN METRES RELATIVE TO ORDNANCE DATUM (OD).
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. ORDNANCE DATUM (OD) = +2.10m CHART DATUM (CD).
4. REFER TO DRG No PB4151/XXX/GA/DR/0002 FOR GENERAL ARRANGEMENT.
5. LONGITUDE AND LATITUDE COORDINATES TO OSGB36.
6. CONTRACTOR SHALL DESIGN AND INSTALL A SACRIFICIAL ANODE CATHODIC PROTECTION SYSTEM IN ACCORDANCE WITH THE SPECIFICATION.
7. REFER TO DRG. No. PB4151-ALS-CD-DR-0004 TO 0007 FOR CONSTRUCTION DETAILS.
8. WALINGS, TIE RODS AND FIXINGS SHOWN INDICATIVE ONLY. WALINGS, TIE RODS AND FIXINGS TO BE CONTRACTOR DESIGNED TO SUIT TIE ROD MANUFACTURER'S GUIDANCE. CONTRACTOR TO ENSURE THE WALING DESIGN MAINTAINS CONTINUITY INTO THE INTERNAL CROSS WALLS WHERE REQUIRED BY THE DESIGN.
9. REFER TO DRG. No. PB4151-ALS-CD-DR-0007 FOR DETAILS OF REMOVABLE POSTS.

LEGEND

TF	TIMBER FENDER
EF	ELEMENT FENDER
B	BOLLARD
L1	LADDER TYPE 1
L2	LADDER TYPE 2
LP	LAMP POST
MR	MOORING RING

SETTING OUT COORDINATES

REF.	EASTINGS	NORTHINGS
S.O.P. 1	167954.41	744667.80
S.O.P. 2	168002.87	744726.39
S.O.P. 3	168000.78	744702.30

REV	DATE	DESCRIPTION	BY	CHK	APP
T1	25.05.18	TENDER ISSUE	YH	SCH	JGF

REVISIONS

CLIENT

CMAL
Caledonian Maritime Assets Ltd
Stòras Mara Cailleannach Eta

PROJECT

LOCHALINE
FERRY TERMINAL WORKS

TITLE

NEW ALIGNMENT STRUCTURE AND SLIPWAY
GENERAL ARRANGEMENT AND CROSS SECTIONS

Royal HaskoningDHV
Enhancing Society Together
HASKONINGDHV UK LTD
MARITIME & AVIATION
74/2 Commercial Quay, Commercial Street
Leith, Edinburgh
EH6 6LX
Tel +44 (0) 131 555 0506
Fax +44 (0) 131 555 0502
info.edinburgh@rhdhv.com
www.royalhaskoningdhv.com

DRAWN	CHECKED	APPROVED
[R	[R	[Re
DATE: SEP '17	SCALE AT A1: AS SHOWN	CAD REF.: [Redacted]

DRAWING No. PB4151-ALS-GA-DR-0003

REVISION T1

A2 Sediment quality raw data

Physical data:

Sample ID	Dredge area	Latitude										Longitude											Total solids (%)	Gravel (%)	Sand (%)	Silt (%)	TOC (%)
Lochaline 1		5	6	°	3	2	.	1	8	1	'N			-5	°	4	6	.	5	0	2	'W	75.8	46.5	50.7	2.87	1.5
Lochaline 2		5	6	°	3	2	.	1	9	3	'N			-5	°	4	6	.	4	9	5	'W	79.9	13.8	83.1	3.15	0.9
Lochaline 3		5	6	°	3	2	.	2	1	5	'N			-5	°	4	6	.	7	7	4	'W	82.1	71.1	28.1	0.87	0.6

Metals and tins data:

Sample ID	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Mercury (Hg)	Nickel (Ni)	Lead (Pb)	Zinc (Zn)	Dibutyltin (DBT)	Tributyltin (TBT)
	mg/kg dry weight									
Lochaline 1	8.24	0.17	42.7	40.7	0.21	24.6	217	132	0.044	0.132
Lochaline 2	3.13	<0.1	29.6	21	0.04	13.1	22.9	38.4	0.008	0.023
Lochaline 3	6.46	0.15	37.1	29.6	0.04	20.8	28.9	115	0.016	0.055

PAH data:

Sample ID		Lochaline 1	Lochaline 2	Lochaline 3
	ACENAPTH	84.4	54.4	149
	ACENAPHY	36.2	14.9	110
	ANTHRACN	138	88.1	144
	BAA	209	149	312
	BAP	227	149	309
	BBF	346	255	741
	BEP			
	BENZGHIP	173	124	363
	BKF	96.1	74.1	207
	C1N			
	C1PHEN			
	C2N			
	C3N			
	CHRYSENE	204	146	362
	DBENZAH	31.6	51.4	63.2
	FLUORANT	384	353	690
	FLUORENE	269	131	590
	INDPYR	135	98.6	330
	NAPTH	392	195	1010
	PERYLENE			
	PHENANT	577	326	654
	PYRENE	275	224	406
µg/kg	THC	29200	28500	39500

Organoghalens data (ICES7):

Sample ID	PCB28 µg/kg	PCB52 µg/kg	PCB101 µg/kg	PCB118 µg/kg	PCB138 µg/kg	PCB153 µg/kg	PCB180 µg/kg
Lochaline 1	<0.1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Lochaline 2	<0.1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Lochaline 3	7.6	3.4	2.8	2.8	5	4.5	4.3