Mallaig Outer Harbour Improvements

Capital Dredge Best Practicable Environmental Option Report

MALLAIG HARBOUR AUTHORITY

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Contents

1 Introduction

This Best Practicable Environmental Option (BPEO) report has been produced to support the dredge and disposal marine licence application under the Marine Works (Scotland) Act 2010 for the proposed Mallaig Outer Harbour improvements (MOHI) development.

1.1 Aims and Objectives

The purpose of this report is to identify and assess the available options for the use/disposal of dredged materials, arising from the development of MOHI development.

The objectives are:

- To provide an overview of the required dredging works;
- Describe the proposed areas for which a dredging campaign is required, including estimated quantity of dredged material likely to be removed;
- Describe the BPEO methodology employed to complete the assessment; and
- To identify and assess options for disposal of dredged material to determine the BPEO for disposal of dredge spoil.

2 Background

Mallaig is a port situated on the west coast of Scotland in the region of Lochaber. The town is situated approximately 42 miles from Fort William at the end of the A830, also known as the Road to the Isles. Mallaig harbour (National Grid Reference: NM 67585 97217) is a working fishing port and a ferry route to the Inner and Outer Hebrides, the Small Isles, and the Knoydart Peninsula. The harbour is managed by the MHA (Mallaig Harbour Authority) and the Harbour Limits encompass the whole of the Harbour basin and approach channel.

There is currently a demand for berthing space within the harbour, primarily to provide additional berthing for fishing vessels but also for an additional CalMac ferry. The MHA's Masterplan details proposals for improving wave climate in the Outer Harbour along with freeing up berth and quayside space due to the high demand for berthing and refuge within the harbour basin, particularly during bad weather when fishing vessels seek shelter.

MHA are proposing to construct a new splay berth, ferry berth, and deepen the waters within the Outer Harbour area of Mallaig Harbour. The development, including the deepening, will cover a total area of 33,000m² and will provide additional berthing space, operational quayside, and laydown space, primarily for the fishing and aquaculture sectors. The harbour improvements will accommodate an increased number of vessels and the dredge will allow for deeper draughted vessels, including well boats, to enter the Outer Harbour in all tidal states.

The outer basin has operated within a restricted depth of -4m Chart Datum (CD) since 1998 when the Outer Harbour was constructed due to budget limitations, however, plans to dredge to -6m CD were allowed for in the design for the future. There is demand to accommodate deeper draughted vessels within the Outer Harbour and for vessels not to be tidally restricted from using the facility. Working under a 'tidal curfew' has been reported as causing issues for fish farm well boats when trying to work to normal staffing and shift patterns at the Mallaig harvest station. It is anticipated that the proposed increase in basin depth to -6m CD will not only ease the tidal curfew issues experienced by fish farm well boats but will also

increase the potential for use of the harbour by small cargo vessels and larger trawlers. It will also improve access to the ice plant for the larger fishing vessels.

Marine licence applications are being sought to allow these improvements to be carried out.

2.1 Dredge Areas and Volumes

Dredging required for the MOHI development will be carried out across approximately 85% of the footprint of the Outer Harbour basin, plus the entrance. Dredging will be carried out to increase the depth from the current level, typically between -4m and -5m CD, to a new level of -6m CD.

The proposed dredge area will comprise an area of 20,100m^2 excluding buffers, see Drawing MOHI-WS2175-XX-00-D-C-9006. An application is being made to consent an area of 23,024m^2, see Drawing MOHI-WS2175-XX-00-DR-C-9106. An estimated total of up to 37,500m^3 of spoil will arise from the dredge made up of 17,500m^3 of bedrock which will need to be blasted and 20,000m^3 soft/loose deposits/overburden. These have been defined as Area B - Hard and Area A – Soft respectively on the dredge licence application.

Specific gravity will vary across the dredge area, for the purpose of this document and the licence a specific gravity of 2 has been assumed, therefore the mass of the combined dredge materials is approximately 75,000 tonnes.

Dredge material removal is expected to be carried out by a backhoe or grab dredger working from floating plant and by a long reach excavator working from shore, a temporary bund or quayside.

2.2 Sampling

Marine Scotland Guidance requires, as a minimum of five sample locations in relation to the proposed volume of the dredge. Seven locations were sampled in order to give an understanding of potential contamination across the entire dredge area. Where the proposed dredge depth is greater than 1m, core sampling was carried out, in line with the guidance and in agreement with Marine Scotland prior to sampling. Additional boreholes were drilled, to understand the geology, the cores from which were not subject to chemical analysis.

Sampling was conducted by Holequest Ltd in line with Marine Scotland Guidance notes on Pre-Disposal Sampling (Marine Scotland, 2017). The borehole logs are provided in Appendix 1.

Sampling was completed using land based vibrocore equipment to achieve core depths up to 13m, equivalent to -18.70m CD. Table 2.1 details the positions of the vibrocore sample stations (Boreholes (BH)) and grab sample (GS) locations utilised for the pre-disposal sampling.

As per Drawing MOHI-WS2175-XX-00-DR-C-0005, four grab samples (GS) (GS9-12) were taken in locations where either the dredge is less than 1m or the amount of overburden is less than 1m (namely GS09). Two core samples (BH05 and 06) were taken where the overburden is greater than 1m. BH02 was anticipated to have less than 1m of overburden but was drilled for geotechnical reasons and was therefore utilised as a sample point. The borehole logs (Appendix 1) show that rock was not encountered above the proposed dredge depth of -6m CD in the three boreholes subject to sampling (BH02, 05 and 06).

The Marine Scotland Guidance notes on Pre-Disposal Sampling (Marine Scotland, 2017) requires cores to be sampled at the surface, then every 50cm, with the three of these classed as surface, middle and bottom being analysed. However, this was not possible in this instance due to the core material encountered. As detailed in the borehole log, the first 3.10m (to -7.77m CD) of BH02 were made up of grey silty sandy, cobbles and boulders of schist including shells. The large components of which were not suitable for chemical analysis. Hence, only a surface sample was achieved.

BH05 initial 0.5m to -4.78m CD comprised of sand and gravel which was sampled. Below this level to 8.9m (-13.18m CD) was slightly gravelly fine to coarse sand gravel, only one sample of which was retrievable for analysis this was 1.3m down (-5.58m CD).

BH06 was gravelly fine to coarse sand and included shell and shell debris to 3.7m (-9.5m CD). The seabed level in this area was -5.8m CD, hence only a shallow dredge will be required in this area to reach -6m CD. A surface sample was taken and one at 1m (-6.58m CD) to provide an understanding of potential contaminants at deeper depths, augmenting the understanding gained from samples retrieved in the other GS and BH.

Table 2.1 summarises the samples achieved.

Table 2.1: Coordinates and Depths of Sampling Stations

Sample ID	Sample Depths (m)	Depth Below CD (m)	Latitude (N)	Longitude (W)
BH02	0	-4.67	57°00.507′	5 °49.652′
BH05	0	-4.28	57 °00.499′	5 °49.567′
	1.3	-4.58		
BH06	0	-5.80	57 °00.473′	5 °49.575′
	1	-6.80		
GS09	0	-4.9	57 °00.467′	5 °49.659′
GS10	0	-5.7	57 °00.488′	5 °49.582′
GS11	0	-5.3	57 °00.515′	5 °49.529′
GS12	0	-5.9	57 °00.485′	5 °49.518′

3 Sample Analysis

All vibrocore samples were analysed by RPS who are accredited to ISO17025. All samples were tested for a suite of chemical parameters analysed against the Action Levels (AL) prescribed by Marine Scotland in the Pre-Disposal Sampling guidance (Marine Scotland, 2017).

Arsenic (As) results have been affected by manufacturer contamination of the Hydrofluoric acid (HF) used in the digest, leading to over-recovery of As, estimated at ~28mg/kg. Cadmium (Cd) and Lead (Pb) results have also been affected by contamination in the HF. This caused under-recovery of Pb and Cd and has been estimated to be up to 75% and 50% respectively.

4 Results

The results of the vibrocore samples analysis have been summarised in this section. The full sample results are available within the spreadsheets entitled, 'Mallaig Pre-disposal Sampling Results,' which has been provided with the dredge licence application.

4.1 Particle Size Distribution

Particle size distribution (PSD) analysis identified that the soft dredge comprised of 66.4% solids of which 13.7% was gravel, 63.2% sand, and 23.1% silt on average across all samples. It is however noted that samples weren't obtained from some cores due to the presence of larger components such as cobbles, hence it is likely that the soft dredge will include large size fractions also. The hard dredge is expected to be 10% boulder, 45% cobble, 30% gravel and 15% sand.

4.2 Trace Metals and Organotins

As shown in the Mallaig Pre-Disposal Sampling Results Spreadsheet, there were exceedances of AL1 of Mercury (Hg), Arsenic (As) in all samples and Lead (Pb) in GS10. The burning of coal is the largest source of Hg air pollution and is also a source of Pb, Cd and As (Union of Concerned Scientists, 2017). The railway used by the steam trains between 1901 to 1967 previously continued into the harbour, to allow fish to be transported by rail (Mallaig Heritage Centre, 2021). Deposition of these elements from the air directly into water or onto ground where they can be picked up in surface water run of are potential sources of this pollutant in the Mallaig Outer Harbour area.

The AL1 for Hg is 0.25mg/kg with AL2 being 1.5mg/kg. All samples have levels slightly above AL1, ranging from 0.26 to 0.32mg/kg, the highest of which is less than 22% of the AL2 level. The relatively consistent levels of Hg measured align with the airborne disposition theory. The average wet weight Hg content of all the samples is 0.18mg/kg which is below AL1. The minor breach of AL1 is unlikely to prevent the material being suitable for disposal at sea. Based on the Soil Guideline Values (SGV) (CL:AIRE, 2021) it may not be suitable for residential uses due to being above 10mg/kg but could be suitable for reuse in commercial settings as it is less than 26mg/kg on average.

As discussed in Section 3, there is an issue with As results such that they may be up to 28mg/kg higher than the actual levels. The highest sample result recorded in GS12 is 41.1mg/kg dry weight. This is only 21.1mg/kg higher than AL1 (20mg/kg), hence taking account of the reagent issue the actual results for all the samples are probably below AL1. As shown in the PR-Details tab, the average wet weight sample is 25.64. Due to the analysis issue, it is assumed that the dredge material is not As contaminated to an extent that would restrict its disposal at sea. Furthermore, it is well below all SGV's (CL:AIRE, 2021) and hence suitable for any onshore reuse purpose from an As perspective.

AL1 of Pb is 50mg/kg, and AL2 is 400mg/kg. Only one sample detected Pb above AL1, however, Pb has potentially been under recorded by up to 75%. The dry weight average of the reported results is 21.3mg/kg which could equate to up to 85mg/kg. The worst-case wet weigh average could be 59.6mg/kg, hence the sediments may be subject to Pb contamination above AL1 but at levels less than a quarter of AL2. As such, the materials are unlikely to give rise to any environmental harm if disposed at sea. Furthermore, they would be suitable for both residential and commercial uses from a Pb perspective based on SGV's (CL:AIRE, 2021).

Cd levels measured were all below the Level of Detection (LOD) of 0.1mg/kg, hence even if they were under recorded by 50%, there is no evidence that they could breach the AL1 of 0.4mg/kg.

Based on the metal analysis, the material is suitable for disposal at sea and reuse in commercial settings, although a specific assessment may be required to demonstrate that the planned reuse is acceptable.

4.3 Polyaromatic Hydrocarbons (PAH)

As shown in the Mallaig Pre-Disposal Sampling Results Spreadsheet, there were exceedances of AL1 of the following PAHs; Acenaphthene in BH05 and Diben(ah)anthracene and Fluoranthene in GS11. There are no Total Hydrocarbon (THC) AL1 exceedances and on average there are no AL1 exceedances. As such the material is acceptable from a PAH perspective for disposal at sea or reuse.

4.4 Organohalogens

No exceedances of AL1 were found in any of the samples for organohalogens, see the Mallaig Pre-Disposal Sampling Results Spreadsheet.

5 BPEO Method

5.1 Introduction

In identifying the BPEO for this proposed dredge campaign the following methodology has been employed:

- Identification of options available for the disposal of material;
- Screening to eliminate unsuitable options;
- Scoring of remaining options; and
- Comparison of options and identification of the BPEO.

5.2 Option Identification

Options were identified through discussions with Mallaig Harbour Authority and engineers from Wallace Stone.

5.3 Screening

All options have been screened against minimum criteria which each option had to meet in order to be taken forward for detailed consideration. Any option which failed to meet one or more of the criteria was not taken forward to the detailed assessment. The criteria used were:

- The proposed option must be suitable for the characteristics of the dredge material;
- It must be technically viable;
- It must allow for the development of the MOHI within the existing development programme; and
- Allow for continued use of the Mallaig Harbour during construction, with no operational impact.

5.4 Scoring

Options were scored against a list of attributes ensuring that the same considerations are given to each option so that they can be compared fairly. Attributes were identified to ensure that environmental, technical, and cost considerations were taken account of in the decision-making process.

Attributes were scored out of 5 with 1 being the worst and 5 being the best. The definitions for each criteria were decided prior to the options being assessed. Each score has been designated a colour to aid visual comparison. The attributes and scoring definitions are provided in Appendix 2.

Options meeting the minimum criteria were scored against each of the attributes (Appendix 3) and reasoning for this scoring provided (Appendix 4).

5.5 Comparison of Options and Identification of the BPEO

Following the scoring of the options, detailed comparison was undertaken to identify the BPEO, and appropriate way forward in managing the dredge material.

6 Assessment of Options

6.1 Identification of Options Available

Several options were initially identified for the disposal of the proposed dredge material including both terrestrial and marine based options. The options identified are outlined below. A "do nothing" scenario is included for consideration in line with standard practice for BPEO assessments.

- Do nothing;
- Disposal to Landfill;
- Spreading on Agricultural Land;
- Reuse within the Development;
- Reuse in Other Developments;
- Deposit at Sea to the Armadale Deposit Site (HE070); and,
- Plough Dredging.

6.2 Screening of Options

Options were screened against the minimum criteria as outlined in Section 5.1.2. This process eliminated four of the seven options as they do not meet one or more of the screening criteria. Reasons as to why the four options have been discounted are discussed below.

6.2.1 Do Nothing

To not carry out dredging would have a significant impact on the proposed development. As noted in Section 2, vessels are currently restricted by the tide as to when they can access the harbour. These vessels need to be able to access the harbour more readily and access safe berthing. To do nothing would result in an ongoing tidal curfew which would undermine the benefits of the creation of the Splay Berth.

6.2.2 Disposal to Landfill

While the chemical and physical characteristics of the material are suitable for disposal to a landfill site, this option has been discounted. The dredge material would account for approximately three times the annual capacity of the closest landfill site, Duisky Landfill Site, located on the A861 near Fort William, approximately 54km by road from Mallaig Harbour. The landfill site which can take 24,000t of waste per year does not have the capacity to take the dredge material and as such, this option is not technically viable. Taking waste to other more distant landfill sites would give rise to programme issues as the trip time would severely limit the amount of waste that could be exported in a day.

Although not part of the screening criteria, it is noted that this option does not align with policy. The Scottish Government launched a Zero Waste Plan for Scotland in 2010 with a vision for a zero-waste society. The plan has a target to recycle 70% of material and a maximum of 5% to landfill by 2025 for all Scotland's waste (Scottish Government, 2010). The disposal of dredged material to existing landfill sites, therefore, does not align with the Scottish Government Policy where the onus is on reducing the amount of material being sent to a landfill site.

The disposal to landfill option is therefore screened out and not taken further.

6.2.3 Spreading on Agricultural Land

This option has not been considered further due to the limited arable land along the west coast of Scotland. In addition, the high saline content makes material unsuitable for spreading onto agricultural land without significant further treatment. Salinity is a key environmental limiting factor for the productivity of plant growth and many crops are salt sensitive, making excess salinity a threat to agriculture (Flowers, 2005). This option is therefore screened out as the characteristics of the dredge spoil and lack of arable land make this option technically unviable.

6.2.4 Plough Dredging

Plough dredging has not been considered further as it not a technically feasible option. Material would have to be moved a considerable distance by the plough dredger, to get it out of the Outer Harbour and its entrance while avoiding other areas of the harbour and navigational channels, to avoid decreasing navigational depths elsewhere. Furthermore, the hard dredge will give rise to rocks of various sizes, some of which may be too large for the plough to move efficiently giving rise to technical issues.

6.3 Assessment of Feasible Options

Following the screening process, the options taken forward for further analysis are:

- Reuse within the Development;
- Reuse in Other Developments; and
- Deposit at Sea to the Existing Armadale Spoil Deposit Site (HE070).

Each of these options have been analysed against the attributes identified in Appendix 2. The options scoring is provided in Appendix 3 with the reasoning for attribute scoring provided in Appendix 4. Where referred to, scores are provided in brackets below.

6.3.1 Reuse within the Development

The construction activities associated with the proposed development include land reclamation in order to construct the new splay berth. The reclamation associated with the new splay berth will require 46,000t of aggregate including Sand, Gravel, Cobbles and Boulders. The 35,000t of hard dredge material is predicted to have an appropriate (PSD) for reuse.

The reuse of dredge material is near the top of the waste hierarchy and is therefore consistent with the Scottish Government's policy of a Zero Waste Scotland by 2025. In addition, the reuse of dredge spoil as part of the development is line with the Waste Directive Framework (Directive 2008/98/EC) and The Waste (Scotland) Regulations 2012 and positively implements and aligns with policy (5).

While there are costs associated with the reuse of dredge material within the development, it is offset by the savings associated with purchasing less aggregate for infill activities (5).

No timescale issues are anticipated with material being immediately available for reuse as infill (5). For material to be suitable for reuse from a construction perspective, it needs to be both chemically and physically suitable. The lack of contamination present and the high rock content, make the hard dredge material both chemically and physically suitable for reuse within the development (4). The soft dredge material is likely to have too high a silt content to allow it to be reused in the development.

In addition to cost savings associated with the reuse of aggregate within the development, there will be minimal transport (5) and handling of materials required with the area requiring infill located adjacent to the area being dredged (4). Some siltation of the water column may occur during placement of material in infill area however, this is anticipated to be slight due to the low silt content, temporary and localised and therefore trivial (4).

As dredge activities are occurring within an operational harbour, management of existing operations around dredge work will be required, which will ensure minimal disruption to operations. Therefore, only trivial impacts on harbour operations are expected through this option (4).

The reuse of material is standard practice and would not require any further licences or permits as it will be permitted as part of the Marine Licence process for the proposed development (4).

The option to reuse dredge material scored 40 out of 45. However, it is recognised that there is more dredge material arising than required for construction, and only the hard dredge would be suitable. Hence, this option if implemented would need to be combined with another option for the soft dredge material.

6.3.2 Reuse in Other Developments

There is the option to reuse dredged material as aggregate in local developments. In order to achieve this, dredge material will need to be transported from marine or land-based plant to an area within the harbour where it can be allowed to drain prior to loading onto trucks and transported directly to the development, or elsewhere for storage awaiting use.

The reuse of material is near the top of the waste hierarchy and is therefore consistent with the Scottish Government's policy of a Zero Waste Scotland by 2025. In addition, the reuse of

dredge spoil as an aggregate at other developments in the Mallaig area is line with the Waste Directive Framework and The Waste (Scotland) Regulations 2012 (5).

For the material to be suitable for reuse, it needs to be both chemically and physically suitable. The hard dredge material will be suitable physically and chemically for reuse in other developments. The sampling would suggest that there is sufficient content of gravel and sand within the soft dredge material to make it physically suitable for use as an aggregate onshore. The specific use will, however, need to consider the silt content of the soft dredge material in ensuring suitability. Due to the slight contamination with Hg the soft dredge material may not be suitable for residential use (3).

While the dredge spoil is suitable for use as aggregate for various developments, local works requiring the material within the construction timeline will need to be identified and tie in with works, ideally being transported directly and avoiding the need for storage (2). There will be a cost involved with retrieving dredge spoil to land, storage, and transportation however, the cost of resale as aggregate can offset transport costs (4).

No site has been identified as present as it is unclear exactly when construction works will commence however, a development nearby would be given priority (3). As previously noted, ideally material would be transported directly from site to the development reusing the material as there is limited space for storage within the harbour area (2). The landing and storage of dredge spoil will require a large area of quay side space, which is already limited. This will significantly impact on current onshore operations within the harbour (2).

In terms of environmental effects, there will be a carbon cost associated with the delivery of materials and potential issues with the storage of materials with some silt content however, a higher carbon cost may be associated with importing material from further afield and this could also avoid the need to quarry for virgin material. The reuse of material also makes use of what could potentially be a waste product if not utilised (4).

The processing and reuse of the material in other developments will need to comply with the relevant waste legislation, a waste exemption may need to be applied for to the Scottish Environment Protection Agency (SEPA) (3).

The option for reuse of the dredge spoil as an aggregate for other developments scored 28 out of 45.

6.3.3 Deposit at Sea to the Existing Armadale Deposit Site (HE070)

There are numerous open dredge and disposal sites located within Scottish Waters for deposition of dredged material. The closest site to the proposed dredge is the Armadale (HE070) Spoil Deposit Site, located off the Isle of Skye, approximately 6.5km northwest of the harbour. Deposit of dredge spoil to HE070 requires dredge material to be disposed of directly from marine plant.

The deposit of dredged spoil at sea to HE070 does not fully align with the Scottish Governments' policy of Zero Waste Scotland (2) as it is low on the waste hierarchy.

There will be a cost associated with transporting the dredge material to the deposit site, however, these are not expected to be significant (3). Disposal would be carried out during dredging works and therefore aligned with the construction programme (5). The disposal site,

as noted, is also not a considerable distance from the site and therefore distance to steam is minimal (4).

As discussed in 2.2, the chemical analysis of the dredge material identified the material to be acceptable for disposal at sea, the high sand and gravel content means that the dredge spoil will drop through the water column rapidly minimising the spread of the dredge spoil through the water column (4).

The deposit of dredge spoil to sea is established and a well-practised methodology (4) and will be permitted in terms of the dredge licence for the development with no further licences or permits required (4) however, the disposal site is located within the bounds of the Inner Hebrides and Minches Special Area of Conservation (SAC) and will therefore require some additional environmental management. The SAC is designated for harbour porpoise and therefore mitigation measures will be required in the form of a Spoil Disposal Marine Mammal and Basking Shark protocol. This will need to be implemented prior to disposal of materials to prevent injury to animals potentially passing below the vessel during disposal, see Supporting Document, Section 6.1.2. This will apply to marine mammals, basking sharks, and otter. Implementing the protocol will provide protection for protected species and therefore not impact upon the features of the SAC and/or individual animals (3).

Sea disposal is anticipated to have only minimal impacts on onshore harbour operations. The dredging works are being carried out within an already working harbour where navigational controls will be in place (4).

The option to deposit dredge spoil to sea to HE070 scored 33 out 45.

6.4 Comparison of Options

The reuse of dredge spoil within the development scored the highest out of the three options assessed, with deposit at HE070 scoring second highest and reuse in other developments scoring lowest.

As the option to reuse dredge spoil within the development scored highest, it is the preferred option, however the quantity of material required (46,000t) is less than the anticipated total dredge quantity (75,000t), and only the hard dredge (35,000t) is physically suitable for reuse within the development. Hence, an alternative option is required for the remaining soft dredge (40,000t) material. As such, the two remaining options need to be considered for the management of the remaining spoil.

The reuse in other developments option scored high against alignment with policy, while deposit at sea scored low as waste disposal is low on the waste hierarchy. Reuse scored well against environmental affects, while deposit at sea scored slightly lower due to potential environmental impacts associated with the dredge deposit site being located within the Inner Hebrides and Minches SAC.

With regards to the impacts on the timescales and harbour operations reuse in other developments scored lower than deposit at HE070. This is due to the requirement to identify a receiving site which will fall within the construction timescale, ideally avoiding storage whereas disposal will be carried out within the construction programme. Reuse in other developments will have an impact on harbour operations as material will require landing and processing in an area of limited space.

Reuse within other developments would score higher if a nearby development was identified aligning to the construction programme. If this can be achieved, this will be a preferred second option with it aligning to policy, being the more environmentally friendly option making use of a product which could potentially be classed as a waste and reducing transport. It is also preferred as it will provide a cost saving for a local development.

It is noted that some of the soft dredge may be removed by land-based plant, this material would be most accessible for onshore export. Material removed by floating plant will be harder to bring ashore and more likely to interfere with harbour operations. If a project can be found, it is assumed that only around 25% of the dredge material could be reused without impacting on the construction timeline or wider harbour operations.

The BPEO is therefore, a combination of the three options discussed.

- Every endeavour should be made to utilise dredged spoil as aggregate in the development as infill. This is expected to be in the order of 35,000t of spoil.
- As much of the remaining dredged spoil (40,000t) as is practicable should be retained where possible, ideally transported to a local development for reuse or potentially stored before being utilised as aggregate in other developments.
- However, if this is not feasible for all or part of the soft dredge material, the remaining dredged spoil should be deposited at sea in the existing Armadale spoil ground (HE070)

The combined approach ensures that the dredging can be completed cost effectively, within project timeframes, with minimal impact on harbour operations and the environment.

7 Conclusion

The proposed dredge includes the removal of approximately 40,000t of soft materials within the Outer Harbour and the entrance area; and the blasting and removal of 35,000t of hard material. The pre-disposal sample results have informed this assessment in terms of providing an understanding of both the chemical and physical status of the soft sediments to be dredged.

Multiple options were considered for the materials, a number of which were screened out early in the process. Three were taken forward for full assessment and scoring against a range of attributes. The option for 'Reuse within the Development' scored the highest, followed by 'Deposit at Sea to the Existing HE070' with 'Reuse in Other Developments' scoring the least. The review and comparison of the options and volume of material requiring management however, identified that a combination of all three options may be appropriate.

Due to a high rock content, the hard dredge material is deemed suitable for reuse within the development and is the highest scoring of the three options. This aligns to the waste hierarchy, can be accommodated within the construction programme and, helps to reduce costs by providing approximately 76% of the project's aggregate requirements, while also having minimal environmental impact. The reuse of dredge material within the development is deemed to be the BPEO for the hard dredge material.

The material from the soft dredge made up largely of sand, gravel, and silt, was deemed to be suitable for marine deposit or reuse in commercial developments. Reuse in other development was recognised as being preferred over sea disposal from a policy and environmental

perspective, however, this impacts on project timescale, technical feasibility, and harbour operations. If an appropriate alternative development aligning to the project timeline can be found, then material retrievable from land-based plant may be reused. Material not suitable or impractical for reuse within other developments should be disposed of to the nearest spoil deposit site in Armadale (HE070). The BPEO for the management of soft dredged spoil is therefore a combination of the two options, reusing in other commercial developments and disposing of excess material at the HE070 spoil deposit site.

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9 Glossary

Acronym	Definition
AL	Action Levels
As	Arsenic
BH	Boreholes
BPEO	Best Practicable Environmental Option
CD	Chart Datum
GS	Grab Sample
HF	Hydrofluoric Acid
Hg	Mercury
kg	Kilograms
LOD	Levels of Detection
m	metres
MHA	Mallaig Harbour Authority
MOHI	Mallaig Outer Harbour Improvements
PAH	Polyaromatic Hydrocarbons
Pb	Lead
PSD	Particle Size Distribution
SAC	Special Area of Conservation
SEPA	Scottish Environment Protection Agency
SGV	Soil Guideline Values
t	Tonnes

Appendix 1: Borehole Logs

HOLEQUEST LIMITED

Holequest Ltd
Winston Road
Galashiels
Tel: 01896 752295

Borehole No
BH01
Sheet 1 of 2

Project Name	Project No.	Co-ords: -	Hole Type
Mallaig Outer Harbour	21/047		RO
Drilling Methods:- Rotary openhole symmetrix, 168mm diameter, SB-13.0m		Level: -5.70 m ACD	Orientation 90
Client:- Mallaig Harbour Authority		Dates: 10/09/2021	Logged By AMcph

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m CD)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.00-1.50	B					Grey sandy silty COBBLES and BOULDERS lithology of schist and includes shell.
		1.50-3.00	B		2.10	-7.80		Grey silty fine to coarse SAND with rare gravel and includes shells and shell debris. Gravel is fine to coarse rounded to sub-rounded.
		3.00-4.50	B		3.90	-9.60		Grey silty fine SAND and includes rare shell debris. Boulder encountered at 3.9m to 4.3m Cored from 4.0-4.6m, no recovery.
		4.50-6.00	B					
		6.00-7.50	B					
		7.50-9.00	B					Running conditions noted from 8.0-9.0m
					9.00	-14.70		Grey slightly silty fine to coarse SAND and fine to coarse sub-rounded to sub-angular GRAVEL of mixed lithology principly of schist with low cobble content.
			Type	Results				

Continued next sheet

Remarks: *Denotes drillers visual assessment of description based on air flushed borehole returns,
Groundwater fluctuating with tide
Paralell seismic and magnotonter survey undertaken
Borehole terminated on engineers instruction

SPT Hammer	Scale	Log Status
	1:50	Preliminary

HOLEQUEST LIMITED
Holequest Ltd
Winston Road
Galashiels
Tel: 01896 752295

Borehole No
BH01
Sheet 2 of 2

Project Name	Project No.	Co-ords:	Hole Type
Mallaig Outer Harbour	21/047	-	RO
Drilling Methods:- Rotary openhole symmetrix, 168mm diameter, SB-13.0m		Level: -5.70 m ACD	Orientation 90
Client:- Mallaig Harbour Authority		Dates: 10/09/2021	Logged By AMcph

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m CD)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Grey slightly silty fine to coarse SAND and fine to coarse sub-rounded to sub-angular GRAVEL of mixed lithology principly of schist with low cobble content.
					13.00	-18.70		End of Borehole at 13.00 m
			Type	Results				

Remarks: *Denotes drillers visual assessment of description based on air flushed borehole returns,
Groundwater fluctuating with tide
Paralell seismic and magnotonter survey undertaken
Borehole terminated on engineers instruction

SPT Hammer | Scale 1:50 | Log Status Preliminary

HOLEQUEST LIMITED
Holequest Ltd
Winston Road
Galashiels
Tel: 01896 752295

Borehole No
BH02
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Mallaig Outer Harbour	21/047		RO
Drilling Methods:- Rotary openhole symmetrix, 168mm diameter, SB-8.0m		Level: -4.67 m ACD	Orientation 90
Client:- Mallaig Harbour Authority		Dates: 16/09/2021	Logged By AMcph

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m CD)	Legend	Stratum Description
		0.00	ES					Grey silty sandy COBBLES and BOULDERS of schist and includes shells.
		0.00-1.50	B					
		1.50-3.00	B					
					3.10	-7.77		Cored from 3.0m-4.5m, no recovery.
		3.00-4.50	B					Grey very sandy silty fine to coarse rounded to sub-rounded GRAVEL lithology of schist and low cobble content. Sand is fine to coarse.
		4.50-6.00	B					
		6.00-7.50	B					
		7.50-8.00						
					8.00	-12.67		End of Borehole at 8.00 m
			Type	Results				

Remarks: *Denotes drillers visual assessment of description based on air flushed borehole returns,
Groundwater fluctuating with tide
Paralell seismic and magnotonter survey undertaken
Borehole terminated on engineers instruction

SPT Hammer	Scale	Log Status
	1:50	Preliminary

HOLEQUEST LIMITED

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Galashiels
Tel: 01896 752295

Borehole No
BH03
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Mallaig Outer Harbour	21/047		RO
Drilling Methods:- Rotary openhole symmetrix, 168mm diameter, SB-2.6m and 6.5-7.7m Rotary cored T2101, 101mm diameter, 2.6-6.5m		Level: -4.37 m ACD	Orientation 90
Client:- Mallaig Harbour Authority		Dates: 08/09/2021-09/09/2021	Logged By AMcph

Well	Water Strikes	Samples & In Situ Testing					Depth (m)	Level (m CD)	Legend	Stratum Description
		Depth (m)	Type	Results						
		0.00-1.50	B				0.60	-4.97		Grey organic sandy SILT includes shells and shell debris*
		1.50-3.00	B							Dark grey SCHIST with joints infilled with grey very silty fine SAND and includes shells, infill lessening with depth.
		2.60-3.50	28	6	0	AZCL	2.60	-6.97		Mainly recovered as NI of angular to sub angular gravel sized fragments of medium strong (along foliation) to strong, narrow banded, dark grey. quartz mica schist
						NI				
		3.50-5.00	80	75	75	AZCL	3.50	-7.87		Medium strong along banding to strong, narrow to very thin banded (dip 80-90°), variably foliated parallel to banding, dark grey quartz mica SCHIST. Strength indicates fresh to slightly weathered Discontinuities: 20-70°, close to wide spaced, persistence seen to 200 mm, terminations at intersection or in rock, undulating, aperture not seen, with patchy greenish grey coating
		5.00-6.50	100	89	89	3				
							6.50	-10.87		Dark grey SCHIST.* Struggle to break core below 6.5m, client instructed rotary openhole to scheduled depth.
							7.70	-12.07		End of Borehole at 7.70 m
			TCR	SCR	RQD	FI				

Remarks: *Denotes drillers visual assessment of description based on air flushed borehole returns,
Groundwater fluctuating with tide
Paralell seismic and magnotonter survey undertaken
Borehole terminated on engineers instruction

SPT Hammer	Scale	Log Status
	1:50	Preliminary

HOLEQUEST LIMITED

Holequest Ltd
Winston Road
Galashiels
Tel: 01896 752295

Borehole No
BH04
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Mallaig Outer Harbour	21/047		RO
Drilling Methods:- Rotary openhole symmetrix, 168mm diameter, SB-3.0m Rotary cored T2101, 101mm diameter, 3.0-6.75m		Level: -5.07 m ACD	Orientation 90
Client:- Mallaig Harbour Authority		Dates: 12/09/2021	Logged By AMcph

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results			Depth (m)	Level (m CD)	Legend	Stratum Description
		0.00-0.60	B							Black slightly gravelly silty organic fine to coarse SAND includes shells, oily sheen and odour.*
							0.60	-5.67		
		0.60-1.50	B							Dark grey SCHIST with joints infilled with grey very silty fine SAND and includes shells, infill lessening with depth.
		1.50-3.00	B							
							2.80	-7.87		
		3.00-3.70	100	93	81	10				Medium strong along banding to strong, narrow to very thin banded (dip 80-90°), variably foliated parallel to banding, dark grey quartz mica SCHIST. Strength indicates fresh to slightly weathered Discontinuities: Set 1: 20-45°, close to medium spaced, persistence seen to 200 mm, terminations at intersection or in rock, undulating, rough, aperture not seen. Set 2: 60-85°, close to medium spaced, persistence seen to 700 mm, terminations at intersection or in rock, planar smooth parallel to foliation otherwise undulating rough, tight to open. Both sets with patchy greenish grey coating to sub-mm fill
		3.70-4.25	100	65	65					
		4.25-5.25	100	80	80					
		5.25-6.05	100	63	30	14				
		6.05-6.75	100	86	86					
							6.75	-11.82		Dark grey SCHIST* Struggle to break core below 6.75m, client instructed rotary openhole to scheduled depth.
							7.75	-12.82		End of Borehole at 7.75 m
			TCR	SCR	RQD	FI				

Remarks: *Denotes drillers visual assessment of description based on air flushed borehole returns,
Groundwater fluctuating with tide
Paralell seismic and magnotonter survey undertaken
Borehole terminated on engineers instruction

SPT Hammer	Scale	Log Status
	1:50	Preliminary

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Holequest Ltd
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Galashiels
Tel: 01896 752295

Borehole No
BH05
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Mallaig Outer Harbour	21/047		RO
Drilling Methods:- Light cable percussion, 203mm diameter, SB-9.6m		Level: -4.28 m ACD	Orientation 90
Client:- Mallaig Harbour Authority		Dates: 14/09/2021	Logged By MT

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m CD)	Legend	Stratum Description
		0.00	ES					Black organic SAND and GRAVEL.*
		0.00-0.50	B					
					0.50	-4.78		Grey to dark grey organic slightly gravelly fine to coarse SAND. Gravel is fine to coase rounded to sub-angular.*
		1.00	ES					
		0.50-2.00	B					
		2.00	SPT	N=17 (2,3/3,3,5,6)				
		2.00-3.50	B					
		3.50	SPT	N=32 (4,5/7,7,9,9)				
		3.50-5.00	B					
		5.00	SPT	N=50 (6,11/13,13,14,10)				
		5.00-5.50	B					
		5.50-7.00	B					
		6.50	SPT	N=16 (5,2/3,3,4,6)				
		7.00-8.90	B					
		8.00	SPT	N=28 (3,4/4,5,9,10)				
					8.90	-13.18		Grey slightly sandy slightly gravelly CLAY with medium cobble and low boulder content. Gravel is fine to coarse rounded to sub-rounded, sand is fine to coarse.
		8.90-9.40	B					
		9.30	SPT	N=50 (20,5/14,36 for 75mm)				
					9.60	-13.88		Obstruction at 9.6m, possible boulder.
								End of Borehole at 9.60 m
			Type	Results				

Remarks: *Denotes drillers visual assessment of description based on air flushed borehole returns,
Groundwater fluctuating with tide
Hard strata/ slow progress from 5.1-5.4m (1.5hrs), 9.3-9.4m(4hr)
Paralell seismic and magnotonter survey undertaken
Borehole terminated due to obstruction

SPT Hammer	Scale	Log Status
HQ01	1:50	Preliminary

HOLEQUEST LIMITED
Holequest Ltd
Winston Road
Galashiels
Tel: 01896 752295

Borehole No
BH06
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Mallaig Outer Harbour	21/047		RO
Drilling Methods:- Light cable percussion, 203mm diameter, SB-4.0m		Level: -5.80 m ACD	Orientation 90
Client:- Mallaig Harbour Authority		Dates: 21/09/2021	Logged By MT

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m CD)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.00-1.50	B					Grey organic fine to coarse SAND and includes shell and shell debris.*
		1.50	SPT	N=14 (3,3/3,4,4,3)				
		1.50-3.50	B					
		3.00	SPT	N=18 (4,3/3,5,7,3)				
					3.50	-9.30		Grey fine to coarse SAND and fine to coarse sub-rounded to angular GRAVEL with medium cobble and low boulder content.*
		3.50-4.00	B					
		4.00	SPT	N=45 (6,8/10,13,12,10)	4.00	-9.80		End of Borehole at 4.00 m
			Type	Results				

Remarks: *Denotes drillers visual assessment of description based on air flushed borehole returns,
Groundwater fluctuating with tide
Paralell seismic and magnotonter survey undertaken
Hard strata/ slow progress from 3.5-4.0m (2hrs)
Borehole terminated due to obstuction.

SPT Hammer	Scale	Log Status
HQ01	1:50	Preliminary

HOLEQUEST LIMITED

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Tel: 01896 752295

Borehole No
BH06A
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Mallaig Outer Harbour	21/047		RO
Drilling Methods:- Light cable percussion, 203mm diameter, SB-6.1m		Level: -5.80 m ACD	Orientation 90
Client:- Mallaig Harbour Authority		Dates: 22/09/2021-23/09/2021	Logged By MT

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m CD)	Legend	Stratum Description
		0.00-1.50	B					Grey slightly gravelly fine to coarse SAND and includes shells and shell debris. Gravel is fine to coarse sub-rounded to angular.*
		1.50	SPT	N=7 (3,3/2,2,1,2)				
		1.50-3.70	B					
		3.00	SPT	N=14 (2,2/4,3,3,4)				
					3.70	-9.50		Grey fine to coarse SAND and fine to coarse sub-rounded to angular GRAVEL with medium cobble and low boulder content.*
		4.50	SPT	N=18 (5,7/4,5,5,4)				
		3.70-5.50	B					
					5.50	-11.30		Grey sandy CLAY with medium cobble and low boulder content. Sand is fine to coarse.*
		5.50-6.10	B					
		6.00	SPT	N=50 (18,7/21,23,6 for 75mm)	6.10	-11.90		End of Borehole at 6.10 m

Type Results

Remarks: *Denotes drillers visual assessment of description based on air flushed borehole returns,
Groundwater fluctuating with tide
Paralell seismic and magnotonter survey undertaken
Hard strata/ slow progress from 5.5-6.1m (2hrs), 6.1m(1hr)
Borehole terminated due to obstruction.

SPT Hammer	Scale	Log Status
HQ01	1:50	Preliminary

Appendix 2: Scoring Attributes

Attribute	Description	1	2	3	4	5
Alignment with Policy	How complex are the regulator requirements and what risks are posed.	In direct conflict with policy.	Does not fully align with policy.	No policy implications.	In the spirit of policy.	Positively implements policy.
Cost	Financial Cost of the Option	Very High	High	Medium	Low	Very Low
Timescale	Will the option fit within the construction timeline? Will the option impact upon harbour operations?	Option will not fit within the construction timeline and will impact upon harbour operations.	Risk will not fit within construction timeline and impact upon harbour operations.	Option will not fit within the construction timeline or will have some impact on harbour operations.	Potential to fit within the construction timeline and potential to have some impact on harbour operations.	Option will fit within the construction timeline and will not impact upon harbour operations.
Material Suitability	Is the chemical makeup and PSD of material suitable for the option selected?	Not all of the material is acceptable.	Requires significant mitigation to be made suitable.	Acceptable with mitigation.	Acceptable material for option.	Ideal material for option.
Distance	Impact location has on logistics for material movements.	Beyond 40 miles	10-40 miles	6-10 miles	1-5 miles	Within 1 mile
Technically Feasibility	Is the option within the capabilities of the PA to carry out.	Technology not proven.	Complex requirements, but proven technology.	Simple proven technology available.	Practicable with basic management.	Standard practice
Environmental Effects	Potential environmental effects associated with implementing the option.	Very Significant	Significant	Minimal	Trivial	None
Impacts on Harbour Operations	Level of interfere with normal harbour operations.	Very Significant	Significant	Minimal	Trivial	None
Legislative Complexity	How complex are the regulator requirements and what risks are posed.	Significant risk additional permits, licences or consents will not be granted.	Requires significant additional permits, licences or consents.	Requires additional permits, licences or consents.	Minor management required to comply with legislation	Complies with all relevant legislation.

Appendix 3: Option Scoring

Attribute	Reuse within the Development	Reuse in other Developments	Disposal at Sea HE070 Armadale
Alignment with Policy	5	5	2
Cost	5	4	3
Timescale	5	2	5
Material Suitability	4	3	4
Distance	5	3	4
Technically Feasibility	4	2	4
Environmental Effects	4	4	3
Impacts on Harbour Operations	4	2	4
Legislative Complexity	4	3	4
Total	**40**	**28**	**33**

Appendix 4: Score Reasoning

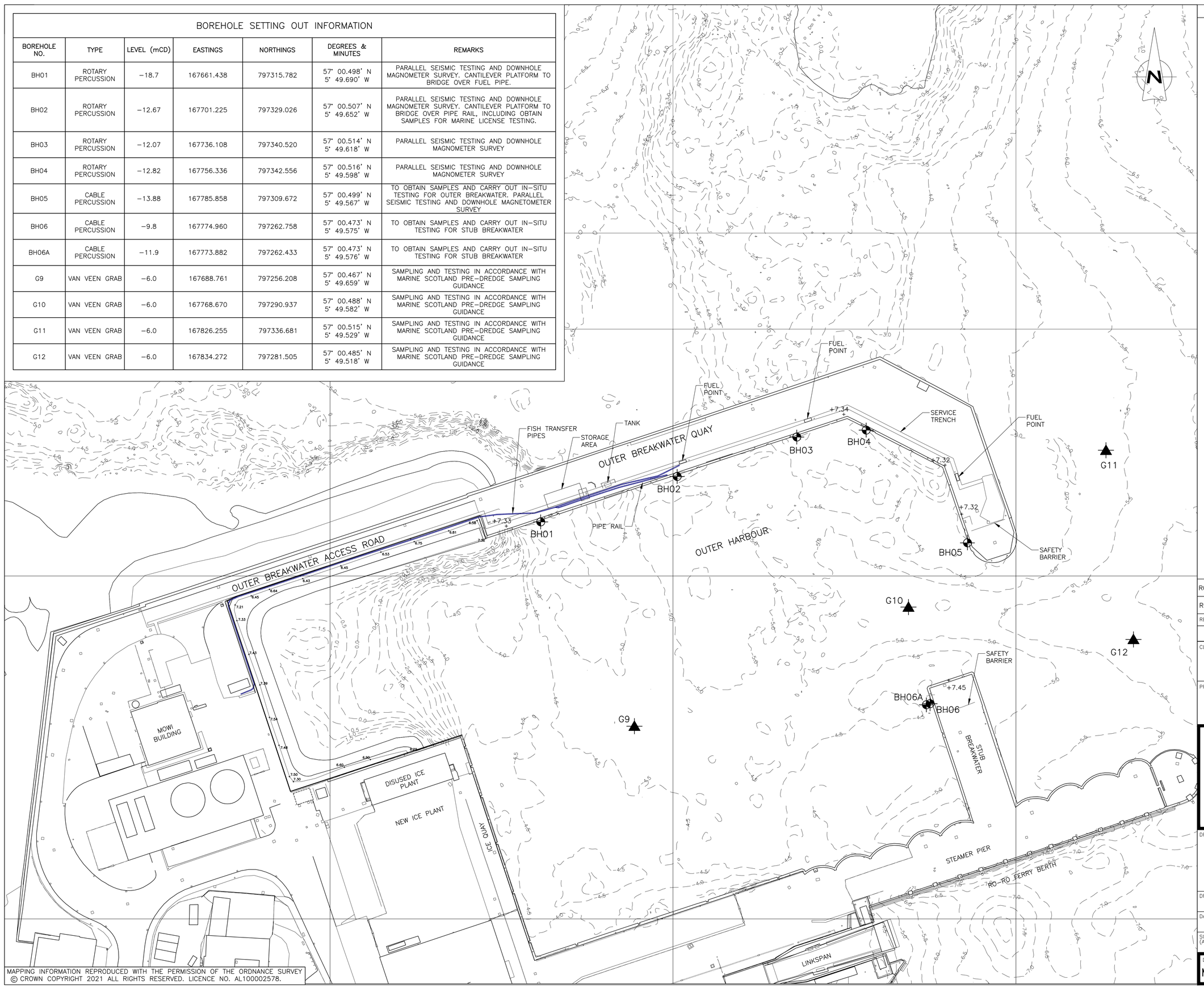
Attribute	Reuse Within the Development	Reuse Within Other Developments	Sea Disposal at He070 Armadale
Alignment with Policy	Reuse of material is near the top of the waste hierarchy; hence this option positively implements government policy for a waste free Scotland by 2025.	Reuse of material is near the top of the waste hierarchy; hence this option positively implements government policy for a waste free Scotland by 2025.	Disposal to Sea is low on the waste hierarchy and as such does not fully align to policy.
Cost	Minimal costs with reuse on site and minimal transportation/handling costs. Cost saving as reduced the need to procure and import aggregate.	Costs associated with transport of material to potential reuse site. Reduced material cost and transport cost for other development.	Cost associated with transport of material to disposal ground.
Timescale	Construction programme would take account of timings to allow material to be reused promptly.	A suitable other development aligning with the construction programme would be required, or storage arrangements to be made.	Material will be disposed of during construction timescale.
Material Suitability	Hard material has been assessed as acceptable for reuse within the development.	The PSD of the material makes it potentially suitable for reuse. Chemically it may not be suitable for residential uses but can be used for commercial purposes.	Material is likely to be acceptable for sea disposal under the Pre-Disposal Guidance issued by Marine Scotland.
Geographical location to site	Site is immediately adjacent to dredging works - distance is therefore not an issue.	No proposed sites identified. Reuse would only be feasible if a reuse site was identified in the local area, i.e., 6-10 miles.	Site is approximately 5km from the Harbour therefore distance to steam is minimal.
Technically Feasibility	Very little management of the material is required as it will be placed directly where needed with minimal handling requirements.	Management required to dewater material. Limited space at Harbour for storage.	The disposal to sea is an established and well-practiced methodology.
Environmental Effects	Siltation of the water column in removal and placement of material but minimal.	Carbon cost associated with delivery to development. Potential environmental issues with storage of material which includes silts i.e., surface water runoff. Not producing a waste material. Avoiding need of quarrying for virgin material.	The disposal to sea at an existing disposal site will have minimal benthic ecology effects, temporary effects on water quality may occur. Requirement for marine mammal and basking shark observations prior to disposal to ensure no animals are present below vessel during disposal.

Attribute	Reuse Within the Development	Reuse Within Other Developments	Sea Disposal at He070 Armadale
Impacts on Harbour Operations	Minimal impacts as material moved very small distance within construction areas only. Navigational controls will be in place during dredging works within a working harbour.	Storage/movement of material would significantly impact upon harbour operations, already limited space. Navigational controls will be in place during dredging works within a working harbour.	Minimal onshore impacts, within working harbour. Navigational controls will be in place during dredging works within a working harbour.
Legislative Complexity	Reuse on site would be permitted under the dredging marine licence.	Reuse within other developments may require additional consents such as waste exemption from SEPA.	Disposal to sea would be permitted under the dredging marine licence.

Drawings

BOREHOLE SETTING OUT INFORMATION

BOREHOLE NO.	TYPE	LEVEL (mCD)	EASTINGS	NORTHINGS	DEGREES & MINUTES	REMARKS
BH01	ROTARY PERCUSSION	−18.7	167661.438	797315.782	57° 00.498' N 5° 49.690' W	PARALLEL SEISMIC TESTING AND DOWNHOLE MAGNOMETER SURVEY. CANTILEVER PLATFORM TO BRIDGE OVER FUEL PIPE.
BH02	ROTARY PERCUSSION	−12.67	167701.225	797329.026	57° 00.507' N 5° 49.652' W	PARALLEL SEISMIC TESTING AND DOWNHOLE MAGNOMETER SURVEY. CANTILEVER PLATFORM TO BRIDGE OVER PIPE RAIL, INCLUDING OBTAIN SAMPLES FOR MARINE LICENSE TESTING.
BH03	ROTARY PERCUSSION	−12.07	167736.108	797340.520	57° 00.514' N 5° 49.618' W	PARALLEL SEISMIC TESTING AND DOWNHOLE MAGNOMETER SURVEY
BH04	ROTARY PERCUSSION	−12.82	167756.336	797342.556	57° 00.516' N 5° 49.598' W	PARALLEL SEISMIC TESTING AND DOWNHOLE MAGNOMETER SURVEY
BH05	CABLE PERCUSSION	−13.88	167785.858	797309.672	57° 00.499' N 5° 49.567' W	TO OBTAIN SAMPLES AND CARRY OUT IN−SITU TESTING FOR OUTER BREAKWATER. PARALLEL SEISMIC TESTING AND DOWNHOLE MAGNETOMETER SURVEY
BH06	CABLE PERCUSSION	−9.8	167774.960	797262.758	57° 00.473' N 5° 49.575' W	TO OBTAIN SAMPLES AND CARRY OUT IN−SITU TESTING FOR STUB BREAKWATER
BH06A	CABLE PERCUSSION	−11.9	167773.882	797262.433	57° 00.473' N 5° 49.576' W	TO OBTAIN SAMPLES AND CARRY OUT IN−SITU TESTING FOR STUB BREAKWATER
G9	VAN VEEN GRAB	−6.0	167688.761	797256.208	57° 00.467' N 5° 49.659' W	SAMPLING AND TESTING IN ACCORDANCE WITH MARINE SCOTLAND PRE−DREDGE SAMPLING GUIDANCE
G10	VAN VEEN GRAB	−6.0	167768.670	797290.937	57° 00.488' N 5° 49.582' W	SAMPLING AND TESTING IN ACCORDANCE WITH MARINE SCOTLAND PRE−DREDGE SAMPLING GUIDANCE
G11	VAN VEEN GRAB	−6.0	167826.255	797336.681	57° 00.515' N 5° 49.529' W	SAMPLING AND TESTING IN ACCORDANCE WITH MARINE SCOTLAND PRE−DREDGE SAMPLING GUIDANCE
G12	VAN VEEN GRAB	−6.0	167834.272	797281.505	57° 00.485' N 5° 49.518' W	SAMPLING AND TESTING IN ACCORDANCE WITH MARINE SCOTLAND PRE−DREDGE SAMPLING GUIDANCE



GENERAL NOTES

1. ALL LEVELS ARE IN METRES AND RELATE TO CHART DATUM.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. TIDE LEVELS, ARE AS FOLLOWS
   HAT = +5.6mCD
   MHWS= +5.0mCD
   MLWS= +0.8mCD
   LAT = 0.0mCD
4. CHART DATUM IS 2.62m BELOW ORDNANCE DATUM.
5. LEVEL INFORMATION BASED ON ASPECT SURVEYS BATHYMETRIC SURVEY DATED MAY 2016.
6. BOREHOLES BH01 TO BH06 TO BE WITHIN 0.5m FROM FACE OF THE SHEET PILE WALLS.

LEGEND

= VAN VEEN GRAB SAMPLE

= BOREHOLE SAMPLE

REV	DATE	DETAILS	DRAWN	CHK'D	APP'D
R02	28.10.21	SETTING−OUT INFORMATION REVISED	JA	RD	GB
R01	19.10.21	RECORD ISSUE	JM	RD	GB

AMENDMENTS

CLIENT

MALLAIG HARBOUR AUTHORITY

PROJECT

OUTER HARBOUR IMPROVEMENTS

Wallace Stone
Consulting Civil Engineers

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DRAWING TITLE

GROUND INVESTIGATION PLAN

DRAWN	CHECKED	APPROVED
AB	RD	GB
DATE: MAY 21	DATE: MAY 21	DATE: MAY 21
SCALE (A1): 1:500	STAGE: RECORD	REV: R02

DRAWING No.

MOHI−WS2175−XX−XX−D−C−0005

DREDGE SETTING OUT INFORMATION			
LOCATION	EASTINGS	NORTHINGS	DEGREES & MINUTES
D01	167645.775	797311.068	57° 00.496' N 5° 49.704' W
D02	167750.776	797345.922	57° 00.517' N 5° 49.603' W
D03	167762.699	797339.853	57° 00.515' N 5° 49.590' W
D04	167778.629	797331.677	57° 00.511' N 5° 49.574' W
D05	167795.429	797304.251	57° 00.496' N 5° 49.556' W
D06	167825.934	797400.000	57° 00.549' N 5° 49.531' W
D07	167860.097	797257.011	57° 00.473' N 5° 49.490' W
D08	167787.153	797272.048	57° 00.479' N 5° 49.563' W
D09	167773.930	797267.673	57° 00.476' N 5° 49.575' W

DREDGE SETTING OUT INFORMATION			
LOCATION	EASTINGS	NORTHINGS	DEGREES & MINUTES
D10	167779.745	797250.173	57° 00.467' N 5° 49.569' W
D11	167742.331	797237.740	57° 00.459' N 5° 49.605' W
D12	167653.496	797208.272	57° 00.440' N 5° 49.691' W
D13	167638.474	797253.644	57° 00.464' N 5° 49.708' W
D14	167634.113	797252.221	57° 00.464' N 5° 49.712' W

GENERAL NOTES

1. ALL LEVELS ARE IN METRES AND RELATE TO CHART DATUM.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. TIDE LEVELS, ARE AS FOLLOWS
   HAT +5.6mCD (+2.98mOD)
   MHWS +5.0mCD (+2.38mOD)
   MLWS +0.8mCD (−1.82mOD)
   LAT 0.0mCD (−2.62mOD)
4. CHART DATUM IS 2.62m BELOW ORDNANCE DATUM.
5. LEVEL INFORMATION BASED ON ASPECT SURVEYS BATHYMETRIC SURVEY DATED MAY 2016.
6. PROPOSED DREDGE −6mCD.
7. MAXIMUM INSTANTANEOUS CHARGE WEIGHT = 50kg.
8. MAXIMUM PEAK PARTICLE VELOCITY = 25mm/s FROM BLASTING ACTIVITY.

LEGEND

BH09 = BOUNDARY POINTS

= SOFT DREDGE < 1m DEEP

= SOFT DREDGE UP TO 1.5m DEEP

= SOFT DREDGE < 1m DEEP AND ROCK ABOVE −6mCD

---- PRE-SPLIT LINE DRILLED AND BLASTED

REV	DATE	DETAILS	DRAWN	CHK'D	APP'D

AMENDMENTS

CLIENT
MALLAIG HARBOUR AUTHORITY

PROJECT
OUTER HARBOUR IMPROVEMENTS

Wallace Stone
Consulting Civil Engineers

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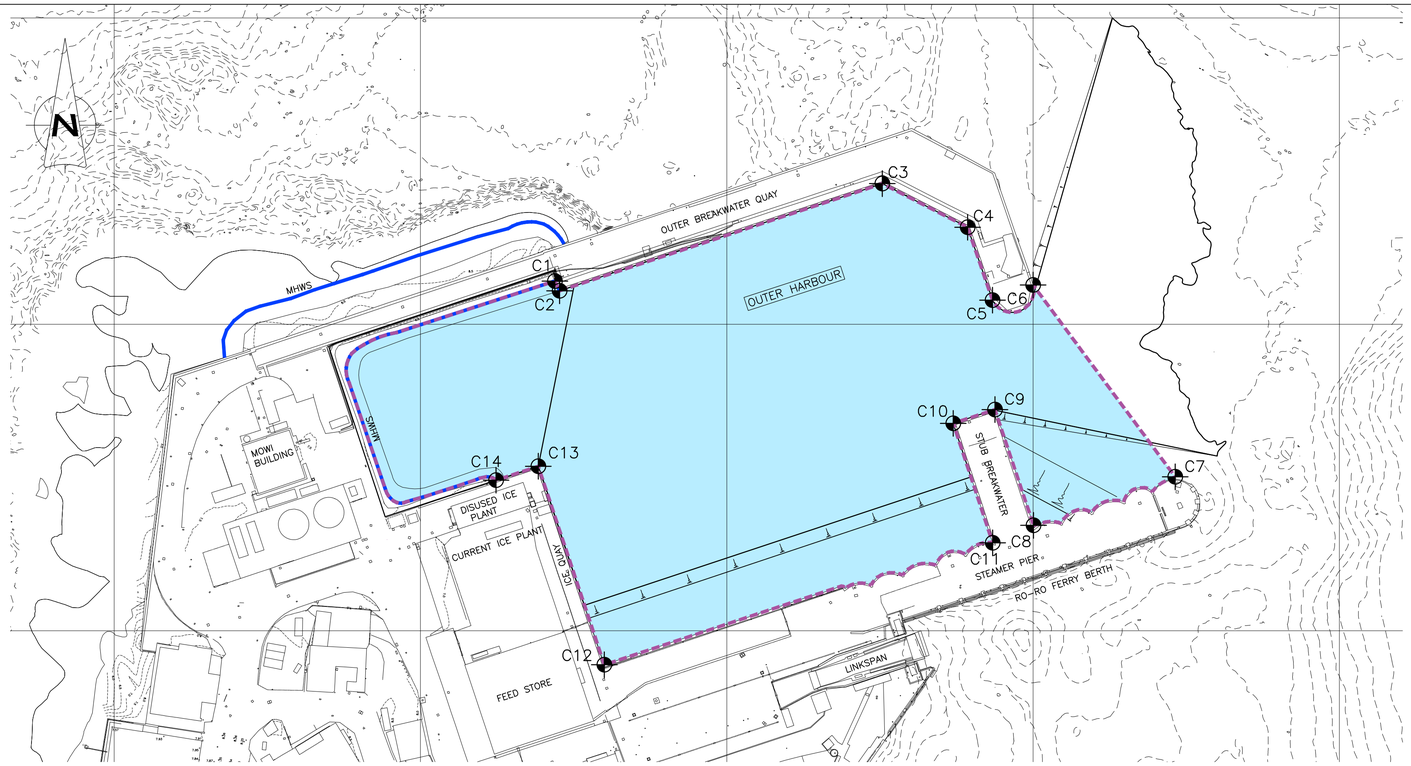
DRAWING TITLE
PROPOSED DREDGE LAYOUT

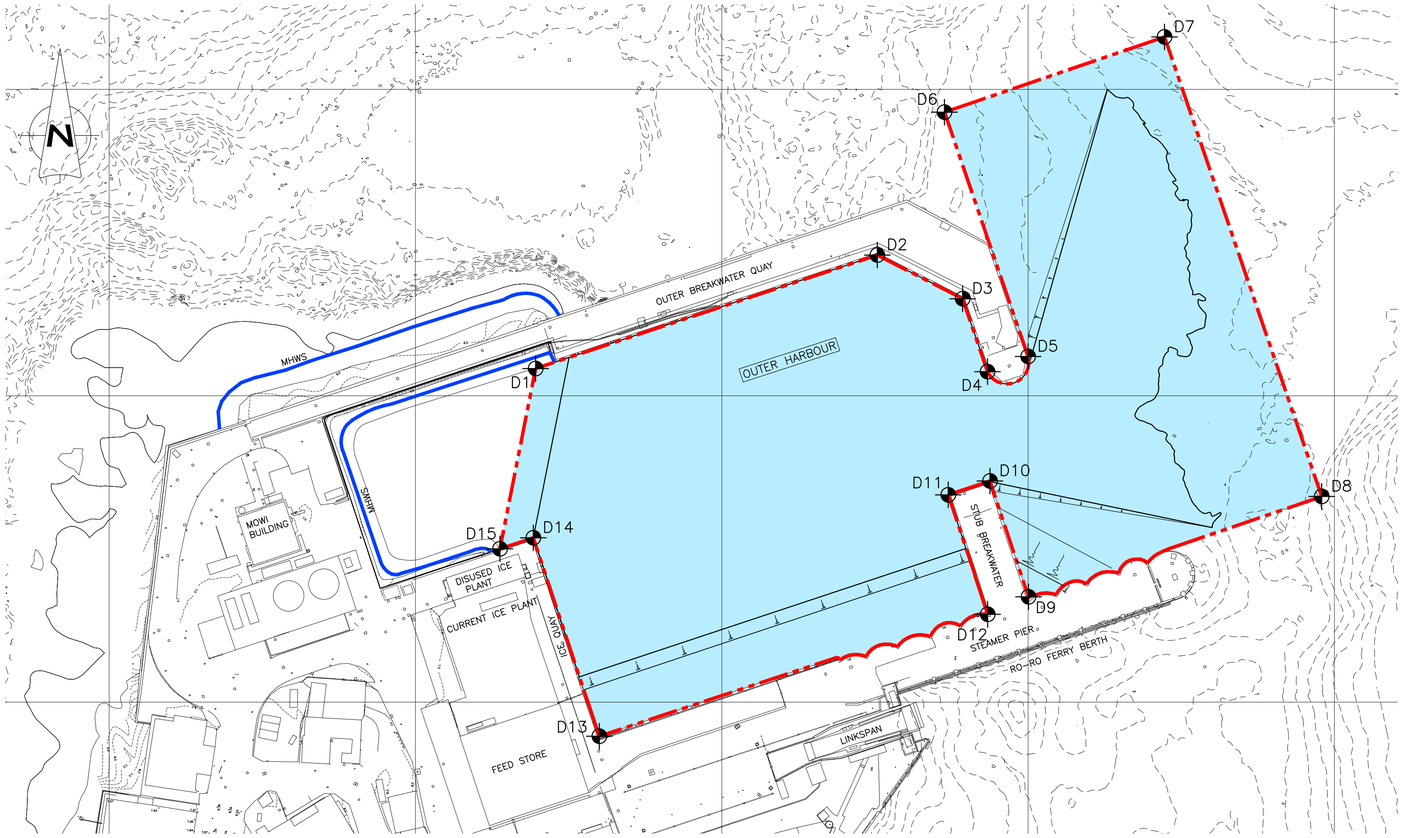
DRAWN	CHECKED	APPROVED
AB	RD	GB
DATE	DATE	DATE
SEP 21	SEP 21	SEP 21
SCALE (A1) 1:500	STAGE PRELIMINARY	REV P01

DRAWING No.
MOHI-WS2175-XX-XX-D-C-9006



MARINE CONSTRUCTION LICENCE SITE BOUNDARY

SCALE 1:1000



DREDGE LICENCE SITE BOUNDARY

SCALE 1:1000

MARINE CONSTRUCTION LICENCE COORDINATES		
POINT	LATITUDE LONGITUDE	NATIONAL GRID REF
C1	N57°0.497' W05°49.706'	NM 67644 97314
C2	N57°0.495' W05°49.704'	NM 67645 97311
C3	N57°0.517' W05°49.603'	NM 67751 97346
C4	N57°0.511' W05°49.574'	NM 67779 97332
C5	N57°0.498' W05°49.565'	NM 67787 97308
C6	N57°0.501' W05°49.552'	NM 67800 97313
C7	N57°0.469' W05°49.503'	NM 67846 97250
C8	N57°0.459' W05°49.548'	NM 67800 97234
C9	N57°0.479' W05°49.562'	NM 67788 97272
C10	N57°0.476' W05°49.575'	NM 67774 97268
C11	N57°0.455' W05°49.561'	NM 67787 97229
C12	N57°0.430' W05°49.683'	NM 67660 97189
C13	N57°0.464' W05°49.708'	NM 67638 97254
C14	N57°0.462' W05°49.721'	NM 67625 97249

DREDGE LICENCE COORDINATES		
POINT	LATITUDE LONGITUDE	NATIONAL GRID REF
D1	N57°0.494' W05°49.710'	NM 67639 97309
D2	N57°0.517' W05°49.603'	NM 67751 97346
D3	N57°0.511' W05°49.574'	NM 67779 97332
D4	N57°0.498' W05°49.565'	NM 67787 97308
D5	N57°0.501' W05°49.552'	NM 67800 97313
D6	N57°0.543' W05°49.583'	NM 67773 97393
D7	N57°0.559' W05°49.514'	NM 67845 97417
D8	N57°0.479' W05°49.455'	NM 67896 97267
D9	N57°0.459' W05°49.548'	NM 67800 97234
D10	N57°0.479' W05°49.562'	NM 67788 97272
D11	N57°0.476' W05°49.575'	NM 67774 97268
D12	N57°0.455' W05°49.561'	NM 67787 97229
D13	N57°0.430' W05°49.683'	NM 67660 97189
D14	N57°0.464' W05°49.708'	NM 67638 97254
D15	N57°0.462' W05°49.719'	NM 67628 97250

GENERAL NOTES

1. ALL LEVELS ARE IN METRES AND RELATE TO CHART DATUM.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. TIDE LEVELS, ARE AS FOLLOWS
   HAT +5.6mCD
   MHWS +5.0mCD
   MLWS +0.8mCD
   LAT 0.0mCD
4. CHART DATUM IS 2.62m BELOW ORDNANCE DATUM.
5. LEVEL INFORMATION BASED ON ASPECT SURVEYS BATHYMETRIC SURVEY DATED MAY 2016.

LEGEND

- MHWS (APPROX)
- DREDGE SITE BOUNDARY
- MARINE CONSTRUCTION LICENCE SITE BOUNDARY
- WORKS BELOW MHWS

REV	DATE	DETAILS	DRAWN	CHK'D	APP'D

AMENDMENTS

CLIENT

MALLAIG HARBOUR AUTHORITY

PROJECT

OUTER HARBOUR IMPROVEMENTS

Wallace Stone
Consulting Civil Engineers

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DRAWING TITLE

PROPOSED DREDGE LICENCE BOUNDARY & MARINE CONSTRUCTION LICENCE BOUNDARY

DRAWN	CHECKED	APPROVED
TC	RD	GB
DATE: OCT 21	DATE: OCT 21	DATE: OCT 21
SCALE (A1): AS SHOWN	STAGE: PRELIMINARY	REV: P01

DRAWING No.

MOHI-WS2175-XX-XX-D-C-9106