Ardersier Port (Scotland) Ltd

Ardersier Port Permitting Support

Best Practicable Environmental Option

ASSIGNMENT A101001-S02
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REVISIONS & APPROVALS

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ACRONYMS

ACRONYM	DEFINITION
AL	Action Level
AP	Ardersier Port (Scotland) Ltd
B_{EA}	Environmental assessment indicator
B_{EC}	Economic cost indicator
B_{HS}	Health and safety indicator
B_i	BPEO indicator
B_P	Practicability indicator
BPEO	Best Practicable Environmental Option
CD	Chart Datum
CSD	Cutter Suction Dredger
DBT	Dibutyltin
EIA	Environmental Impact Assessment
ETF	Energy Transition Facility
m^3	Metres squared
MHWS	Mean High Water Springs
MD-LOT	Marine Directorate – Licensing Operations Team
N	Number of assessment criteria applied in each module
NM	Nautical mile
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
S_{EA}	Sum of assessment criteria scores for environmental assessment
S_{EC}	Sum of assessment criteria scores for economic cost
SEPA	Scottish Environment Protection Agency
S_{HS}	Sum of assessment criteria scores health and safety assessment
S_P	Sum of assessment criteria scores for engineering practicability
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
TBT	Tributyl tin
THC	Total hydrocarbon

ACRONYM	DEFINITION
TSHD	Trailing Suction Hopper Dredge
W_{EA}	Assessment module weighting for environmental assessment (25%)
W_{EC}	Assessment module weighting for economic cost (25%)
W_{HS}	Assessment module weighting for health and safety (25%)
W_{P}	Assessment module weighting for practicability (25%)

1 INTRODUCTION

Ardersier Port (Scotland) Ltd (herein referred to as 'AP') is the owner and developer of the Ardersier Port near Inverness. Following the completion of AP's Phase 1 development, AP is proposing an extension of the Ardersier Energy Transition Facility (ETF) that will create a larger area for the logistics, manufacturing and assembly needs of the offshore wind industry. Increasing the scale of the Ardersier ETF supports the economic growth and net zero ambitions of both the Scottish and UK Governments. Because of the size of the components used in offshore wind, large land areas and deeper water depth are needed to fulfil the requirements of offshore wind projects and the supply chain businesses that play a part in assembling, building and deploying the equipment needed for the offshore wind turbines. AP is therefore seeking a marine licence to carry out capital dredging and sea deposit of dredged material during the proposed Ardersier EFT development to deepen the port, as well as carry out a small amount, estimated to be 2,000-3,000 m^3, of dredging around the Tern Island located to the east of the ports navigational channel to further isolate the island from land to ensure land predators do not have access to it (Figure 1-1).

An Environmental Impact Assessment (EIA) for the full Ardersier Port Expansion project has been carried out Ardersier Port Energy Transition Facility – Port Extension, EIAR November 2025 to support the planning permission and marine licence applications. The full project description can be found in Chapter 3 of the EIA Report, and full assessment of the environmental impacts of the capital dredging and sea deposit of dredged material can be found in the accompanying EIA Report. In summary, AP is applying for a marine licence for dredging and sea deposit of dredged material to allow for the removal and deposit of 2,000,000 m^3, or 3,200,000 wet tonnes, of dredge material over a three year period starting in March 2027. This dredging will deepen the harbour to generally -12.4 m chart datum (CD) in the western harbour extension area and to up to -6 m CD in the easternmost part of the harbour. The dredging takes place approximately 800 m to 1800 m from the mouth of the current harbour entrance. The main dredging campaign will most likely be carried out using a Cutter Suction Dredger (CSD). Additionally, up to two Trailing Suction Hopper Dredgers (TSHD) would support the CSD. They would initially act as barges for dredged material disposal but may also be used to fine tune the dredge shape following completion of the CSD operations. Two split hopper barges are also expected to be used during the sea deposit operations. Utilising these vessels would allow for the dredging to be completed in approximately 12 weeks from commencement, however, to allow for flexibility, project schedule changes and weather delays, a three year marine licence is being applied for. It is proposed that the dredged material will be deposited at the designated Burghead sea deposit site (CR030) pending the outcome of this assessment, with potential for some of the material being used for extending Tern Island should this be requested by NatureScot (estimated 35,000 m^3 of sand and gravel would be used for this).

Under the Marine (Scotland) Act 2010, when deposit of a substance or object, here dredged material, is proposed, the practical availability of any alternative method of dealing with the substance or object must be considered. Dredging guidance from the marine regulator, Scottish Government's Marine Directorate – Licensing Operations Team (MD-LOT), states that all sea deposit marine licence applications must be supported by a detailed assessment of the alternative options which sets out the reasons, including financial, that have led to the conclusion that deposit of the materials at sea is the Best Practicable Environmental Option (BPEO) (Scottish Government, 2015). The BPEO assessment also takes into consideration the physical and chemical composition of the dredged material in determining the suitability for the material for use options and sea deposit. This BPEO report sets out the process and outcomes of the BPEO assessment carried out to determine the best use of the dredged material.

Figure 1-1 Dredging location

2 CHEMICAL AND PHYSICAL CHARACTERISATION OF THE DREDGED MATERIAL

Chemical and physical characterisation of dredged material must be carried out prior to dredging and sea deposit taking place to ensure that the dredged material does not contain contaminants and is suitable for sea deposit should the BPEO conclude this is the best option for the material. 'OSPAR Guidelines for the Management of Dredged Material at Sea' (OSPAR Commission, 2024) states that the substances that are considered of most concern for the marine environment are those with combined properties of persistence, toxicity and liability to bioaccumulate. Typically, the most important contaminants associated with dredged material include organotin compounds, heavy metals, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs) and oils (OSPAR Commission, 2024). The OSPAR Guidelines require each Contracting Party (including the UK) to set national Action Levels (AL) for the common sediment contaminants. The Scottish AL's are set in the Pre-disposal Sampling Guidance Version 2 – November 2017 (Scottish government, 2017). Dredged material with contaminant concentrations below AL1 are considered to be of little environmental concern for sea deposit and are generally accepted for sea deposit should the BPEO conclude this to be the best option. Material with concentrations above AL2 is considered unsuitable for normal deposit at sea but may be suitable for other management options. Material with concentrations between AL1 and AL2 requires more detailed assessment before suitability for deposit at sea can be determined.

Sediment samples of the dredge area were collected and analysed in March and April 2023 (to support the Phase 1 development) and September 2025. Under the OSPAR Commission 'OSPAR Guidelines for the Management of Dredged Material at Sea', the OSPAR contracting Parties have committed to a standard sampling frequency of three years to support any dredged material deposit applications. The results of samples collected in 2023 are therefore still valid, but were supplemented with additional samples from the dredge area in accordance with a sediment sampling plan which was approved by MD-LOT on 23rd of May 2025. Further confirmation from MD-LOT has been received that the samples collected in 2023 can still be used to evidence the levels of contaminants in the sediments.

32 borehole samples of the dredge pocket were collected (10 in 2023, 22 in 2025) in line with MD-LOT's Pre-disposal Sampling Guidance, Version 2 – November 2017 (Scottish Government, 2017), and sub-samples of the cores collected were analysed for surface, middle and bottom layers. The sampling locations within the dredge pocket are shown in Figure 2-1. Three surface grab samples ("TI A, B and C" on the results spreadsheet) from around the Tern Island were also collected for the small amount (estimated to be 2,000-3,000 m^3) of dredging to be conducted there. The sampling showed that the sediment type in the dredged area is predominantly sand with some silt and a small amount of gravel.

2.1 Chemical analysis

The 98 sub-samples were analysed in accordance with MD-LOT's Pre-disposal Sampling Guidance, Version 2 – November 2017 (Scottish Government, 2017) and assessed against the Scottish AL's. The results are summarised below.

All Tributyl tin (TBT) and dibutyltin (DBT) concentration were below AL1 (while Scotland has not set an AL1 or AL2 for DBT, the same AL1 is assumed for DBT as for TBT as per Mason *et al.* (2022)).

The PCB concentrations in all sediment samples were below AL1.

The heavy metal, total hydrocarbon (THC) and PAH exceedances of AL1 are summarised in Table 2-1 – no AL2 exceedances were recorded during sampling, and all average concentrations for all contaminants tested were below AL1. If not listed in Table 2-1, the concentrations of other contaminants were below AL1 and considered to be of little environmental concern for sea deposit. Further consideration of the samples where AL1 exceedance were recorded is also provided in Table 2-1. It is concluded that as any exceedance are minor or negligible and highly localised with contaminant averages well below AL1, the material is suitable for sea deposit if this option is chosen following the BPEO assessment.

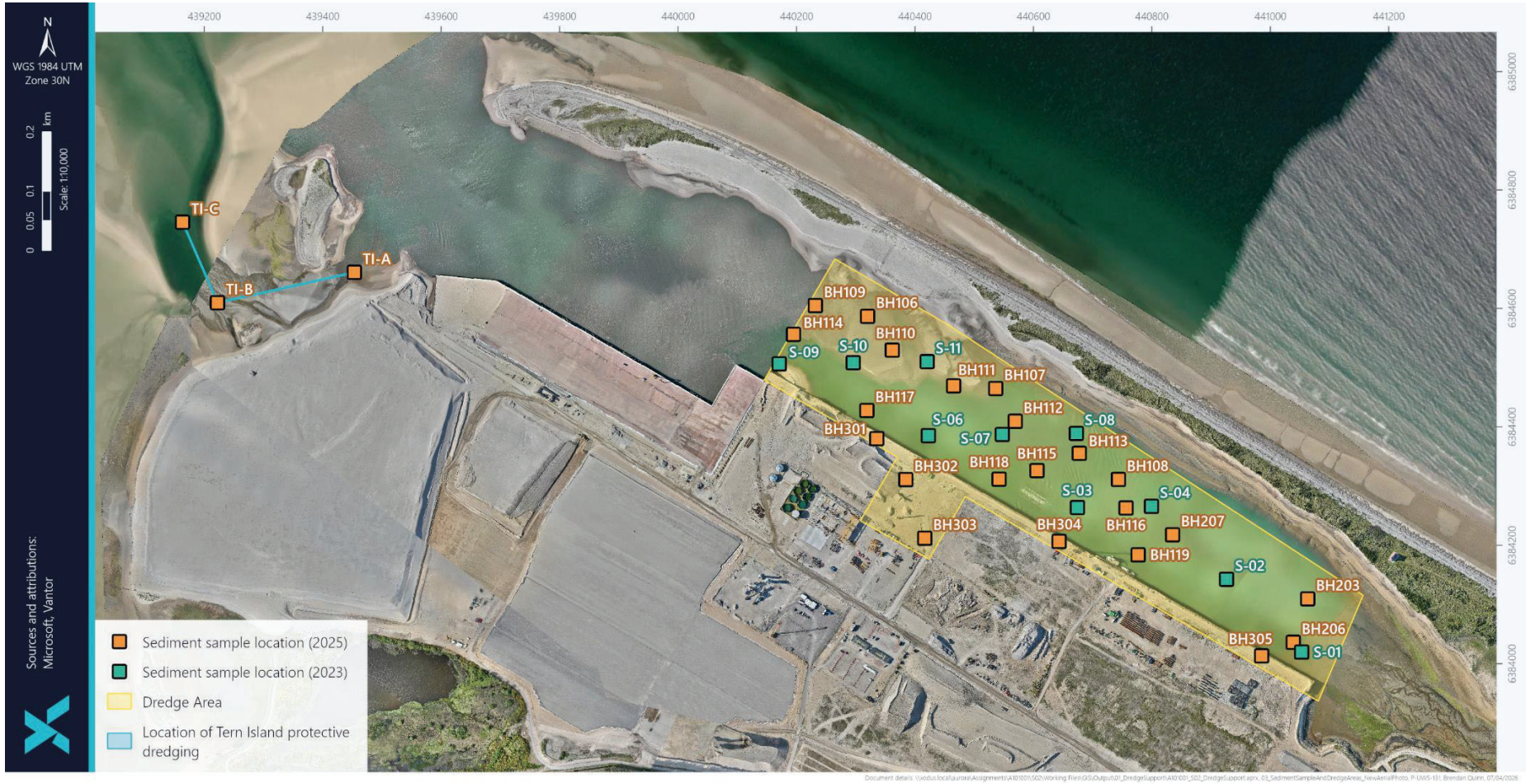

Figure 2-1 Sediment sampling locations

Table 2-1 Sediment sample contaminant AL1 exceedances from sediment sampling

CONTAMINANTS	AL1 (MG/KG DRY WEIGHT)	AL2 (MG/KG DRY WEIGHT)	ARDERSIER PORT SAMPLES	FURTHER CONSIDERATION
Copper	30	300	1/98 samples had an exceedance of AL1 at 31.2 mg/kg	The AL1 exceedance is only 1.2 mg/kg above AL1 so considered a marginal exceedance. The average concentration of all copper samples is 4.53 mg/kg and considerably below AL1.
Zinc	130	600	7/98 samples had an exceedance of AL1. the maximum concentration recorded was 212 mg/kg which is considerably below AL2.	The average concentration of all zinc samples is 23.24 mg/kg and considerably below AL1. The zinc samples are therefore not considered an issue.
PAHs	Compound specific	No AL2 set for PAHs	11/98 samples recorded individual PAH concentrations above AL1: • Benzo(a)pyrene 1 exceedance at 114 µg/kg, AL1 is 100 µg/kg; • Benzo(K)fluoranthene 1 exceedance at 103 µg/kg, AL1 is 100 µg/kg; • Diben(ah)anthracene 4 exceedances, highest 19.8 µg/kg, AL1 is 10 µg/kg; • Fluoranthene 4 exceedances, highest 127 µg/kg, AL1 is 100 µg/kg; • Indeno(1,2,3-cd)pyrene 1 exceedance at 105 µg/kg, AL1 is 100 µg/kg; • Perylene 8 exceedances, highest 199 µg/kg, AL1 is 100 µg/kg; and	All exceedances of AL1 are considered fairly marginal. All average concentrations are considerably below AL1 so the isolated AL1 exceedances are not considered to be an issue.

CONTAMINANTS	AL1 (MG/KG DRY WEIGHT)	AL2 (MG/KG DRY WEIGHT)	ARDERSIER PORT SAMPLES	FURTHER CONSIDERATION
			• Pyrene 6 exceedances, highest 137 µg/kg, AL1 is 100 µg/kg.	
THC	100	No AL2 set for THC	6 exceedances, highest at 204 mg/kg.	The individual exceedances of AL1 are considered fairly marginal (lowest at 111 mg/kg). The average THC concentration is considerably below AL1 at 13 mg/kg, so the individual samples are not considered an issue.

3 AVAILABLE OPTIONS FOR USE AND DISPOSAL OF DREDGED MATERIAL

The BPEO assessment is a systematic assessment of the practicality and health and safety, environmental and cost implications of alternative dredged material use options. The BPEO determination takes into account the Waste Hierarchy set out in Article 4(1) of the EU Waste Framework Directive (2008/98/EC) (European Parliament and of the Council, 2008). The Waste (Scotland) Regulations 2012 implement the Waste Framework Directive obligations in Scotland. Furthermore, the Environmental Protection Act 1990 section 34 makes it the duty of everyone who produces, keeps or manages controlled waste, or as a broker or dealer has control of such waste, to take all such measures available to that person as are reasonable in the circumstances to apply the waste hierarchy set out in Article 4(1) of the Waste Directive. The Waste Hierarchy (Figure 3-1) places emphasis on minimisation and re-use of dredged material, with sea deposit only being used if no alternative options are available.

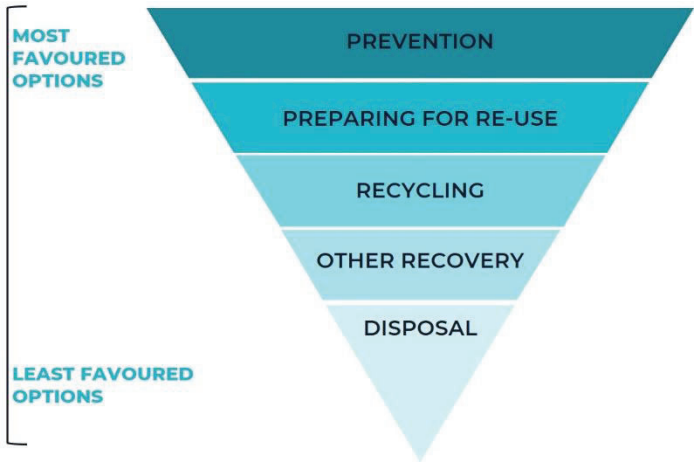

Figure 3-1 Waste Hierarchy for options for use of dredged material

The key stages of the BPEO assessment are:

- Identification of options (see section 3.1);
- Screening of options (see section 3.2);
- Selection of assessment criteria (see section 4.1);
- Analysis and evaluation of options based on the criteria (see section 4.2); and
- Evaluation of BPEO (see section 4.3).

The following sections set out the key stages of the BPEO assessment.

3.1 Identification of options

A long list of options for dealing with the dredged material was developed with AP. AP still has a significant amount of dredged material left from the Phase 1 development, and this material is currently held at Ardersier Port and will

be re-used on site during the Ardersier ETF extension in site reprofiling and as construction material. Since the Phase 1 development, AP has maintained regular contact with the local authority (The Highland Council) and other local stakeholders in an effort to make dredged material available to those who may be able to commit to receipt of the material. The option identification process also considers the particulars of the dredging campaign, including timing and dredge amount over the three-year period for which a licence is applied for. The options considered are provided in Table 3-1.

Table 3-1 Screening of potential dredged material use options

LOCATION	TYPE	OPTION	ASSESSMENT	SCREENED IN FOR FURTHER CONSIDERATION? (Y/N)
Sea	N/A	Do nothing/no dredging	The proposed capital dredging campaign will support the proposed expansion of the Ardersier EFT. This is essential to allow for a larger area and water depth for the logistics, manufacturing, assembly and deployment needs of the offshore wind industry. Increasing the scale of the Ardersier ETF supports the economic growth and net zero ambitions of both the Scottish and UK Governments. It is not possible to realise the project without further capital dredging to increase the water depth. Therefore, not carrying out the capital dredging is not considered a viable option. Full consideration of the Ardersier Port Expansion can be found in Chapters 1, 3 and 5 (Socioeconomic) of the EIA Report.	No
Land	Disposal	Disposal on land (landfill site)	Dewatering of the dredged material would be required prior to the material being transported to a landfill site by trucks to a landfill site. Dewatering requires extensive space, either for a drying lagoon or a dewatering facility at the quayside, which is not available at the port. This combined with the transportation requirements (multiple truck loads) and additional permit costs would be high. Existing landfill sites would need to cope with receiving up to 2,000,000 m^3 (approx. 3,200,000 wet tonnes) of dredged material over three years. The closest open landfill site to Ardersier Port is the Nether Dallachy landfill site in Moray, located 62 km away from the port. This site can accommodate 122,000 tonnes of waste annually. Due to the distance and processing requirements for the landfill site disposal, this option is discounted.	No

LOCATION	TYPE	OPTION	ASSESSMENT	SCREENED IN FOR FURTHER CONSIDERATION? (Y/N)
Land	Disposal	Incineration on land	The material that will be dredged from the port is mostly composed of local sand and some silt. This material is not combustible, with a high water content. Incineration is therefore not a suitable option for material disposal.	No
Land	Habitat creation or improvement	Agricultural use	Dredged material may be suitable for use as an agricultural soil if the material is treated to remove salt and if the material contains a high amount of silt and organic components as opposed to gravel and sand. Further analysis of the material would be required to determine the suitability of the material as agricultural soil and the desalination requires extensive space which is not available at the port. For agricultural use, a Waste Management Exemption from Scottish Environment Protection Agency (SEPA) may be required. North-East of Scotland and Moray Firth regions already have plentiful arable land that can support vegetable, fruit and cereal farming for human consumption (Scottish Government, 2023) and there is no requirement for imported soil material. This option is therefore not considered further.	No
Sea	N/A	Using methods that do not require disposal	Dredging methods such as plough, agitation or water injection dredging do not require the loading of the material on a vessel and transport of dredged material to a location outside of the dredging site. These methods are not considered a feasible option due to the amount of dredging required, combined with the coastal processes at the port. Plough dredging is most appropriate for moving small amounts of material short distances. If plough dredging alone was used to carry out the capital dredging campaign, the campaign would take a long time and the material would only be moved to deeper water immediately outside the dredge channel where the material may lead to reduced water depth at the entrance. This option is therefore not considered sustainable alone. Agitation and water injection dredging are not considered sustainable due to lack of water flow that could transport the suspended material away from the dredge location, as well as the sandy composition of the material (fine particles are more suitable for these methods). This option is therefore not considered further.	No

LOCATION	TYPE	OPTION	ASSESSMENT	SCREENED IN FOR FURTHER CONSIDERATION? (Y/N)
Sea/Land	Habitat creation or improvement	Beach/coastal recharge	This option uses the dredged material beneficially for the purposes of habitat creation or enhancement. As the dredged material's physical properties typically have to be similar to those of the receiving environment to ensure no habitat type alteration or loss of visual and other amenities takes place, beach or coastal recharge are considered viable options. Whether the dredged material can be used for habitat creation or improvement depends on the availability of suitable receiving environments where environmental enhancement is required. NatureScot has indicated that dredged material may be suitable for relocation to inter- and subtidal areas adjacent to the Whiteness Sands close to the harbour entrance. The material may also be suited for beach recharge offsite. This requires the landowner's permission following identification of a suitable receiving environment. The Highland Council has been consulted with regards to potential beach recharge opportunities in its jurisdiction and the council has indicated that West beach at Nairn may be suitable for beach nourishment. This option would, however, require testing of the receiving environment, further permits and an agreement between the parties before the dredging takes place. Discussions with The Highland Council regarding this option are however ongoing. Discussions have also taken place between Angus Council and AP with regards to potential use of dredged material for dune and beach restoration at Montrose Beach. Angus Council does not yet have the necessary permits to carry out the beach recharge operations, and the transportation distance (180 km) and associated costs are prohibitive. Furthermore, NatureScot has indicated its preference for local use of the material. It should also be noted that as part of previous capital dredging licence (MS-00010940, approximately 200,000 wet tonnes of dredged material has been deposited below Mean High Water Springs (MHWS) as reinstatement of an inner section of Whiteness Head Spit. Given the varying requirements for coastal recharge, the site is unlikely to require the quantity of dredged	Yes

LOCATION	TYPE	OPTION	ASSESSMENT	SCREENED IN FOR FURTHER CONSIDERATION? (Y/N)
			material that is anticipated to be generated from this campaign (2,000,000 m^3 or 3,200,000 wet tonnes). Nevertheless, due to the surrounding environment around AP comprising of subtidal sandbanks, sand dunes and sandflats and the potential local habitat erosion, the material could potentially be used for habitat beach or coastal recharge. This option is therefore considered further, although AP considers maintenance dredged material be more suitable for this purpose due to the lower volume involved.	
Sea/Land	Engineering uses	On-site reuse in reprofiling or as construction material	The dredged material could potentially be used on site for site reprofiling and as construction material during site development activities. As the material is composed primarily of sand with some silt, the material should be suitable for this end use if required. The saline content of the dredged material however makes it unsuitable as a construction material without grading, washing, drying and storage. This may make this option uneconomical and impractical. Furthermore, a significant amount of dredged material from Phase 1 development's capital dredging is still sitting at Ardersier Port waiting to be used in construction. This option is however assessed further due to the scale of the overall project.	Yes
Sea/Land	Engineering uses	Offsite use/recycling as aggregate or construction material	As the material is composed primarily of sand with some silt, the material could be used as aggregate or as construction material if sorted and graded. The saline content of the dredged material however makes it unsuitable as a construction material without grading, washing, drying and storage. This may make this option uneconomical and impractical. The material could be sold to local users if the time of dredging aligned with the needs of potential local users, and the port's commercial team has attempted to find suitable end users. The transportation and handling costs of the material would also be higher than the market cost of aggregate and construction materials, limiting potential sale opportunities.	Yes

LOCATION	TYPE	OPTION	ASSESSMENT	SCREENED IN FOR FURTHER CONSIDERATION? (Y/N)
			AP however continues to investigate potential off-site commercial use opportunities and this option is considered further.	
Sea	Aquatic placement	Deposit at a sea deposit site	Whiteness Sands B and C designated sea deposit sites are located in the immediate vicinity of the dredge area. These areas are however shallow and tidally influenced, and located in the vicinity of designated sites, namely Inner Moray Firth Special Protection Area (SPA) / Ramsar Site, Moray Firth SPA, Whiteness Head Site of Special Scientific Interest (SSSI) and the local seal haul-out, that could be adversely impacted by the deposit plans. Due to the small size and capacity of the Whiteness Sands B and C designated sea deposit sites, the sites are unlikely to be able to accommodate the required amount of dredged material from the new capital dredging campaign. The Sutors sea deposit site is also located 9.3 km from the dredge area, but has a small footprint of 213,000 m^2. This site is also used by Port of Cromarty Firth and Port of Nigg for sea deposit of material, taken up much of the site's capacity. This site is unlikely to be able to accommodate the amount of material that will be dredged. Therefore, an alternative deposit site (Burghead) has been considered (Figure 3-2). The deposit site is located 30 km from the dredge area and as such the cost and transport requirements associated with deposit at the sea deposit sites are expected to be greater than those associated with deposit at Whiteness Sands B and C. However, given the higher capacity at the Burghead deposit site, it likely represents the most viable option. The relative capacities of all deposit sites in the vicinity of the project are summarised in Table 3-2. This option would involve deposit of the material into an area intended for receiving dredged material. This option is taken forward for further consideration.	Yes

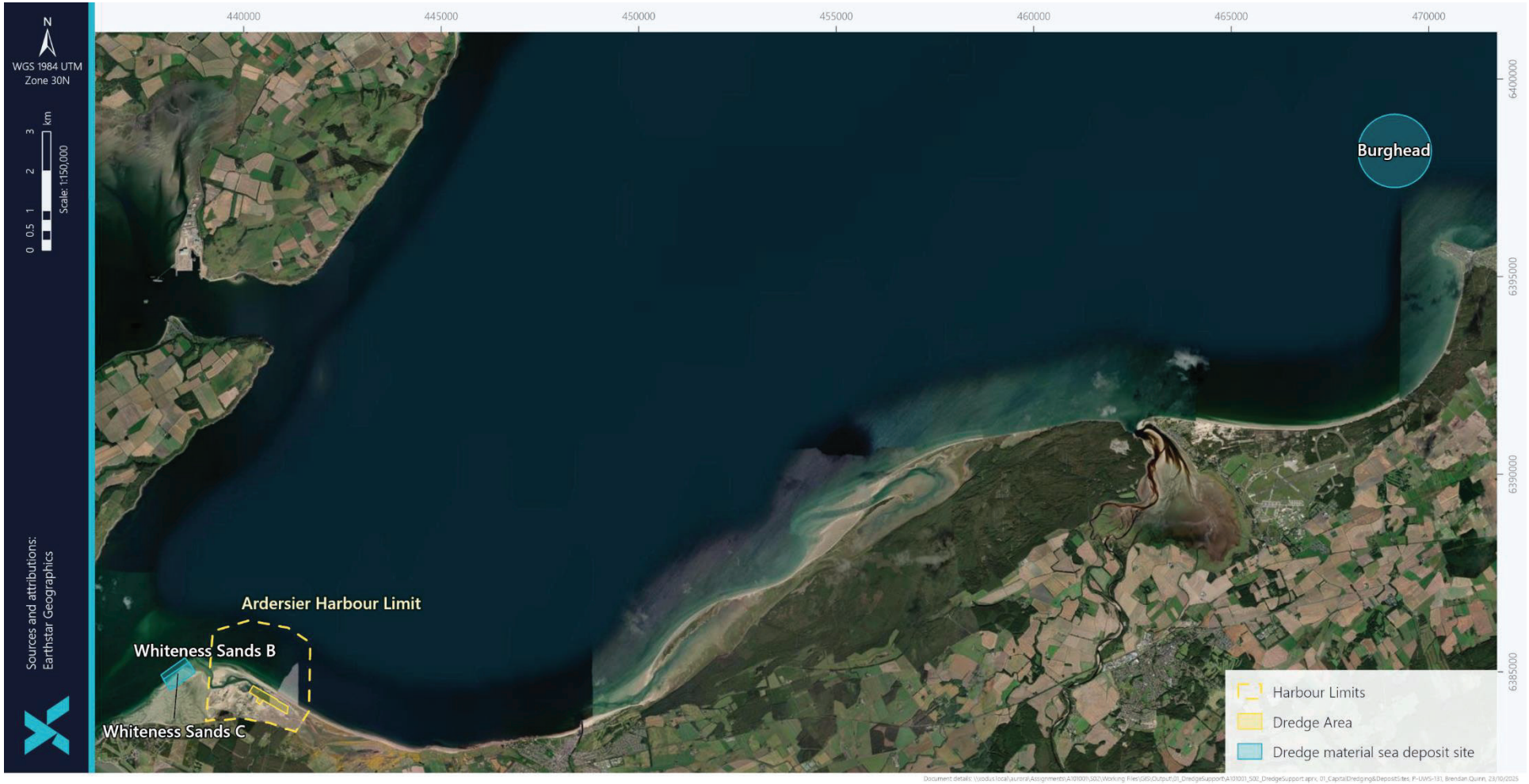

Figure 3-2 Whiteness Sands B, C and designated Burghead sea deposit sites, and the dredge area

3.2 Options screening

Following the compilation of a long list of potential options for dredged material use, each option was screened 'in' or 'out' from further consideration based on feasibility of the options. The options considered and outcome of the screening are provided in Table 3-1, alongside justification for screening out those options which have not been taken forward for further consideration.

Following the screening of potential dredged material options, the following were carried over to the detailed, quantitative BPEO stage:

- Beach/coastal recharge;
- On-site reuse in reprofiling or as construction material;
- Offsite use/recycling as aggregate or construction material; and
- Deposit at a sea deposit site.

A summary of the necessary works or methodology for each option being taken forward for detailed BPEO assessment is provided below.

3.2.1 Beach/coastal recharge

This option uses the dredged material beneficially for the purposes of habitat creation or environment enhancement. The dredged material's physical properties typically have to be similar to those of the receiving environment to ensure no habitat type alteration or loss of visual and other amenities takes place. As the material is expected to consist of sand with some fractions of silt, beach or coastal recharge are considered viable options. Beneficial use both in the vicinity of Ardersier Port and further away are explored below.

Whether the dredged material can be used for habitat creation or improvement depends on the availability of suitable receiving environments where environmental enhancement is required. Under the previous capital dredging and sea deposit marine licence (MS-00010940), there was a requirement to use up to 400,000 wet tonnes of the dredged material for Whiteness Head Spit reinforcement. The spit restoration during capital dredging was carried out to reinstate the spit following historical degradation and monitoring of the success of this activity is ongoing. If in the future the spit is degrading again further reinforcement could be considered, but this is unlikely as the tidal flows inside the harbour are very weak. Currently further restoration is not necessary. Moreover, the site is unlikely to require the quantity of dredged material that is anticipated to be generated from this campaign (2,000,000 m^3 or 3,200,000 wet tonnes).

NatureScot has indicated that dredged material may be suitable for relocation to intertidal and subtidal areas adjacent to the Whiteness Sands close to the harbour entrance. The reason for this is that the current dredge channel established under the previous marine licence MS-00010940 may disrupt the transport of sand along the spit towards Whiteness Sands and NatureScot had concerns that this will lead to future erosion. This area is close to the Whiteness Sands B and C sea deposit sites and subtidal deposit to the deposit sites is explored further in section 3.2.4. Material placed in the vicinity of the Whiteness Sands would allow for the material, predominantly sand, to circulate in the same coastal sediment cell, reinforcing the sand flats associated with the Whiteness Sands SSSI. Options for beach or

coastal recharge at Whiteness Sand could include piping or rainbowing the material from the dredger or sediment barge to the desired areas west of the harbour mouth (sea deposit at Whiteness Sands B and C is considered in section 3.2.4. Using pipes or rainbowing is considerably more expensive and slower than bottom dumping (See Table 4-2 for further details). Due to the large amount of material that will be generated during the proposal capital dredging, Whiteness Sands B and C will be unable to accommodate all the dredge arisings. While some benefit can be gained from beneficial use of Whiteness Sands area, the proposed maintenance dredging of the harbour (pending marine licence application MS-00011248) is better suited for this purpose due to the more modest amount of material generated.

It should be noted that NatureScot and AP are currently considering an enhancement plan to extend the nearby Tern Island. The current proposal includes a small amount of dredging (estimated to be 2,000-3,000 m^3) around the Tern Island to isolate it from the land by forming a 2 m wide, 100 m long channel to prevent land predators for reaching this bird roosting location. The material from Tern Island dredging will be brought on land for use as construction material, and will not be deposited at sea. A small proportion of the dredged material could also be set aside to create the additional area of island (estimated at approximately 35,000 m^3 of sand and gravel), subject to NatureScot's recommendation and MD-LOT approval.

Highland Council has been consulted with regards to potential beach recharge opportunities in its jurisdiction and the council has indicated that West beach at Nairn, located approximately 10 km from the port, may be suitable for beach nourishment. This would however require the movement of the material to the beach either by trucks or vessels, and it is likely that only a fraction of the material would be required. Any beach replenishment option would, however, require testing of the receiving environment, further permits and an agreement between the parties before the dredging takes place, and none have been progressed by The Highland Council to date. Furthermore, further processing as the material placed on the beach would be required, including potentially evening out the dredged material using bulldozers or similar machinery, unless allowed to disperse naturally with tides if placed in the subtidal area. Moving and dispersing the material by vessels is more efficient and also avoids double handling of the material (i.e. moving the material from vessels to land, dewatering, and moving the material onto trucks). AP will however continue to liaise with the Council to discuss opportunities for making the material available for beneficial use in the future.

Discussions have also taken place between Angus Council and AP with regards to potential use of dredged material for dune and beach restoration at Montrose Beach. The total amount of material required is up to 400,000 tonnes per year. Angus Council does not yet have the necessary permits to carry out the beach recharge operations, and the transportation distance (180 km) and associated costs are currently prohibitive. Moving the material by trucks would require multiple truck loads (e.g. 400,000 tonnes of sand moved by standard 27 tonne trucks would require approximately 14,815 truck movements) to be moved through the site and the road network and is considered a less viable option considering the amount of material potentially dredged. Assuming 30 truckloads a day for 5 days a week, it would take approximately 23 months to deliver all the material to Montrose, whereas the dredging campaign can be completed within 12 weeks if vessels are used to transport the material to the Burghead sea deposit site.

If placed outside of the designated sea deposit sites, any beach or coastal recharge in the intertidal area would require the landowner's permission following identification of a suitable receiving environment. The receiving environmental would also be subject to physical testing to ensure the dredged material (primarily sand) does not change the local habitat type. A communication plan to inform the local resident of the activity would also be

required, and the receiving environment would not be available to members of the public during the operations due to health and safety considerations. While AP is looking into providing dredged material available for beneficial use project on non-for-profit basis, the transport requirements and Crown Estate Scotland fees would often lead to the proposal becoming prohibitively expensive or lead to monetary losses. Furthermore, most the of the beneficial use options would not support the volume of the capital dredging (2,000,000 m^3).

Consideration of the beneficial use options however continues with third parties.

3.2.2 On-site reuse in reprofiling or as construction material

During the previous capital dredging carried out under marine licence (MS-00010940), out of the 3,900,000 m^3 (equivalent to 6,240,000 wet tonnes) of sediment produced as a result of the capital dredge campaign, 1,600,000 m^3 of sediment was brought ashore for on-site works (i.e. working platform formation). This material is still kept at the site, and will be used during the Ardersier ETF extension project as site reprofiling, working platform establishment and as infill. There is therefore no further need for the material during the project's construction Phase. Furthermore, any additional reuse would involved several stages of material handling: pumping of the dredged material onshore, natural dewatering, manual moving and stockpiling, loading onto trucks for transport, grading and compaction of the material to the desired design and loadbearing specification. Storage of additional material would sterilise substantial areas of port land, removing its availability for offshore wind operational, storage, and commercial development purposes. There is also no planning permission for storage of the material on land.

Due to the surplus of this material following completion of the Ardersier ETF Phase 1 in 2025, there will be no need for further dredged sand on site. The volume of the capital dredging (2,000,000 m^3) is expected to be significantly greater than any additional onsite requirements that may arise (if any).

3.2.3 Offsite use/recycling as aggregate or construction material

Due to its physical properties (primarily sand), the dredged material could be used as aggregate or as construction material offshore if sorted and graded. The saline content of the dredged material however makes it unsuitable as a construction material without grading, washing, drying and storage. This may make this option uneconomical and impractical. The material could be sold to local users if the time of dredging aligned with the needs of potential local users.

Limited options for offsite use were identified during the previous capital dredging campaign when a known, large amount of sand was available for a period of several years. Whilst the volume of this capital dredging (2,000,000 m^3) is expected to be lower than the previous capital dredging (3,900,000 m^3), the market for sales of sand do not differ from the market conditions that existed at the time of the previous capital dredge in 2025. Despite effort by AP's commercial team, there are no firm local or regional export opportunities for sand sales of any significant volume and export over greater distances remains largely uneconomic because of transportation and associated handling costs. The volume recovered during the Phase 1 development (1,600,000 m^3) combined with the new capital dredging exceed local or regional demand for resale or beneficial reuse beyond the Ardersier ETF. As such, there would be limited opportunity for export of any additional dredged material.

In addition, any sand sales, if realised, would also introduce quayside constraints with transportation vessels reducing capacity for higher-value offshore wind project activities. Managing the stockpile imposes ongoing operational and logistical challenges, including material handling and dust suppression. In addition, land and quay capacity delivers significantly greater value if available for core port operations and/or leased to strategic offshore wind tenants, rather than continuing to support low-value sand storage or potential sales operations.

The transportation and handling costs of the material would also be higher than the market cost of aggregate and construction materials, limiting potential sale opportunities. AP's commercial team has made significant efforts over the past couple of years to find end users for large quantities of sand, but these efforts have not led to securing commercial or non-commercial uses of the material. AP however continues to investigate potential off-site commercial use opportunities.

3.2.4 Deposit at a sea deposit site

Whiteness Sands B (CR023) and C (CR021) open sea deposit sites are located in the immediate vicinity of the dredged area, approximately 1.1 km or 0.6 nautical miles (NM) away (Figure 3-2). However, neither site is likely to accommodate the volume of material that is expected to be dredged under the proposed operations (approximately 2,000,000 m^3). Moreover, the sites have already been identified for the deposit of any material resulting from maintenance dredging in the area (covered under MS-00011248). To date, no maintenance dredging has been carried out however this may limit the capacity of the Whiteness Sands sites should it take place in the future. A summary of all available nearby sea disposal sites is provided in Table 3-2.

Table 3-2 Closest Open Sea Deposit Sites

SITE NAME	DISTANCE (KM)	WATER DEPTH (M)	FOOTPRINT (M^2)	SUBSTRATE
Whiteness Sands B&C (CR021 & CR023)	1.1	<5	321,920	Sand
Sutors (CR019)	9.3	24 - 51	213,000	Sand
Burghead (CR030)	30.0	17 – 40	2,693,840	Sand and shells
Lossiemouth (CR031)	47.7	21.5	130,740	Sand and shells

Of the sites identified in Table 3-2, Burghead (CR030) is the only site likely to support the quantity of material expected from the proposed capital dredging (2,000,000 m^3). For example, is 2,000,000 m^3 was deposited in a site with the footprint of 400,000 m^2, the sediment thickness would be 5 m. A large enough site is therefore required to be able to accommodate the material without compromising the water depth and forming a navigation hazard, or introducing significant environmental effects. The Burghead sea deposit site (CR030) is therefore considered the best

option despite the distance to the port. The location of the Burghead (CR030) site relative to the proposed dredge area is portrayed in Figure 3-2.

As the Burghead (CR030) site is located approximately 30 km from the proposed dredge site, any material would need to be transported to the site (likely via barge). Assuming a mean capacity of 4,000 m^3 per barge, disposal at the Burghead site (CR030) would require approximately 500 barge movements to deposit all dredged material at the Burghead site (CR030). AP considers the dredging and deposit campaign to take 12 weeks should the Burghead site be used.

It should be noted that AP is considering carrying out further environmental studies to support the re-opening and expansion of the currently closed Whiteness Sands A sea deposit site (CR022). The sediment transport modelling carried out to date suggests that Whiteness Sands A would be most optimal location for the dredged material deposit to ensure the material migrates to the desirable location within Whiteness Sands to coastal recharge. Before further studies are completed, only open sites are considered as an option for sea deposit of dredged material.

4 BPEO EVALUATION

4.1 Selection of BPEO assessment criteria

In order to undertake an impartial and structured comparison of the various BPEO options, a weighted ranking system with a predefined set of assessment criteria was used. The criteria were selected specifically for use for Ardersier Port and the assessment is based on a four-module assessment. Each module contains a set of criteria (Table 4-1) and these were allocated equal. The four modules include:

- Practicability (25%);
- Health and safety (25%);
- Environmental Assessment (25%); and
- Cost assessment (25%).

Table 4-1 BPEO assessment criteria

CRITERIA	SPECIFICS
Environmental	Environmental impacts due to material handling and treatment
	Transport requirements
	Marine environmental impact
	Policy/legislative acceptability
	Public and stakeholder acceptability (including visual and amenity implications, business reputation and impacts on other marine users)
Practicability	Material space and weight requirements if stored
	Downtime/delay risk
	Requirement to treat/process material before use
	Commercial/equipment/technology availability, maturity and deployment speed
	Overall performance
Health and safety	Health and safety implications to personnel
	Health and safety implications to members of the public
	Navigation safety
Cost	Capital cost (e.g. requirement to purchase pipes or a vessel, new deposit site opening, treatment facility)
	Operating cost (£ per m^3), including treatment and handling costs

CRITERIA	SPECIFICS
	Additional risks or benefits to port
	Commercial value to port

Each module is broken down into a series of criteria, each with an equal ranking, which is fully presented in Appendix B. It should be noted that whilst each module may contain a different number of questions, because the average result for each module is calculated (by dividing the score by the number of questions) the effect of this variation in module criteria on the result (section 4.3) is minimised. The criteria were developed by Xodus considering AP's experience with dredging operations, including costs for different options (Table 4-2).

Table 4-2 Costs of dredged material use options

COSTS (£) PER M3 OF DREDGED MATERIAL				
Option	Beneficial use - coastal replenishment/beach nourishment	Beneficial use - site profiling	Recycling - aggregate as a resource	Sea deposit
Dredging	3-5	4-6	3-5	3-5
Sea deposit	n/a	n/a	n/a	2-3
Pump ashore	6-9	6-9	6-9	n/a
Pipeline for beach recharge	5-10	n/a	n/a	n/a
Onshore handling from point of deposit	2	2	2	n/a
Profiling - on site or on beach	2	2	n/a	n/a
Total	18-28	14-19	11-16	5-8

4.2 Quantitative BPEO assessment

The full quantitative BPEO assessment is provided in Appendix A of this document. For each option, a relative score was allocated. These scores were used to calculate a proportionally weighted BPEO indicator (B_i) to produce a relative ranking of options to assist in the identification of the BPEO. The B_i was calculated using the following formula:

$$B_i = B_P + B_{HS} + B_{EA} + B_{EC}$$

Where

$$B_P = (S_P/N)W_P$$

$$B_{HS} = (S_{HS}/N)W_{HS}$$

$$B_{EA} = (S_{EA}/N)W_{EA}$$

$$B_{EC} = (S_{EC}/N)W_{EC}$$

- Bi = Overall BPEO indicator
- B_P = Practicability indicator
- B_{HS} = Health and safety practicability indicator
- B_{EA} = Environmental assessment indicator
- B_{EC} = Economic cost indicator
- S_P = Sum of assessment criteria scores for practicability
- S_{HS} = Sum of assessment criteria scores health and safety assessment
- S_{EA} = Sum of assessment criteria scores for environmental assessment
- S_{EC} = Sum of assessment criteria scores for economic cost
- N = Number of assessment criteria applied in each module
- W_P = Assessment module weighting for practicability (25%)
- W_{HS} = Assessment module weighting for health and safety (25%)
- W_{EA} = Assessment module weighting for environmental assessment (25%)
- W_{EC} = Assessment module weighting for economic cost (25%)

The B_i is relatively sensitive to the assessment module weight (hence the importance of correctly setting the module weight at the start of the BPEO process); however, sensitivity analysis of the scoring assured that the resulting outputs were representative.

4.3 BPEO assessment

The quantitative assessment of the different BPEO options is shown in Table 4-3. The quantitative assessment ranks the BPEO options as follows, with the highest index value indicating the overall best option:

- Beneficial use – beach/coastal recharge – B_i = 3.22
- Recycling – Onsite reuse for site profiling or as construction material – B_i = 3.27
- Recycling – Offsite use as aggregate or construction material – B_i = 2.88
- Sea deposit – B_i = 4.22

Taking the engineering and methodology practicability, environmental considerations, cost and health and safety into account as detailed in Appendix A, sea deposit of dredged material at the Burghead sea deposit site is the BPEO.

Table 4-3 BPEO Assessment Results

CRITERIA	BEACH/COASTAL RECHARGE	ON-SITE REUSE IN REPROFILING OR AS CONSTRUCTION MATERIAL	OFFSITE USE/RECYCLING AS AGGREGATE OR CONSTRUCTION MATERIAL	DEPOSIT AT A SEA DEPOSIT SITE
Environmental				
Further treatment or environmental impacts due to treatment	3	3	2	5
Transport requirements	3	4	1	3
Marine environmental impact	5	5	5	4
Policy/legislative acceptability	4	5	4	4
Public and stakeholder acceptability (including visual and amenity implications, business reputation and impacts on other marine users)	4	5	5	4
BEA ((Sum/N x W) (W=25%) (N=5) (2 decimal places)	*0.95*	*1.10*	*0.85*	*1.00*
Practicability				
Additional space and weight requirements. How much area does a volume of sand storage require.	3	1	1	5
Downtime/delay risk/temporal restrictions	2	2	2	4
Requirement to treat/process material before use, ie. suitability for deposit (eg. change chemical and physical properties, desalination, drying)	4	2	2	5

CRITERIA	BEACH/COASTAL RECHARGE	ON-SITE REUSE IN REPROFILING OR AS CONSTRUCTION MATERIAL	OFFSITE USE/RECYCLING AS AGGREGATE OR CONSTRUCTION MATERIAL	DEPOSIT AT A SEA DEPOSIT SITE
Commercial/equipment/technology availability, maturity and deployment speed (including availability of vessels and facilities) eg. if specific treatment is required	3	3	3	5
Performance (including discharge rate, excluding down time)	3	2	1	5
BP ((Sum/N) x W) (W=25%) (N=5) (2 decimal places)	*0.75*	*0.50*	*0.45*	*1.20*
Health and Safety				
Personnel Safety Potential effect on injury and plant accident frequency	4	4	4	4
Health and safety implications to members of the public	4	5	4	5
Navigation safety (eg. multiple vessels in close proximity, tight working areas)	4	2	2	4
BHS ((Sum/N) x W) (W=25%) (N=3) (2 decimal places)	0.83	0.92	0.83	1.08
Cost				
Capital cost (£) (eg. requirement to purchase pipes or a vessel, new deposit site opening, treatment facility)	5	5	5	5
Operating cost to port (£ per m^3), including treatment and handling costs	1	2	3	4

CRITERIA	BEACH/COASTAL RECHARGE	ON-SITE REUSE IN REPROFILING OR AS CONSTRUCTION MATERIAL	OFFSITE USE/RECYCLING AS AGGREGATE OR CONSTRUCTION MATERIAL	DEPOSIT AT A SEA DEPOSIT SITE
Risk on port operations also benefit (money to be made?) third party involvement	3	3	2	5
Commercial value to port	2	2	2	1
BEC ((Sum/N x W) (W=25%) (N=4) (2 decimal places)	0.69	0.75	0.75	0.94
BI =BP+BHS+BEA+BEC	3.22	3.27	2.88	4.22

4.4 Conclusion

This BPEO assessment was carried out to systematically identify the best option for the disposal of AP's capital dredge material. The BPEO assessment showed that considering the environmental, cost, practicability and health and safety of the different dredged material use options, sea deposit at the Burghead deposit site is the best option. This assessment was largely driven by the capacity of the site relative to other deposit sites in the area, as well as the cost, transport and handling requirements of the other options assessment. Moreover, due to the previous capital dredging campaign (MS-00010940) and potential maintenance dredging (MS-00011248), there is limited requirement for any additional dredged material for on-site or off-site commercial or beneficial use. Sea deposit at Burghead instead of storing, sorting and handling the material at port will ensure that AP to maintain focus on its core target sector of offshore wind, thereby supporting the clean power and industrial strategy objectives of the Scottish and UK Governments.

A marine licence application has therefore been prepared for submission to MD-LOT for the dredging of up to 2,000,000 m^3 of material, with sea deposit at the Burghead sea deposit site, with potentially a small amount used for Tern Island expansion. The environmental impacts from the dredging and sea deposit operations will be assessed fully in the Ardersier Port Expansion EIA Report November 2025.

5 REFERENCES

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APPENDIX A FULL BPEO ASSESSMENT

Environmental Assessment (W = 25%)						Beach/coastal recharge	On-site reuse in reprofiling or as construction material	Offsite use/recycling as aggregate or construction material	Deposit at a sea deposit site
Criteria	**1**	**2**	**3**	**4**	**5**				
Further treatment or environmental impacts due to treatment	Unacceptable – further treatment, processing and transport to processing site required far away from location of dredging	High further treatment, processing and transport to processing site required, often outwith the region where the activity takes place	Moderate further treatment, processing and transport to a regional processing site required	Minor (local) treatment or additional onward transport to facilitate processing required	Negligible treatment or additional onward transport to facilitate processing required	3	3	2	5
Transport requirements	Major transport requirements, >50 km distance and multiple vessels and land transport options required	High transport requirements, 10-50 km, multiple vessels and/or land transportation option required	Moderate transport requirements, >10 km or multiple a vessel and land transportation required	Minimal/local transport requirements (< 2 km), using a single vessel	No transport requirements	3	4	1	3
Marine environmental impact	Persistent/ irreversible landscape scale environmental impact. With widespread impacts to sensitive environments and/or major water bodies	Localized, severe but reversible impact, medium-long term environmental impact. Marine environment is able to fully recover from the impact	Localized, short-medium term environmental impact. Marine environment is able to fully recover from the impact	Localized, short term environmental impact. Marine environment is able to fully recover from the impact or slightly benefit from the proposal	Low probability of any adverse environmental impact to the marine environment - potential for environmental benefits	5	5	5	4
Policy/legislative acceptability	Not in line with policies	Aligns poorly with policies	Acceptable alignment with policies	In line with policies but not top option	In line with all policies	4	5	4	4
Public and stakeholder acceptability (including visual and amenity implications, business reputation and impacts on other marine users)	Not acceptable, major and permanent adverse impacts	Low acceptability, long lasting major adverse impacts	Moderate acceptability, moderate duration and adverse impact	High acceptability, short duration and low adverse impacts, some benefits	Public support, negligible or temporary adverse impacts or added benefits	4	5	5	4
Practicability (W = 25%)						**Beach/coastal recharge**	**On-site reuse in reprofiling or as construction material**	**Offsite use/recycling as aggregate or construction material**	**Deposit at a sea deposit site**
Additional space and weight requirements.	Major space & weight issues (e.g. storage of material)	High space & weight issues (e.g. storage of material)	Moderate space & weight issues (e.g. storage of material)	Low space & weight issues can be managed within existing layout	No space & weight issues	3	1	1	5
Downtime/delay risk/temporal restrictions due to selected method	Likely downtime risks or temporal restrictions	High downtime risks or temporal restrictions (weeks)	Moderate downtime risks or temporal restrictions (days)	Low downtime risks or temporal restrictions (hours)	No downtime or temporal restrictions	2	2	2	4
Requirement to treat/process material before use, i.e. suitability for deposit (eg. change chemical and physical properties, desalination, drying)	Extensive treatment/processing required	High amount of treatment/processing required	Some treatment/processing required	Minimal treatment/processing required	No treatment/processing required	4	2	2	5

Commercial/equipment/technology availability, maturity and deployment speed (including availability of vessels and facilities) e.g. if specific treatment is required	Methodology still being developed and not available	Methodology developed and should be commercially available within 3 to 5 years	Process at pilot, trial or planning stage	Can quickly be made available to port or recently implemented	Currently available to port, proven track record	3	3	3	5
Performance (including discharge rate, excluding down time)	Poor performance to date or significant uncertainty over performance. Very slow (e.g. discharge requires transportation elsewhere)	Mixed performance to date or slow discharge rate (e.g. via a pipeline)	Acceptable performance. and has potential to meet objective. Moderate discharge rate (e.g. rainbowing)	Sound performance. Performs consistently to meet objective. Quick but controlled discharge	Technology better than requirements of objective. Immediate and uncontrolled discharge (e.g. bottom dumping)	3	2	1	5
Health & Safety (W = 25%)						**Beach/coastal recharge**	**On-site reuse in reprofiling or as construction material**	**Offsite use/recycling as aggregate or construction material**	**Deposit at a sea deposit site**
Personnel Safety Potential effect on injury and plant accident frequency	Likely/expected injuries to occur	Occasional conditions may allow injuries to occur	Seldom/in exceptional conditions injuries may occur	Unlikely/reasonable to expect no injures to occur.	Negligible potential for increased illness or injury.	4	4	4	4
Health and safety implications to members of the public	Likely/expected injuries to occur	Occasional conditions may allow injuries to occur	Seldom/in exceptional conditions injuries may occur	Unlikely/reasonable to expect no injures to occur.	Negligible potential for increased illness or injury.	4	5	4	5
Navigation safety (e.g. multiple vessels in close proximity, tight working areas)	Severely restricted site with multiple vessels and trips	Highly restricted site with multiple vessels and trips	Seldom/in exceptional conditions navigation safety issues may arise	Unlikely/reasonable to expect no navigation safety issues due to small amount of vessel traffic and space available	Negligible navigation safety issues, minimal additional vessel traffic needed	2	2	2	4
Cost Assessment (W = 25%)						**Beach/coastal recharge**	**On-site reuse in reprofiling or as construction material**	**Offsite use/recycling as aggregate or construction material**	**Deposit at a sea deposit site**
Capital cost (£) (e.g. requirement to purchase pipes or a vessel, new deposit site opening, treatment facility)	High >50000	Medium to high 15000-50000	Medium 5000-15000	Low <5000	No capital cost	5	5	5	5
Operating cost to port (£ per m^3), including treatment and handling costs	High >20	Medium to high 15-20	Medium 10-15	Low to medium 5-10	Low <5	1	2	3	4
Risk on port operations	Risk of stopping dredging	High risk of slowing down dredging (> 1-day additional time)	Medium risk of slowing down dredging (up to 1-day additional dredging time)	Low risk of slowing down dredging (up to half a day additional dredging time)	Slowing down dredging unlikely/limited	3	3	2	5
Commercial value to port	No value, only high costs to port	Limited value to port	+/- 0	Low commercial value - some costs recoverable or alternative use options to port	High commercial value internally or externally	2	2	2	1