Associated British Ports

Troon Harbour Maintenance Dredging

Best practicable environmental option assessment

November 2020





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Document Information

Document History and Authorisation		
Title	Troon Harbour Maintenance Dredging	
	Best practicable environmental option assessment	
Commissioned by	Associated British Ports	
Issue date	November 2020	
Document ref	R. 3550	
Project no	R/4761/1	
Date	**Version**	**Revision Details**
27/11/2020	1	Issued for Client Review
03/12/2020	2	Issued for Client Use

Prepared (PM)	Authorised (QM/PD)
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Suggested Citation

ABPmer, (2020). Troon Harbour Maintenance Dredging, Best practicable environmental option assessment, ABPmer Report No. R. 3550. A report produced by ABPmer for Associated British Ports, November 2020.

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1 Introduction

1.1 Background

Associated British Ports (ABP) is the Harbour Authority for the Port of Troon, situated on the east coast of the Firth of Clyde in South Ayrshire. Commercial activities at Troon include fishing, a crucial role in the UK's timber trade, as well as handling an array of project cargoes. It is also a destination for smaller cruise vessels, and the site of a shipyard and yacht marina.

To maintain depths at the operational berths and in the approach channel to the Port, and thus allow safe passage to vessels wishing to use the Port, ABP must undertake regular maintenance dredging. As part of the required dredging, the dredged material has to be disposed of. Historically this has involved placement of the dredge arisings in an offshore site in the Firth of Clyde under a licence granted to ABP by the Marine Scotland Licensing Operations Team (MS-LOT) in accordance with the Marine (Scotland) Act 2010 Part 4. The most recent previous licence number is 05611/15/0, which expired 6 October 2018 and requires renewal.

ABP is in the process of applying for a maintenance dredge licence for the Port of Troon. Part of the application procedure for the licence under Section 27(2) of the Marine (Scotland) Act is an assessment of the Best Practicable Environmental Option (BPEO) for managing the dredge arisings. Such an assessment was previously undertaken in 2015 and examined a wide range of possibilities for managing the dredge arisings. This document provides an updated review to support the application for renewal of the maintenance dredge licence.

1.2 Report scope

This report provides a Waste Hierarchy Assessment (WHA) to determine the BPEO for the use/disposal of the dredged material that is required for a Marine Licence under the Marine (Scotland) Act, 2010.

The report is structured as follows:

Section 1: Introduction;

Section 2: Sets out the dredge requirement;

Section 3: Provides a review of the policy;

Section 4: Outlines the dredge material characterisation;

Section 5: Waste Hierarchy Assessment;

Section 6: Presents the overall WHA and BPEO conclusion.

2 Dredge Requirement

Virtually all of the material requiring to be dredged at the Port of Troon originates from the natural shallow water sediments of the Ayrshire Coast, entering the harbour area from seaward as a result of high energy storms. The material deposits in the lee of the protective breakwater, with small quantities of finer sediment entering the dock.

Because the mechanisms controlling sediment movement at the harbour are primarily weather dependent, the resulting siltation and hence the need for maintenance dredging is not readily predictable, other than on average. The amount and rate of siltation has been found to vary depending upon the severity and frequency of floods and storms, as does the proportion of deposited sediment originating from the landward and seaward sources.

Table 1 summarises the volumes for the period from 1990. The volume of material that has to be dredged each year to maintain safe navigable depths and allow the port to function, and the rate of sediment inflow, mean that typically maintenance dredging has been undertaken at Troon no more than about once a year.

Table 1. Previous dredge and disposal quantities at Ayr[1] and Troon from 1990

Licence Period (mm/yy)	Amount Dredged (m^3)	Tonnes Dredge Ayr	Tonnes Dredge Troon	Tonnes (Total)
09/92 - 09/93	22310			32784
09/93 - 09/94	31079			47050
10/94 - 10/95	62908			82425
10/95 - 10/96	32019			53151
10/96 - 10/97	10335			17156
11/97 - 11/98	22757			37776
02/99 - 12/99	13000			21580
01/00 - 11/00	23823			39546
01/01 - 01/02	11418			18840
01/03 - 31/03	35375			55892
04/04 - 03/05	39461	35465	26884	62349
04/05 - 03/06	28586			45165
04/06 - 03/07	32725	27237	24469	51706
04/07 - 03/08	44798			70780
04/08 - 04/09	32019	29106	21485	50591
04/09 – 04/10	39185	39404	22508	61914
04/10 – 04/11	30449	34949	13161	48110
04/11 – 04/12	61061	66592	17672	84264
04/12 – 01/13	20199	27875		
04/13 – 01/14	40191	51095	4369	55464
06/14 – 06/15	46250	63128	697	63825

[1] The Port of Ayr has been included in this table as the two areas were previously licensed (and therefore dredge arisings were grouped) together. However, the maintenance dredge licence applications have now been separated, and therefore this document only considers dredge arisings from Troon.

The Marine Licence application currently being prepared is to dredge to a depth of no more 6 m below Chart Datum (CD) in the approaches to the harbour, -5.5 mCD along the west pier, and -4 mCD in the main basin. This requires the dredging and disposal of 32,500 m^3 of material or a maximum of 40,000 tonnes (wet weight). This will be carried out annually at most.

2.1 Current dredge practice

Maintenance dredging at Troon is undertaken by dredgers operating under contract to ABP. The contract dredgers are generally owned by UK Dredging (UKD), part of the ABP group of companies, or by other commercial dredging contractors. Two types of dredger have been employed in recent years. A trailer suction hopper dredger (TSHD) has been used for the dredging of the approach channel at Troon, while a self-propelled grab hopper dredger is used within the basins and for work close to quay walls.

Admiral Day, a grab hopper dredger, will be the principal vessel for the proposed maintenance dredge activities operated by Wyre Marine. There may also be a requirement to engage a larger vessel such as UKD Orca (TSHD) during the period of the licence. This would be operated by UKD.

Both types of dredger are designed to deposit the dredge arisings at a licensed disposal site through bottom opening doors.

3 Policy Review

Dredged material is classed as a waste material once removed and is strictly controlled as it enters the waste stream. Beneficial use and disposal of dredged material at sea are controlled Under the London Convention 1972, the 1996 Protocol, the OSPAR Convention 1992 and the revised EU Waste Framework Directive (2008/98/EC). Under the Marine (Scotland) Act 2010 alternatives to disposal of the dredged material are to be explored and documented in the form of a BPEO assessment. Should this assessment identify a practical alternative to disposal of dredged material, this option should be further considered before consent for disposal at sea (or land) is made. Any identified locations for use and/or disposal also need to take account of the UK Government Sustainable Development Strategy and the Marine Policy Statement (see Section 3.1).

3.1 Marine policy statement

The UK Government Sustainable Development Strategy sets out the need for all Government policy to be in line with the principles of sustainable development (HM Government, 2005). These principles are expressed through the five high-level marine objectives which take forward the UK vision for the marine environment of "clean, healthy, safe, productive and biologically diverse oceans and seas". These high-level objectives are: (1) Achieving a sustainable marine economy; (2) Ensuring a strong healthy and just society; (3) Living within environmental limits; (4) Promoting good governance; and (5) Using sound science responsibly.

It is becoming increasingly important that space within the marine environment is utilised effectively to ensure activities can be undertaken in a sustainable manner with minimal conflict between users. The UK Marine Policy Statement (MPS) (HM Government, 2011) is the framework for preparing Marine Plans and taking decisions affecting the marine environment. The MPS indicates that, "The Marine Plan should identify areas of constraint and locations where a range of activities may be accommodated. This will reduce real and potential conflict, maximise compatibility between marine activities and encourage co-existence of multiple uses" (Defra, 2011).

The policy specifically states that dredging "is essential to the functioning of ports and marinas" (Section 3.6.3) and the disposal can have "benefit in maintaining sedimentary systems" and suitable material at appropriate locations can have "benefit in providing material for alternative uses, such as construction, beach nourishment or salt marsh restoration" (Section 3.6.4).

3.1.1 Scotland's National Marine Plan

Troon Harbour lies in the Clyde Scottish Marine Region (SMR). Currently the Clyde Regional Marine Plan is in draft form (see Section 3.1.2), and therefore decisions in the interim must be made in accordance with the National Marine Plan (Scottish Government, 2015). Furthermore, compliance with the principles documented in the UK's Sustainable Development Strategy should be guaranteed for any locations considered for re-use and/or disposal.

The Scotland National Marine Plan notes that marine licence "applications will be considered in accordance with the objectives and policies of the plan" with a presumption in favour of sustainable development and use of the marine environment". The marine licensing process is also used to reach a "balanced view on whether an individual project should be consented" taking careful account of the use of the development and economic benefit in an appropriate and proportionate manner.

Scotland's National Marine Plan (Scottish Government, 2015) highlights that safeguarding the viability of routes used by shipping, ensuring safety of navigation and encouraging development of Scottish ports and harbours are essential for the continuation and growth of economic prosperity provided by ports and harbours and the variety of sectors they support.

As part of these considerations, dredging is recognised as an essential activity to maintain existing shipping channels, establish safe approaches to new ports or open up routes to old ports. Dredged material may be disposed of at licensed marine disposal sites or used for alternative purposes such as land reclamation or coastal nourishment, if suitable, to minimise seabed disposal. Licensed disposal areas may change, typically as a result of disuse, monitoring information or the need for sites in additional locations. The consideration of both dredged navigation channels and disposal sites in marine planning and decision making is important to support safe access to ports and the disposal of dredged material in appropriate locations (Scottish Government, 2015).

While Scotland's National Marine Plan highlights the requirements for dredging and disposal to support port development and navigational safety, it also highlights a number of key issues. Dredging to maintain navigation channels can cause loss or damage to habitats and species and exposure of buried archaeological remains. Dredging requirements may increase if ship size increases and deeper and wider navigation channels are required. Dredging, and the disposal of dredged material, may impact on other sea users on a temporary basis, and dredged areas and disposal sites may not be compatible with other specific uses. Dredging is a licensable activity and, therefore, the potential environmental impacts are assessed through licensing procedures (Scottish Government, 2015).

3.1.2 Draft Clyde Regional Marine Plan

In March 2017, Scottish Ministers gave a Direction to the Clyde Marine Planning Partnership (CMPP) and its public authorities to develop a Regional Marine Plan for the Clyde Marine Region (CMR). A pre-consultation draft of the Clyde Regional Marine Plan is available from the CMPP website[2].

Objective SHIP 5 of the pre-consultation draft of the Clyde Regional Marine Plan states that where capital or maintenance dredging is proposed, opportunities for associated environmental enhancement should be explored. This is to be measured during marine licence determination process.

Policy SHIP 5 also states that:

> *"Licence applications for capital and maintenance dredging activities will be supported where they can demonstrate that consideration has been given to practicable and cost-effective environmental enhancement measures, such as beneficial use of dredged material or dredging methods that retain sediment in the natural system, and how these enhancements will be delivered where this is practicable. Consideration of the Best Practicable Environmental Option should incorporate natural capital considerations, including within cost-benefit analysis."*

In line with these objectives and policies, this report provides a WHA and consideration of the BPEO for the use/disposal of the dredged material.

[2] https://www.clydemarineplan.scot/marine-planning/clyde-regional-marine-plan/#progress (accessed November 2020)

3.2 Waste policy

The Waste Framework Directive (75/442/EEC) was originally adopted in 1975, followed by substantial amendment in 1991 (91/156/EEC) and a codified version in 2006 (2006/12/EC).

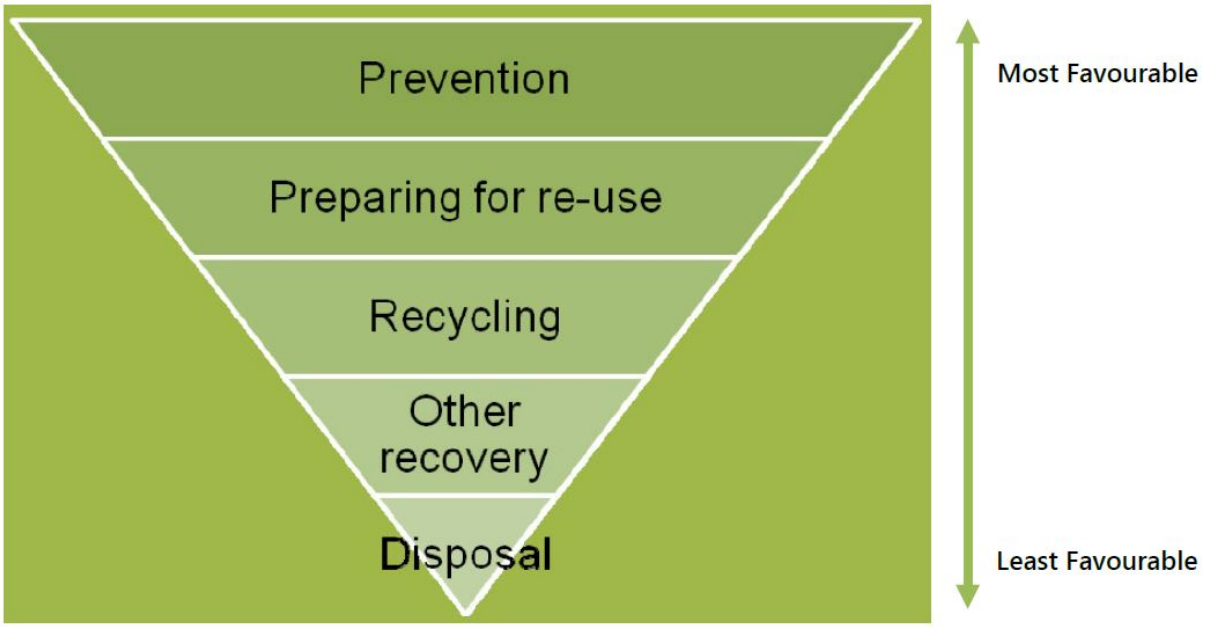
The revised Waste Framework Directive (2008/98/EC) repealed earlier versions, providing a general framework of waste management requirements and sets the basic waste management definitions for the European Union (EU). It lays down measures to protect the environment and human health by preventing or reducing the adverse impacts of the generation and management of waste and by reducing overall impacts of resource use and improving the efficiency of such use. It defines 'waste' as any substance or object which the holder discards or intends or is required to discard.

Article 4 of the revised Waste Framework Directive sets out five steps for dealing with waste, ranked according to environmental impact, commonly referred to as the 'waste hierarchy' (see Figure 1 and Table 2). The WHA (and therefore the determination of the BPEO) are strongly governed by the waste hierarchy.

Prevention, which offers the best outcomes for the environment, is at the top of the priority order, followed by preparing for re-use, recycling, other recovery and disposal, in descending order of environmental preference.

The waste hierarchy places emphasis on waste prevention or minimisation of waste, followed where possible by re-use of the material. For any dredging project, the *in situ* characteristics of the material (physical and chemical), the method and frequency of dredging (and any subsequent processing), determines its characteristics for consent through the waste hierarchy (Section 4).

This understanding is central for consideration of management options and determination of the BPEO for dealing with the management of dredged material. An applicant must take account of the waste hierarchy and consider alternative means of disposal of dredged material before applying for a licence to dispose of dredged material at sea (HM Government, 2011).



Source: Adapted from Defra (2011)

Figure 1. Waste hierarchy

Table 2. Stages of the waste hierarchy

Stage	Name (Article 4)	Definition (Article 3)
1	Prevention	Measures taken before a substance, material or product has become waste, that reduce: (a) The quantity of waste, including through the re-use of products or the extension of the life span of products; (b) The adverse impacts of the generated waste on the environment and human health; or (c) The content of harmful substances in materials and products.
2	Preparing for re-use	Any operation by which products or components that are not waste are used again for the same purpose for which they were conceived.
3	Recycling	Any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations.
4	Other recovery (e.g. energy recovery)	Any operation, the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy. Annex II sets out a non-exhaustive list of recovery operations.
5	Disposal	Any operation which is not recovery even where the operation has as a secondary consequence the reclamation of substances or energy. Annex I sets out a non-exhaustive list of disposal operations.

Where prevention of the dredging is not possible, then the volume to be dredged should be minimised, then options for re-use of the material, recycling and other methods of recovery must be considered in the first instance. In the context of dredge material this could include, for example:

- Engineering uses, such as:
  - Aggregate for the construction industry;
  - Land creation and improvement;
  - Beach nourishment;
  - Construction of offshore berms;
  - Capping material; and
  - Temporary disposal at sea (e.g. in an aggregate site) for future re-use.
- Agriculture and product use:
  - Aquaculture; and
  - Construction material.
- Environmental enhancement:
  - Intertidal feeding/creation, e.g. islands for birds, mudflat and saltmarsh creation, fisheries habitat and wetland restoration.
- Post treatment of the dredge material to change its character prior to determining a potential use, for example:
  - Dewatering to create consolidated sediments;
  - Separation basins; to separate sediments into different size classes for different uses;
  - Soil manufacturing; and
  - Physio-chemical treatments of contaminated sediments.

Following such treatments, the material may be able to be used for example, as top soil or bricks etc. Should no practical and cost-effective solutions be identified, final options for the disposal of the dredged material are considered. These include:

- Marine disposal in licenced deposit sites; and
- Land based disposal in terrestrial landfill (possibly after treatment such as incineration).

Each of the stages in the waste hierarchy have been considered in turn, where practical, for the management of the dredge arisings within this assessment. This has also taken into account the respective policies as outlined above.

4 Dredge Material Characteristics

A specific sediment sample plan was provided by MS-LOT in the context of the proposed dredging activities. As specified in this plan, four surface sediment samples were collected on the 21 October 2020 within the dredge area. The location of these samples and the dredge area is shown in Figure 2.

The results of the physical and chemical analyses undertaken on the samples are presented below in Section 4.1 and 4.2 respectively.

4.1 Physical

Particle size analysis (PSA) has been undertaken on the sediments to be dredged (Figure 2). This grading is shown in Table 3.

The material to be dredged is mixed comprising of fine to coarse sand, mud (silt/clay) and a small proportion (*circa* <10%) of gravel. The relative mix varies with location in the harbour and approach to the harbour. Outside of the harbour, the majority of material comprises sand (between 78-93 %). Within the harbour, the proportion of sand is less with about a third to two thirds comprising silt/clay (between 35-59 %).

Table 3. Particle size analysis for sediment samples taken from within the dredge area

Sample	Grain size (%)		
	Gravel (>2 mm)	Sand (63-2000 µm)	Silt/clay (<63 µm)
Location A	1.7	93.4	4.9
Location B	0.8	78.4	20.8
Location C	8.1	56.7	35.2
Location D	0.0	40.7	59.3

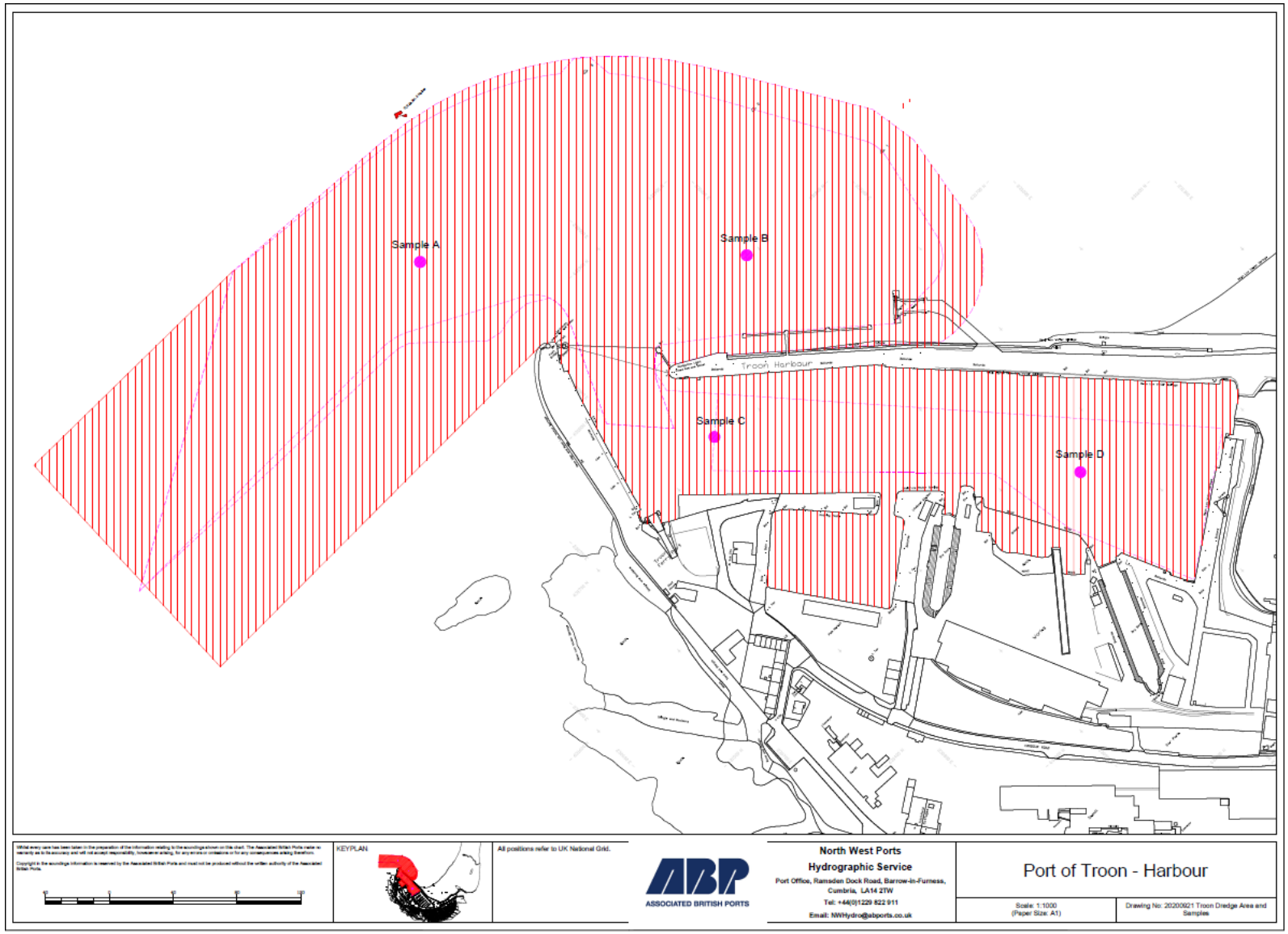


Figure 2. Sediment sampling locations within dredge area

4.2 Chemical

4.2.1 Present contamination

Chemical analysis of samples obtained during the survey was undertaken by SOCOTEC and a sub-set of the results are presented in Table 4. As required by MS-LOT, the full set of results will also be provided with the marine licence application in the pre-disposal sampling results form. The samples were analysed for concentrations of the following chemical determinands (dry weight):

- Metals (arsenic, cadmium, chromium, copper, mercury, nickel, lead, zinc);
- Organotins (tributyltin (TBT), dibutyltin (DBT));
- Polychlorinated biphenyls (PCBs) (including ICES 7 congeners: 028, 052, 101, 118, 138, 153, 180);
- Polycyclic aromatic hydrocarbons (PAHs) (including United States Environmental Protection Agency (USEPA) suite of 16: Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(123-cd)pyrene, Dibenzo(ah)anthracene, Benzo(ghi)perylene);
- Polybrominated diphenyl ethers (PBDEs); and
- Total hydrocarbon content (THC).

Unlike water quality, there are no formal quantitative environmental quality standards (EQS) in the UK for the concentration of chemicals in sediments, although the Water Framework Directive (2000/60/EC) has introduced optional standards for a small number of priority and priority hazardous substances. Marine Scotland (2017) provides a series of Action Levels to assist in the assessment of dredged material (and its suitability for disposal to sea, assuming this is considered appropriate under the waste hierarchy). In general, concentrations of chemicals in dredged material below Action Level 1 (AL1) are likely to be acceptable for disposal at sea, although it may require monitoring conditions if the dredge is large in scale or in a sensitive area. In contrast, dredged material with concentrations above Action Level 2 (AL2) is generally considered unsuitable for disposal at sea. Dredged material with concentrations between AL1 and AL2 requires further consideration before a decision can be made. This could potentially include a restriction on sea disposal of certain areas of dredge spoil, monitoring of the dredge material and disposal site and specific treatment or mitigation measures (Marine Scotland, 2017).

Results show that all samples were below AL1 (Marine Scotland, 2017) for arsenic, chromium, TBT and DBT. Other metals were found to marginally exceed AL1. Cadmium, copper, mercury, and zinc exceeded AL1 at Locations C and D. Nickel exceeded AL1 at all locations and lead exceeded AL1 at Location D only. All PAHs were below AL1 at Location A, with the exception of fluoranthene, phenanthrene and pyrene. Locations B, C and D had concentrations above AL1 for the majority of PAHs. Total hydrocarbon content also exceeded AL1 at Locations B, C and D. All of the ICES 7 PCBs were below AL1, and PBDE concentrations were also low, below the limit of detection (no action levels exist for PBDEs).

Overall, sediment contaminant concentrations within the dredge area are relatively low and are generally either below, or marginally exceed, AL1, with no exceedances of (or contaminant concentrations close to) the respective AL2. Therefore, sediment contamination results suggest the material would be considered acceptable for disposal in the marine environment. This is considered further with regard to the BPEO in Section 5.3.3.

Table 4. Concentration of chemical determinands in surface sediment samples collected from four locations in the dredge area

Parameter	Unit	Action Level		Sediment Concentrations			
		AL1	AL2	Location A	Location B	Location C	Location D
Arsenic	mg/kg	20	70	7.6	7.3	10.5	11.3
Cadmium	mg/kg	0.4	4	0.18	0.26	0.5	0.49
Chromium	mg/kg	50	370	40.1	35.4	49.3	41.6
Copper	mg/kg	30	300	17.4	20.9	45.2	107
Mercury	mg/kg	0.25	1.5	0.1	0.15	0.36	0.57
Nickel	mg/kg	30	150	56.3	44.6	56.9	48.6
Lead	mg/kg	50	400	18.8	19.4	45.6	71.6
Zinc	mg/kg	130	600	76.4	78.7	149	189
Tributyltin	µg/kg	100	500	<5	<5	14.9	35.1
Dibutyltin	µg/kg			15.7	<5	16.5	40.9
Acenaphthene	µg/kg	100	-	9.01	20.1	202	57.5
Acenaphthylene	µg/kg			5.32	33.9	35.3	128
Anthracene	µg/kg			27.1	96.4	212	545
Benzo[a]anthracene	µg/kg			59.8	228	643	1350
Benzo[a]pyrene	µg/kg			65.3	316	763	1810
Benzo[b]fluoranthene	µg/kg			48.2	229	625	1230
Benzo[ghi]perylene	µg/kg			46.4	209	484	1050
Benzo[k]fluoranthene	µg/kg			33.4	152	379	778
Chrysene	µg/kg			57.9	282	736	1430
Diben[ah]anthracene	µg/kg	10	-	8.63	37.2	109	224
Fluoranthene	µg/kg	100	-	119	367	1420	2380
Fluorene	µg/kg			12.9	41.7	150	127
Indeno[1,2,3-cd]pyrene	µg/kg			37.7	177	498	1020
Naphthalene	µg/kg			26.3	51.3	95.3	131
Phenanthrene	µg/kg			102	301	778	1310
Pyrene	µg/kg			127	420	1280	3120
Total Hydrocarbon Content	µg/kg	100000	-	44700	465000	520000	858000
PCB 28	µg/kg	20	180	0.22	0.22	0.48	0.66
PCB 52	µg/kg			0.3	0.26	0.73	1.53
PCB 101	µg/kg			0.22	0.18	0.88	2.25
PCB 118	µg/kg			0.12	0.09	0.9	2.24
PCB 138	µg/kg			0.1	0.19	1.39	3.09
PCB 153	µg/kg			0.18	0.25	1.47	3.08
PCB 180	µg/kg			0.12	<0.08	0.75	1.62

Parameter	Unit	Action Level		Sediment Concentrations			
		AL1	AL2	Location A	Location B	Location C	Location D
BDE17	µg/kg	-	-	<0.1	<0.1	<0.1	<0.1
BDE28	µg/kg			<0.1	<0.1	<0.1	<0.1
BDE47	µg/kg			<0.1	<0.1	<0.1	<0.1
BDE66	µg/kg			<0.1	<0.1	<0.1	<0.1
BDE85	µg/kg			<0.1	<0.1	<0.1	<0.1
BDE99	µg/kg			<0.1	<0.1	<0.1	<0.1
BDE100	µg/kg			<0.1	<0.1	<0.1	<0.1
BDE138	µg/kg			<0.1	<0.1	<0.1	<0.1
BDE153	µg/kg			<0.1	<0.1	<0.1	<0.1
BDE154	µg/kg			<0.1	<0.1	<0.1	<0.1
BDE183	µg/kg			<0.1	<0.1	<0.1	<0.1
BDE209	µg/kg			<0.1	<0.1	<0.1	<0.1
Key	**Below AL1**						
	Above AL1, below AL2 (if applicable)						

5 Waste Hierarchy Assessment

As described in Section 3.2 the waste hierarchy ranks waste management options according to the best environmental practice. The following section discusses the options, with respect to the management of the sand and silt arising from maintenance dredging of the Port of Troon.

5.1 Prevention

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

1) Do Nothing (i.e. do not undertake maintenance dredging);
2) Reduce the dredging requirement and hence the volume of dredge arisings.

The main approach to avoiding the generation of waste would be to not undertake the proposed maintenance dredging. To cease all maintenance dredging would, however, ultimately restrict the maximum size of vessel that could safely navigate to the Port of Troon and therefore limit the competitiveness of the Port, eliminating existing trades and services. Maintenance dredging is therefore seen as essential for the ongoing operations of the Port of Troon which supports the employment of people directly on the port estate and jobs (fishermen, hauliers, suppliers etc.) in the Troon area and further into west Scotland.

The maintenance dredging requirement has been optimised/minimised to facilitate safe and efficient navigation of vessels and is consistent with marine plan policies. This means a minimum depth required in the channel of 6.0 m below CD. A hydrographic survey is carried out to determine the current depths and the amount needed to be dredged. Monitoring of vessel's echo sounders is also carried out, as well as using feedback from port users. These methods inform the decision 'to call' for a dredge campaign.

These methods of monitoring mean the dredger is only called when necessary; in recent years this has typically been no more than once a year. Additionally, the hydrographic survey allows specific areas of the harbour to be 'targeted' to maximise efficiency and minimise the dredge volume (hence disposal quantity) required.

The use of water injection dredging (WID) is an alternative method to minimise the need for a separate waste disposal activity. However, the coarse sediments to be removed are not conducive for use of the method and the sediment is likely to settle in areas which would create an increased supply of sediment to return to the approach channel. This would effectively increase the future maintenance requirement. The method is therefore not considered viable.

In summary, all measures to prevent and/or reduce the volume of waste generated by the project have been fully considered and the present dredge management provides the minimum dredge requirement for the existing trade and activity through the Port.

5.2 Re-use, recycling and other recovery

Potential options have been identified for uses of the dredge arisings from the Port of Troon. These include, for example, engineering projects (e.g. land reclamation), agricultural land improvement, land reclamation, beach replenishment and other forms of recovery, such as for aggregates or building

materials (following treatment). These options are reviewed below with respect to the maintenance dredge arisings.

5.2.1 Re-use

Soil improvement

The dredge material comprises predominantly sand with a smaller quantity of silt. The material would also have a high water and saline content and organic content. Therefore, the expected dredge spoil is not suitable for soil conditioning or spreading on agricultural land without extensive treatment. As such the materials would not improve the growing capability of soil to any significant extent and in general it would be detrimental to growth. The only possible agricultural or landscaping benefit would be localised improvements in drainage if the material was used to raise depressions or otherwise increase soil permeability. However, any local demand for soil is also easily satisfied from normal sources, and the logistics of moving the material to any site would be like that described for sacrificial land disposal, in Section 5.3.1, below.

Land reclamation

The material is potentially suitable for use in creating new land, either on the coast or inland. Its size and texture give it good drainage and loadbearing characteristics. Appropriate potential uses include general raising of ground levels, road embankment construction and any situation where bulk infill might be required. Should any reclamation project on the Ayrshire Coast require fill, ABP would be prepared to offer material dredged from Troon. In the absence of any known project, however, the option is not considered the BPEO at this stage.

Construction product use

The dredged material has a possible use in the manufacture of concrete, asphalt, glass and other materials made from silica. Sands used in these industries are required to be of a specified quality, to have a consistent quality and to be free from salts and organic material.

The material dredged from Troon has been examined for possible use in concrete production and glass manufacture and has been found to be unacceptable because treatment would be required to remove salt and organic material. No demand has resulted for the material landed at Troon. The option is therefore not considered the BPEO.

5.2.2 Recycling

Beach nourishment/replenishment

The dredged material may be suitable for beach nourishment either to counteract erosion or to improve amenity when the beach is used for public recreation. The dredged material is either derived from or would contribute to the natural coastal processes, and if the Port of Troon did not exist, it is likely that it would form part of the natural sediment circulatory system of the Ayrshire Coast.

The beaches surrounding Troon, extending south to Ayr and north to the River Irvine, are all experiencing erosion. This is particularly noticeable to the south and north of Troon where wave erosion of the backing dunes had to be countered by hard protection. There would thus be benefit to the Ayrshire beaches in terms of both erosion reduction, and amenity upgrading as the beaches are widely used for recreation.

A study undertaken by the University of Strathclyde in 1995 (Allan, 1995) has examined the potential for nourishing the beaches using material dredged from Troon (and Ayr). It identified a problem relating to the transport and placement of material on the beaches. Because of the relatively flat slopes of the beaches, bottom dumping from grab or trailer dredgers even at high tide would leave the material at some distance from the upper beach. The trailer dredger could pump the material ashore using a floating pipeline, but this would require it to be installed and maintained through the surf zone.

Therefore, the best practical option for placement on the beaches was identified as the use of Irvine Harbour for berthing the dredgers with material then being conveyed south by pipeline or by dump trucks. Dump trucks would seem the most practicable but would introduce significant environmental and safety issues with the increase of lorry journeys (e.g. 750 loads, based on 15,000 tonne dry weight of material, and a 20-tonne lorry capacity) on the roads. Both options would therefore involve considerable additional environmental costs, in addition to significant financial implications, compared with sea disposal.

Responsibilities for beach management, and hence any beach nourishment activities, lie with the local authorities, in this case South Ayrshire and North Ayrshire councils. These councils would require taking the initiative in developing a beach management plan based on intermittent nourishment. The involvement of other agencies such as The Crown Estate, Scottish Natural Heritage and Marine Scotland would also be required.

Furthermore, for beach replenishment to be considered the BPEO for management of the maintenance dredge material the following consents, and assessment would be required:

- Consent of Marine Scotland is required for works in tidal waters under Marine (Scotland) Act 2010;
- Consent to dispose of material to the foreshore or seabed from both Marine Scotland and The Crown Estate. The Crown Estate, generally, may be happy to issue consent, providing all other statutory consents are in place and subject to negotiation of a disposal fee;
- Consultation with the local councils;
- Local acceptability of the use of the dredged material as beach replenishment; and
- Assessment of the environmental implications of a beach recharge at the identified location and the potential effects of any dispersion (which may include statutory requirements such as Environmental Impact Assessment, or Water Framework Directive assessment).

The results of the Allan (1995) study demonstrate that use of the material dredged from Troon for nourishing the Ayrshire beaches is a potential environmental option, and preferable to at-sea disposal. However, the study also identified major practical and organisational difficulties, environmental and safety issues, as well as the significantly increased costs, which would need to be addressed by all interested parties. ABP would be willing to participate in discussions in the future should projects be identified. However, there are currently no known beach nourishment schemes being progressed by South Ayrshire or North Ayrshire councils.

At this time, given that no ongoing projects have been identified, and ABP is unaware of potential projects being taken forwards by the local councils, beach nourishment is not considered as a practical disposal option to be progressed within the timescales of the present licence application. Should projects be identified in the future a full assessment would be required to determine the overall feasibility and balance of environmental costs and potential benefits of a beach nourishment scheme.

5.3 Disposal

5.3.1 Sacrificial landfill

The dredged material is largely inert, and the concentration of contaminants is predominantly below that considered to require special care of controlled disposal in a licensed landfill. Therefore, placement of the dredge material at a licensed landfill site would be unnecessary.

Furthermore, the nature of the dredged material (a mixture of sand, silt and gravel) is unsuitable for sacrificial landfill without involving an extensive transport and treatment process. Disposal to landfill would involve a complicated material handling operation involving sea to land transfer, de-watering, loading to trucks and transport to site. In addition, there would need to be a change in dredger type, for example from a TSHD designed for maintenance dredging to one designed for aggregate recovery or a change to a mechanical form of dredger, unless a settling lagoon could be constructed. These considerations would all add considerably to the complexity of managing the dredge arisings both from a practicality and cost perspective.

South Ayrshire, East Ayrshire and North Ayrshire councils, the three authorities local to the harbours, do not have sites that are able to accept the quantities of material dredged from Troon. Commercial operators of licenced landfill sites might accept the material but only at a charge which would compensate for the significant loss of volume. There is considerable difficulty in obtaining suitable landfill sites for domestic and commercial waste throughout Ayrshire, and there would be no environmental benefit in placing relatively clean marine sediments in existing or new sites. Owners and operators of sites are reluctant to sacrifice space for inert material thus shortening the life of their site and reducing capacity for industrial and domestic controlled wastes. This would place increased pressure to open further sites in the locality, which is unlikely to be favoured by either local authorities or the public.

In view of the reasons noted above, it is concluded that the transfer of the dredged material to landfill is not a practical option and therefore can be discounted as the BPEO.

5.3.2 Incineration

The sediment dredged from Troon comprises approximately 40-95 % sand and gravel. Placing the material in an incinerator would only result in removal of the organic fraction. Incineration of the material from Troon is not a practical option; it would result in a very substantial inert residual volume and produce no environmental benefit. This option is thus not considered appropriate as the BPEO.

5.3.3 Sea

The dredged material is suitable for disposal in the sea at an appropriate site. It is in part derived from the sea bed, and in part would eventually form the sea bed. As such, the material could be disposed of in a near shore site, where it is likely to continue to be part of the natural circulatory system.

Material dredged from Ayr and Troon has historically been relocated in an offshore disposal ground (Ayr Bay – MA050). This option allows both the grab dredgers and trailer dredgers to work efficiently. Sea disposal has not been demonstrated to have caused significant adverse impact on the marine environment at and around the disposal site. No complaints have been received from fishing or other marine interests and there is no evidence that the use of the new site licenced in 1987 has resulted in turbidity, discolouration, foaming, odour or floating substances either at the site or on the shore. No

objections have been received on amenity grounds and ABP is unaware of the disposal of dredge arisings causing any interference with other legitimate uses of the sea.

It is thus considered that this shallow water dispersive site to the north of Ayr and south of Troon is the most practical option for at-sea disposal. Here, sediment of similar characteristics to that dredged occurs on the sea bed and allows the sediment to be retained within the natural circulation system, as it would if the harbours did not exist.

The traditional objections to shallow water disposal of dredged material are on navigational, fishing and environmental grounds. ABP is the only port authority within the area proposed and the only authority with dredged areas or harbours which could be affected by the movement of the relocated sediment. It is considered that with the use of a dispersive site and considering the total quantity of material to be relocated annually, the frequency of dredging and the size of the dredgers used, the change in water depth resulting from the relocation will be insignificant.

With regard to fishing and the marine environment, the shallow water in Ayr Bay is not fished on a regular basis and is not one regarded by local fisheries officers or fishermen as a fish breeding ground. The shallow depth means that the sea bed is one subject to considerable natural disturbance during storms, and marine life existing in such a high energy environment is unlikely to be affected detrimentally by the controlled release over a wide area of material of similar characteristics to that existing on that sea bed. Any organic material would be released by the disposal, but this would either fall to the seabed or be moved by surface or sub-surface currents. Some discolouration of the water might also result. Both these effects would be within the natural variation that occurs at the site.

With respect to sediment-bound contaminants in the dredge material (see Section 4.2.1), the majority of sediment samples contained contaminants at concentrations below AL1, with no exceedances for PCBs, TBT, DBT, arsenic, and chromium. Whilst other metals, PAHs and total hydrocarbon content (THC) concentrations in some sediment samples were between AL1 and AL2, most of these only marginally exceeded AL1. No samples were above, or close to, AL2 (where available). During disposal of dredge material at sea, sediments will disperse in the water column and a proportion of the contaminants within the sediment will partition in to the dissolved phase. EQSs exist for dissolved concentrations in the water column, presenting concentrations that should not be exceeded to protect human health and the environment.

The licensed disposal site at Ayr Bay (MA050) is a dispersive site located approximately 5 km offshore. Sediments disposed of at this location would quickly be dispersed in the wider area, particularly finer material, and as such the dissolved concentration of contaminants would likely be low. In addition, PSA (see Table 3) has shown the dredge material includes a significant sand fraction, whereas contaminants are typically associated with fine (silty) material. In considering PAHs, which were found to most consistently exceed AL1, these compounds are highly hydrophobic and only a small proportion would be expected to partition in to the dissolved phase (and thus become more readily bioavailable). Furthermore, the hopper capacity of the vessel proposed in the marine licence application (Admiral Day), is 212 m^3, and therefore only relatively small quantities of material would be deposited at any one time. This further reduces the likelihood that EQSs would be exceeded following the disposal of the material in Ayr Bay (MA050).

ABP thus considers that relocation of the material dredged from Troon in the designated disposal area to be the BPEO. It continues to allow flexibility in the dredging operation, it will help to contain dredging costs, it will retain sediment within the coastal circulation zone, and it is unlikely to have significant adverse navigation or environmental impacts.

6 Conclusion

This review of the options available for the prevention, re-use and recycling of the material dredged from the Port of Troon has developed from earlier BPEO studies in the light of experience gained in actively seeking alternatives to at-sea disposal.

The material dredged by ABP from the Port of Troon consists of predominantly sand and silt which is derived from the coastal circulation system. Dredging is required to ensure vessels are able to safely navigate to the Port of Troon and deliver goods and services to Scotland. As such, preventing the production of waste is not possible in this case.

Options for the re-use and recycling of the material have been examined. The high sand and salt content of the sediment also means that it is of little use as a growing medium or as a soil conditioner. Its use in construction products is also not considered appropriate. Whilst it is theoretically possible for the sediment to be used in creating new land, the absence of any current known projects in the local area discounts its use at this stage.

The material may be suitable for beach nourishment and there is a potential need for Ayrshire beaches to be supplied with sediment for coastal protection and amenity enhancement. However, a study carried out into the feasibility of using the dredged material for local beach nourishment identified major practical problems, environmental and safety issues, increased disposal costs and no established enabling organisation. ABP has no responsibility for coastal protection and no powers to undertake such work on Ayrshire beaches. Therefore, at this time, it is considered that beach nourishment is not a practical option.

Nevertheless, ABP is willing to make material available for beach nourishment assuming there were no significant practical, environmental or cost implications for its marine dredging operations. ABP would be pleased to participate in discussions with local authorities and other interested organisations, in order to overcome the practical, economic and legislative difficulties in using dredged sediment for beach nourishment opportunities. However, it is considered unlikely that this would be practicable in the timescales required for this marine dredge licence application.

The prevention, re-use or recycling of the dredge material is not considered possible and options for disposal have been assessed. The material does not contain contaminants at concentrations considered to be unacceptable for at-sea disposal. There is accordingly no need for and no environmental benefit to be gained by incineration of the material or its placement in a licensed landfill.

The dredged material is considered suitable for sea disposal, and disposal at the present licensed disposal site at Ayr Bay (MA050) has not (to the knowledge of ABP) resulted in adverse environmental impacts or been a cause of complaint. Therefore, it is concluded that the BPEO for the placement of maintenance dredge arisings from the Port of Troon is near shore disposal in a dispersive site in Ayr Bay (present disposal site).

7 References

Allan, M. J. (1995). Beneficial use of dredged material from the Firth of Clyde. Terra et Aqua, Number 61, December 1995.

Clyde Marine Planning Partnership - Clyde Regional Marine Plan: https://www.clydemarineplan.scot/marine-planning/clyde-regional-marine-plan/#progress (accessed November 2020)

Department for Environment, Food and Rural Affairs (Defra). (2011). Guidance on applying the Waste Hierarchy. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69403/pb13530-waste-hierarchy-guidance.pdf (accessed August 2019)

HM Government, (2005). Securing the Future Delivering UK Sustainable Development Strategy. Her Majesty's Government.

HM Government. (2011). UK Marine Policy Statement. HM Government, Northern Ireland Executive, Scottish Government, Welsh Assembly Government. March 2011 London: The Stationery Office. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69322/pb3654-marine-policy-statement-110316.pdf (accessed August 2019).

Marine Scotland. (2017). Pre-disposal Sampling Guidance Version 2 - November 2017. Available online at: https://www.gov.scot/Resource/0052/00528031.pdf (Accessed August 2018).

Scottish Government. (2015). Scotland's National Marine Plan. A Single Framework for Managing Our Seas. Marine Scotland. The Scottish Government, Edinburgh 2015. Available online at: http://www.gov.scot/Resource/0047/00475466.pdf (accessed August 2019).

8 Abbreviations/Acronyms

ABP	Associated British Ports
AL	Action Level
BPEO	Best Practicable Environmental Option
CD	Chart Datum
CMPP	Clyde Marine Planning Partnership
CMR	Clyde Marine Region
DBT	Dibutyltin
EC	European Commission
EEC	European Economic Community
EQS	Environmental Quality Standard
EU	European Union
HM	Her Majesty's
ICES	International Council for the Exploration of the Sea
mCD	metre(s) Chart Datum
MPS	Marine Policy Statement
MS	Marine Scotland
MS-LOT	Marine Scotland Licensing Operations Team
OSPAR	Oslo-Paris Convention
PAH	Polycyclic Aromatic Hydrocarbons
PBDE	Polybrominated Diphenyl Ethers
PCB	Poly-chlorinated Biphenyls
PSA	Particle Size Analysis
SI	International System of Units
SMR	Scottish Marine Region
SOCOTEC	SOCOTEC UK Ltd
TBT	Tributyltin
THC	Total Hydrocarbon Content
TSHD	Trailer Suction Hopper Dredger
UK	United Kingdom
UKD	UK Dredging
USEPA	United States Environmental Protection Agency
WHA	Waste Hierarchy Assessment
WID	Water Injection Dredging

Cardinal points/directions are used unless otherwise stated.

SI units are used unless otherwise stated.

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