Port of Rosyth Maintenance Dredge Disposal: Marine Licence Application

Best Practicable Environmental Option Report

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1. INTRODUCTION

1.1 BACKGROUND

This report has been prepared by Environmental Resources Management Ltd (ERM) on behalf of Forth Ports Ltd (Forth Ports) in support of a Marine Licence application for disposal of dredged material at sea from maintenance dredging from the Port of Rosyth.

Under the *Marine (Scotland) Act, 2010*, *Section 21(1),* a Marine Licence issued by the Marine Directorate (1) is required for the deposit of substances or objects within waters adjacent to Scotland. Under *Part 4, Section 27(2),* the Marine Directorate has an obligation to consider the availability of practical alternatives when considering applications involving disposal of material at sea. Applications for a Marine Licence to dispose of dredged spoil at sea require a Best Practical Environmental Option (BPEO) (2) assessment, demonstrating that alternatives to sea disposal have been investigated and that sea disposal does not pose an unacceptable risk to the marine environment and other legitimate users.

This report compares various options for the disposal of maintenance dredge material from the Port of Rosyth and identifies the BPEO.

Marine Licences for maintenance dredging activities are valid in Scotland for up to three years (3). Forth Ports currently holds a maintenance disposal licence (MS-00010442) permitting the disposal of dredge spoil from dredging to maintain safe navigable depths at the Port of Rosyth which covers the period 11 March 2024 to 10 March 2027. This current application is to cover the period from 11 March 2027 to 10 March 2030.

1.2 THE NEED FOR DREDGING AND SPOIL DISPOSAL

The Port of Rosyth is located on the north bank of the Forth Estuary approximately 1 nautical mile (nm) (2 km) west of the Forth Road Bridge. Rosyth was formerly a Ministry of Defence (MoD) naval base. Rosyth 2000 bought the land and quays of the base in 1997 and Forth Ports, part of Rosyth 2000, has the responsibility for maintenance dredging in Forth Ports' area of jurisdiction. As confirmed by Forth Ports, the port had between 472 and 584 vessel movements a year from 2023 to 2025, including to and from the Rosyth Naval Dockyard (4).

In line with *Scotland's National Marine Plan (Marine Planning Policy Transport 4), Section 13,* the planned dredging operations will continue to maintain and support the sustainable development of the Port of Rosyth. Forth Ports plans to continue the 1997 to 2023 regime of annually dredging the Port of Rosyth and the approach channel to the port. It is proposed that the dredged material resulting from the maintenance dredging will be disposed of at sea at the licenced marine disposal site at Oxcars. This site has been used for disposal of dredged material from the Port of Rosyth for over 27 years. Figure 1.1 shows the proposed disposal site.

(1) Formerly named Marine Scotland. Guidance and standards produced by Marine Scotland are now referenced to the Marine Directorate in this report.
(2) The term BPEO was derived by the Royal Commission on Environmental Pollution who described it as a procedure which "establishes, for a given set of objectives, the option that provides the most benefit or least damage to the environment as a whole, at an acceptable cost, in the long term as well as in the short-term".
(3) Marine (Scotland) Act 2010, Part 4 Marine Licencing. General Guidance for Applicants. Available online http://www.scotland.gov.uk/Resource/0043/00435338.pdf
(4) Forth Ports pers comms May 2026.

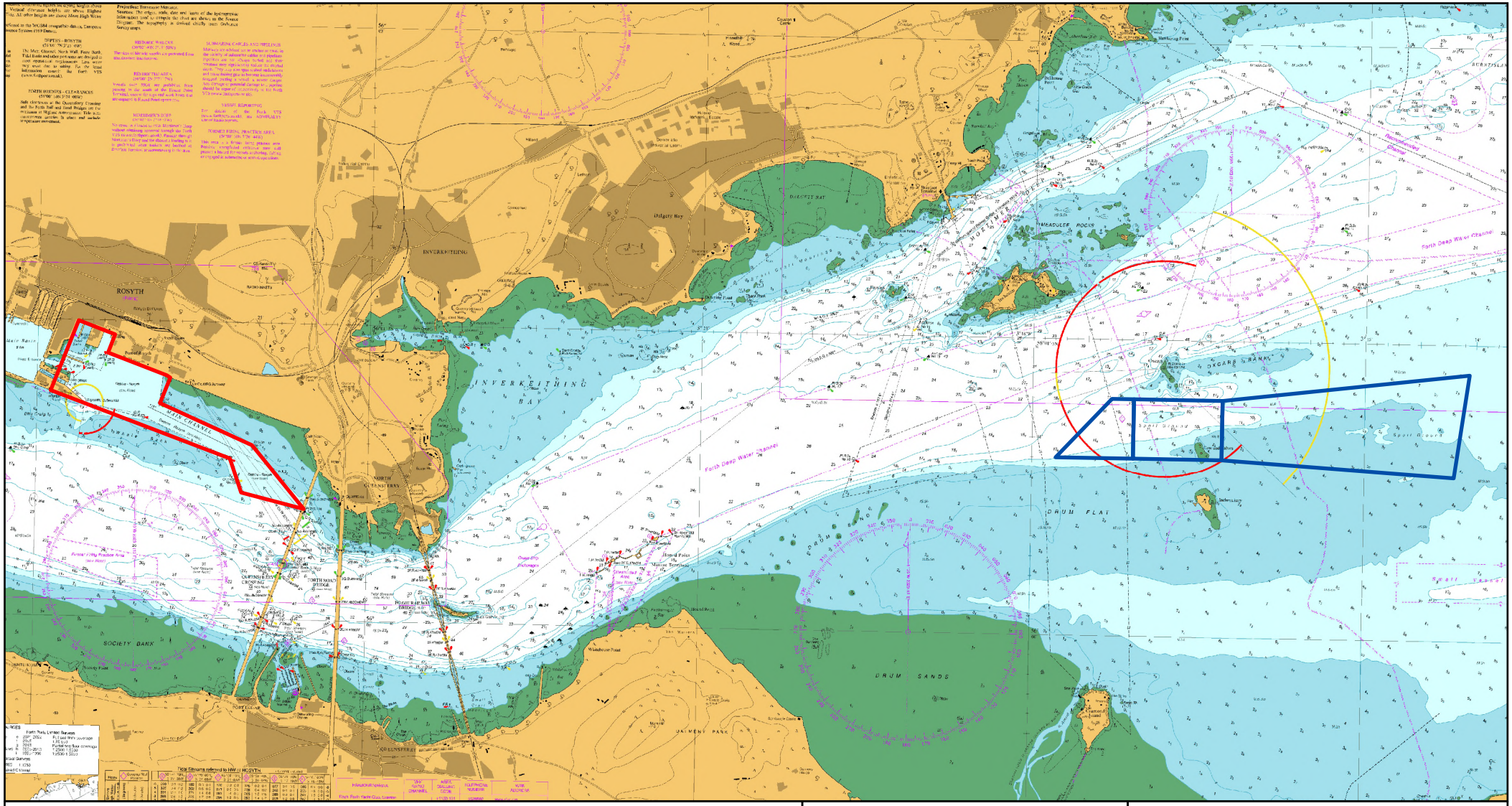


Figure 1.1
Port of Rosyth
Proposed Disposal Site

SCALE: See Scale Bar	VERSION: A01
SIZE: A4	DRAWN: RW
PROJECT: 0396143	CHECKED: MI
DATE: 13/04/2026	APPROVED: MI

ERM

PROJECTION: British National Grid

Path: \\vmukspgisfs01\Data\London\Projects\0391463 - Forth Ports\MAPS\0396143 - Forth Ports.aprx\0396143 - Forth Ports - Rosyth 2026 - Figure 1.1 - Proposed Dredge Area and Disposal Site - A01

The port and approach channel naturally experience sediment accretion due to the deposition of riverine and estuarine material originating upstream. Forth Ports has a statutory duty, as the Harbour Authority, to ensure safe navigation and therefore requires to undertake ongoing maintenance dredging and disposal of the dredged material. Should Forth Ports consider the 'Do Nothing' approach, and not undertake the maintenance dredging operations, a navigable depth would not be maintained, and the Port of Rosyth would not be able to continue to service current vessels and future vessel use of the port.

1.3 PREVIOUS MAINTENANCE DREDGE SPOIL DISPOSAL ACTIVITIES

The MoD had previously dredged the port area before Forth Ports took over annual dredging of the key berthing areas in 1997. From 1998 to the end of 2000 dredging was undertaken with the Abbotsgrange, a small trailing suction dredger that was owned by Forth Ports. Since January 2001, Forth Ports have contracted United Kingdom Dredging (UKD) for the majority of operations within the Forth Estuary. The UKD Marlin (shown in Figure 1.2) is a larger trailing suction dredger, with a hopper capacity of 3,000 m^3, double that of the Abbotsgrange. It is likely that this or a similar vessel will be used for future dredging operations, subject to relevant contracting arrangements. In addition, smaller vessels such as the Wyre Sand or Cherry Sand (shown in Figure 1.3) will be used for the shallower areas where the larger dredging vessels cannot work

Since 1998, Forth Ports have disposed of the majority of materials from the Port of Rosyth at the Oxcars disposal site approximately 5.5 nm (10 km) east of the port within the Firth of Forth (see Figure 1.1 for location of the Oxcars disposal site in relation to port). The exception to this was the disposal of dredged material from the port during 2001 at the Blae Rock disposal site located approximately 3.5 nm (6.5 km) east of the Oxcars site (see Table 1.3). The was related to additional dredging works in the inner part of the port as well as ongoing maintenance dredging operations in the area.

1.4 PROPOSED DREDGING AND DISPOSAL OPERATIONS

Forth Ports wishes to apply for a licence from the Marine Directorate for the disposal of dredge spoil to a maximum of 400,000 m^3 of dredged material per annum (up to 520,000 wet tonnes based on density of 1.3 [(5)]). This is required to ensure compliance with safe vessel berthing and to allow for any fluctuation in sediment deposition or contingencies.

To maintain access to the port, Forth Ports requires to dredge the port and main approach channel, typically for 17 to 25 days (24 hr working) over three to nine months of the, depending on siltation levels and operational requirements, including the vessel requirements for access to and from the Rosyth Naval Dockyard. The planned dredging operations would typically be undertaken in a number of short campaigns lasting approximately three to five days each throughout the year. The boundary co-ordinates of the planned dredge areas are presented in Table 1.1 and illustrated in Figure 1.1.

(5) Conversion factor used by Forth Ports for maintenance dredge sediments from the Port of Rosyth. Forth Ports pers comm May 2026.

FIGURE 1.2 DREDGE VESSEL - UKD MARLIN

FIGURE 1.3 DREDGE VESSELS – WYRE SANDS AND CHERRY SAND

http://www.wyremarineservices.co.uk/fleet-and-equipment.html
https://www.ukdredging.co.uk/UKD_Fleet/Cherry_Sand/

TABLE 1.1 CO-ORDINATES OF PLANNED DREDGE AREA AT PORT OF ROSYTH

Node	Latitude	Longitude
A	56° 1.494' N	3° 26.638' W
B	56° 1.427' N	3° 26.307' W
C	56° 1.334' N	3° 26.368' W
D	56° 1.225' N	3° 25.833' W
E	56° 1.213' N	3° 25.802' W
F	56° 1.084' N	3° 25.889' W
G	56° 0.880' N	3° 25.050' W
H	56° 0.563' N	3° 24.573' W
I	56° 0.640' N	3° 25.140' W
J	56° 0.811' N	3° 25.248' W
K	56° 1.138' N	3° 26.881' W

Coordinates in WGS84, degrees decimal minutes

For the ongoing maintenance dredging operations at the Port of Rosyth, Forth Ports proposes to continue to use the Oxcars disposal site as it is the closest licensed site to the port, which minimises the travel distance for the dredging vessel to and from the disposal site.

The water depth within the proposed Oxcars disposal site ranges from 2.1 m below Chart Datum (CD) at the centre of the site and increases to 13.7 m below CD towards the west of the site. The site has previously been extended to the west (Extension A and Extension B) and the coordinates of the boundaries of Oxcars Main and the two extensions are provided in Table 1.2 and shown in Figure 1.1.

TABLE 1.2 COORDINATES OF OXCARS DISPOSAL SITE

Disposal Site	Latitude	Longitude
Oxcars Main	56° 01.20’ N	003° 16.29’ W
	56° 00.83’ N	003° 14.19’ W
	56° 01.35’ N	003° 14.06’ W
	56° 00.90’ N	003° 16.29’ W
Oxcars Extension A	56° 01.20’ N	003° 17.09’ W
	56° 00.90’ N	003° 16.29’ W
	56° 01.20’ N	003° 16.29’ W
	56° 00.90’ N	003° 17.09’ W
Oxcars Extension B	56° 01.20’ N	003° 17.29’ W
	56° 00.90’ N	003° 17.09’ W
	56° 01.20’N	003° 17.09’ W
	56° 00.90’N	003° 17.79’ W

All coordinates in WGS84, degrees decimal minutes

The annual volume of dredged material deposited at the Oxcars disposal site from the Port of Rosyth from 1998 to 2025 ranged from 35,540 m^3 to 380,589 m^3 (see Table 1.3). The annual increase in dredging volumes from approximately 2010 was in response to changing siltation patterns in the area and for dredging works required for access of vessels into the Rosyth Naval Dockyard and longer-term maintenance at Port of Rosyth.

TABLE 1.3 VOLUME AND DISPOSAL SITE FROM THE PORT OF ROSYTH (1998-2026)

Year	Quantity (m^3)	Disposal site
1998	60,000	Oxcars
1999	88,295	Oxcars
2000	35,540	Oxcars
2001	306,875	Blae Rock
2002	118,850	Oxcars
2003	91,301	Oxcars
2004	61,552	Oxcars
2005	73,365	Oxcars
2006	76,174	Oxcars
2007	45,010	Oxcars
2008	59,842	Oxcars
2009	98,141	Oxcars
2010	125,669	Oxcars
2011	198,755	Oxcars
2012	149,818	Oxcars
2013	184,861	Oxcars
2014	206,149	Oxcars
2015	174,569	Oxcars
2016	380,589	Oxcars
2017	195,474	Oxcars
2018	161,760	Oxcars
2019	214,878	Oxcars
2020	180,470	Oxcars
2021	170,346	Oxcars
2022	256,720	Oxcars
2023	208,432	Oxcars
2024	270,976	Oxcars
2025	208,105	Oxcars
2026 (to end Mar)	74,590	Oxcars

Data source: Forth Ports May 2026.

1.5 DESCRIPTION OF SEDIMENT TO BE DREDGED AND DISPOSED

In line with the Marine Directorate guidelines on pre-dredge sampling protocol [6], a survey programme was undertaken on 19 January 2026. Surface sediment samples were collected at 13 stations using a Van-Veen grab. For each of the samples the following physical and chemical analysis was undertaken by Socotec UK Ltd.

- Sediment moisture content and sediment particle density.
- Sediment particle distribution.
- Total Organic Carbon.
- Metals: arsenic, cadmium, chromium, copper, mercury, nickel, lead, and zinc.
- Tributyl Tin.
- Polycyclic Aromatic Hydrocarbons
- Total Hydrocarbon Content.
- Poly Chlorinated Biphenyls.
- Presence of asbestos.

The location of the sample stations and the results of the physico-chemical analysis are presented in Appendix A1.

The sediment comprises sandy mud and slightly gravelly sandy mud with ten samples being defined as coarse silts and three as very coarse silts (using the Folk and Ward classification). The material to be dredged comprises recent infill sediments from the Forth Estuary.

There are concentrations of some metals (chromium, mercury, nickel, lead and zinc) and some polycyclic aromatic hydrocarbons (PAHs) above the Marine Directorate Action Level 1 but all were below Action Level 2 [7]. This is consistent with previous samples for this and other ports in the Forth Estuary and Firth of Forth and is associated with the historic industrial discharges to the Forth Estuary. Samples from the Oxcars disposal site and other disposal sites in the Forth Estuary and Firth of Forth have been analysed by the Marine Directorate. A summary of the historic sample analysis is provided in presented in Appendix A2.

An assessment of potential impacts of sea disposal operations is provided in Appendix B.

1.6 SCOPE OF THE STUDY

This report provides an appraisal of available disposal options and short-lists those that are considered to be practicable. Various disposal options are assessed in accordance with the Waste Hierarchy, as defined in the European Waste Framework Directive (2008/98/EC) [8]. The short-listed options are then evaluated against strategic, health and safety, environmental and cost considerations. The short-listed options are then compared to determine the BPEO.

(6) Guidance for the sampling and analysis of sediment and dredged material to be submitted in support of applications for sea disposal of dredged material. Available online http://www.scotland.gov.uk/Resource/0044/00443832.pdf
(7) Action Levels for metals, PCBs, TBT and PAHs are used by the Marine Directorate to assess the suitability for disposal of sediments at sea.
(8) Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives. Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32008L0098

The remainder of this report is structured as follows.

- Section 2 describes the BPEO assessment method.
- Section 3 describes each of the available disposal options and summarises their respective advantages and disadvantages.
- Section 4 compares the disposal options.
- Section 5 identifies the BPEO.

Further supporting information is provided in the three Appendices.

- Appendix A: Sediment Sample Chemical Analysis Results.
- Appendix B: Environmental Impacts of Disposal Operations.
- Appendix C: Consultee Responses.

2. BPEO ASSESSMENT METHOD

2.1 INTRODUCTION

The BPEO study was undertaken using the following method.

- Identification of potential disposal options.
- Preliminary appraisal and short-listing of options based on practicability.
- Assessment of the short-listed options based on:
  - strategic considerations;
  - worker and general public health and safety considerations;
  - environmental considerations i.e. what the environmental impacts would be; and
  - cost, in terms of capital and maintenance/operating costs.
- Comparison of the relative merits and performance of the options and identification of the BPEO.

Information was obtained through literature review, and the following consultees were requested to provide any relevant information they hold and any comment on the proposed sediment disposal operations.

- Fife Council.
- Forth District Salmon Fisheries Board (FDSFD).
- Maritime and Coastguard Agency (MCA).
- Nature Scot (NS).
- Northern Lighthouse Board (NLB).
- Scottish Environment Protection Agency (SEPA).
- The Crown Estate Scotland (CES).

2.2 IDENTIFICATION OF OPTIONS

The following seven potential treatment/disposal options for the dredged material were identified:

- beach nourishment;
- coastal reclamation and construction fill;
- spreading on agricultural land;
- sacrificial landfill;
- incineration;
- other disposal options and reuse; and
- sea disposal.

2.3 PRELIMINARY APPRAISAL

A preliminary appraisal of each of the options identified above was undertaken, based on an assessment of the practicability of each option with regard to availability of suitable disposal sites. Following the preliminary appraisal, those options that were considered to be practicable were short-listed for further assessment.

2.4 ASSESSMENT OF OPTIONS

The short-listed options were then subject to a more detailed assessment. The fourteen parameters which were used to assess the performance of the short-listed options are described below under four main categories.

2.4.1 STRATEGIC CONSIDERATIONS

Strategic considerations included the following.

- **Practicability**. Whether the option is technically and operationally practicable.
- **Availability of sites/facilities**. Whether there are any sites or facilities which can take the dredge spoil.
- **Security of option**. Whether Forth Ports will have control over all stages of the disposal operations.
- **Established practice.** Whether technologies and techniques proposed are established and therefore whether the performance and potential difficulties of the technologies and techniques can be anticipated.
- **General public acceptability**. Whether the general public are likely to object to or support the proposals.
- **Likely agency acceptability**. Whether public agencies are likely to have any major concerns when consulted on the Marine Licence application.
- **Legislative implications.** Compliance with relevant legislation and the potential management controls required.

2.4.2 HEALTH AND SAFETY CONSIDERATIONS

The health and safety considerations are summarised below.

- **Public health**. Whether there would be any risk of a detrimental effect on public health, based on predicted pathways and receptors.
- **Safety**. Considering potential sources of hazard and probability that there would be any risk to the general public or workers.

2.4.3 ENVIRONMENTAL CONSIDERATIONS

The environmental performance considerations are summarised below.

- **Contamination/pollution**. Whether there is potential for contamination or pollution that could result in failure to meet Water Framework Directive (WFD) objectives and associated Environmental Quality Standards (EQSs: the amount or concentration of a substance that should not be exceeded in an environmental system). Contamination is defined as the presence of an unwanted constituent in the natural environment whilst pollution is the introduction of contaminants into the natural environment that causes adverse change.
- **Ecological impact**. Assessing the significance of any potential impact on important habitats or species, including designed sites.
- **Interference with other legitimate activities**. Whether there are likely to be impacts on other activities, such as other users of the port, marine waters or roads.
- **Amenity/aesthetic**. Assessing whether there is likely impact on local amenity e.g. visual, olfactory or noise impact resulting from the disposal activities.

2.4.4 COST CONSIDERATIONS

Cost of disposing of dredged material was considered in terms of the capital costs (construction of facilities and equipment hire /purchase costs) and operational costs (transport costs and disposal costs, including site operation).

2.4.5 COMPARISON OF OPTIONS

The performance of each option was evaluated on a scale from Low to High according to definitions presented in Table 2.1. Intermediate grades (Low to Medium and Medium to High) were also used where the assessment was marginal between Low, Medium or High. The results of the assessment process are presented in *Section 3* and *Section 4*.

TABLE 2.1 DEFINITIONS OF PERFORMANCE

Consideration	High	Medium	Low
Strategic Considerations			
Technical and Operational Practicality	Few practical difficulties, easy to undertake and process is proven to be straightforward and robust. Low number of stages and each stage easy to control.	Some practical difficulties. Moderate number of stages with some difficulties.	Major practical difficulties. Large number of steps with some major difficulties.
Availability of Sites/Facilities	Suitable site/facility available within 1 km of the port by road and 10 km by sea.	Suitable site/facility available within 10 km of the port by road and 20 km by sea.	No suitable sites/facilities within the vicinity of the port (over 10 km by road and 20 km by sea).
Security of option	In complete operational control of Forth Ports.	Is mainly in control of Forth Ports with some outside involvement for which there are alternative sources of supply.	Has elements that are out of Forth Ports control for which there are no practical alternative sources of supply.
Established Practice	Technology and techniques are established and used for dredge spoil disposal.	Technology and techniques have been tested but not applied to dredge material.	Technologies and techniques are untested and unforeseen problems are likely.
General Public Acceptability	Likely to be acceptable to the general public based on reaction to similar operations.	Unlikely to provoke a strong negative or positive reaction based on reaction to similar operations.	Likely to provoke a strong negative reaction based on reaction to similar operations.
Likely Agency Acceptability	Likely to be generally acceptable to statutory bodies after consultation.	Statutory bodies may have some concerns that may be overcome through further consultation and option development.	Statutory bodies may have major concerns that may not be overcome through consultation and option development.
Legislative Implications	Would comply with legislation with a low level of management control and intervention.	Requires some management control and intervention to achieve compliance.	Requires a high level of management control and intervention to achieve compliance.
Health and Safety Considerations			
Public Health	Will not cause the general public or workers to be exposed to substances or	May cause some low-level intermittent exposure to substances or activities potentially hazardous to health.	Risk of exposing workers and general public to substances or activities potentially hazardous to health.

Consideration	High	Medium	Low
	activities potentially hazardous to health.		
Safety	No significant safety risks to the general public or to workers with no specific controls required.	Low safety risk to the general public or to workers which is easily controlled.	Moderate to high safety risk to the general public or to workers and difficult to control.
Environmental Considerations			
Contamination/ Pollution	Compliant with emission standards and water/sediment/ground quality objectives. Low risk of harm from substances released to environment.	Environmental quality standards may be approached or breached occasionally. Some risk of harm to environment.	Environmental quality standards may be breached regularly and there is a moderate or high risk of harm to environment.
Ecological Impact	Priority species and habitats under the UK Biodiversity Framework [(9)] and qualifying features and species under the *Habitats Regulations, 2019* [(10)] will not be affected.	Priority species and habitats under the UK Biodiversity Framework and qualifying features and species under the *Habitats Regulations, 2019* may be slightly affected.	Priority species and habitats under the UK Biodiversity Framework and qualifying features and species under the *Habitats Regulations 2019*, are likely to be significantly affected.
Interference with other Legitimate Activities	Little potential for interference with other activities.	Some potential for interference with other activities.	High potential for interference with other activities.
Amenity/Aesthetic	No significant impact on local amenity or aesthetic qualities.	Potential for impacts of moderate significance on local amenity or aesthetic qualities.	Potential for impacts of high significance on local amenity or aesthetic qualities.
Cost			
Capital and maintenance	£5 m or less.	Between £5 m and £10 m.	More than £10 m.

(9) JNCC and Defra (on behalf of the Four Countries' Biodiversity Group). 2012. UK Post-2010 Biodiversity Framework. July 2012. Available from: http://jncc.defra.gov.uk/page-6189.
(10) The Conservation (Natural Habitats, &c.) (EU Exit) (Scotland) (Amendment) Regulations, 2019 apply to European sites (formerly Special Protection Areas and Special Areas of Conservation).

3. PRELIMINARY ASSESSMENT OF AVAILABLE DISPOSAL OPTIONS

3.1 INTRODUCTION

This section describes the identified disposal options and makes a preliminary assessment of each based on overall practicality. There are a number of steps that are common to some of the land-based options and these are described in Section 3.2 to avoid repetition. The section concludes by identifying those options that are short-listed for further consideration in the BPEO process.

The seven identified disposal options are:

1. beach nourishment;
2. coastal reclamation;
3. spreading on agricultural land;
4. sacrificial landfill;
5. incineration;
6. other disposal options and reuse; and
7. disposal at sea.

3.2 COMMON STEPS TO LAND-BASED DISPOSAL OPTIONS

The disposal options that have land-based components include:

- beach nourishment (if material transported by road);
- coastal reclamation and construction fill (if material transported by road);
- spreading on agricultural land;
- sacrificial landfill;
- incineration; and
- other disposal options and reuse (such as brick making/concrete aggregate/topsoil production).

The steps that are common to the land-based disposal options are:

- landing the dredged material;
- storage of dredged material;
- dewatering the dredged material;
- loading and transport for disposal; and
- disposal/treatment.

These steps are described below along with a discussion of the practicalities of undertaking these steps for sediment material dredged from the Port of Rosyth.

3.2.1 LANDING THE DREDGED MATERIAL

All of the land-based options require transport to onshore facilities. This could be via a pumped discharge, conveyor or grab. As Forth Ports does not have suitable facilities at the Port of Rosyth or elsewhere within the Forth Estuary and Firth of Forth area for landing

dredged material, a new coastal landing facility would be required to enable the material to be landed.

3.2.2 STORAGE OF DREDGED MATERIAL

Once the dredged material has been landed, it will require storage prior to onward transport for final disposal. A storage facility may therefore require construction at the landing site, capable of retaining the dredged material and associated run-off and dust.

3.2.3 DEWATERING THE DREDGED MATERIAL

The land disposal options require dewatering of the dredged material either to make transport more feasible or to create a material which is suitable for disposal to land or incineration i.e. disposal of a more solid sludge.

There are three approaches that could be used for drying marine sediments: construction of settling lagoons, use of a mobile centrifuge unit and filter press, as described below.

Settling Lagoons

Settling lagoons are large, ring-dammed structures into which the dredged material would be pumped. These could be built within the intertidal area or on land. The material would be piled up in the lagoons which would have a drainage system to collect the water and watery sludge from the dredged material for further treatment (e.g. by hydrocyclone, as described below) or to be transported offsite for disposal. The lagoons would need to be of sufficient size to contain the dredged material prior to transport. They would also need to be accessible by road and have facilities to load the dredged material into tankers or sealed heavy goods vehicles (HGVs) for transport to the disposal/treatment centre. To minimise the distance the wet dredged material would have to be transported from the dredger, the lagoons would need to be located near the landing site.

Setting up settling lagoons would require assessment to ensure that any leachate from them would not contaminate groundwater and a licence would be required from SEPA under the *Water Environment (Controlled Activities) Regulations (2011)*. Forth Ports advise that the potential to be able to find appropriate space to create settling lagoons close to the Port of Rosyth is considered to be low. Furthermore, as the material contains some metals and PAHs above Action Level 1 (see Appendix A for sample analysis data), it might be additionally necessary to construct the lagoons with special liners to retain the contaminants and consider treatment of the drainage water from the lagoons.

Centrifuge or Hydrocyclone System

The use of a centrifuge or hydrocyclone system to dewater the material to a level suitable for disposal to landfill (approximately 10% water content) may be required, depending on the final water content of the recovered material. One mobile unit system was reported as being capable of treating up to 150 m^3 hr^{-1} depending on unit size and material solids content. Other systems may be available that can process material at different rates, however, for the purposes of this assessment a rate of 150 m^3 hr^{-1} has been used. If material can be dried at a rate of 150 m^3 hr^{-1}, to dewater a total volume of approximately 400,000 m^3 would require approximately 2,668 hours (222 days assuming working 24 hrs a day). Other units with lower throughputs could take longer. The liquids extracted from the centrifuge or hydrocyclone system may need to be treated if they contain contaminants, prior to disposal.

Filter Presses

Filter presses are used to separate solids and liquids using pressure. The press is filled with the spoil, building up pressure before the spoil is strained through filter cloths by force. The remaining dried spoil can then be removed from the filter press and taken away for disposal. This drying process achieves the best level of dryness of the three options, however, is considerably more expensive than either of the other two options. The liquids extracted from the filter presses may need to be treated if they contain contaminants, prior to disposal.

3.2.4 LOADING AND TRANSPORT FOR DISPOSAL

A loading facility would be required adjacent to the storage or dewatering area to load the material into covered HGVs for transport to treatment/disposal sites. The required infrastructure would include hard standing area to allow a fleet of HGVs to be loaded by mechanical excavators. Although some areas of hard standing may be available at the Port of Rosyth, there are no storage or dewatering sites adjacent to the possible loading area.

Assuming the materials can be dried to a water content of 10% (by volume) at the Port of Rosyth, the estimated 374,000 m^3 (11) of dried materials would require transport for disposal, either to a land reclamation project, agricultural area, landfill site or to an incinerator.

A volume of 374,000 m^3 of dried (to 10% water content) material equates to approximately 486,200 tonnes (12). Assuming 20 tonne capacity sealed HGVs are used, this would equate to up to 24,310 return trips or 48,620 vehicle movements per annum.

The significance of the number of movements will be dependent upon the distance to the disposal/treatment site and the existing volume of HGVs on the haulage routes. The levels of HGV movements in the Rosyth area are already high (the Port of Rosyth is approximately 3 km from the M90 motorway) so this level of movement may be acceptable at the collection end. However, there is more likely to be an issue with regard to increase in traffic flows on rural roads if they are used to reach disposal/treatment sites.

3.2.5 DISPOSAL/TREATMENT

None of the drying processes (i.e. lagoons, filter press or centrifuge/hydrocyclone) are likely to reduce the concentration of metals, PAHs and salt present within the dredged material. This may restrict disposal and reuse options, and pre-treatment may be required to reduce contaminant concentrations prior to disposal on land.

Where an option involves disposal on land, there is an issue of classification of the dredged material. Once the material has been removed from the port area for disposal on land it will be classed as waste. The waste then requires disposal at a licensed waste management facility and to be transported by a registered waste carrier. In the waste hierarchy set out in the *Waste Management Licensing (Scotland) Regulations, 2011*, dredged spoil is coded as 17 05 05 (Mirror Hazardous) or 17 05 06 (Mirror Non-hazardous), depending on the concentrations of particular contaminants. If landfill is identified as the disposal route for this waste, then further analysis may be required to ensure that the material meets the Waste Acceptance Criteria for hazardous landfill sites.

(11) 400,000 m^3 total spoil at 85% solids content equals 340,000 m^3 plus 34,000 m^3 (10% water content) equals 374,000 m^3.
(12) Based on a density of 1.3 tonnes per m^3 of dredge spoil.

The saline nature of the sediment also restricts its application on land, as without going through a washing process it will not be able to support any form of terrestrial flora growth.

3.3 BEACH NOURISHMENT

3.3.1 PROCESS DESCRIPTION

Beach nourishment involves the disposal of the dredged material on a beach directly from the dredging vessel or, if dewatering was required, the spoil would be brought ashore and dewatered prior to transport or placement on the beach using earth moving plant.

3.3.2 SUITABLE SITES FOR BEACH NOURISHMENT

Beach nourishment requires materials of a similar composition to the existing beach materials and usually involves clean sand or gravel. The sediment from within the proposed dredge zone generally comprises fine material (sandy mud) with small quantities of gravel present in some of the samples (slightly gravelly sandy mud). The sediment from the Port of Rosyth is not suitable for beach recharge, due to the particle size distribution and the presence of contaminants such as some metals and organics (PAHs).

Due to the risk of direct exposure to contaminated sediment, spoil containing contaminants disposed of at the public recreational sites such as beaches is considered less suitable than if it were disposed of at sea. Action Levels provided by the Marine Directorate are specific to the disposal of material to sea, where the sediment does not come into direct contact with the public, rather than at recreational areas. Guidance published by NatureScot [13] on managing coastal erosion in beach/dune systems refers to the use of materials that are not contaminated in any way but does not provide equivalent action levels for contaminants. NatureScot has previously confirmed that it would only be appropriate to use material on a beach of similar sediment particle size distribution and provided contaminant levels were not of concern.

No sites requiring beach nourishment using this type of sediment material have been identified through consultation (see Appendix C). Given the conservation status of the Forth Estuary and Firth of Forth, the lack of available beaches for nourishment, the contamination of the spoil and its particle size composition, beach nourishment is not a practicable option.

3.4 COASTAL RECLAMATION AND CONSTRUCTION FILL

3.4.1 PROCESS DESCRIPTION

This section considers the use of the dredged material in coastal reclamation projects or as fill material inland. Depending on the potential site, reclamation or fill could involve landing, storage, dewatering, possible desalination and transport. Coastal use directly from the dredging vessel would be preferable, as this would involve pumping or spraying the material directly from the dredger or barge to the site where it was needed and would avoid handling and transporting the material on land.

3.4.2 SUITABLE SITES FOR COASTAL RECLAMATION

Forth Ports and the coastal local authorities are the most likely bodies to be responsible for or aware of reclamation projects in the Forth Estuary and the Firth of Forth. No sites for coastal

(13) Scottish Natural Heritage (2000). A Guide to Managing Coastal Erosion in Beach/dune Systems. Summary 7: Beach Nourishment.

reclamation have been identified through the consultation process as requiring any of the dredged material. In addition, the dredged material would not be suitable for many reclamation sites due to the low compressive strength properties of predominantly muddy sediments. The spoil could be pumped into bunded lagoons at the edge of the Firth of Forth to create land that could be used for development, agricultural or similar purposes.

The majority of the intertidal area falls within the Firth of Forth Site of Special Scientific Interest (SSSI) and Firth of Forth Special Protection Area (SPA), Forth Islands SPA, and Outer Firth of Forth and St Andrews Bay Complex SPA. The SPAs are a large estuarine/marine sites and NatureScot has previously expressed the view on similar BPEO assessments that further loss of intertidal habitats in the Forth Estuary and Firth of Forth is not considered a realistic option.

3.4.3 CONSTRUCTION FILL MATERIAL

Use of dredged material as construction fill in inland construction projects would not be appropriate because of low compressive strength properties of muddy sediments and the need for landing, drying and transport of the dredged material. If landing, drying and transport were feasible then it may be that the material could be used for quarry/landfill capping. However, the presence of contaminants in the dredged material and its high salt content make this option unattractive.

3.5 SPREADING ON AGRICULTURAL LAND

3.5.1 PROCESS DESCRIPTION

SEPA has previously confirmed that the disposal or recycling of marine dredged material on agricultural land does not fall within the exemptions under Paragraph 7 of Schedule 1 of the *Waste Management Licensing (Scotland) Regulations, 2011*, and the activity would therefore require to be licensed. Planning permission may also be required from the local authority. In support of the application to dispose of the dredged material to agricultural land, evidence that the material would not cause pollution of the environment or harm to human health would need to be provided.

The disposal of marine dredged material to agricultural land would involve landing, dewatering, storage, desalination and transport for disposal. Dewatering the dredged material in lagoons, centrifugal drier or filter press would remove some of the salt, however it is likely that desalination would still be required. Desalination could be achieved by placing the spoil in lagoons, layering it with sharp sand, spraying fresh water over the material and allowing leaching of the salt back into the Forth Estuary.

Approximately 51,730 tonnes of sludge are recycled to agricultural land across Scotland (2020 data) [(14)]. Forth Ports are seeking to dispose of approximately 400,000 m^3 of dredged material (approximately 520,000 wet tonnes at 1.3 tonnes m^{-3}) of dried material, equating to approximately 1000% of the current volume of annually recycled sludge in Scotland.

(14) Situation and Compliance Report on the Disposal of Urban Wastewater and Sludge in Scotland 2020, Published August 2025. https://www.gov.scot/publications/situation-compliance-report-disposal-urban-wastewater-sludge-scotland-2020/documents

As the material from the Port of Rosyth has a low organic carbon content (an average of approximately 3.85% from the sediment sample analysis) spreading dredged material from the Port of Rosyth on agricultural land is not considered a practicable option.

In addition, the material sampled at the Port of Rosyth has contamination from some metals and PAHs above Action Level 1, so the spoil cannot be applied to land without confirmation from SEPA that levels of these contaminants are acceptable.

3.6 SACRIFICIAL LANDFILL

3.6.1 PROCESS DESCRIPTION

The type of landfill site which can take the spoil is dependent upon the classification of the waste. As discussed above, it is understood that the waste would be classified as hazardous or non-hazardous (i.e. not inert) and therefore a suitably licensed landfill site with sufficient capacity is required.

3.6.2 AVAILABLE LANDFILL SITES

Subsequent to implementation of the *Landfill Allowance Scheme (Scotland) Regulations 2005* and re-evaluation of landfill licences, there are currently two sites within an hour's drive from the Port of Rosyth able to accept inert, non-hazardous waste and non-reactive hazardous wastes.

The Avondale Landfill, Polmont, is located approximately 19 miles southwest of the Port of Rosyth. However, the Avondale site is not large enough to accommodate all of the dredged material and would only consider taking some of the dredged material upon closure of one or all of the phases within the plant.

Fife Council landfill site in Cupar (Lower Melville Wood), approximately 32 miles north of Rosyth, also has the capability to accept non-hazardous material. In 2024 (most recent published data), it landfilled 15,637 tonnes of wastes, including 7,624 tonnes of soil/stones [15]. To receive 520,000 wet tonnes of dredge material from the Port of Rosyth, volume of similarly classed waste material to the landfill site would be approximately 68 times the current volumes landfilled (if the full annual volume of material was dredged each year).

3.6.3 TAXES AND ROYALTIES

The material will be exempt from landfill tax under the terms of the *Landfill Tax (Scotland) Act 2014* issued by the Scottish Government that specifies that dredged material from any inland waters, including harbours and their approaches, are not subject to landfill tax.

3.7 INCINERATION

3.7.1 PROCESS DESCRIPTION

Incineration would involve landing the dredged material, dewatering, possibly storing it and transporting it to either an existing incinerator or a newly constructed incinerator. The residual incineration ash would then require disposal. Options for disposal of ash include landfill, reclamation and spreading on agricultural land.

(15) https://wikiwaste.org.uk/index.php/Fife_Council,_Lower_Melville_Woods,_Fife#Summary. https://informatics.sepa.org.uk/WasteSiteCapacity/. Accessed 05/02/2026.

The average total organic content of the material to be dredged is 3.85%, based on the thirteen surface samples collected in 2026, and therefore there is only a small combustible component within the material. It is anticipated that incineration would result in a reduction in volume of the dried spoil by only 13.85% i.e., 3.85% organics plus 10% water content. Incinerator operators generally require material to have an organic content above 20% to ensure efficient combustion and would most likely reject material with an organic content below this threshold [16].

A further consideration is that the material to be dredged contains some metals and some PAHs above Action Level 1. In a typical thermal desorption incineration process it is likely that some of the contaminants would be removed and the leaching potential of metals would be reduced, however, the ash is likely to still be contaminated. Pre-treatment may be required for the removal of metals. Emissions to atmosphere from the incineration processes would also require to be controlled by SEPA/EA under the *Environmental Protection Act 1990.*

3.7.2 AVAILABLE INCINERATOR SITES

There were 15 operational waste incinerators in Scotland according to the SEPA report covering the calendar year 2024 (SEPA 2025) [17] processing 1.86 million tonnes of waste (mainly household wastes and sorting residues). Two tonnes of hazardous wastes were incinerated in Scotland in 2024. There were no soils, mineral wastes or dredging spoils incinerated.

The nearest high temperature hazardous waste incinerator is at Ellesmere Port, Merseyside (approximately 364 miles south of the Port of Rosyth) and transport would be costly and is unlikely to be practicable. Based on the most recent data (from 2024), of the 73,080 tonnes of waste material dealt with at this site there was no dredge spoil [18].

3.8 OTHER DISPOSAL OPTIONS AND REUSE

The other disposal options are re-injection into the tidal flats via a pipeline and reuse in brick making, concrete aggregate or topsoil production processes.

3.8.1 RE-INJECTION

This would involve the construction of a pipeline to take the dredged spoil to a high tide point on the Torry Bay mudflats and injecting it at a velocity back into the mudflats. The advantage of this is that it effectively keeps the sediment within the sediment cell. The disadvantage of this is that the re-injection at velocity would be likely to have an adverse impact on the protected mudflat habitat through disturbance and erosion and may affect the ornithological interest in the mudflats.

Due to the costs associated with the construction and maintenance of the pipeline and the disturbance during construction and operation of the pipeline on the ornithological interest of the mudflats this option is not considered to be practicable.

(16) Baldovie Waste to Energy Plant, pers comm, January 2017
(17) SEPA 2024. Waste incinerated in Scotland- 2023. Official Statistics. https://data.gov.scot/sepa/waste/incinerated.html#revisions-policy. Accessed May 2026.
(18) https://wikiwaste.org.uk/index.php?title=Ellesmere_Port_Incinerator. https://www.data.gov.uk/dataset/0de19ba3-9c2f-417c-b092-4a6baaf9744d/incinerator-annual-monitoring-reporting. Accessed May 2026.

3.8.2 BRICK MAKING/CONCRETE AGGREGATE/TOPSOIL PRODUCTION

There are processes by which marine sediments can be made into bricks or can be used to form concrete aggregate. The advantage is that the materials can be beneficially used and metals are sealed into the bricks or aggregate. Previous consultations between Forth Ports and a brick making factory confirmed that the mineralogy of the material would not be appropriate for brick making and the contamination by salt would likely make the material unacceptable as a construction material.

Almost no agricultural species can grow in salty soils and very few in brackish soils. The salinity of the dredged sediment would require to be reduced naturally by rainwater or by a washing and dewatering process before consideration for use as topsoil. The best topsoil is a mixture of sand, silt, clay and organic matter and must be clean for use in the production of food crops [19].

3.9 DISPOSAL TO SEA

3.9.1 PROCESS DESCRIPTION

Disposal at sea involves the dredge material being transported to a licensed disposal site in the dredging vessel. It involves the dredger sailing to a licenced disposal site and releasing the materials, usually by lowering the excavator head into the water or through bottom doors. A global navigation satellite system (GNSS) is used to position the vessel in the disposal area to record the spoil discharge locations. This approach takes place at sea and does not require the landing of any materials.

3.9.2 AVAILABLE SITES

There are seven licenced marine disposal sites in the Forth Estuary and Firth of Forth: Bo'ness, Oxcars, Blae Rock, Kirkcaldy, Methil and two sites designated at Narrow Deep. For the dredging operations at Rosyth, Forth Ports would propose to use the Oxcars disposal site located approximately 5.5 nm east of Rosyth within the Firth of Forth. This site has historically been used for the disposal of the majority of the dredged material from Rosyth. The time required for one cycle (dredging - travelling - discharging - travelling) is approximately three hours.

3.10 CONCLUSION

The description of the available options allows options that are evidently impracticable to be ruled out. This is summarised in Table 3.1. The assessment of the short-listed options taken forward for further consideration is presented in Section 4.

(19) Permanent International Association of Navigation Congresses. Permanent Technical Committee II. Working Group 19. 1992. Beneficial Uses of Dredged Material, Issue 19.

TABLE 3.1 SHORT-LISTING OF OPTIONS

Option	Assessment	Result
Beach Nourishment	This option does not appear to be practicable. The material is not suited to beach nourishment in the Forth Estuary or the Firth of Forth and there are no beaches identified by Forth Ports, consultees or in the NCCA (2017) [20] within the Forth Estuary or the Firth of Forth that require nourishment with this grade of material.	Discard
Coastal Reclamation and Construction Fill	This option may be practical. The salt content, poor load bearing properties and the potential concentration of contaminants limits the available options for reuse of the dredged material.	Short-list
Spreading on Agricultural Land	This option does not appear to be practicable. The material is not desirable for disposal on agricultural land due to potentially containing concentrations of contaminants and having a low organic content (<5%). Disposal on agricultural land would require a Waste Management Licence and evidence that there would be no harm to human health.	Discard
Sacrificial Landfill	This option may be practicable and there are two local sites within one to two hours' drive from the Port of Rosyth. There is a large number of steps involved in storage, dewatering and transport and landfill site operators may be unwilling to accept the material due to the sediment composition, contamination levels and the large volumes.	Short-list
Incineration	This option does not appear to be practicable. The material is not suited to incineration due to low organic content (<5%) and large volume of spoil involved. If incinerated, volume would only slightly reduce and there are no available incinerators in Scotland that could take this amount and type of material.	Discard
Other Uses	This option may be practicable in the form of brick making, concrete aggregate and topsoil production.	Short-list
Disposal at Sea	This option is practicable and has been the BPEO for previous dredging campaigns at the Port of Rosyth	Short-list

(20) Fitton JM, Rennie AF and Hansom JD (2017). Dynamic Coast - National Coastal Change Assessment: Cell 2- Fife Ness to Cairnbulg Point. CRW1014/2.

4. ASSESSMENT OF SHORT-LISTED DISPOSAL OPTIONS

4.1 INTRODUCTION

This section presents an assessment of each option against the assessment definitions of performance listed in Table 2.1. A classification of likely performance is provided for each of the criteria and the assessment is then summarised in Section 5.

The environmental effects of disposal at sea are addressed in Appendix B.

4.2 COASTAL RECLAMATION AND CONSTRUCTION FILL

4.2.1 STRATEGIC CONSIDERATIONS

Operational Feasibility

The reuse of the dredged material for reclamation will involve either direct pumping from the dredger into the disposal site or landing, drying, desalinating, storing and transporting the material disposal on land. This option would be achievable if disposal sites were available adjacent to the Forth Estuary or the Firth of Forth.

Classification: Medium

Availability of Sites

No coastal sites requiring this grade of material for reclamation or construction fill have been identified by Forth Ports, consultees or in the latest Dynamic Coast – National Coastal Change Assessment (2017) [21] or in the updated 2021 research reports [22].

Classification: Low

Security of Option

No sites have been identified as belonging to Forth Ports, so disposal to reclamation sites is out with their control and could present practical problems, such as scheduling in sediment delivery with the required dredging programme.

Classification: Low to Medium

Established Practice

The use of suitable dredged materials in coastal reclamation and construction fill is common practice and the technologies and techniques are well established, however, this is for dredged primary aggregate materials such as sands and gravels.

Classification: Low to Medium

General Public Acceptability

Use of the materials for reclamation is likely to be viewed as an acceptable option by the general public. Depending on the method of transporting the dredged material to the site requiring it will affect acceptability by the general public. Transport by sea is likely to be

(21) Fitton, J.M., Rennie, A.F., and Hansom, J.D. (2017). Dynamic Coast - National Coastal Change Assessment: Cell 2 - Fife Ness to Cairnbulg Point, CRW2014/2

(22) A.F. Rennie, J.D. Hansom, M.D. Hurst, F.M.E Muir, L.A. Naylor, R.A. Dunkley, & C.J. MacDonell (2021). Dynamic Coast: The National Overview. CRW2017_08. Scotland's Centre of Expertise for Waters (CREW). Available online with Research. Summary at: https://www.crew.ac.uk/dynamic-coast.

viewed as more favourable than transport by land, which may be viewed as unacceptable by local residents and road users.

Classification: Medium to High

Likely Agency Acceptability

Use of the dredged material for reclamation or construction fill is likely to be acceptable to public agencies. There may be some concerns regarding the proposed volume of material to be transported by HGVs for reasons relating to air quality and proximity to residential areas.

Classification: Medium to High

Legislative Implications

The disposal of dredged material from the Port of Rosyth directly from the dredger to a reclamation site requires a Marine Licence from the Marine Directorate under Section 20(1) of the *Marine (Scotland) Act 2010*.

Once landed, the dredged material would be classed as waste under the *Waste Management Licensing (Scotland) Regulations, 2011* and the disposal will therefore require a waste management licence and an exemption for reclamation works.

As well as a Marine Licence for the construction works, consent will be required from the planning authority and a levy paid to the Crown Estate Scotland.

Classification: Medium to High

4.2.2 HEALTH, SAFETY AND ENVIRONMENTAL CONSIDERATIONS

Public Health

No risks to public health are anticipated due to the short-term increase in HGV traffic.

Classification: Medium to High

Safety

Transferring the dredged material ashore has risks associated with operational activities, all of which have mitigation measures in place. Should the dredged material be transported by HGV, there may be an increase in safety risks associated with the movement of materials for disposal, particularly if tankers/sealed HGVs travel through populated areas and along minor roads.

Classification: Medium

Contamination/Pollution

The dredged material may be classified as hazardous or non-hazardous (i.e. not inert) due to the concentration of contaminants with respect to land-based disposal, however, further analysis would be required to confirm this, and run-off and leaching may need to be controlled. There may be localised and temporary deterioration in air quality from HGV movements.

Classification: Medium

Ecological Impacts

There are unlikely to be any ecological risks resulting from the use of dredged materials for reclamation, assuming any contaminants are contained within the site and there would be no significant impact on national or local priority species or habitats. If the site was to be used for terrestrial habitat creation, then the salt levels would limit plant growth.

Classification: Medium to High

Interference with Other Legitimate Activities

The disposal of dredged material is unlikely to interfere with other activities unless the reclamation site is in the port area, in which case the dredger may interfere with other port users. If HGVs are used to transport the dredged material, they may affect other road users.

Classification: Medium to High

Amenity/Aesthetic

If the dredged material is disposed of directly from the dredger there is low risk to amenities/aesthetics. If disposed of by HGV, landing, storage and transport may result in an impact to both amenities and aesthetics of the area.

Classification: Medium to High

4.2.3 COST CONSIDERATIONS

If the dredged material was pumped directly ashore there would be no further capital costs. The estimated operational costs below would apply:

- operational costs for the operation of the dredger - £0.75 million per annum;
- Pumping material to site – approximately £4 million pumping costs (£10 per m^3 [23] for 400,000 m^3).

Total: 14.25 m over three years.

Classification: Medium

If the dredged material was transported by road, the estimated costs below would apply.

- operational costs for the operation of the dredger: £0.75 m per annum;
- a discharge berth for the dredger with a storage facility: £3.5 m;
- lagoons to settle dredged material and possibly desalinate: £5 -£10 m; or
- dockside centrifuge facility capable of dewatering and desalinating 400,000 m^3 of silt per annum: £30-40 m;
- loading and transport (sealed HGVs) – assuming the disposal site is less than one hour drive away and based on one HGV transporting 20 tonnes material at a cost of £100/load [24]: £2.6m/year.

Total £23.55 m to 53.55 m over three years.

Classification: Low

(23) Based on previous consultation with contractors.
(24) Estimated cost based on consultation with HGV operator at £50/hour for two hours per load.

4.3 SACRIFICIAL LANDFILL

4.3.1 STRATEGIC CONSIDERATIONS

Operational Feasibility

Disposal to landfill would require the landing, storage and drying of the dredged materials prior to transporting to a landfill facility. Approximately 520,000 wet tonnes of material would require to be landed, dried and then transported. This option has practical difficulties relating to drying the dredged material and transport of material to a landfill site.

Classification: Low to Medium

Availability of Sites / Facilities

Under the *Landfill (Scotland) Regulations*, 2003 the presence of contaminants will classify the material as hazardous or non-hazardous rather than inert and consequently reduces the number of available landfill sites capable of accepting this material.

The nearest suitable site is located at Avondale Landfill, Polmont, approximately 19 miles from Rosyth, however as discussed above, due to the dredged sediment composition and volume, Avondale would be unable to receive any of the material [25]. The Lower Melville Wood, Cupar, sites is approximately 32 miles from Rosyth and can accept non-hazardous material, however not at the quantities that will be dredged from the Port of Rosyth. There are no other sites identified that would be able to take the type and volume of dredged material from the Port of Rosyth.

Classification: Low

Security of Option

Whilst Forth Ports have control over the dredging operations, it would have no control over the continued availability of landfill space for the material or the disposal route.

Classification: Low to medium

Established Practice

Dredged material has historically been disposed of to landfill sites for small one-off dredging operations, however it is not established practice to routinely dispose of large quantities of dredged material in this way. Landfill sites require the dredged material to be dried to 10% water content before acceptance. It is unlikely that this is a practice that would be acceptable if there are other viable alternatives.

Classification: Low to Medium

General Public Acceptability

Disposal of the material to landfill is likely to be acceptable to the general public. However, the transport of the dredged material from the Port of Rosyth to potential landfill sites may be unacceptable to residents and other road users.

Classification: Medium to High

(25) Avondale pers comm, February 2016.

Likely Agency Acceptability

Scotland's Zero Waste Plan (2010) establishes the direction of the Scottish Government's policies for sustainable waste management. One such policy is to reduce landfilling of waste to 5% of all wastes by 2025. Although this target was not met, there is continuous drive to reduce landfill waste as part of the Scottish Government 2024 Scotland's Circular Economy and Waste Route Map to 2030 [(26)]. As such there may be objection to dredged material routinely requiring space in landfill.

Disposal to nearby landfill sites is likely to be acceptable to SEPA provided the materials are regarded as suitable for landfill, however, the acceptability would depend on the quantities to be disposed of and further assessment and classification of hazardous substances.

Classification: Medium

Legislative Implications

The material would be controlled waste material for the purposes of transport, storage and disposal. As such, *Section 34(7)* of *The Environmental Protection Act* 1990 and *Regulation 6* of the *Pollution Prevention and Control (Scotland) Regulations* 2012 will apply, and compliance is likely to be possible. The disposal of the material will also require a waste management licence under the *Waste Management Licensing (Scotland) Regulations 2011*.

Classification: Medium

4.3.2 HEALTH, SAFETY AND ENVIRONMENTAL CONSIDERATION

Public Health

There may be a slight risk to public health due to the significant increase in HGV traffic may arise.

Classification: Medium

Safety

There may be an increase in safety risks associated with the movement of materials for disposal, particularly if tankers/sealed HGVs travel through populated areas and along minor roads.

Classification: Medium

Contamination/Pollution

There may be a small risk of leaching of contaminants being disposed of in landfill, however, these should be contained on site.

Classification: Medium to High

Ecological Impacts

Although there is a small risk of contaminants leaching out from the dredged material, this would be at very low concentrations and is unlikely to cause significant harm to the local ecology. The salt content in the material may prevent plant growth unless covered in a topsoil.

(26) https://www.gov.scot/publications/scotlands-circular-economy-waste-route-map-2030/pages/4/

Classification: Medium to High

Interference with Other Legitimate Activities

The increase in HGV movements may interfere with other road users. Baseline traffic data for the A985 in the vicinity of the port indicates that approximately 5% of all road traffic in Rosyth are HGVs (27). As a result of the proposed disposal to landfill, the proportion of HGVs in the total traffic flow would increase during periods when dredged material was being transported. On average, this would increase HGV annual traffic to approximately 6% of all road traffic at that location (28). In addition, depending on the landing and storage arrangements there may be potential for interference with other port users.

Classification: Medium

Amenity/Aesthetic

The movement of HGVs through the area will have an impact on local amenity through noise, vibration, visual impacts and road congestion. This risk also applies to the disposal site.

Classification: Medium

4.3.3 COST CONSIDERATIONS

The estimated costs below would apply:

- operational costs for the operation of the dredger - £0.75 million per annum;
- a discharge berth for the dredger with a storage facility: £30-40 m;
- lagoons to settle dredged material and possibly desalinate: £5 - £10 m; or
- dockside centrifuge facility capable of dewatering and desalinating 400,000 m^3 of silt per annum: £20 m;
- loading and transport (sealed HGVs) – assuming the disposal site is less than one hour drive away and based on one HGV transporting 20 tonnes material at a cost of £100/load (29): £2.6 m.
- a Waste Management Licence.

Total £23.55 m to 53.55 m over three years.

Classification: Low

4.4 OTHER DISPOSAL OPTIONS AND REUSE

4.4.1 STRATEGIC CONSIDERATIONS

Operational Feasibility

Reuse for brick making, concrete aggregate or topsoil production would require the landing, storage and drying of the dredged materials prior to transporting to a landfill facility. Approximately 520,000 wet tonnes would require transport. There are practical difficulties

(27) UK Traffic Data, A985 Rosyth. 2024 data. Available online https://roadtraffic.dft.gov.uk/manualcountpoints/50801. Accessed May 2026.
(28) 2024 data present an average of 258,055 HGVs on the A985 at Rosyth per annum, which would increase to 310,055 HGV movements and the total annual vehicle movements from of 5,155,260 to 5,207,260 on the A985 at Rosyth) with the transport of dredged material from Rosyth by road. Based on 7 days a week.
(29) Estimated cost based on consultation with HGV operator at £50/hour for two hours per load.

relating to handling the dredged material at the Port of Rosyth. The availability of suitable factories/facilities to process the dredged material and markets for the final products are also considerations.

Classification: Low to Medium

Availability of Sites/Facilities

There are no known sites or facilities to receive the dredged material for other uses such as topsoil production, aggregates or brick making.

Classification: Low

Security of Option

Although Forth Ports would have control over the dredging and landing, they would not have control over the continued acceptance of the materials for aggregates or making bricks.

Classification: Low to Medium

Established Practice

Use of marine aggregates such as clean sands and gravels are used as a source of primary construction aggregates, but muddy sediments are not used for this purpose. Whilst topsoil has been made from dredged material in the past, it is not common practice.

Classification: Low to Medium

General Public Acceptability

Making bricks, concrete or topsoil is likely to be publicly acceptable depending on the end use. However, the transport of the material over a large distance may not be acceptable to residents and other road users.

Classification: Medium to High

Likely Agency Acceptability

It is likely that brick making, concrete production and topsoil production would be acceptable to agencies and considered a positive activity. However, the contaminant levels in the samples would make using the material for topsoil unattractive.

Classification: Medium to High

Legislative Implications

SEPA would control emissions from brick making factories under the provisions of the *Environmental Protection Act 1990*. A waste management licence would also be required for their transport and storage under the *Waste Management Licensing (Scotland) Regulations 2011*.

Classification: Medium

4.4.2 HEALTH, SAFETY AND ENVIRONMENTAL CONSIDERATIONS

Public Health

Low risks to public health are anticipated due to the short-term increase in HGV traffic.

Classification: Medium

Safety

There are unlikely to be any significant safety risks associated with making bricks, concrete or topsoil with the exception that there may be an increase in safety risks associated with the movement of materials, particularly if HGVs travel through settlements and along minor roads.

Classification: Medium

Contamination / Pollution

The contaminant levels in the dredged material would make using the material for topsoil unattractive. Pollution from plant emissions is not likely to be an issue provided emissions are controlled in accordance with licences.

Classification: Medium

Ecological Impacts

Making bricks or concrete should have no adverse ecological effects, provided the materials were decontaminated and desalinated before use.

Classification: High

Interference with Other Legitimate Activities

There is a slight risk that movement of the material would impact other road users.

Classification: Medium to High

Amenity/Aesthetic

The movement of HGVs through the area will have an impact on local amenity through noise, vibration, visual impacts and road congestion. This risk also applies to the disposal site.

Classification: Medium to High

4.4.3 COST CONSIDERATIONS

The estimated costs below would apply:

- operational costs for the operation of the dredger - £0.75 million per annum;
- a discharge berth for the dredger with a storage facility: £30-40 m;
- lagoons to settle dredged material and possibly desalinate: £5 to £10 m; or
- dockside centrifuge facility capable of dewatering and desalinating 400,000 m^3 of silt per annum: £20 m;
- loading and transport (sealed HGVs) – assuming the disposal site is less than one hour drive away and based on one HGV transporting 20 tonnes material at a cost of £100/load [(30)]: £2.6 m.
- a Waste Management Licence.

Total £23.55 m to 53.55 m over three years.

Classification: Low

(30) Estimated cost based on consultation with HGV operator at £50/hour for two hours per load.

4.5 SEA DISPOSAL

4.5.1 STRATEGIC CONSIDERATIONS

Operational Feasibility

Operationally disposal at the Oxcars site is comparatively simple as it does not require the landing, storage and drying of the spoil and all the necessary procedures are understood. As this is the present discharge route for the ongoing maintenance dredge operations at the Port of Rosyth, it has been proven as practicable and all the necessary procedures are understood and logistical arrangements in place.

Classification: High

Availability of Sites

The sites/facilities which are required for the sea disposal option are those which are already used. No other disposal sites have been indicated by Forth Ports as available at this time for the dredged material from the Port of Rosyth.

Classification: High

Security of Option

Forth Ports will have full control over all stages in the dredging and disposal process assuming they receive a disposal licence.

Classification: Medium to High

Established Practice

Disposal at the Oxcars licenced disposal site is the current practice for the disposal of the dredged spoil from the Port of Rosyth. It is, therefore, established and proven as effective.

Classification: High

General Public Acceptability

Forth Ports has confirmed that recent similar disposal operations from the Port of Rosyth have not attracted any comments. Dredging operations are unlikely to affect members of the general public, with the possible exception of some recreational users when the vessel is transiting to and from the disposal site.

Classification: High

Likely Agency Acceptability

Informal consultations with the regulatory bodies and other interested parties to date indicate that there is no objection to Sea Disposal at Oxcars and they have no knowledge of any alternative sites that could make beneficial use of the material. Formal consultations will be undertaken by the Marine Directorate following submission of the Marine License application.

Classification: Medium to High

Legislative Implications

A Marine Licence will be required from the Marine Directorate and provided that the BPEO is satisfactory, and the statutory consultees do not object, it is established practice that a Marine

Licence will be issued. Compliance should not therefore demand significant management control. Permission will be required from the Crown Estate Scotland for disposal of spoil to Crown Estate Scotland owned seabed.

Classification: Medium to High

4.5.2 HEALTH, SAFETY AND ENVIRONMENTAL CONSIDERATIONS

Public Health

The risk of members of the general public being exposed to contamination from the dredged material is regarded as low. Commercial species of demersal fish are not taken from the area and no food chain links between sediment contamination or contamination liberated into the water column, and human consumers leading to impacts on public health are considered likely.

Classification: Medium to High

Safety

The operations are undertaken at sea, therefore members of the general public are not likely to be exposed to risk from the disposal activities. The contractor appointed to undertake the dredging and disposal operations be subject to a health, safety and environmental audit by Forth Ports.

Classification: High

Pollution/Contamination

The effects on water quality of the disposal operations and the potential for impacts on sediment contamination may cause the occasional exceedance of Environmental Quality Standards and failure to meet Water Framework Directive (WFD) objectives although based on current evidence this would be localised and short-term.

Classification: Medium

Ecological Impacts

The disposal operations may affect the benthic fauna in proximity to the disposal site due to suspended sediments depositing on the seabed outside the disposal site. It is anticipated that there will not be any significant impact on the Forth Estuary and Firth of Forth marine ecosystem as a whole given the scale and duration of effects. There may be some short-term effects such as displacement on migrating fish due to increased turbidity caused by the discharge of dredged material into the water column, but these impacts are not predicted to cause mortality or alter the viability of populations.

Under the proposed disposal proposals, cumulative impacts with other operations are not predicted to create a significant impact to the Firth of Forth SPA, Forth Islands SPA, Outer Firth of Forth and St Andrews Bay Complex SPA, Firth of Forth SSSI, SACs farther afield or marine ecosystems.

Classification: Medium to High.

Interference with Other Legitimate Activities

The transport and disposal activities may cause some disruption to other users of the Firth of Forth and Forth Estuary, however as the operations will only be occurring for a limited period

of time and are controlled directly by Forth Ports it is not anticipated that there will be any significant interference. In addition, historic operations at Oxcars have not resulted in any reported disruption to other Firth of Forth and Forth Estuary users.

Classification: High

Amenity/Aesthetic

The disposal activities may cause some short-term disruption to other users of the Forth Estuary and Firth of Forth, but the proposals will contribute to the normal functioning of the Port of Rosyth and maintain its capacity to provide access to the Rosyth Naval Dockyard.

Classification: Medium to High

4.5.3 COST CONSIDERATIONS

There would be no capital required to purchase new equipment. Operational costs for the operation of the dredger to dredged up to 400,000 m^3 each year are approximately £0.75 m.

The total costs would be £2.25 m over 3 years.

Classification: High

5. SUMMARY OF THE BPEO

5.1 INTRODUCTION

This section summarises the assessment of options against the criteria described in Chapter 2: Table 2.1 and identifies the BPEO.

5.2 COMPARISON OF OPTIONS

Seven options were initially considered for the disposal of the dredged spoil from the Port of Rosyth. These were reduced to a short-list of four options based on practicality. A summary of the key considerations with regard to each of the four short-listed options is provided below and illustrated in Table 5.1.

5.2.1 COASTAL RECLAMATION AND CONSTRUCTION FILL

Operationally coastal reclamation and construction fill would be possible, however it would likely be costly and could involve several contractors to undertake the transition from vessel to bunded lagoons and then drying and fixing of the material in the lagoons. The sediment is mixed, comprising primarily sandy mud, with some slightly gravelly sandy mud. The sediment has low compressive strength properties, making it unsuitable for most types of construction. In addition, the presence of some heavy metals and PAHs classes it as hazardous or non-hazardous rather than inert, which restricts its suitability for application on land.

Currently there are no significant areas of coastal reclamation planned in the Forth Estuary or Firth of Forth. The costs of this option would be high due to the requirement for construction of a landing and storage facility, a drying facility and transport costs.

5.2.2 SACRIFICIAL LANDFILL

Operationally, disposal to landfill will be achievable but problematic. The dredged materials would require landing and drying in specially constructed facilities and would then require transport in sealed HGVs to an appropriate landfill site. There are limited sites available to take the material, and a full analysis of the contaminants in the material would be required by the operators before final acceptance.

Whilst small amounts of dredged sediment material are sometimes disposed of to landfill, it is not common practice. The general public and relevant agencies are likely to consider this disposal option acceptable, however, there may be concerns related to the increases in HGV transport by road. There is also likely to be concern about the alignment with Scotland's *2024 Circular Economy* and *Waste Route Map to 2030* [31] which targets a reduction in the volume of material being disposed to landfill.

The requirement for transport will result in some safety and public health risks and may cause interference with other legitimate activities. There would be an increase in traffic volume due to HGV movements, along with elevated carbon dioxide emissions. There is a low risk of ecological disturbance. The costs of this option would be high due to the requirement for construction of a landing and storage facility, a drying facility and transport costs.

(31) https://www.gov.scot/publications/scotlands-circular-economy-waste-route-map-2030/pages/4/

5.2.3 OTHER DISPOSAL OPTIONS AND REUSE

Operationally this option would be achievable but there would be difficulties associated with the requirement to land, store, dry and transport the material. Forth Ports would have limited control over the option and it is not common practice to use marine dredged material for these purposes. It is likely to be viewed as an attractive option by the general public and agencies, and no legislative issues are anticipated. There would be potential for benefit through substitution of recycled material for primary minerals.

Environmental and public health and safety concerns associated with this option are linked to transport of the materials and are anticipated to be minimal. There will be no significant impact on amenity and little interference with other legitimate users. As with Sacrificial Landfill, Coastal Reclamation and Construction Fill, capital costs would be high because of the need for landing, storage and drying facilities and transport costs.

The mineralogical composition, low organic content and salinity of the material limit its suitability for use for brick making, as concrete aggregate or in topsoil production as it would require treatment to desalinate and decontaminate the material.

5.2.4 SEA DISPOSAL

Operationally, few difficulties are anticipated with disposal at Oxcars, and this site has been historically used for disposal of dredged materials from the Port of Rosyth. It is anticipated that this option will be acceptable to both the general public and relevant agencies. Forth Ports would retain oversight of the dredging process through the appointment of contractors, and the associated risks to safety and public health are anticipated to be low.

There will be some short-term effects on water quality during disposal, such as raised turbidity and suspended sediment levels, which may have short-term and localised ecological effects, but these are considered to be not significant (see Appendix B). There is unlikely to be interference with other legitimate activities and there is not anticipated to be any impact on local amenity or navigation, which is managed by the Forth and Tay Navigation Service.

5.3 IDENTIFICATION OF THE BPEO

The assessment of options highlights the major operational difficulties associated with the landfill and other use options that primarily relate to lack of available sites and facilities and the nature of the material. There are also major costs associated with the need to construct landing, storage and drying facilities at, or close to, the Port of Rosyth.

The proposed disposal of dredged material at sea supports the objectives set out in Scotland's *National Marine Plan* and will support the planned dredging operations to safeguard the access to the Port of Rosyth and Rosyth Naval Dockyard and navigational safety.

Disposal at sea will keep the dredged material within the ecosystem, maintaining the sediment budget for the area. In line with guidance from Marine Directorate, the Best Practicable Environmental Option is identified as the disposal at a licensed sea disposal site. The preferred site for this is the Oxcars disposal site.

TABLE 5.1 SUMMARY OF ASSESSMENT OF OPTIONS

Criteria	Coastal Reclamation and Construction Fill	Sacrificial Landfill	Other Disposal Options and ReUse	Sea Disposal
Operational feasibility				
Availability of sites/facilities				
Security of option				
Established practice				
General public acceptability				
Likely Agency acceptability				
Legislative implications				
Public health				
Safety				
Pollution/contamination				
Ecological impact				
Interference with other users				
Amenity/aesthetic				
Cost considerations	#			

#: Medium if pumped to site

Key: Performance of Options	
Low	
Low to Medium	
Medium	
Medium to High	
High	

APPENDIX A SEDIMENT SAMPLE CHEMICAL ANALYSIS

A1 PORT OF ROSYTH SEDIMENT SAMPLE DATA

A1.1 INTRODUCTION

Samples of seabed sediments to be dredged were collected from the Port of Rosyth by Forth Ports on 19 January 2026 and analysed by Socotec UK Ltd. The survey plan followed the Marine Directorate guidance and was approved on the 8 January 2026. Based on the maximum application dredge volume and depths, grab samples from thirteen stations were required. Sample station locations are presented in Table A1.1 and shown on Figure A1.1.

TABLE A1.1 POSITIONS OF THE ROSYTH 2026 SAMPLE STATIONS

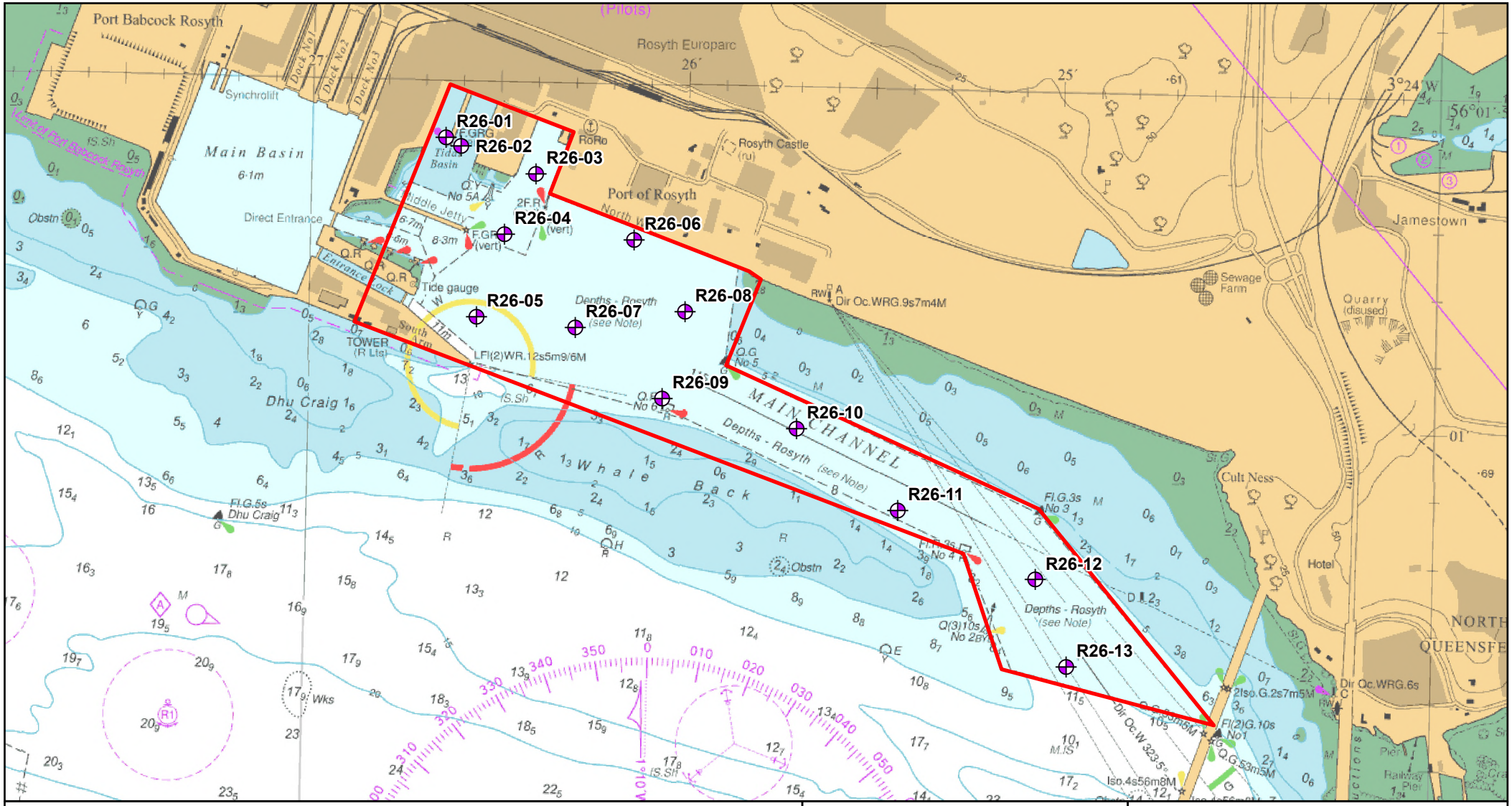
Sample Station	Latitude	Longitude
R26-01	56° 1.415' N	3° 26.646' W
R26-02	56° 1.403' N	3° 26.606' W
R26-03	56° 1.363' N	3° 26.405' W
R26-04	56° 1.273' N	3° 26.486' W
R26-05	56° 1.149' N	3° 26.556' W
R26-06	56° 1.268' N	3° 26.141' W
R26-07	56° 1.136' N	3° 26.292' W
R26-08	56° 1.163' N	3° 26.001' W
R26-09	56° 1.033' N	3° 26.057' W
R26-10	56° 0.993' N	3° 25.698' W
R26-11	56° 0.874' N	3° 25.425' W
R26-12	56° 0.774' N	3° 25.055' W
R26-13	56° 0.646' N	3° 24.968' W

Coordinates in WGS84, degrees decimal minutes

The surface sediment samples were photographed (see Figure A1.2), subsampled on deck and stored in pre-cleaned sample containers provided by Socotec. Each sample was labelled, and a field log was kept to record the sample location, date and time sample was taken. Samples were kept chilled and sent by overnight courier in coolboxes to the analytical laboratory. For each of the samples the following chemical analysis was undertaken.

- Sediment water content and density.
- Sediment particle size distribution (PSD).
- Total Organic Carbon (TOC).
- Metals (As, Cd, Cr, Cu, Hg, Ni, PB, Zn).
- Tributyl Tin (TBT).
- Polycyclic Aromatic Hydrocarbons (EPA 16 PAHs).
- Poly Chlorinated Biphenyls (ICES 7 PCBs).
- Total Hydrocarbon Content (THC).
- Presence of asbestos.

Marine Directorate Action Levels are discussed in Section A1.2 and the sediment sample data are presented in Section A1.3 to Section A1.8.



Limits of Dredging Area

Sediment Sample Position

0 100 200 300 400 500

Metres

N

Figure A1.1
Port of Rosyth
Surface Sediment Sample Locations

SCALE: See Scale Bar	VERSION: A01
SIZE: A4	DRAWN: RW
PROJECT: 0396143	CHECKED: MI
DATE: 05/05/2026	APPROVED: MI

ERM

PROJECTION: British National Grid

Path: \\vmukspgisfs01\Data\London\Projects\0391463 - Forth Ports\MAPS\0396143 - Forth Ports.aprx\0396143 - Forth Ports - Rosyth 2026 - Figure A1.1 - Surface Sediment Sample Locations - A01

FIGURE A1.2 PORT OF ROSYTH 2026 SEDIMENT SAMPLE PHOTOGRAPHS

		
R26-01	R26-02	R26-03
		
R26-04	R26-05	R26-06
		
R26-07	R26-08	R26-09
		
R26-10	R26-011	R26-12
		
R26-13		

A1.2 MARINE DIRECTORATE ACTION LEVELS

Table A1.2 and Table A1.3 set out the Action Levels for metals, PCBs, TBT and PAHs used by the Marine Directorate to assess the suitability for disposal of sediments at sea.

TABLE A1.2 MARINE DIRECTORATE ACTION LEVELS: METALS

Metal	AL1 ($mgkg^{-1}$ dry weight)	AL2 ($mgkg^{-1}$ dry weight)
Arsenic	20	70
Cadmium	0.4	4
Chromium	50	370
Copper	30	300
Mercury	0.25	1.5
Nickel	30	150
Lead	50	400
Zinc	130	600

TABLE A1.3 MARINE DIRECTORATE ACTION LEVELS: PCBS, TBT AND PAHS

Determinand	AL1 ($mgkg^{-1}$ dry weight)	AL2 ($mgkg^{-1}$ dry weight)
ICES 7 PCBs	0.02	0.18
TBT	0.10	0.50
PAHs		
Naphthalene	0.10	
Phenanthrene	0.10	
Anthracene	0.10	
Fluoranthene	0.10	
Pyrene	0.10	
Benz[a]anthracene	0.10	
Chrysene/Triphenylene	0.10	
Benzofluoranthenes	0.10	
Benzo[a]pyrene	0.10	
Indenopyrene	0.10	
Benzoperylene	0.10	
Acenaphthylene	0.10	
Acenaphthene	0.10	
Fluorene	0.10	
Dibenz[a,h]anthracene	0.01	
Total PAHs	100	

In general, contaminant levels in dredged material below Action Level 1 are of no concern and are unlikely to influence the licensing decision. A breach of Action Level 1 does not automatically preclude disposal at sea but usually requires further consideration before a decision can be made. Dredged material with contaminant levels above Action Level 2 is generally considered unsuitable for normal sea disposal, however, may be suitable for other management options such as treatment or seabed burial/capping, unless a compelling case can be made for normal sea disposal.

A1.3 METAL RESULTS

Concentrations of metals are presented in Table A1.4. Levels above Marine Directorate Action Level 1 are highlighted in blue. No concentrations above Action Level 2 were recorded.

TABLE A1.4 METAL CONTAMINANTS FROM THE PORT OF ROSYTH (MG KG^{-1}) 2026

Station	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
R26-01	15.3	0.16	61.3	29.5	0.71	33.4	60.8	131
R26-02	16.2	0.16	63.4	28.4	0.69	34.6	60.4	132
R26-03	17.6	0.19	63.7	28.4	0.69	35.6	62	135
R26-04	18.3	0.17	64.4	27.4	0.65	35	61	129
R26-05	19	0.19	63.6	28.2	0.67	35.3	63.5	132
R26-06	17.4	0.17	61.3	27.3	0.67	34	58.8	127
R26-07	16.8	0.16	57.9	26	0.65	31.9	56.7	125
R26-08	17.6	0.18	57.8	28.4	0.66	32.1	58.4	129
R26-09	16	0.18	47.8	23.8	0.54	27.4	48.7	115
R26-10	17	0.16	51.5	26.2	0.57	29.3	51.3	116
R26-11	15.6	0.15	47.8	22.3	0.5	27.3	45.8	103
R26-12	16.2	0.14	51.7	23.1	0.54	28.4	48.2	105
R26-13	14.5	0.14	49.9	24	0.53	28.2	49	108
Mean	**16.73**	**0.165**	**57.08**	**26.38**	**0.62**	**31.73**	**55.74**	**122.08**
Range	14.5-19.0	0.14-0.19	47.8-64.4	22.3-29.5	0.53-0.71	27.3-35.6	45.8-63.5	103-135

As = Arsenic, Cd = Cadmium, Cr = Chromium, Cu = Copper, Hg = Mercury, Ni = Nickel, Pb = Lead and Zn = Zinc.

Table A1.5 provides a comparison of metal data from samples analysed from 2000 to 2026. The ranges in results for all metals over the period for which there is available sample data are large and, in most surveys, the mean concentrations of some metal concentrations are above Action Level 1. The mean concentration for Hg was above Action Level 2 in 2003.

TABLE A1.5 METAL CONTAMINANTS FROM THE PORT OF ROSYTH (MG KG^{-1}) 2000 TO 2026

Year		As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
2000	Mean	16.5	0.2	68.0	42.5	1.2	32.1	68.3	147
	Range	16.5	0.2	68.0	42.5	1.2	32.1	68.3	147
2001	Mean	17.8	0.3	84.2	46.7	1.1	39.1	80.5	149.4
	Range	16.5-18.6	0.1-1.0	77.6-92.3	44.0-52.4	1.0-1.4	37.2-40.9	72.1-85.6	136-162
2003	Mean	18.3	0.2	78.5	57.9	1.6	35.9	89.6	156.3
	Range	13.5-21.9	0.0-1.0	51.4-105	30.9-189.9	0.9-2.6	24.7-43.4	58.2-137.5	102.5-229.7
2004	Mean	18.9	0.0	69.5	38.8	1.0	35.4	80.8	137.9
	Range	18.6-19.3	0.0	68.4-70.0	38.3-39.6	0.9-1.1	35.2-35.7	79.7-81.7	136.6-139
2007	Mean	14.7	N/A	58.7	29.4	0.6	30.0	58.9	105.9
	Range	12.5-17.0	N/A	46.3-71.6	23.8-34.8	0.4-0.7	24.6-35.3	46.6-70.2	88.4-126
2008	Mean	16.1	BDL	70.1	32.0	0.7	33.3	63.9	125.7
	Range	12.4-17.6	BDL	52.0-80.8	22.5-36.8	0.5-0.9	25.6-36.6	43.1-71.6	92.2-145
2012	Mean	16.5	0.1	65.8	38.7	1.1	31.5	73.3	135.5
	Range	16.5-16.6	0.1-0.2	65.0-66.5	37.6-40.8	1.0-1.1	31.4-31.7	69.4-76.3	133.1-137.1
2017	Mean	18.1	0.5	82.4	31.5	0.6	36.6	58.6	260.8
	Range	15.0-20.6	0.1-4.5	67.7-93.2	23.6-48.1	0.5-0.9	30.9-40.6	45.9-65.6	108.0-1,730
2020	Mean	16.46	0.32	91.61	31.44	0.65	31.91	56.05	132.5
	Range	15.2-	0.13-	74.6-	24.9-	0.47-	26.5-	44.2-	104-210
2023	Mean	17.71	0.12	58.07	29.05	0.57	32.56	50.65	123.79
	Range	13.6-21.2	<0.04-0.22	40.9-74.2	20.4-37.4	0.46-0.68	23.7-41.1	40.4-59.6	95.3-158
2026	Mean	16.73	0.165	57.08	26.38	0.621	31.73	55.74	122.08
	Range	14.5-19.0	0.14-0.19	47.8-64.4	22.3-29.5	0.53-0.71	27.3-35.6	45.8-63.5	103-135
2000-2026	**Mean**	**17.07**	**0.17**	**71.27**	**36.78**	**0.89**	**33.65**	**66.94**	**147.17**
	Range	**12.4-21.9**	**BDL-4.5**	**40.9-106**	**20.4-189.9**	**0.4-2.6**	**23.7-43.4**	**40.4-137.5**	**88.4-1,730**

A1.4 POLYCHLORINATED BIPHENYLS RESULTS

Polychlorinated biphenyls (PCBs) are organic compounds comprising a biphenyl group (composed of two benzene rings) with between one and ten bonded chlorine atoms. PCBs are highly toxic, persistent pollutants and are readily bioaccumulated in animals.

Although production in the UK ceased in the 1970s, PCBs still enter the marine ecosystem through the disposal of industrial plant, emissions from old electrical equipment and from landfill sites [32].

Dry weight concentrations of ICES 7 PCBs from samples collected in 2026 are presented in Table A1.6. No ICES 7 PCB levels exceed Action Level 1 (0.02 mg kg^{-1}) in any of the samples.

TABLE A1.6 PCB CONTAMINANTS FROM THE PORT OF ROSYTH (MG KG^{-1}) 2026

Station	Sum of ICES 7 PCB Concentrations
R26-01	0.00773
R26-02	0.00771
R26-03	0.00722
R26-04	0.00674
R26-05	0.00682
R26-06	0.00694
R26-07	0.00828
R26-08	0.00715
R26-09	0.00594
R26-10	0.00595
R26-11	0.0055
R26-12	0.00591
R26-13	0.00264
Mean	**0.00650**
Range	**0.00264 – 0.00828**

ICES 7 PCB congeners (with IUPAC numbers): 28 - 2,4,4’ - Trichlorobiphenyl, 52 - 2,2’,5,5’ - Tetrachlorobiphenyl, 101 - 2, 2’, 4, 5, 5’ - Pentachlorobiphenyl, 118 - 2, 3’, 4, 4’, 5 - Pentachlorobiphenyl, 138 - 2, 2’, 3, 4, 4’, 5’ - Hexachlorobiphenyl, 153 - 2, 2’, 4, 4’, 5, 5’ - Hexachlorobiphenyl, 180 - 2, 2’, 3, 4, 4’, 5, 5’ - Heptachlorobiphenyl.

Table A1.7 presents a comparison of mean dry weight concentrations of ICES 7 PCBs from samples collected in 2000 to 2026.

(32)Forth Replacement Crossing: Environmental Statement 2009. Available online from http://www.transportscotland.gov.uk/strategy-and-research/publications-and-consultations/j11223-081.htm

TABLE A1.7 PCB CONTAMINANTS FROM THE PORT OF ROSYTH (MG KG^{-1}) 2000 – 2026

Year	Mean Sum of ICES 7 PCB Concentrations
2000	0.0117
2003	0.0116
2004	0.0139
2012	0.0122
2017	0.0111
2020	0.0086
2023	0.0008
2026	0.0065
Range 2000-2026	**0.0008 - 0.0139**

ICES 7 PCB congeners (with IUPAC numbers): 28 - 2,4,4' - Trichlorobiphenyl, 52 - 2,2',5,5' - Tetrachlorobiphenyl, 101 - 2, 2', 4, 5, 5' - Pentachlorobiphenyl, 118 - 2, 3', 4, 4', 5 - Pentachlorobiphenyl, 138 - 2, 2', 3, 4, 4', 5' - Hexachlorobiphenyl, 153 - 2, 2', 4, 4', 5, 5' - Hexachlorobiphenyl, 180 - 2, 2', 3, 4, 4', 5, 5' - Heptachlorobiphenyl.

A1.5 POLYCYCLIC AROMATIC HYDROCARBONS

Levels of PAHs are presented in Table A1.8. Levels of PAHs are presented in Table A1.9. Levels above Marine Directorate Action Level 1 for individual PAHs are highlighted in blue. The Total Hydrocarbon (THC) concentrations are also reported (in $mgkg^{-1}$). There are no Action Levels for THC.

A comparison of mean dry weight concentrations of PAHs from samples collected between 2003 and 2026 are presented in Table A1.9 which shows that PAH concentrations of the majority of individual PAHs are variable with levels of some PAHs in some years being above Action Level 1.

TABLE A1.8 ANALYSIS OF PAHS FROM THE PORT OF ROSYTH (µG KG^{-1} DRY WEIGHT) 2026

Station	R26-01	R26-02	R26-03	R26-04	R26-05	R26-06	R26-07	R26-08	R26-09	R26-10	R26-11	R26-12	R26-13
LMW PAH													
Acenaphthene	38.4	39.4	40.6	45.1	45.8	42.5	75	78.7	61.9	68.8	78	69.2	79.1
Acenaphthylene	54.5	55.9	60.5	62.7	55.8	44.3	61.8	54.4	45	47.4	53.6	54.1	53
Anthracene	134	125	121	137	149	131	182	143	119	145	167	157	152
Fluorene	89.2	85.9	88.8	92.1	92.5	85.7	105	102	82.6	90.8	104	98	99.9
Naphthalene	204	190	195	195	217	204	213	217	181	197	237	193	203
Phenanthrene	337	326	300	346	359	325	387	399	297	358	402	356	388
HMW PAH													
Benzo(a)anthracene	257	260	244	266	289	239	328	277	215	234	287	277	290
Benzo(a)pyrene	318	328	310	329	351	295	382	337	258	276	366	336	347
Benzo(b)fluoranthene	367	386	370	372	385	338	398	389	289	306	385	366	378
Benzo(ghi)perylene	333	341	346	327	342	302	351	364	269	265	332	328	345
Benzo(k)fluoranthene	265	267	255	264	285	240	297	276	205	214	283	254	301
Chrysene	280	281	266	288	307	262	335	303	229	253	300	290	303
Dibenzo(ah)anthracene	54.7	65.3	67.4	64.5	66.4	47.8	68.3	66.3	50.3	52.4	68	65.1	54.5
Fluoranthene	472	456	415	461	496	437	576	530	386	439	505	491	550
Indenopyrene	313	325	314	313	327	280	335	332	243	254	325	305	313
Pyrene	543	538	506	547	583	510	641	600	468	515	583	560	604
THC (mg kg^{-1})	378	385	384	348	354	329	273	388	292	292	320	376	319

TABLE A1.9 COMPARISON OF PAHS FROM THE PORT OF ROSYTH 2003 TO 2026 (MG KG^{-1} DRY WEIGHT)

Year	2003	2004	2007	2008	2012	2017	2020	2023	2026
PAH	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**
LMW PAH									
Acenaphthene	BDL	BDL	BDL	BDL	0.046	0.029	0.053	0.036	0.059
Acenaphthylene	BDL	BDL	BDL	BDL	0.004	0.013	0.065	0.059	0.054
Anthracene	0.195	0.182	0.087	0.038	0.183	0.124	0.165	0.140	0.143
Fluorene	0.096	0.090	0.044	0.019	0.090	0.089	0.109	0.092	0.094
Naphthalene	0.262	0.263	0.194	0.052	0.273	0.221	0.245	0.234	0.204
Phenanthrene	0.491	0.465	0.236	0.100	0.473	0.290	0.402	0.350	0.352
MMW PAH									
Benzo(*a*)anthracene	0.370	0.396	0.163	0.071	0.333	0.238	0.302	0.254	0.266
Benzo(*a*)pyrene	0.451	0.252	0.196	0.088	0.376	0.247	0.345	0.275	0.326
Benzo fluoranthenes	1.098	0.951	BDL	0.248	0.956	0.578	0.271	0.542	0.313
Benzo(GHI)perylene	0.612	0.409	0.176	0.077	0.364	0.239	0.341	0.299	0.327
Chrysene/Triphenylene	0.507	0.417	0.193	0.083	0.360	0.240	0.314	0.259	0.284
Dibenz[*a,h*]anthracene*	BDL	BDL	0.0049	0.002	0.0124	0.050	0.066	0.047	0.061
Fluoranthene	0.625	0.601	0.293	0.133	0.571	0.394	0.497	0.450	0.478
Indenopyrene	0.471	0.447	0.165	0.071	0.325	0.177	0.286	0.244	0.306
Pyrene	0.747	0.708	0.362	0.157	0.686	0.440	0.596	0.540	0.554

*Action Level 1 is 0.01 mg $kg^{-1.}$

ND = Not Detected

Note only those 15 PAHs for which there are historic data are reported. Benzo fluoranthenes are the sum of Benzo(b)fluoranthene and Benzo(k)fluoranthene

A1.6 TRIBUTYLTIN

Tributyltin (TBT) is a highly toxic compound historically used as an anti-biofouling agent in paint used to coat the hulls of vessels. It is also toxic to non-target organisms and is linked to immune-suppression and imposex [33] in snails and bivalves. TBT was also used in various industrial processes as a biocide and can enter the marine environmental through effluent discharges. In some cases, TBT can also be persistent in the marine environment. Mean dry weight concentrations of TBT from the samples collected are presented in Table A1.10. No samples were observed to have TBT concentrations above Marine Directorate Action Level 1 (0.1 mg kg^{-1}).

TABLE A1.10 TBT FROM THE PORT OF ROSYTH (MG KG-1 DRY WEIGHT) 2026

Station	TBT Concentration
R26-01	<0.005
R26-02	<0.005
R26-03	<0.005
R26-04	<0.005
R26-05	<0.005
R26-06	<0.005
R26-07	<0.005
R26-08	<0.005
R26-09	<0.005
R26-10	<0.005
R26-11	<0.005
R26-12	<0.005
R26-13	<0.005
Mean	**<0.005**

(33) The development of male characteristics in females

A comparison of TBT concentrations from samples collected in 2017, 2020, 2023 and 2026 are presented in Table A1.11, which shows that TBT concentrations are below Action Level 1 in all years.

TABLE A1.11 TBT FROM THE PORT OF ROSYTH (MG KG^{-1} DRY WEIGHT) 2017 TO 2026

Year		TBT Concentration
2017	Mean	<0.012
	Range	<0.002-0.059
2020	Mean	<0.0087
	Range	<0.005-0.0536
2023	Mean	<0.005
	Range	<0.005-<0.005
2026	Mean	<0.005
	Range	<0.005 - <0.005
2017-2026	Mean	**<0.0076**
	Range	**<0.002-0.059**

A1.7 ASBESTOS

No asbestos was reported from any of the samples.

A1.8 SEDIMENT PHYSICAL PROPERTIES

The physical properties of the dredge sediment were analysed on the thirteen sediment samples taken from the Port of Rosyth in 2026. Sediments were predominantly sandy mud and slightly gravelly sandy mud.

Gravel is defined as >2 mm.

Sand is defined as >63 µm<2 mm.

Mud (silts and clays) is defined as <63 µm.

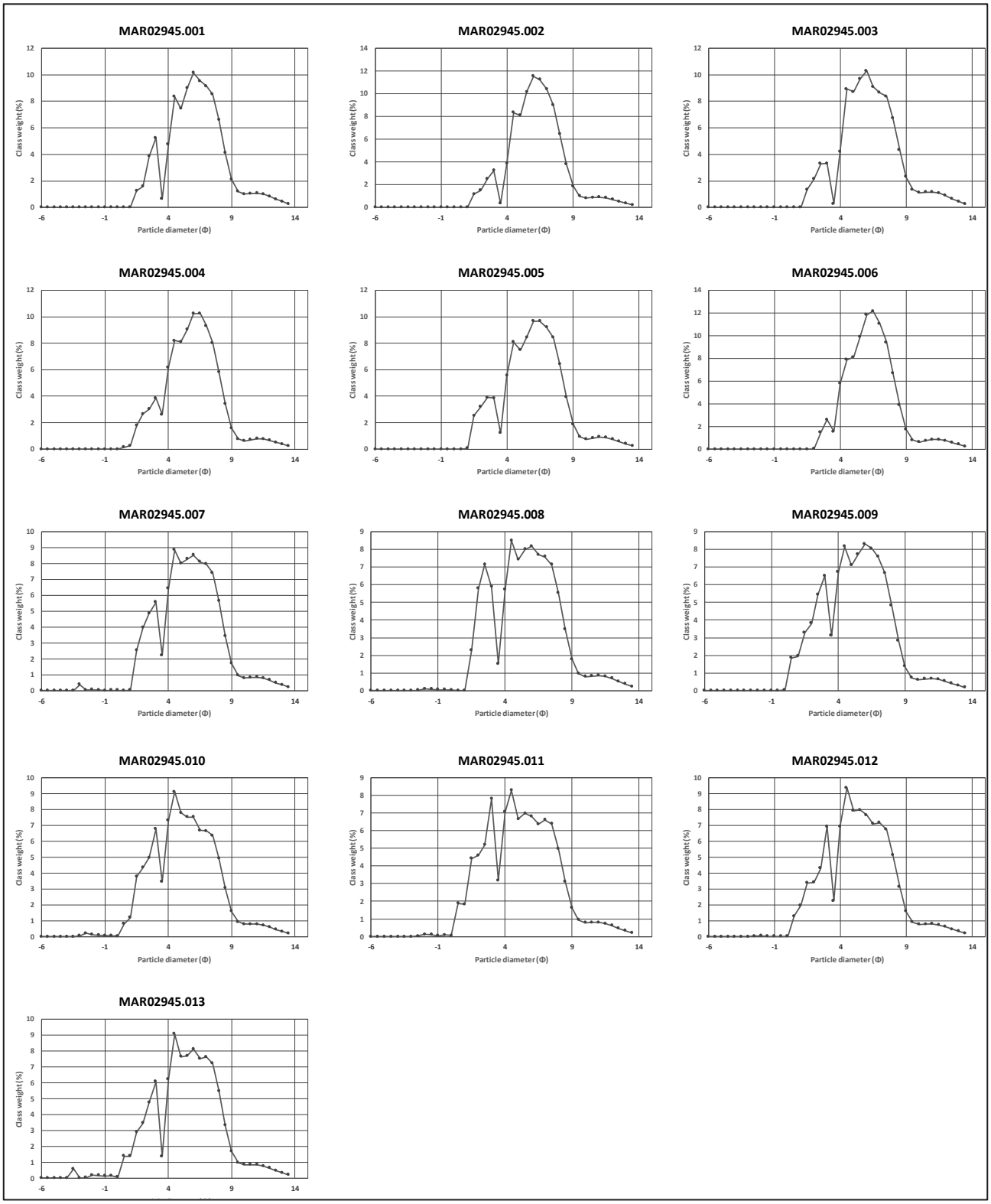
Table A1.12 and Figure A1.3 present the 2026 data.

Sediment contamination is typically higher in sediments less than 63 µm diameter e.g. mud due to the increased surface area providing more adhesion sites for contaminants than the same volume of sand or gravel.

TABLE A1.12 PORT OF ROSYTH 2026 SEDIMENT DATA SUMMARY

Station	R26-01	R26-02	R26-03	R26-04	R26-05	R26-06	R26-07	R26-08	R26-09	R26-10	R26-11	R26-12	R26-13
Textural Group Classification	Sandy Mud	Sandy Mud	Sandy Mud	Sandy Mud	Sandy Mud	Sandy Mud	Slightly Gravelly Sandy Mud	Slightly Gravelly Sandy Mud	Sandy Mud	Slightly Gravelly Sandy Mud	Slightly Gravelly Sandy Mud	Slightly Gravelly Sandy Mud	Slightly Gravelly Sandy Mud
Folk and Ward Description	Coarse Silt	Coarse Silt	Coarse Silt	Coarse Silt	Coarse Silt	Coarse Silt	Coarse Silt	Coarse Silt	Very Coarse Silt	Very Coarse Silt	Very Coarse Silt	Coarse Silt	Coarse Silt
Folk and Ward Sorting	Very Poorly Sorted	Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted
Mean µm	17.231	16.149	16.033	20.295	19.179	15.643	25.587	28.081	31.664	31.585	34.061	29.761	28.471
Mean phi	5.859	5.952	5.963	5.623	5.704	5.998	5.288	5.154	4.981	4.985	4.876	5.070	5.134
Sorting Coefficient	2.196	1.977	2.189	2.085	2.225	1.800	2.361	2.466	2.397	2.443	2.558	2.445	2.507
Skewness	0.035	0.013	0.076	-0.033	-0.026	0.049	-0.016	-0.015	-0.058	0.039	0.037	0.002	-0.044
Kurtosis	1.169	1.245	1.224	1.115	1.147	1.13	1.054	0.997	0.949	0.977	0.888	1.037	1.063
Gravel (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.52	0.26	0.00	0.51	0.30	0.07	1.10
Sand (%)	17.38	12.69	14.61	20.52	20.31	11.41	25.60	28.40	32.66	32.68	36.14	30.49	27.69
Mud (silts and clays) (%)	82.62	87.31	85.39	79.48	79.69	88.59	73.89	71.34	67.34	66.81	63.56	69.44	71.22
Total Organic Carbon (%)	4.17	3.83	4.15	4.02	4.27	4.19	4.19	4.3	3.04	3.89	3.38	3.48	3.17
Solids (%)	37.4	31.9	31.4	34.0	32.7	38.4	40.0	39.7	49.0	39.8	36.6	41.8	51.4
Density	2.57	2.57	2.58	2.54	2.57	2.56	2.55	2.55	2.56	2.56	2.58	2.58	2.58

FIGURE A1.3 PORT OF ROSYTH 2026 SEDIMENT PSD



A2 DISPOSAL SITE SEDIMENT SAMPLE DATA

Table A1.13 presents metal and PCB concentration data from sediment sampled from within the Oxcars disposal site and from other disposal sites within the Firth of Forth and Forth Estuary. Levels above Marine Directorate Action Level 1 for metals and PCBs are highlighted in blue.

TABLE A1.13 CONCENTRATION OF METALS AND PCBS (MG KG^{-1}) FROM DISPOSAL SITES IN THE FIRTH OF FORTH AND FORTH ESTUARY

Site Name	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	Sum ICES 7 PCBs
Oxcars 2011 (n=6)	11.2	0.1	42.5	22.2	0.6	22.3	153.5	92.2	0.007 (2007, n=6)
Oxcars 2015 (n=3)	15.7	0.3	79.6	41.6	1.0	35.8	78.1	141.7	0.008
Narrow Deep 2011 (n=6)	9.5	0.2	42.9	21.6	0.49	22.9	53.4	109.4	0.008 (n=3)
Narrow Deep 2015 (n=4)	11.7	0.2	63.8	24.6	0.6	30.0	58.4	105.9	0.003 (n=3)
Methil 2011 (n=3)	6.9	0.07	13.7	7.14	0.07	8.97	20.2	39.8	0.0004 (n=3)
Methil 2015 (n=1)	8.7	0.1	18.0	9.6	BDL	11.2	14.5	72.8	0.0004 (n=3)
Kirkcaldy 2011 (n=3)	6.24	0.1	21.9	16.2	0.14	16.4	21.7	45.9	-
Kirkcaldy 2015 (n=3)	8.9	0.1	43.1	17.0	0.2	22.0	30.6	62.9	0.0025 (n=3)
Blae Rock 2007 (n=3)	13.4	BDL	59.7	32.4	0.8	28.2	63.9	108.6	0.008 (n=5)
Blae Rock 2011 (n=6)	17.2	0.1	39.6	21.9	0.5	21.4	52.1	80.3	0.01 (n=2)
Bo'ness 2011 (n=7)	14.5	0.1	50.8	23.3	0.8	23.6	56.9	95.7	0.005 (n=3)
Bo'ness 2015 (n=5)	18.6	0.1	59.6	26.5	0.7	27.5	54.2	114.0	0.004 (n=3)

Data provided by the Marine Directorate (2019)
Key: n = the number of samples analysed (where known)

Note that monitoring of disposal sites is not mandatory therefore, the data presented in Table A1.13 are the most recent data available. Metal concentrations in samples from Oxcars from 2011 and 2015 are generally lower or similar to the material dredged from the Port of Rosyth, with the exception of Pb which was higher at Oxcars in 2011 (refer to Table A1.4 for 2000 to 2026 mean metal concentrations).

APPENDIX B ENVIRONMENTAL IMPACTS OF DISPOSAL OPERATIONS

B1 INTRODUCTION

This Appendix addresses the environmental impacts of the maintenance dredging work at the Port of Rosyth and the disposal of dredged material at the licenced Oxcars disposal site. Impacts on water quality, sediment quality, and habitats and species are considered. Table B1.1 presents the impact summary.

The identification and assessment of environmental impacts of the disposal of dredged material follows guidance from the Environment Agency, Clearing the Waters for All [(34)].

As the Marine Licence application is for disposal of the dredged material, impacts of the dredging activities are not addressed, other than in the context of Bathing Waters and cumulative impacts from existing and proposed dredging and disposal activities, and other activities and developments.

Potential impacts on general vessel movements and fishing due to the dredging operations and disposal operations are not considered to be significant as commercial traffic in the main channel is controlled by Forth Ports' standard operating procedures.

B2 IMPACTS OF DISPOSAL

B2.1 INTRODUCTION

As described in Section 1.3, it is proposed that up to 400,000 m^3 of material would be dredged from the Port of Rosyth and disposed at Oxcars disposal site within the Firth of Forth. The scheduling of the dredging and disposal operations will depend on operational requirements, including the requirements of vessel movements into and out of the Rosyth Naval Dockyard. In previous years this has taken place for short periods of up to five days over between 3 and 9 months a year. Typically, dredging and disposal takes place over a period of approximately 17 to 25 days a year. The cycle time from dredging to disposal and back to the dredging site is approximately 3 hours.

The material to be disposed consists primarily of sandy mud with some gravel factions. The concentrations of contaminants are *presented* in Appendix A1. Samples were taken at 13 stations (R26-01 to R26-13) and the results are summarised here.

- The mean concentrations of metals were all below Action Level 2, with mean concentrations of arsenic, cadmium and copper all below Action Level 1.
- TBT concentrations were below Action Level 1 at all stations.
- The concentration of all PCBs (sum of Ices 7 PCBs) were below Action Level 1 for all stations.
- The total PAH concentration at all survey stations was below Action Level 1. For individual PAHs, the majority were above Action Level 1. The PAHs above Action Level 1 were dominated by the more persistent HMW PAHs.
- No asbestos was recorded in any of the samples.

(34) Best, M (2016). Clearing the Waters for All: WFD guidance for developers and regulators in estuarine and coastal waters. Environment Agency.

Available metal and PCB concentration data from sediment sampled in the Oxcars disposal site are presented in Appendix A2 and show the concertation of some metals are above Action Level 1 but below Action Level 2, which is similar to other disposal sites within the Firth of Forth and Forth Estuary.

B2.2 IMPACTS ON WATER AND SEDIMENT QUALITY

There are no designated bathing waters with 2 km of the dredging area or disposal sites. The nearest is Aberdour Silversands on the north coast of the Firth of Forth which is approximately 4 km from the Oxcars disposal site.

Coastal water quality in the Firth of Forth and Forth Estuary are currently classified as Good [35]. The salinity in the Firth of Forth averages 33‰, decreasing into the Forth Estuary under the influence of freshwater inputs. Suspended solids levels in the inner Firth of Forth are usually low compared to levels in the upper estuary [36]. In the Firth of Forth, dissolved oxygen concentrations show little variation with depth and are approximately 90-95% but may be lower during periods of high summer water temperatures [37].

The material disposed at Oxcars will fall to the seabed by gravity and consists of cohesive lumps of dredged material. Fine sediment will be liberated as it sloughs off the descending material and when the clumps reach the seabed. Field measurements of suspended solids in surface waters following similar disposal operations indicate that less than 5% of the discharged material escapes the descending density jet [38].

The natural levels of suspended sediments in the Forth Estuary and the Firth of Forth vary with seasonal weather conditions and this contributes to the natural sedimentation levels in the Firth of Forth.

Although there are no reported studies on suspended sediment levels from the Oxcars disposal site, there has been a number of studies within the Firth of Forth that provide an insight on the suspended sediment dynamics within the Firth of Forth and the effects of dredge spoil disposal activities.

- Studies undertaken by Transport Scotland (2009) for the Forth Replacement Crossing showed that increases in suspended sediment concentrations from dredging works were short-lived and localised [39].
- Data from Middle Bank in the Firth of Forth during dredging operations in 2008 [40] recorded baseline mean suspended solids concentrations between 8.87 mg l^{-1} and 10.3 mg l^{-1} (mean 9.1 mg l^{-1}), under calm conditions.
- Studies undertaken by FugroEMU (2013) [41] to measure the suspended sediment concentrations in the sea outside the Port of Leith Outer Berth (with two sample locations about mid-way between the Port of Leith and the Narrow Deep spoil site) showed near bed

(35) https://www.sepa.org.uk/data-visualisation/water-classification-hub/ Accessed May 2026.
(36) SEPA monitoring buoy data from Gunnet Ledge, Firth of Forth, available online from http://www.sepa.org.uk/environment/environmental-data/monitoring-buoys-network/gunnet-ledge/
(37) SEPA. 1998. Winter Nutrient Distribution in the Firth of Forth, 1987 - 1997. Report TW 01/98, January 1998.
(38) Kennish M.J. 1992. Ecology of Estuaries Anthropogenic Effects Dredging and Dredged Spoil Disposal p357-397
(39) Transport Scotland, 2009. Forth Replacement Crossing: Environmental Statement.
(40) ERM, 2008. Middle Bank Aggregate Production Licence: Monitoring Report. A report for Westminster Gravels Ltd.
(41) FugroEMU. 2013. Normal Resolution Survey Report. Port of Leith Marine Ground Investigation. Report to Scottish Enterprise, March 2013.

concentrations of 10 - 50 mgl^{-1} in calm wave conditions, peaking at between 200 - 1000 mg l^{-1} during high wave conditions.

- Modelling studies were undertaken by Royal Haskoning (2022) [42] of the suspended sediment concentrations of dredge spoil disposal at Narrow Deep from the dredging associated with the development of the new Port of Leith Outer Berth. The Environmental Impact Assessment undertaken for the project concluded that the majority of the dredged material would rapidly descend to the seabed following discharge and that, at the worst case, some dispersion of fine material would take place, extending 3 km along the seabed toward east and west of the disposal location. The peak suspended sediment concentrations would be up to 150 mg l^{-1} but would be short-lived and would only occur at the seabed. Much lower concentrations of suspended sediments were predicted at the surface and mid-water depths. These predicted increases in suspended sediment concentrations were short-lived and would dissipate with tidal currents.

Significant increases in suspended sediments associated with the disposal operations are therefore likely to be confined to the immediate area of the spoil ground and for a short period.

Any increased nutrient levels from suspended sediments from disposal operations may stimulate local algal production, although the effects are predicted to be short-term and confined to the immediate area of the disposal operations. Nitrogen is generally regarded to be the limiting nutrient in estuarine and marine systems and in its reduced form (ammoniacal nitrogen) is also toxic to fish. As a consequence of the reduced (oxygen demanding) nature of the seabed sediments, nitrogenous nutrients are likely to be in this form.

The oxidation of anoxic sediments released into the water column has been shown to reduce oxygen concentrations by up to 58% [43]. Based on the background levels this may reduce the oxygen saturation to between 40 and 50% (equating to approximately 4 to 5 mg l^{-1}). Therefore, if the disposal operations occurred during a period of 'naturally' low dissolved oxygen it is possible that the Water Quality standards for EC Freshwater Fisheries Directive of oxygen concentration greater than 6 mg l^{-1} would not be met [44]. It is predicted that this would be short-lived, due to the limited period over which disposal is intended to occur, and localised, based on previous dredge plume studies. The impacts are not considered to be significant given the generally high dissolved oxygen levels anticipated at the disposal site, the low levels of organic carbon in the dredged sediments (3.85% based on the 13 surface samples analysed) and the extent of the area potentially affected.

Although there may be some release of contaminants such as metals and PAHs into the water column during disposal operations, the majority of the dredged material will descend to the seabed rapidly. Sediment bound contaminants liberated during the disposal operations will quickly become complexed with particulate matter in the water column and be re-deposited on the seabed. Previous studies have shown that metal concentrations in the water column remained consistent following sediment disposal. In addition, the natural sedimentation in the

(42) Royal Haskoning DHV. UK Ltd. 2022. Port of Leith Renewable Energy Hub. Environmental Impact Assessment Report. PC2045-RHD-ZZ-XX-RP-EV-0007.
(43) Brown C. 1968. Observations on Dredging and Dissolved Oxygen in a Tidal Waterway. Water Resources Research Vol 4, No 6, p1381.
(44) UKTAG 2010. Water Framework Directive: An approach to the Revoked Directives:- the Freshwater Fish Directive, the Shellfish Directive and the Dangerous Substances Directive. Available online from: http://www.wfduk.org/resources%20/approach-revoked-directives-%E2%80%93-freshwater-fish-directive-shellfish-directive-and-dangerous.

Forth Estuary and the Firth of Forth aids the removal of contaminants from the water column and incorporates them in the seabed sediments.

PAHs tend not to be volatile and are poorly soluble and therefore readily absorb onto particulate matter in the water column and are incorporated into marine sediments. The PAHs in the sediment samples comprised both low molecular weight (LMW) (two and three benzene rings) and high molecular weight (HMW) (more than 3 benzene rings) compounds. The HMW PAHs are generally the less water soluble, less acutely toxic and slower to biodegrade (*i.e.* more persistent) than the LMW PAHs. All 13 samples had some individual PAHs concentrations above Action Level 1 and these were both LMW and HMW PAHs.

The ratios of individual PAHs have been used to determine the likely anthropogenic source of PAHs in the environment: *e.g.* from petroleum hydrocarbons (petrogenic) or combustion sources (pyrolytic). Petrogenic PAHs are often characterised by phenanthrene to anthracene (Ph/An) ratios more than 10, whereas pyrolytic PAH from combustion processes are characterised by Ph/An ratios less than 10. Ratios of fluoranthene to pyrene (Fl/Py) of less than 1 generally indicates petrogenic sources while ratios more than 1 generally come from pyrolytic sources [(45)].

For all the sediment samples analysed from the Port of Rosyth in 2026 the Ph/An ratios were between 2.13 and 2.79 and the Fl/Py ratios were between 0.82 and 0.91. This suggests that these contaminants are from both combustion and petroleum hydrocarbon sources and are very similar to the results from the 2017, 2020 and 2023 sample analysis and from other ports and harbours within the Forth Estuary and the Firth of Forth. This supports the view that recorded contamination in the sediments has been transported into the port with the accumulated sediments from the wider Forth Estuary and Firth of Forth sediment circulation system.

There was a large reduction in point source discharges of metals and hydrocarbons within the Forth Estuary and the Firth of Forth between the mid-1980s and 1990s [(46)]. Reduction and improved regulation of point source discharges have improved many aspects of the Forth system: inputs of organic material have declined and there has been an associated rise in dissolved oxygen during summer in the upper Forth Estuary. The rise in dissolved oxygen has led to increasing numbers of smelt caught in the upper estuary and to increasing inputs of nitrate generated by nitrification in the suspended sediment maxima of the estuary during summer. In winter, conservative mixing of nutrients occurs and there has been little change in winter nutrient concentrations in the Forth Estuary and Firth of Forth. Metal and trace organic inputs have been reduced so that aqueous concentrations have fallen rapidly [(47)]. With efforts focussed on improving the water quality of the Forth Estuary and the Firth of Forth in more recent years, point source discharges have continued to decrease and the water quality of the Forth Estuary and the Firth of Forth has continued to improve as a result [(48)].

It is not anticipated that the disposal operation at the Bo'ness disposal site will introduce significant amounts of contamination into the water column. Disposal of the dredged material

(45) Y.W. Qiu, G. Zhang, G.Q. Liu, L.L. Guo, X.D. Li, O. Wai. 2009. Polycyclic aromatic hydrocarbons (PAHs) in the water column and sediment core of Deep Bay, South China. Estuar. Coast. Shelf Sci., 83 (1) pp. 60-66.
(46) SEPA. 1998. Trace Metals in the Forth 1986 - 1996. Available online from http://www.sepa.org.uk/science_and_research/data_and_reports/water/forth_estuary_trace_metals.aspx
(47) Dobson, J., Edwards, A., Hill, A. et al. 2001. Decadal change in the Forth Estuary and the Firth of Forth in relation to the North Sea 1980-2000. Senckenbergiana maritima 31: 187. https://doi.org/10.1007/BF03043028.
(48) SEPA, 2014. Scottish bathing waters 2013-2014. Available online http://www.sepa.org.uk/media/39125/scottish-bathing-waters-report-2013-2014.pdf

may result in a localised and short-term increase in the levels of some contaminants, however, the deposited sediment will disperse over time. The short-term, localised and intermittent increase in the levels of some contaminants in the water column, for a dredge spoil disposal process that has been going on for many years, is not considered likely to affect the overall Good water body quality status of the Forth Estuary and Firth of Forth with respect to the Water Framework Directive.

B2.3 IMPACTS ON BENTHIC ECOLOGY

The benthic macrofaunal communities recorded in proximity to Oxcars disposal site are expected to be typical for estuarine conditions and not considered to be of high conservation significance due to the wide distribution, low diversity and lack of any rare or notable species [49].

The impact on benthic communities will depend on the comparative rates of natural deposition (currently unknown) and the deposition due to the dredging disposal operations.

It is anticipated that the deposition of dredged material at the Oxcars disposal site will result in the loss (burial) of the benthos within and in the immediate vicinity of the 'deposition zone' within the disposal site. Localised impoverishment of the fauna (in terms of abundance and diversity) is likely along the axis of tidal flow as a result of secondary impacts comprising sediment deposition subsequent to the disposal activities.

Oxcars is an existing licenced spoil ground therefore the benthic communities in this area will have been impacted by the ongoing spoil deposition activities that have occurred there intermittently over the last 28 years. Given the relatively homogenous nature of benthic communities and their exposure to the naturally high levels of suspended levels during periods of low river flow and availability of similar habitat within the Firth of Forth, the spatial extent of predicted sediment related impacts to benthos (and resultant impact on prey availability for foraging seabirds) are not considered to be significant.

B2.4 IMPACTS ON SEABIRDS

The Firth of Forth SPA, Forth Islands SPA and the Outer Firth of Forth and St Andrews Bay Complex SPA are designated for rare, vulnerable and regularly occurring migratory bird species [50].

There are three potential effects of the disposal of dredge material at sea on seabirds; increased suspended solids, release of contaminated particulates and physical disturbance of birds by the dredging vessel. These effects could potentially have a significant effect on the qualifying interests of the SPAs by reducing prey availability and disturbing bird behaviour and breeding patterns. The vessel used for disposal of the material will be travelling to and from the Port of Rosyth and the disposal site during a series of dredging campaigns lasting approximately three to five days each, a round trip of approximately 11 nautical miles.

The SPAs support breeding seabirds which forage over a wide area. The disposal of the dredged material will result in localised increases in suspended sediment which may reduce the ability of fish-eating birds to forage around the disposal site due to impaired visibility during

(49) Elliot M & Kingston P F (1987). The Sublittoral Benthic Fauna of the Estuary and Firth of Forth, Scotland. Proceedings of the Royal Society of Edinburgh, 93B, pp 449-465
(50) European Communities (1979) Council Directive 79/409/EEC on the conservation of wild birds.

disposal operations. However, the area affected is a small percentage of the total available foraging habitat, with alternative sources of prey available close by.

It is noted that Oxcars is an established and long-term disposal site with disposal activities being ongoing at the time that the area was designated as SPAs. Given that disposal was an existing activity it is considered that the proposals will not have significant effects on the qualifying interest of the SPAs.

B2.5 IMPACTS ON FISH

The River Teith Special Conservation Area (SAC), the Isle of May SAC, the Berwickshire and Northumberland Coast SAC and the Moray Firth SAC are designated under the Habitats Directive (51) for their habitats and fish and mammal species of European importance.

Atlantic salmon, river lamprey and sea lamprey inhabit and migrate up and down the Firth of Forth and Forth Estuary to reach spawning grounds in the River Teith SAC and may therefore pass the Oxcars disposal site. The Forth District Salmon Fishery Board has advised that smolts are likely to be passing through the lower estuary during June and July. The river lamprey grows to maturity in estuarine environments and between October and December moves into fresh water to spawn in clean rivers and streams. The sea lamprey spends most of its life at sea, only returning to freshwater to spawn around April and May.

A potential effect of disposal at sea is for increased levels of suspended solids to disturb fish migration routes and areas they occupy. The proposals are not likely to have a significant effect on fish for the following reasons.

- The concentration of suspended sediment at which the passage of salmonid fish is affected has been observed to be approximately 500 mg l^{-1} (52). Studies in the US, looking at a variety of salmonid species, illustrates that fatalities to smolts (50%) can occur at high suspended sediment concentrations over extended periods (*e.g.,* exposure of between 488 to 19,364 mg l^{-1} for 96 hrs) (53). The natural suspended sediment maxima in the Forth Estuary is in the upper estuary with mean concentrations over forty times higher than in the Firth of Forth (130 mg l^{-1} at Kincardine (54) and average 3 mgl^{-1} at Gunnet Ledge (55)).
- The disposal activities will take place within the main Firth of Forth which represents a small area where sea lamprey and salmon smolts may be present or may pass through. It is noted that the width of the Oxcars disposal site is between 7 and 12% of the width of the Firth of Forth at this location, which is approximately 8 km (4.3 nm) wide. The fish species will be able to avoid the area during the short periods of raised suspended sediment during disposal and migrate using an alternative route through the Firth of Forth.
- The dredging and disposal process is not continuous: the time required for one cycle (dredging - travelling - discharging - travelling) is approximately three hours. Additional delays to avoid interactions with other vessels are common, *e.g.*, the dredger returning

(51) European Communities (1992) Council Directive 92/43/EEC on the conservation of natural habitats and of wild flora and fauna.
(52) Redding M.J. and Schreck C.B. 1987, Physiological effects on coho salmon and steelhead of exposure to suspended solids, Transactions of the American Fisheries Society, Vol 116 pp737-747
(53) Bash J, Berman, C and Bolton S. 2001. Effects of Turbidity and Suspended Solids on Salmonids. Prepared for Washington State Transportation Commission, Department of Transportation and U.S. Department of Transportation, Federal Highway Administration
(54) Transport Scotland, 2009. Forth Replacement Crossing: Environmental Statement.
(55) SEPA monitoring buoy data from Gunnet Ledge, Firth of Forth, available online from http://www.sepa.org.uk/environment/environmental-data/monitoring-buoys-network/gunnet-ledge/

from the disposal site may be instructed by Vessel Traffic Services to wait outside the harbour to allow other vessels to enter/leave.

A localised, short-term and non-continuous increase in suspended sediment concentrations affecting a small proportion of the width of Firth of Forth is not anticipated to affect the migration of adult salmon, smolts or other fish species, based on the evidence of studies on the effects of suspended sediments on salmonids and the predicted suspended sediments concentrations resulting from the disposal operations. It has been reported that Atlantic salmon numbers have been decreasing in Scotland and farther afield over the ten years from 2210 to 2019 [56], including in areas in Scotland where there have been no dredge spoil disposal operations. Forth Ports' dredge spoil disposal operations have been ongoing at Oxcars for over 28 years, covering the periods of much higher salmon numbers indicating that there is no causal link between the ongoing spoil disposal activities and a broad scale decline in salmon numbers. Seasonal restrictions to operational requirements to dispose of dredged material at the Oxcars disposal site are therefore not considered to be justified.

B2.6 IMPACTS ON MARINE MAMMALS

The Isle of May SAC, in the outer Firth of Forth, and the Berwickshire and North Northumberland Coast SAC are designated for populations of grey seal. Grey seals forage widely and may forage at the Oxcars disposal site. Potential effects on grey seals resulting from the disposal activities are disturbance and noise due to vessel movements and disposal activities and displacement of prey species as a result of increased levels of suspended sediment at the disposal site.

The proposals are not likely to have a significant effect on grey seals for the following reasons.

- The small area of potential foraging affected by disposal activities at the Oxcars disposal site.
- The intermittent and short duration of disposal activities (typically 17 to 25 days over 3 to 9 months a year).
- The small increase in total vessel movements associated with the disposal activities in relation to total vessel movements within the Forth estuary and the Firth of Forth.
- The long-term existing disposal operations in the area which pre-date the site designation.

Bottlenose dolphins are a Habitats Directive Annex II species and are resident in the Moray Firth SAC. They are infrequent summer visitors to the Firth of Forth, mainly between June and September [57] [58].

Vessel movements and noise have the potential to disturb or displace marine mammals and disposal activities have the potential to displace prey species within and in the vicinity of the Oxcars disposal site. The proposals are not likely to have a significant effect on bottlenose dolphins for the following reasons.

(56) https://www.britishecologicalsociety.org/understanding-decline-atlantic-salmon-catches-scotland/#:~:text=The%20Scottish%20Government%20has%20collected,the%20previous%205%2Dyear%20average. [accessed February 2022]
(57) Evans P. G. H. Chapter 5.15 Whales, Dolphins and Porpoises. In Coasts and Areas of the United Kingdom. Region 4 South- east Scotland: Montrose to Eyemouth, ed by J H Barne, C F Robson, S S Kaznowska, J P Doody, N C Davidson and A L Buck, pp 129-132. JNCC (Coastal Directories Series).
(58) https://www.hw.ac.uk/news/articles/2023/river-forth-s-whales-porpoises-dolphins-and.htm. Accessed April 2024.

- The distance between the disposal site and the SAC is large and the proportion of the bottlenose dolphin population anticipated to pass through the area affected by disposal activities is anticipated to be low.
- The extent of vessel movements associated with the disposal activities relative to total vessel movements within the Firth of Forth and Forth Estuary.
- The short duration of disposal activities each month (typically 17 to 25 days over 3 to 9 months a year).
- The relatively low speed and direct line of travel of dredge vessel movements to and from the disposal site (*i.e.,* no fast moving and erratic vessel movements).
- The long-term existing disposal operations in the area which pre-date the site designation.

B2.6 SUMMARY OF IMPACTS

Table B1.14 presents a summary of the impacts and an assessment of significance of the impacts in relation to the sensitivity/importance of the disposal site.

TABLE B1.14 SUMMARY OF SIGNIFICANCE OF IMPACTS

Receptor	**Impact Significance Justification**	**Impact Significance**
Water quality at disposal site	Disposal will be periodic and sediment will descend to the seabed rapidly. Suspended sediments will disperse with the tide, and any impacts will be localised, intermittent and short-term.	Not Significant
Sediment quality at disposal site	Increase in the levels of some contaminants will be localised, intermittent and short term and the deposited sediment will disperse within the open water system over time.	Not Significant
Benthic ecology at disposal site	Oxcars is designated as a disposal site. Disposal will occur over a relatively short period of time each year and similar habitat is available in close proximity to the site.	Not Significant
Seabirds	Proposed disposal operations are over a relatively short period of time each year and the area affected is a small percentage of the total available foraging habitat, with alternative sources of prey available close by. The SPAs were designated after the Oxcars disposal site was designated and have not been impacted by historic and ongoing disposal operations.	Not Significant
Marine mammals and fish	Proposed disposal operations are over a short period of time each year the area affected is a small percentage of the total available foraging habitat, with alternative sources of prey available close by. The volume of dredger vessel traffic will not be significant in relation to the existing traffic in the Firth of Forth and Forth Estuary. The SACs were designated after the Oxcars disposal site was designated and have not been impacted by historic and ongoing disposal operations.	Not Significant

B3 CUMULATIVE EFFECTS WITHIN THE FORTH ESTUARY AND THE FIRTH OF FORTH

B3.1 INTRODUCTION

The potential impacts of the sea disposal option have been assessed within Section B1.2 in isolation from other activities within the Firth of Forth and Forth Estuary. The impacts associated with the sea disposal option are not predicted to result in adverse effects on the integrity of the SPAs and SACs, however, it is possible that cumulative impacts with other projects could result in significant impacts.

A definition of cumulative impacts as 'impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions, together with the project' [59] has been adopted. For the purposes of this report, the assessment of potential cumulative impacts have been restricted to activities and proposed activities with the potential to directly impact the water and / or sediment quality within the SPAs and SACs. The other activities considered therefore include those that are at some distance from the activities at the Oxcars disposal site but are within the foraging range of species that may utilise both areas.

B3.2 PAST AND CURRENT ACTIVITIES WITHIN THE FORTH ESTUARY AND THE FIRTH OF FORTH

B3.2.1 INTRODUCTION

The Firth of Forth and Forth Estuary has previously experienced pollution from a number of industrial sources and sewage discharges, such as the petro-chemical operations at Grangemouth and the sewage works at Seafield. The Imperial Chemical Industries (ICI) chemical plant previously based in Grangemouth is also known to have been a source of mercury into the Forth Estuary, as have the coal fired power stations, such as Longannet [60]. Over the past 40-50 years, however, most of these pollution sources have been controlled or eliminated altogether.

Additional improvements to sewage works and other effluent treatment plants upstream have improved the condition of the water coming down the rivers and estuary into the Firth of Forth.

In addition, there are unknown and diffuse sources of discharges into the Forth Estuary, Firth of Forth and riverine inputs to these areas, for example from agricultural run-off and unrecorded drainage outfalls.

B3.2.2 PETRO-CHEMICALS AND POWER GENERATION

The INEOS refinery and wider petro-chemical complex at Grangemouth are historically a dominant source of oil related PAHs in the Forth Estuary and the Firth of Forth.

The Longannet coal-fired power station on the north bank of the estuary closed in March 2016 and is currently being demolished. The historic release of combustion related PAHs and mercury from this source will have contributed to the PAH and mercury loading within the

(59) European Union. Guidelines for the Assessment of Indirect and Cumulative Impacts, as well as Impact Interactions, DG XI Brussels Downloaded from http://ec.europa.eu/environment/eia/eia-studies-and-reports/guidel.pdf
(60) Lee D.S., Nemitz, E., Fowler D., Hill P. and Clegg S. 2020. Sources Sinks and Levels of Atmospheric Mercury in the UK. DERA/AS/PTD/CR000114.

Forth Estuary and Firth of Forth [61]. Water from the Firth of Forth was abstracted and used as cooling water by the power station before being discharged back into the Forth Estuary.

Methil power station was a small base load coal slurry-fired power station, located on the south side of the mouth of the River Leven, where the river enters the Firth of Forth at Methil. The power station started operations in 1965 and was decommissioned in 2000, finally being demolished in 2011. Water from the Firth of Forth was abstracted and used as cooling water by the power station before being discharged back into the Firth of Forth.

Cockenzie power station was a coal-fired power station located on the southern shore of the Firth of Forth near to Cockenzie and Port Seaton. It generated electricity between 1967 and 2013, with demolition of the station completed in 2015. Water was abstracted from and discharged back into the Firth of Forth in the same way it was for Longannet and Methil.

B3.2.2 COMMERCIAL FISHING ACTIVITY

The sandeel fishery on the Wee Bankie, at the mouth of the Firth of Forth, has been closed since 2000 on seabird conservation grounds. The initial five-year period was reviewed and extended following the reduction in numbers of some seabird species observed during a 2004 count (reduced sandeel numbers may be linked) within the Firth of Forth [62].

Improved water quality in the Firth of Forth has led to a resumption of cockle fishing, particularly on the Fife coast. Uncontrolled cockling could impact upon wintering bird populations by causing loss of prey species, directly (removal of cockles) and indirectly (damage to non-target species). A Special Nature Conservation Order (SNCO) was implemented under the *Conservation (Natural Habitats) Regulations 1994* to the outer Firth of Forth, including Forth Bridge to Granton Harbour and from Leith Docks to Joppa. This Order, implemented in March 2003, was revoked and reissued in 2006, and still stands [63].

B3.2.4 OTHER DREDGING DISPOSAL ACTIVITIES

In addition to the intended maintenance dredging activities at Rosyth with disposal at Oxcars, Forth Ports manages six other dredging operations within the Forth Estuary and Firth of Forth. The operations comprise the following.

- Grab/backhoe dredging at Newhaven with disposal at Oxcars disposal site: maximum capacity for maintenance dredging is 15,000 m^3 per annum (19,500 wet tonnes), undertaken over four weeks, usually in Spring.
- Plough and grab dredger for maintenance dredged material from Granton with disposal at the Oxcars disposal site. Maximum quantity of disposed material is 10,000 m^3 (14,000 wet tonnes) per annum and operations are undertaken over one or two periods of ten to twenty days per annum.
- Trailer suction dredging in Grangemouth: maximum capacity for maintenance dredging is 1,700,000 m^3 per annum, undertaken over four days every month. Forth Ports have applied for an amendment to its current Marine Licence which permits disposal to the Bo'ness disposal ground, to allow the Oxcars disposal site to be used under specific

(61) Richardson D.M., Davies I.M., Moffat C.F., Pollard P. and Stagg R.M. 2001. Biliary PAH metabolites and EROD activity in flounder (*Platichthys flesus*) from a contaminated estuarine environment. J. Environ. Monit., 3, 610-615.
(62) Marine Scotland (2012). The Distribution of Zooplankton Prey of Forage Fish in the Firth of Forth Area, East Coast of Scotland. Available online http://www.scotland.gov.uk/Publications/2012/08/2345/1 .
(63) http://gateway.snh.gov.uk/sitelink/siteinfo.jsp?pa_code=8499

circumstances. This would be during any periods of essential dredge spoil disposal operations being undertaken during low water spring tides during the salmonid migration period (typically a six week period from early April to the end of May).

- Trailer suction dredging in Leith with disposal at Narrow Deep disposal site: maximum capacity for maintenance dredging is 200,000 m^3 per annum (260,000 wet tonnes). The dredging operations to maintain the approach channel and docks takes place for up to 3 to 4 days every three months (12 to 16 days per annum), subject to siltation rates and commercial requirements.
- Grab/backhoe dredger at Methil harbour and approach channel with disposal at Methil disposal site: maximum quantity of disposed material is 12,500 m^3 (17,500 wet tonnes) per annum. The dredging and disposal operations are undertaken during high water periods over up to ten days per annum.
- Grab dredger and plough at Kirkcaldy with disposal at Kirkcaldy disposal site: maintenance dredging of approximately 15,000 m^3 (21,000 wet tonnes) per annum. The work would be undertaken over ten to twenty days per annum.

The actual timing of dredging and volumes required to be dredged during each campaign depend on operational requirements and sedimentation rates (for example due to storm events, which can happen at any time of year).

Other recent, ongoing or planned licenced dredging activities in the Firth of Forth include the following (note these are based on planned or licenced activities so actual volumes dredged may be lower).

- Babcock Marine at Rosyth had a Marine Licence for maintenance dredging of up to 100,000 tonnes between September 2022 and September 2023 with disposal at Oxcars B.
- Forth Ports undertook the development of the Leith Outer Berth to accommodate vessels that are unable to enter the lock gates into the Port of Leith. The work involved the removal of 101,000 m^3 of material from the Leith outer berth with disposal at the Narrow Deep B soil disposal ground.
- Trailer suction and backhoe dredging with self-propelled barge at Defence Munitions Crombie, with a maximum quantity of material to be disposed of 22,000 m^3 per annum for maintenance [64] (although this has not been undertaken annually), with disposal at Bo'ness spoil ground.
- Maintenance dredging at Granton Harbour undertaken by the Royal Forth Yacht Club by agitation of 5,904 tonnes per annum between August 2021 and August 2023. The was also a previous licence to dredge 86,980 m^3 at Granton Harbour with disposal at Bo'ness or Narrow Deep spoil ground between August 2019 and July 2022 as part of the harbour development works.
- Maintenance dredging using land-based plant of 1,200 tonnes over two years at Dysart Harbour, Fife, with disposal on the adjacent foreshore where it is dispersed on the incoming tide (July 2019 to July 2021).

(64) Rosyth International Container Terminal. Operational In-combination Assessment of Maintenance Dredging and Implications for the River Teith SAC. Jacobs, 2011.

- Dredging of up to 33,800 wet tonnes using a plough dredger at Port Edgar within the confines of the marina between April 2021 and February 2024 with disposal to the entrance to the marina.
- Work began on the Forth Replacement Crossing at the end of 2011, and capital dredging works for the bridge support foundations started at the beginning of 2012. The purpose of the dredging was to create access for the construction of the foundations for the structures which will support the new bridge. In total 180,000 m^3 of silt and sand was dredged from the seabed to form access channels for bridge foundation works between 2011 and 2016 (65) and the spoil was disposed of at the Oxcars spoil disposal ground. For the larger dredged rock material, the Blae Rock spoil disposal ground was used.

Ongoing maintenance dredging spoil disposal operations require licence renewals every three years by the Marine Directorate. Potential impacts are therefore assessed and reviewed every three years prior to granting a Marine Licence. The historical disposal route for spoil from all listed dredging operations has been deposition at sea, and to date, no environmental impacts, other than direct impacts within the spoil disposal grounds, have been reported.

B3.2.3 OFFSHORE WIND FARMS

There is one existing and one proposed single turbine wind farm developments in the Firth of Forth, offshore from Methil. The information provided below is based on the companies' websites.

- **Levenmouth Demonstration Turbine** (66)

  The Offshore Renewable Energy (ORE) Catapult's seven megawatt wind turbine was completed in 2013 and is located 50 m from the coast connected to the land by a ramp. The tower stands at 110 m and is 196 m to the top of the blade. Samsung had previously owned the wind turbine demonstrator, before selling to ORE Catapult in December 2015.

  In March 2014 2-B Energy secured investment to fund the establishment of two full-scale test units at the site (two six megawatt turbines to be located approximately 1.5 km offshore standing at 109 m above the lowest tide, 186 m to top of blade). A marine Licence was granted in January 2017, and planning permission was granted with a Section 36 consent variation awarded in August 2018 to operate the turbine to 2029.

- **Forthwind Demonstration Project** (67)

  Forthwind proposes to install a single turbine with a generating capacity of up to 20 megawatts and a meteorological mast 1.5 km offshore from the coast at Methil. The application replaced the previous two turbine scheme, approved in 2016. A Marine Licence and Section 36 consent was granted in March 2023 and the facilities are currently under preconstruction.

There are four large scale offshore windfarm development sites in the outer Firth of Forth area. These sites are at some distance from the Oxcars spoil disposal ground (circa 75 to 115 km) but are within the foraging areas of the qualifying features of the SPAs and SACs. In addition, there will be power export cables laid on the seabed from the windfarm sites to coastal substations within the Firth of Forth. Other potential windfarm sites in the outer Firth of Forth

(65) Hochtief (UK) Construction (2016). Forth Road Bridge Replacement - Queensferry Crossing. Available online http://www.hochtief-construction.co.uk/bridges_Forth_Road.shtml
(66) https://ore.catapult.org.uk/products-services/levenmouth-demonstration-turbine. Accessed May 2026.
(67). https://forthwind.co.uk/. Accessed May 2026.

area are at a concept/early planning stage. The information provided below is based on the companies' websites.

- **Seagreen Offshore Wind Farm** (68)

  Scottish and Southern Electric (SSE) Renewables, TotalEnergies and PTT Exploration and Production Public Company Limited (PTTEP) joint venture partnership Seagreen Wind Energy was awarded the exclusive development rights for the Firth of Forth Zone by Crown Estate Scotland. The zone covers an area of 2,852 km^2 in the outer Firth of Forth and is 27 km off the Angus coastline and 66 km off the East Lothian coastline. Seagreen was awarded consent by the Scottish Government in October 2014 to develop the northern part of the Firth of Forth Zone to generate up to 1,050 megawatts of power from up to 150 turbines. The design was updated and approved in 2018 to comprise fewer, larger wind turbines. The 1075 MW from the 114 turbines installed in 2022 became fully operational in October 2023 with the power exported 19 km by cable to Carnoustie in Angus. The Seagreen 1A project is to add a further 36 turbines which has consent to connect to the National Grid at Cockenzie in East Lothian via a new 110 km export cable. The project was granted a Marine Licence in 2021. Montrose port is the location of the operations and maintenance base.

- **Neart na Gaoithe Offshore Wind Farm** (69)

  NnG Offshore Wind was granted consent by the Scottish Government in 2018 to build a 448-megawatt offshore wind farm in the outer Firth of Forth comprising up to 54 wind turbines up to 208 m high occupying an area of approximately 105 km^2. It was developed by EDF renewables and ESB. Construction commenced in 2020 with seabed preparations being undertaken prior to piling works. An onshore operations and maintenance base at Eyemouth received planning permission in September 2020. First power was generated in October 2024, and the wind farm was fully commissioned and completed in 2025. The electricity export cable lands at Thorntonloch Beach in East Lothian and connects to the grid at the Crystal Rig wind farm in the Lammermuir Hills.

- **Inch Cape Offshore Wind Farm** (70)

  Consent was granted for the proposed Inch Cape Offshore Wind Farm, located 15 km off the Angus coast, in October 2014. Consent was delayed following an objection lodged by the Royal Society for the Protection of Birds and final approval was given in 2017. A revised scope of design was granted by Scottish Ministers in June 2019. This scope reduced the number of wind turbine generators from 110 to 72. The turbines will occupy an area of 150 km^2. The windfarm will export electricity via two 85 km cables to a new substation at Cockenzie. In October 2023 onshore enabling works were completed and the main civil engineering works commenced in early 2024 with construction commencing in 2025. The first export cable was installed in 2025 and the second in 2026. The project is scheduled to be fully operational in 2027. Once fully operational the wind farm will have an export capacity of approximately 1.1 gigawatts. It will be operated out of a base in Montrose Port, currently under construction.

(68) https://www.seagreenwindenergy.com/. Accessed May 2026.
(69) https://nngoffshorewind.com/project/. Accessed May 2026.
(70) https://www.inchcapewind.com/. Accessed May 2026.

- **Berwick Bank Offshore Windfarm** [71]

  The Berwick Bank Wind Farm is a proposed offshore wind farm located in the outer Firth of Forth, approximately 37.8 km east of St. Abb's Head and 47.6 km from the East Lothian coastline. It has a design capacity of up to 4.1 GW which is sufficient to power 6 million homes. There are two electricity grid connection points one at Branxton in East Lothian and one at Cambois near Blyth in Northumberland. A planning application for the offshore array and grid connection to east Lothian was submitted in late 2022 and consent was granted in summer 2025. The Project has secured two grid connection points, one at Branxton, near Torness in East Lothian and a second at Blyth, Northumberland

B3.4 CONCLUSIONS

Potential cumulative impacts associated with the above activities can be broadly categorised as comprising suspension of sediments during dredge spoil disposal operations resulting in loss or smothering of benthos, the discharge of contaminants with the potential to impact both water and sediment quality, and the disturbance to seabirds and mammals from piling operations and vessel movements.

Other dredging and disposal activities and the windfarm construction activities are at some distance from the Oxcars disposal site and no significant cumulative impacts from suspended sediments, noise and other vessel movements from these activities on the Oxcars site are considered likely.

The dredge spoil disposal operations at the Oxcars disposal site pre-date the SPA and SAC designations and there is no evidence to suggest that the past and current disposal operations at Oxcars disposal site managed by Forth Ports have impacted the integrity of designated sites, supported species, or resulted in other significant environmental impacts either alone or cumulatively with other activities in the area.

(71) https://www.berwickbank.com/. Accessed May 2026.

APPENDIX C CONSULTEE RESPONSES (EXTRACTS FROM LETTERS/EMAILS)

1. Fife Council 28/04/2026

I have received your letter re: Rosyth port dredging materials. I have asked around our team and we don't have any ideas/suggestions from our perspective for beneficiary use of this material.

Fife Council, Harbours and Coastline Team, Glenrothes

2. Northern Lighthouse Board 28/04/2026

Northern Lighthouse Board have no objection to the use of the Oxcars spoil ground for the proposed Port of Rosyth dredge campaign.

Coastal Inspector, Northern Lighthouse Board

3. Maritime and Coastguard Agency 24/04/2026

As the MCA is a primary advisor/statutory consultee, the MCA's marine licensing and consenting team will be consulted on your Marine License application as part of the formal consultation process which will be undertaken by the Marine Directorate in this case. We will therefore respond within the given timeframe, once the consultation has been received by us.

Marine Licensing and Consenting Advisor

4. The Crown Estate Scotland 22/04/2026

I can confirm that Crown Estate Scotland have no objection to the dredging and disposal operation as described and are not aware of any currently available disposal or reuse options for the dredged material.

This operation will require a consent from Crown Estate Scotland as the owner of the seabed and we will engage with Forth Ports on that in due course. I note that the area indicated on your chart overlaps with the Port Babcock statutory harbour limits and the area dredged by them and assume that this has been agreed between Forth Ports and Port Babcock.

Bidwells, on behalf of Crown Estate Scotland.

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