



Buckie, Findochty, Portknockie, Cullen Best Practicable Environmental Options (BPEO) Report



April 2023

CONTROL SHEET

Client: Arch Henderson LLP / The Moray Council
 Project Title: Buckie, Findochty, Portknockie, Cullen
 Report Title: Best Practicable Environmental Options (BPEO) Report
 Document number: 13349
 Project number: 377468

Issue Record

Issue	Status	Author	Reviewer	Approver	Issue Date
1	Final	CCAS	GD	GD	04/04/2023
2	Final	CCAS/FR	CCAS	CCAS	20/04/2023
3	Final	CCAS/FR	GD	GD	13/07/2023
4	Final	CCAS/FR	GD	FR	16/08/2023

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1 INTRODUCTION

Moray Council are seeking to renew their dredge licenses for Buckie, Cullen, Findochty, and Portknockie harbours. All of the accompanying application forms are for maintenance dredges with the exception of Buckie Harbour which incorporates a capital dredge due to proposed deepening of the harbour. As part of the licensing process applicants are required to undertake a Best Practicable Environmental Option (BPEO) assessment for the disposal routes for the prospective dredge material in conjunction with the assessment of the chemical and physical properties of the same material to ensure that quality of the material is suitable for the identified disposal route(s).

1.1 Scope of Report

Sediment sampling was recently undertaken at the four sites with sample locations detailed in the drawings in Appendix A.

The purpose of this report is to review each of the available potential disposal options for the dredged materials. The options which are not considered to be practicable are rejected and the reasons for doing so are explained.

Those options which are practicable are examined in detail and assessed against the following considerations: -

- Environmental;
- Strategic; and
- Cost.

The report then compares the practicable disposal options and draws a conclusion on the BPEO.

1.2 Background to Application

The sediment sampling was undertaken in February 2023.

The proposed dredge areas and volumes are detailed in Table 1-1 below with the dredge areas presented in Appendix A.

Table 1-1: Proposed Dredge Areas and Approximate Dredge Volumes

Dredge Area	Approximate Dredge Volume (m ³)	Dredge Thickness range (m)
Buckie	28,000	<1.0m to 1.5m
Cullen	3,500	<1.0m
Findochty	3,500	<1.0m
Portknockie	3,500	<1.0m

Each of the harbours are applying for maintenance dredge applications, with the exception of Buckie which is seeking to dredge deeper and requires a capital dredge licence for the works. Sample core depths are presented below in Table 1-2 detailing their length and how the base of the sample relates to proposed dredge depths. The harbour has a current target dredge depth of 3.1m below Chart

Datum. The capital dredge element is for Basin 4 which is not currently included for maintenance dredging and is proposed to be lowered to c.2.0m below chart datum.

Table 1-2: Buckie Sample Locations and Depths

Sample Location ID	Bed Level (CD)	Core Length (m)	Depth at end of Sample (CD)
BK1A	-3.11	1.2	- 4.31
BK2	-2.44	1.3	- 3.74
BK3	-2.25	1.5	- 3.75
BK4D	-2.30	0.9	- 3.2
BK5	-2.73	0.15 (Grab*)	-
BK6	-2.86	0.15 (Grab*)	-
BK7	-2.69	0.15 (Grab*)	-

*Note: Grab samples are considered to represent 1.0m below surface i.e. dredge depths of ≤ 1.0 m.

At present, the exact dredging details are unconfirmed, but it is envisaged that dredging would be carried out potentially by a combination of methods including the Council owned Back-hoe Dredger MV Selkie. Further details on the dredging methodologies will be provided once tendering of works has been completed.

Buckie, Findochty, Portknockie and Cullen are in proximity to the Moray Firth Special Protected Area (SPA) with the relevant SPA interests noted as wintering seabird species. Buckie, Findochty, Portknockie and Cullen harbours lie less than 1km from the Southern Trench Marine protected Area (MPA) boundary.

1.3 Sediment Sampling and Nature of Marine Sediments on Site

Samples from the proposed dredge area were collected in February 2023 and submitted for analysis in line with Marine Scotland's guidance and the agreed sampling plan(s). The sample logs are provided in Appendix B with Laboratory certificates and data summary tables in Appendix C.

Samples were recovered from all positions as planned with some shorter cores recovered than targeted in Buckie due to the presence of rock outcrops in the area. The harbour engineer confirmed that the harbour is cut into bedrock in this area.

Dominant sediment type at each site is as follows:

- Buckie – predominately sand with areas up to 50% sand and 50% silt.
- Cullen – sand.
- Findochty – sand.
- Portknockie – sand and silt.

The following sections details the exceedances of the Revised Action Levels (RALs) with further consideration of these exceedances undertaken in in Section 4 as needed.

Table 1-3: Buckie Harbour Screening Results

Contaminant	No. of RAL 1 Exceedances	No. of RAL 2 Exceedances
Arsenic	0 of 15	0 of 15
Cadmium	9 of 15	0 of 15
Copper	9 of 15	0 of 15
Chromium	0 of 15	0 of 15
Mercury	2 of 15	0 of 15
Nickel	0 of 15	0 of 15
Lead	9 of 15	0 of 15
Zinc	8 of 15	0 of 15
PAHs	13 of 15	N/A
PCBS	0 of 15	0 of 15
TBT	1 of 15	0 of 15
THC	11 of 15	N/A
PBDEs	N/A	N/A

Table 1-4: Cullen Harbour Screening Results

Contaminant	No. of RAL 1 Exceedances	No. of RAL 2 Exceedances
Arsenic	0 of 3	0 of 3
Cadmium	0 of 3	0 of 3
Copper	0 of 3	0 of 3
Chromium	0 of 3	0 of 3
Mercury	0 of 3	0 of 3
Nickel	0 of 3	0 of 3
Lead	0 of 3	0 of 3
Zinc	0 of 3	0 of 3
PAHs	0 of 3	N/A
PCBS	0 of 3	0 of 3
TBT	0 of 3	0 of 3
THC	0 of 3	N/A
PBDEs	N/A	N/A

Table 1-5: Findochty Harbour Screening Results

Contaminant	No. of RAL 1 Exceedances	No. of RAL 2 Exceedances
Arsenic	0 of 3	0 of 3
Cadmium	2 of 3	0 of 3
Copper	2 of 3	0 of 3
Chromium	0 of 3	0 of 3
Mercury	0 of 3	0 of 3
Nickel	0 of 3	0 of 3
Lead	0 of 3	0 of 3
Zinc	0 of 3	0 of 3
PAHs	3 of 3	N/A
PCBS	0 of 3	0 of 3
TBT	0 of 3	0 of 3

THC	1 of 3	N/A
PBDEs	N/A	N/A

Table 1-6: Portknockie Harbour Screening Results

Contaminant	No. of RAL 1 Exceedances	No. of RAL 2 Exceedances
Arsenic	0 of 3	0 of 3
Cadmium	0 of 3	0 of 3
Copper	1 of 3	0 of 3
Chromium	0 of 3	0 of 3
Mercury	0 of 3	0 of 3
Nickel	0 of 3	0 of 3
Lead	0 of 3	0 of 3
Zinc	0 of 3	0 of 3
PAHs	1 of 3	N/A
PCBS	0 of 3	0 of 3
TBT	0 of 3	0 of 3
THC	1 of 3	N/A
PBDEs	N/A	N/A

1.3.1 PBDEs

Marine Scotland requested that PBDEs were included within the analytical suite. There are no action levels at present for screening of data. One or more of the 12 PBDEs were recorded in samples at or above the detection level in all of the sites.

1.4 Summary

All harbours recorded at least one sample of more with an exceedance of RAL1 for one of the key contaminants of concern. Further assessment of these results are required should this material be deemed suitable for sea disposal.

No results were recorded which exceeded RAL 2, where an action level is available.

1.5 Historic Harbour Results - Buckie

EnviroCentre were previously provided sample results for Buckie in support of previous licence applications. The findings of that assessment are contained within EnviroCentre Report 9209, June 2020. The data quality assessment concluded that RAL1 was exceeded for several metals, PAHs in several samples. RAL 2 levels were not exceeded in any of the samples tested.

The findings of the most recent sampling campaign reflects the findings from the previous sampling exercise.

2 DISCUSSION OF AVAILABLE DISPOSAL OPTIONS

The BPEO process is geared towards identifying a preferred overall strategy from the perspective of the environment as a whole, as opposed to detailed optimisation of any one selected scheme. It is a structured and systematic process to identify and compare strategic options in a transparent manner. Alternatives are evaluated in terms of their projected implications for the environment together with consideration of practicability, social and economic issues as well as within a wider strategic context.

The key stages of a BPEO are:

- Identification of options;
- Screening of options;
- Selection of assessment criteria;
- Analysis and evaluation of criteria; and
- Evaluation of BPEO.

Further details on methodology are provided within each section.

2.1 Identification and Screening of Available Disposal Options

A number of options are available for disposal of dredged sediments. The options considered are provided in Table 2-1 along with justification for screening out those options which have not been taken forward for further consideration.

Table 2-1: Initial Best Practicable Available Options

Location	Options	Screening Assessment	Carry forward?
Harbour/ Quayside	Leave in situ	Not an option due to the project specific requirements to maintain the depth of the operational harbours	No
	Infilling of an existing dry dock/harbour facility/development site (re-use)	There are currently no proposed developments in the local area which could accommodate this material.	No
	Beach Nourishment	<p>While sediments with high sand content are suitable for beach replenishment, material with a high silt content are not generally considered suitable. Typically, the material used in replenishment projects needs to be of a similar nature i.e. grain size proportions to that of the receiving beach. There is potential for this option to be adopted assuming that the timings of dredging and opportunities for disposal align.</p> <p>Much of the Moray coast are within/in proximity to designated sites (SSSI, SPA, MPA) and hold both national and international importance to nature conservation. Specific beach nourishment projects would require to be supported by Environmental Assessments as a minimum to inform how the project could affect the environment as a result of disturbance to the intertidal area, changes to the sediment levels, the variable composition and quality of the material and measures devised from the assessment outcomes to minimise impacts on the environment. The harbour authority (Moray Council) have expressed an interest in the possibility of using the dredged material for a beach nourishment project. The dredge material from sites/areas within sites which predominantly comprises sand would be the preferred material.</p>	Yes
Land	Landfill Disposal	This is possible but it is unlikely that this option will offer long term solution due to lack of space at landfills. Landfill space is currently at a premium and does not offer a sustainable solution either financially or environmentally for the disposal of dredged arisings. Dredged material likely to require treatment first in a dewatering facility. Significant cost associated with set up of dewatering facility at the quayside plus transportation and additional costs associated with gaining the necessary planning and regulatory consents.	No

	Land Incineration	The dredged material consists of non-combustible material (silts, sands, gravels, shells) with a low combustible component and very high-water content.	No
	Application to Agricultural Land	The dredged material would need to be treated to reduce salt concentrations to acceptable levels. Would require detailed chemical analysis and assessment as well as a Waste Management License Exemption. Would require special precautions during spreading in relation to the risk of odour and watercourses / aquifers. The availability of land for this option will be limited within a reasonable haulage distance of the dredge arisings. Large volumes each year are unlikely to be viable to dispose of in this manner and would potentially have a detrimental effect on existing terrestrial habitats.	No
	Recycling	Recycling of dredged material is theoretically possible, however, due to the varied lithology there would need to be either segregation during dredging works to minimise the entrainment of fine-grained material into the sands, or energy and water rich processing on land. This is not currently understood to be an established disposal and reuse route in proximity to the Moray Council Harbours at present and is not likely to be something which could be established in the project timeframes due to the requirement for various permitting requirements including waste management licencing, discharge consents for process water as well as increased road transportation for delivery of waste material and collection of processed material.	No
Sea	Aquatic disposal direct to seabed.	Relatively low cost, minimal transportation requirements compared to all other options and potential for low environmental risk due to the requirement for regulatory approval and sediment characterisation.. The closest spoil ground to all of these sites, and have had dredged material disposed of historically is Buckie CR040 centred at the point: 57° 42.220' N, 002° 57.170' W	Yes

2.2 Summary of Identified BPEO Options

Following review of the available options, two options were identified for further detailed BPEO assessment which are as follows:

- Beach Nourishment; and
- Sea Disposal.

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

2.2.1 Beach Nourishment

This method would involve the following material handling stages:

- Dredging (at low tide);
- Temporary stockpiling of material on land;
- Transfer of sediment on to wagon;
- Placement of sediment on beach; and
- Distribution/profiling of sediment by excavator.

It is anticipated that dredging will be undertaken using a long-arm excavator on land. The material will then be temporarily stockpiled before being transferred into a suitable wagon for transport to the identified beach site(s) before it is then suitably distributed and profiled. Moray Council will give consideration to suitable candidate sites ahead of the dredging works. There is potential for some temporary disruption to local residents as a result of the HGV movements.

2.2.2 Sea disposal

This option handles material in a single stage namely transport to the disposal site. The existing licensed disposal site is CR040 Buckie. It is located in naturally deep water with ease of access, has a large capacity and is anticipated to be active for the foreseeable future.

3 FURTHER CONSIDERATION OF REMAINING DISPOSAL OPTIONS

3.1 Detailed BPEO Assessment

Each of the identified options was assessed against the criteria detailed in Table 3.1 below.

Table 3-1: BPEO Detailed Assessment Criteria

Primary Criteria	Description and Attributes
Strategic	<ul style="list-style-type: none">• Operational aspects, including handling, transport etc.• Availability of suitable sites/facilities• General Public/local acceptability• Legislative Implications• Summary of the outcome of consultation with third parties
Environmental	<ul style="list-style-type: none">• Safety Implications• Public Health Implications• Pollution/ Contamination Implications• General Ecological Implications• Interference with other legitimate activities e.g. fishing• Amenity/Aesthetic Implications
Costs	<ul style="list-style-type: none">• Operating costs e.g. labour, site operations, environmental monitoring• Capital e.g. Transport, equipment hire

3.1.1 BPEO Strategic Assessment

Table 3-2 below provides details of the strategic assessment for each option taken forward for the detailed BPEO assessment:

Table 3-2: BPEO Strategic Assessment

Criteria	Beach Nourishment	Sea Disposal
Operational Aspects (inc. handling and transport)	<p>This method would likely involve road transport from the dredge site to the reuse site.</p> <p>The need for additional environmental assessment and potential licencing requirements would need to be established up front and taken into consideration to ensure that it minimised pressure on the required project timescales.</p>	<p>There would be no double handling of the dredged material. Transportation to the disposal site would be by dredger or barge(s) depending on methodology.</p>
Availability of suitable sites/facilities	<p>Early discussions with Moray Council have identified that this may be an option in relation to at least one of the sites subject to further discussions and consideration of the proposals.</p>	<p>The marine disposal site has been designed to accommodate the quantities typically generated by dredging operations. The chemical analysis of the sediments from the proposed dredge sites would indicate that the material is likely to be acceptable for testing pending further risk assessment for contaminants present at levels between Action Level 1 and Action Level 2.</p>
General Public /Local acceptability	<p>The beach nourishment project is likely to be generally welcomed by the public, as it will be seen as a way of bolstering and protecting the beach from erosion. There would likely be a short period of disruption but would likely be acceptable in the event that the longer term amenity value objectives of the project are achieved.</p>	<p>Traditionally accepted disposal route for dredged material and limited public impact.</p>
Legislative Implications	<p>This option may have licencing requirements over and above the routine dredge and disposal licencing. This may add additional programme/timescale pressures which make this option less favourable or practical. This should be established prior to progressing to ensure that project timescales are realistic and achievable.</p>	<p>This is an accepted disposal route as long as a Marine Licence is obtained.</p>

3.1.2 BPEO Environmental Assessment

Table 3-3 details the environmental assessment for each option taken forward for detailed BPEO assessment.

Table 3-3: BPEO Environmental Assessment

Criteria	Beach Nourishment	Sea Disposal
Safety Implications	HGV movements between the harbours and reuse site increase potential for accidents to occur. Work would be undertaken in accordance with H&S legislation.	Minimal handling of material required as it is directly placed at the disposal site. Work would be undertaken in accordance with H&S legislation.
Public Health	Limited potential for human contact assuming that the public are excluded from the active work area. Some potential for dust release during beach profiling works (only if the sediment dries out).	Low potential for human contact during dredging and disposal operations. Once deposited at disposal site pathways for human contact greatly reduced.
Pollution/contamination	HGVs transporting material to the beach site would have implication on carbon footprint and potential for local impact on air quality. Potential also for temporary noise impacts and dust release during profiling works (if sediment dries out).	Pollutant concentrations in dredged material to be disposed are limited to acceptable levels through regulatory licensing processes. Information with regards to the type of disposal site with regards to its effects on sediments has not been provided. Correspondence with Marine Scotland has previously concluded that disposal sites in Scotland are Dispersive.
General Ecological Implications	Significant ecological implications are unlikely as a result of deposition of additional sand on the beach. The receiving beach would need to be assessed on its location within or in proximity to sensitive ecological features/designations.	Disposal at the Buckie site has historically been used and is the closest licensed disposal site.
Interference with other legitimate activities	Significant interference or disruption with other operations would not be anticipated. Recreational beach users would require to be excluded from the beach while works are undertaken. Ideally these works would be undertaken out with the bathing season.	Designated disposal site, as such there is considered no significant impact to commercial vessels or commercial fishing.

Criteria	Beach Nourishment	Sea Disposal
Amenity / Aesthetic Implications	Temporary visual impacts during sediment placement and beach profiling works but no long term impacts. Some potential for odour emissions and noise impact although these impacts will be short term.	Limited short term visual / odour / noise effects as dredged material is transported by dredger and disposed of below sea level.

3.1.3 BPEO Cost Assessment

Costs were assessed for each of the options taken forward for detailed BPEO assessment. The BPEO assessment considered the typical costs associated with dredging, transportation to the disposal site, construction of treatment facilities (where applicable) and methods employed to protect the environment for each of the identified options. As costs are generally “Commercially Sensitive” the rates are based on experience within industry (as opposed to formal quotations).

Since the beach nourishment and sea disposal options are to be proposed both as options assuming that timescales for beach nourishment and dredging programme overlap, costs for each based on a nominal dredge of 8,000 tonnes (approximately 4,000m³) of dredged material has been set for comparative purposes.

The assumptions to calculate the costs are as follows:

- Dredging costs are estimated to be £3.21 per m³;
- Ship transportation costs from the dredged area to disposal / transfer site have been calculated based on £1.85 per tonne.
- Due to the relatively small volume likely to be used for Beach Nourishment, and anticipated free draining nature of the material, i.e. sand, no cost has been included for the establishment and operation of a dewatering facility. It has been assumed that dewatering would be undertaken by temporary storage of sediment until it dried out;
- Costs associated with transfer of dewatered material to lorry are based on a wheeled shovel (costing £500/day) operating for 2 hours per day for 4 days (although a minimum hire charge may make this cost higher);
- To transport sediment from the harbour to the beach (for beach nourishment), it is anticipated that this would use a 26 tonne wagon and it is estimated that 308 return trips would be required to transport 8,000 tonnes of material. The location and distance of a receiving beach is not yet known, but for the purposes of costing is assumed to be within 3 miles of the harbour. The haulage cost per mile is estimated to be £2.25 per mile. 308 return trips of 3 miles each way = 1,848 miles. The cost therefore is assumed to be approximately £4,158.
- The cost for an excavator to distribute sediment and profile the beach following placement of sediment has been assumed as £450 per day for 5 days.

Table 3-4 provides details on the Cost assessment for each option taken forward for detailed BPEO assessment:

Table 3-4: BPEO Cost Analysis

Activity	Beach Nourishment (£)	Sea Disposal (£)
Dredging	12,840	12,810
Mobilisation of Marine Plant for Sea Disposal	-	5,000
Transport by vessel to disposal site	-	14,800
Transfer of material to lorry	2,000	-
Transportation Cost to Beach	4,158	-
Excavator for beach profiling works	2,250	-
Total Costs	21,248	32,610

Note: The above costs do not take into account the cost required to gain planning or licensing consents or potentially to purchase land (where applicable). They also do not take account of the influence volumes will have on costs (economies of scale).

3.2 BPEO Assessment Discussion

For each of the above assessment criteria, the options were qualitatively and semi-quantitatively (for costs) assessed against feasibility/preference and awarded a ranking ranging from 1 to 4; 1 being the most acceptable and 4 being the least acceptable option. The assignment of rank was on the basis of professional judgement.

The individual assessment criteria rankings for each option were added up to give an overall hierarchy of preference. Table 3-5 below provides a summary of the BPEO assessment.

Table 3-5: BPEO Summary

Criteria	Beach Nourishment	Sea Disposal
Environment	2	2
Strategic	2	3
Costs	1	3
TOTAL SCORE	5	8

Moray Council has indicated that beach nourishment may be an option for some of the dredged spoil but further consideration of this needs to be undertaken.. This is being kept as an option as it meets the requirement for beneficial reuse where possible.

Deposition of the dredged material at a licensed marine disposal site has traditionally been deemed acceptable. The licensed marine disposal site has been designed to allow easy access as well as being capable of accommodating the quantities of material typically generated by dredging activities. Material handling is limited to transportation thereby reducing the risk for pollution incidences occurring. Pollutant concentrations within sediments are also limited to acceptable levels through regulatory requirements. On comparison with other disposal options the cost associated with sea disposal of the dredged material is considered to be the most financially viable.

3.3 Conclusions

The Best Practicable Environmental Option for disposal of the dredged material from the sites has therefore been assessed as sea disposal or where possible, beach nourishment.

As identified in the sediment chemical quality section, further assessment is deemed necessary to confirm the suitability of the sediment for disposal to the wider environment. The following section details this assessment.

4 FURTHER ASSESSMENT

As detailed in Section 1, on the basis of the exceedances of Action Level 1, further assessment to determine the suitability of the material for sea disposal is deemed a requirement.

The approach for this further assessment is outlined as follows:

- Provide an overview of the proposed dredge works and the identified disposal site including existing chemical monitoring data for the site where available; and
- Compare existing chemical data with other recognised sediment assessment criteria including those listed below. Summary tables are provided in Appendix B.

Background Assessment Concentration (BAC) - BACs were developed by the OSPAR Commission (OSPAR) for testing whether concentrations are near background levels. Mean concentrations significantly below the BAC are said to be near background. However, it should be noted that river catchments have their own unique geochemical finger prints and are also governed by the geology within the catchment, so in theory one set of background level values is not applicable to all situations;

Effects Range Low (ERL) - ERLs were developed by the United States Environmental Protection Agency (USEPA) for assessing the ecological significance of sediment concentrations. Concentrations below the ERL rarely cause adverse effects in marine organisms. Concentrations above the ERL will often cause adverse effects in some marine organisms;

Probable Effects Level (PEL) – PELs (Marine) have been adopted from the Canadian Environmental Quality Guidelines (http://www.ccme.ca/en/resources/canadian_environmental_quality_guidelines/) If a concentration is recorded above the PEL this is the probable effect range within which adverse effects frequently occur. The Threshold Effect levels (TELs) have been included in the summary table in Appendix B, but have not been used as part of the further assessment as they typically fall below the RAL1

Review of potential risks to the list of receptors identified in “Water Framework Directive Assessment: estuarine and coastal waters (<https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters>) to draw conclusions from available information and provide recommendation for proposed disposal routes.

4.1 Analytical Data Review

Existing analytical data for the proposed dredge sites are provided in Summary Table A in Appendix C. This data has been summarised against RAL 1 & 2, the BAC, ERL and PEL. As detailed previously, the data has not been reviewed against the Canadian TEL as these numbers are typically lower than RAL1.

While individual site results were compared against RAL1 and RAL2 in preceding sections, the further screening will be undertaken for all data and any specific issues identified for individual harbours.

A summary of the exceedances is detailed below:

4.1.1 Action Level 1

Exceedances of RAL1 can be summarised as follows:

- Arsenic – 0 of 24 samples recorded arsenic levels above RAL1.
- Cadmium – 11 of 24 samples recorded cadmium levels above RAL1.
- Copper – 12 of 24 samples recorded copper levels above RAL1.
- Chromium – 0 of 24 samples recorded chromium levels above RAL1.
- Lead – 9 of 24 samples recorded lead levels above RAL1.
- Mercury – 2 of 24 samples recorded mercury levels above RAL1.
- Nickel – 0 of 24 samples recorded nickel levels above RAL1.
- Zinc – 8 of 24 samples recorded zinc levels above RAL1.
- PAHs – 17 of 24 samples recorded at least one PAH species above RAL1; and
- THC – 13 of 24 samples recorded total hydrocarbons above RAL1.
- TBT 1 of 24 samples recorded total TBT above RAL1.
- PCBs 0 of 24 samples recorded PCBs above RAL1.

4.1.2 ERL & PEL Review

Exceedances of the ERL (where one is available) can be summarised as follows:

- Copper – 11 of 24 samples recorded copper levels above the ERL;
- Mercury – 6 of 24 samples recorded mercury levels above the ERL;
- Lead – 6 of 24 samples recorded mercury levels above the ERL;
- Zinc – 7 of 24 samples recorded zinc levels above the ERL; and
- PAHs – 10 of 24 samples recorded at least one PAH species above the ERL.

Exceedances of the PEL (where one is available) can be summarised as follows:

- Copper– 5 of 24 samples recorded copper levels above the PEL all at Buckie Harbour.
 - BK3 – 0.5-1.0m;
 - BK3 – 1.0-1.5m;
 - BK4D – 0.0-0.15m;
 - BK4D – 0.15-0.45m; and
 - BK4D – 0.45-0.9m.
- Zinc – 1 of 24 samples recorded zinc levels above the PEL, specifically sample BK3 – 0.5-1.0m from Buckie Harbour.

4.1.3 Action Level 2

All sample results were recorded below RAL 2, where values are available for review.

4.2 Averages

Review of the averaged data for each site has been undertaken i.e. considering the material as a single volume for disposal from each site. These data are provided in Tables B, C, D and E. The concentrations of the various contaminants of concern are quite variable, the review of average data against the available adopted assessment criteria are summarised below. Note there were no exceedances for average concentrations from Cullen Harbour for any of the screening criteria.

4.2.1 Buckie Harbour

- RAL1 was exceeded for the following contaminants of concern: cadmium, copper,, lead, zinc, various PAHs and THC for the associated average concentration.
- ERL was exceeded for copper, lead, zinc and benzo(ghi)perylene
- There were no average concentrations recorded in exceedance of their respective PEL or RAL2 where one is available.

4.2.2 Findochty Harbour

- RAL1 was exceeded for the following contaminants of concern: copper, various PAHs for the associated average concentration;
- ERL was exceeded benzo(ghi)perylene only; and
- There were no average concentrations recorded in exceedance of their respective PEL or RAL2 where one is available.

4.2.3 Portknockie Harbour

- RAL1 was exceeded for various PAHs for the associated average concentration;
- ERL was exceeded benzo(ghi)perylene only; and
- There were no average concentrations recorded in exceedance of their respective PEL or RAL2 where one is available.

4.3 Chemical Assessment Conclusions

Multiple samples recorded exceedances of RAL1 for metals, TBT, PAHs and THC across all sites. There were no exceedances of RAL2 with where one is available for review.

Several individual samples recorded exceedances of the ERL for various metals and PAH species, while 2 individual samples recorded exceedances of the PEL for PAHs. However, when the averaged data is considered, the ERL is exceeded for PAH (5 species) only. No exceedances of the PEL or RAL 2 were noted against averaged concentrations.

4.4 Buckie Disposal Site – CR040

Moray Council are looking at disposing the various harbour sediment arisings at Buckie disposal ground CR040.

Results of samples collected by Marine Scotland are compared against the ERL and PEL in Table F in Appendix A.

A limited data set for the Buckie disposal site (one sample for metals and PAHs)) was provided by Marine Scotland for review. The sample was collected in 2000. All the metal concentrations were recorded below the ERL and PEL for corresponding contaminants of concern where available for review. 4 PAHs species recorded an exceedance of the PEL where one is available for review.

The sediment at the harbours is in general, similar in nature to that of the sample collected in the disposal site, but it should be noted that 23 years of deposition have occurred since the last sample was collected by Marine Scotland, so current conditions will likely reflect a combination of natural conditions in the wider site area as well as the quality of material deposited there under licence.

4.5 Water Framework Directive Assessment

As outlined in the Water Framework Directive Assessment: estuarine and coastal waters, there are several key receptors which can be impacted upon including the following:

- Hydromorphology
- Biology – habitats
- Biology – fish
- Water quality
- Protected areas

Each of these points are considered in Table 4-1 below:

Table 4-1: Receptor Risk Assessment

Key Receptor ¹	Brief Summary of Potential Effects on Receptor	Further Consideration Required?	Comment
Hydromorphology (Source Area and Disposal Site)	Morphological conditions, for example depth variation, the seabed and intertidal zone structure tidal patterns, for example dominant currents, freshwater flow and wave exposure	No	<p>Dredging and Sea Disposal The areas proposed to be dredged are routinely subject to dredging to maintain depth in the harbours and approach. The Buckie Harbour site and disposal sites are located in the Portgordon to Findochty coastal water body (ID:200146) with remaining sites located in the Findochty to Knockhead coastal water body (ID:200497). Both coastal water bodies have an overall classification status of “good” and a classification of “high” specifically for hydromorphology. The water bodies are not considered to be Heavily Modified. The classification of these water bodies takes into account the presence of the disposal site, so no further assessment is considered to be required.</p> <p>Beach Nourishment While there may be temporary, localised effects on the given receiving beach, grading of sediment by the excavator and incoming tides are likely to quickly move sediment into a natural morphology. The impacts on local hydromorphology from disposal are considered to be no more significant than sand naturally being transported to and from the coastline by tides/currents. The suitability of dredged material for the receiving beach, in terms of particle size, will be investigated and confirmed prior to the dredging and disposal exercise. No further assessment with respect to the water framework directive is likely to be required.</p>

¹ <https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters>

Key Receptor ¹	Brief Summary of Potential Effects on Receptor	Further Consideration Required?	Comment
Biology - habitats	Included to assess potential impacts to sensitive/high value habitats.	No	<p>The dredge sites are in proximity to designated features including the following designated sites:</p> <ul style="list-style-type: none"> • Moray Firth Special Area of Conservation • Moray Firth Special Protection Area • Southern Trench Marine Protected Area <p>Of these three sites only the Southern Trench MPA has designations for habitats (shelf deeps and burrowed mud habitat).</p> <p>The dredge sites are c. 1Km from this site.</p> <p>The disposal site is licensed and it is assumed that consideration of these habitats were given when choosing the disposal location.</p> <p>No further assessment considered necessary.</p>
Biology – fish	Consideration of fish both within the estuary and also potential effects on migratory fish in transit through the estuary	No	<p>Dredging and Sea Disposal</p> <p>The material proposed to be dredged/deposited as part of dredging campaign(s) is similar in nature with material previously deposited. In addition, there is no estuary in close proximity to the site in which migratory fish would be migrating towards. Immediately out with the harbour lies open sea with no obvious constraints. No further assessment considered necessary.</p> <p>It is noted that under periods of exceptionally hot and dry weather the potential for oxygen related issues to arise: <i>i.e.</i> oxygen depletion and it is proposed that dredging works will be avoided as far as practicable during such times.</p>

Key Receptor ¹	Brief Summary of Potential Effects on Receptor	Further Consideration Required?	Comment
Water Quality	Consideration must be given to water quality when contaminants are present in exceedance of CEFAS RAL1.	No	<p>Findochty, Portknockie and Cullen harbours are all located within the Findochty to Knockhead coastal area with an over classification of Good.</p> <p>Buckie is located within the Portgordon to Findochty coastal area which is Classified as Good</p> <p>Contaminants are noted to exceed CEFAS RAL1 within sediment samples.. Potential effects associated with sea disposal are considered to be both local and temporary. Further consideration of potential effects is discussed in section 4.6 for completeness.</p>
Protected Areas	<p>If your activity is within 2km of any WFD protected area, include each identified area in your impact assessment.</p> <ul style="list-style-type: none"> • special areas of conservation (SAC) • special protection areas (SPA) • shellfish waters • bathing waters • nutrient sensitive areas 	Yes	<p>The proposed dredging sites site are located within 2km of</p> <ul style="list-style-type: none"> • Moray Firth Special Area of Conservation - • Moray Firth Special Protection Area • Southern Trench Marine Protected Area <p>The disposal site is located within the Moray Firth SPA and Southern Trench MPA.</p> <p>Cullen Harbour is c. 570m southeast of the Cullen Bay Bathing waters. The sites are not within 2km of shellfish waters. Further consideration to the protected sites is provided below in section 4.5.</p> <p>Beach Nourishment</p> <p>The location of any potential receiving beach is not yet known, therefore consideration with regard to protected areas will be required when the location is known.</p>

4.6 Potential Risk to Water Quality and Protected Areas

The potential risks to water quality at the dredge sites and disposal site are further considered as all other receptors have been screened out of the assessment.

SEPA classified the Findochty to Knockhead and Portgordon to Findochty coastal water body as overall “good” and pass for specific pollutants. No classification is provided for priority substances.

Although there are contaminants of concern above the RAL1 within the sediment for disposal, it is considered that these levels will not contribute to an overall degradation of water quality at the disposal site. While any effects are considered to be both localised and temporary, the potential for both dilution and natural attenuation in the open waters beyond the harbour wall is considerable.

The key contaminants for impacting water quality are considered to be metals as these have the potential to dissolve or desorb from sorption sites within the sediment. However, the overall concentrations of metals are generally low and natural geochemical processes will limit their solubility along with the large dilution potential it is not expected that there would have a long term impact on water quality.

PAHs and hydrocarbons are hydrophobic with low aqueous solubility and will naturally remain associated with organic sediment fractions, rather than become dissolved within the water column. On this basis, the risks associated with impact to water quality from chemical contaminants in sediment are considered to be low, with the associated dilution potential providing further mitigation.

The key risk to water quality is considered to be an increase in turbidity/suspended solids during the sea disposal activity. Although this is likely to cause a localised increase in suspended solids, it is considered that this will be both local and temporary in nature and has been factored into the selection and location of the agreed sea disposal ground.

Table 4-2 summarises the physical sediment type versus the proposed dredge volume.

Table 4-2: Summary of PSA Data

Dredge Area	Gravel (>2mm)	Sand (0.063mm<Sand<2mm)	Silt & Clay (<0.063mm)	Quantity to be dredged m ³
Buckie	7.8%	55.5%	36.7%	28,000
	2,184m ³	15,540 m ³	10,276 m ³	
Cullen	0.03%	99.97%	0	3,500
	1.05 m ³	3,498.95 m ³	0 m ³	
Findochty	0.31%	69.67%	30.02%	3,500
	10.85 m ³	2,438.45 m ³	1,050.7 m ³	
Portknockie	0.1%	69.4%	30.5%	3,500
	3.5 m ³	2,429 m ³	1,067.5 m ³	

The dominant sediment type across the majority of the dredge sites is sand. Silt comprises between 30% and 37% off the sites with the exception of Cullen which has no silt in the samples collected.

Given that an average of 55-99.7% of the sediment across all dredge areas comprises sand and gravel, it is considered that the majority of the deposited sediment will fall out of suspension quickly at the disposal site with limited lateral spread.

The silt and clay material is considered to have a longer suspension time than sand and gravel sized particles when in suspension. Depending on how the material is dredged, the cohesive nature of the material will mean that it would fall as consolidated units with minimal dispersion.

It is noted that the Buckie disposal grounds have been utilised for the maintenance dredge disposal from surrounding dredge sites for a number of previous exercises (including the period of the most recent SEPA water quality classification for chemical status of the waterbody which accommodates the disposal grounds as “good”).

In summary, the associated risk with degradation of water quality directly associated with the proposed disposal is considered to be Low i.e. unlikely to cause a change in status of the waterbodies in question at both the dredge and disposal sites.

4.6.1 Protected Areas

The Moray Firth Special Area of Conservation (SAC), Special Protection Area (SPA) and Southern Trench Marine Protected Area (MPA) are present beyond the harbour walls. The Buckie disposal; is located within the SPA and MPA. The specific features designated within the SAC and SPA are noted in the tables below. The SAC and SPA extend across a large area of coastline and coastal water; and will encompass a variety of features. Not all of the features listed below will be present at every location.

Table 4-3: Moray Firth SAC Features²

Feature Type	Feature	Latest Assessed Condition
Marine (incl. marine mammals)	Bottlenose dolphin (<i>Tursiops truncatus</i>)	Favourable Maintained
	Subtidal sandbanks	Favourable Maintained

The SAC is a protected area for bottlenose dolphins and subtidal sandbanks. Neither of these features are likely to be affected by dredging activity, as dolphins are unlikely to be present within or in the immediate vicinity of the harbours to be dredged. Protected subtidal sandbank features are unlikely to be present in the harbours as they are subject to ongoing maintenance dredging. With respect to the disposal site, the SAC listing does not specify dredging activities as a negative pressure impacting protected features, despite the disposal ground being within the SAC. Moreover, it is assumed that the presence of the SAC was taken into account when the Buckie disposal site was approved for use.

Table 4-4: Moray Firth SPA Features³

Feature Type	Feature	Latest Assessed Condition
Birds	Common scoter (<i>Melanitta nigra</i>)	Favourable Maintained
	Eider (<i>Somateria mollissima</i>)	Favourable Declining
	Goldeneye (<i>Bucephala clangula</i>)	Unfavourable Declining
	Great northern diver (<i>Gavia immer</i>)	Favourable Maintained
	Long-tailed duck (<i>Clangula hyemalis</i>), non-breeding	Favourable Maintained
	Red-breasted merganser (<i>Mergus serrator</i>), non-breeding	Favourable Maintained
	Red-throated diver (<i>Gavia stellata</i>), non-breeding	Favourable Maintained
	Scaup (<i>Aythya marila</i>), non-breeding	Unfavourable Declining

² <https://sitelink.nature.scot/site/8327>

³ <https://sitelink.nature.scot/site/10490>

Feature Type	Feature	Latest Assessed Condition
	Shag (<i>Phalacrocorax aristotelis</i>), breeding and non-breeding	Favourable Maintained
	Slavonian grebe (<i>Podiceps auritus</i>), non-breeding	Favourable Maintained
	Velvet scoter (<i>Melanitta fusca</i>), non-breeding	Unfavourable Declining

The SPA is a protected area for seabirds. Neither the dredging or disposal activities are considered likely to result in a significant negative impact to breeding and non-breeding bird populations, primarily due to the localised and temporary nature of the works. In addition, the SPA listing does not specify dredging activities as a negative pressure impacting protected features, despite the disposal ground being within the SPA. Moreover, it is assumed that the presence of the SPA was taken into account when the Buckie disposal site was approved for use.

All the dredge sites are located less than 1km south of the boundary of the recently designated Southern Trench MPA. The Buckie sea disposal site is located within the MPA.

The Conservation and Management Advice document for the MPA⁴ has been reviewed as part of this assessment. The document notes the protected features within the MPA, along with the latest assessment condition. This information is summarised in Table 4-5.

Table 4-5: Southern Trench MPA - Protected Features and Conditions (NatureScot, 2020)

Protected Feature	Feature Type	Feature Condition (2019)
Burrowed mud	Inshore sublittoral sediment (Marine)	Favourable
Fronts	Large-scale feature (Marine)	Favourable
Minke whale (<i>Balaenoptera acutorostrata</i>)	Mammals (Marine)	Favourable
Shelf deeps	Large-scale feature (Marine)	Favourable
Quaternary of Scotland (subglacial tunnel valleys and moraines)	Quaternary geology and geomorphology	Favourable
Submarine Mass Movement (slide scars)	Geomorphology	Favourable

Each of the protected features noted in Table 4-5 will be considered in turn, with the risk of negative impacts on the feature assessed in the context of sea disposal works. Features of the MPA are not considered to be at risk as a result of dredging or beach nourishment works due to the relative small-scale of the works and distances involved. Therefore, these are not considered any further.

Burrowed Mud

The Conservation and Management Advice for the MPA states that burrowed mud habitats are “highly sensitive to physical disturbance.”

Table 2 of the Advice document provides specific management advice for marine deposit sites and burrowed mud:

“Minimise the likely effects of new disposal sites where there would be likely to be an impact upon burrowed mud habitats. Early pre-application discussions are recommended and these should focus

⁴ <https://sitelink.nature.scot/site/10477>

on the appropriate siting of new disposal sites and any pre-submission surveys to avoid impacts within areas of burrowed mud habitat.”

The specific management advice refers only to the establishment of new disposal sites and therefore it is considered likely that the presence of the Buckie disposal site was taken into account upon the designation of the MPA, and that the existing disposal site would not be situated in an area of burrowed mud habitat. No further assessment is considered necessary.

Minke Whale

The Conservation and Management Advice for the MPA notes that minke whales are “sensitive to entanglement and incidental bycatch.” The sea disposal activity is not considered to cause a risk to minke whales in those regards.

Minke whales are also noted to be sensitive to underwater noise, collision and water pollution. There may be some short-lived, temporary effects on underwater noise as a result of the disposal activity may be experienced. Secondly, it is considered that the risk of underwater collision between a minke whale and the dredging vessel is no greater than any other vessel passing through the MPA area. Finally, the effects on water quality as a result of the disposal to sea have been considered above. Effects on water quality are likely to be localised and temporary.

It is considered likely that the presence of the dredge spoil disposal site will have been taken into account when the MPA was designated, and on that basis the potential risks to minke whale are considered to be acceptable.

Table 2 of the MPA document provides specific management advice for marine deposit sites and minke whales:

“Minimise the potential impact of new deposit sites (including disused/closed sites if to be reopened) on the habitat of sandeels. Early pre-application discussions are recommended and these should consider the appropriate siting of new deposit sites and any pre-submission surveys to ensure that the habitat of sandeels is maintained in extent and suitability.”

The specific management advice refers only to the establishment of new disposal sites (or re-opening of old ones) and therefore it is considered likely that the presence of the Buckie disposal site was taken into account upon the designation of the MPA, and that the existing disposal site would not be situated in an area of sandeel habitat (which are feeding grounds for minke whale).

If considered necessary through statutory consultation with NatureScot, then a Marine Mammal Observer (MMO) could be deployed to the dredging vessel to monitor minke whale activity at the disposal ground.

Fronts

The Conservation and Management Advice for the MPA states that thermal fronts states that “the MPA could be sensitive to pressures such as changes in tidal flow or physical changes to the seabed.” The deposition of sediment at the Buckie disposal ground will cause a change in the seabed topography as deposited material settles.

However, it is known that sediment disposal sites in Scotland are generally dispersive, therefore any changes to seabed topography are likely to be temporary. Moreover, the Advice document also states: *“Currently most pressures associated with human activities in the marine environment are considered unlikely to cause significant risk of impact on the fronts feature within the MPA.”* It is also assumed that the dredge spoil disposal site would have been taken into account when the MPA was designated. No further assessment is considered necessary,

Shelf Deepes

The Conservation and Management Advice for the MPA states that: “*Shelf deepes are considered to be robust, entirely natural in origin and are not considered to be at risk of significant damage from human activity.*” Therefore, the dredging and disposal activity is considered unlikely to have a negative impact on shelf deepes.

Quaternary of Scotland

According to the Conservation and Management Advice for the MPA, subglacial tunnel valleys are “highly resistant” and are “not sensitive or have a low sensitivity” to human activities. Further assessment with regard to subglacial tunnel valleys is not considered necessary.

Moraines are stated to have a “*medium sensitivity to sub-surface abrasion and changes in tidal flow, and a high sensitivity to physical removal.*” The deposition of sediment at the Buckie disposal site is not considered likely to have a negative impact on the moraines. It is considered unlikely that a licensed disposal site would have been permitted in an area known to have protected moraine features susceptible to sub-surface abrasion. Further assessment is not considered necessary.

Submarine Mass Movement

The Conservation and Management Advice for the MPA states that slide scars have a “medium sensitivity... to any activities that could cause obscuring”. The deposition of dredged sediment at the Buckie disposal site may cause temporary obscuring of slide scars, if present at the disposal site.

However, it is known that sediment disposal sites in Scotland are dispersive, therefore any obscuring by deposited sediment is likely to be temporary. In addition, the licenced disposal site has been present at Buckie since at least 1995⁵ (although the exact opening date of the site is not currently known). It is considered unlikely that the disposal site would continue to remain open for sediment deposits if there was likely to be a significant risk of damage to the protected slide scar features. Further assessment is not considered necessary.

In summary, there are unlikely to be significant negative impacts on protected features of the SAC, SPA and MPA as a result of dredging and sea disposal activities. It is acknowledged that this assessment may require to be updated to take account of disposal/re-use by beach nourishment, depending on the location of the receiving beach.

5

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/197331/TR_SE_A2_ExistingActivities.pdf (See Table 6)

5 CONCLUSIONS AND RECOMMENDATIONS

Review of available information has highlighted that although several contaminants of concern exceed RAL1 in sediment samples, assessment of key receptors identified from the Water Framework Directive assessment for estuarine and coastal waters concluded that there is a low risk of the sediments impacting upon the overall ecological or chemical status. Additionally, the contaminants of concern levels recorded in the sediment are not considered likely to have a significant adverse impact on the sediment quality already located within the disposal ground. The materials nature is similar to that previously licensed for disposal in the existing maintenance dredge licence.

Overall, based on the multiple lines of evidence approach adopted to further assess the exceedances identified in the sediment assessment, the material as a whole is considered suitable for sea disposal.

As outlined earlier in the report, there is potential for some of the dredged material to be used for beach nourishment. Further consideration is to be given this option ahead of future dredging works. Marine Scotland will be notified in advance should this be a viable option with regards to dredge timescales and the bathing season.

The sea disposal option is considered to have no significant long-term impact on the marine environment; the disposal site is readily accessible from all the dredging areas and is the most cost effective option.

The BPEO has been identified as sea based disposal for suitable material supplemented by beach nourishment where feasible.

REFERENCES

Marine Scotland (2017). Pre-Dredge Sampling Guidance Version 2: Scottish Government.

Marine Scotland (2015). Guidance for Marine Licence Applicants Version 2: Scottish Government.

APPENDICES

A FIGURES



Legend

- Dredge Areas
- Sediment Samples**
- ◆ Grab
- Vibrocore

Notes

1. The following locations were not submitted for analysis due to limited sediment recovery, with sample stations re-located in an attempt to retrieve deeper cores: BK1, BK4, BK4A, BK4B and BK4C.

Do not scale this map

Client
Arch Henderson LLP

Project
Moray Council Dredging
Buckie Harbour

Title
Buckie Harbour Sediment Sample Locations

Status
Final

Drawing No. 377468-QGIS003	Revision -	Date 05 Apr 2023
Drawn FR	Checked GD	Approved CCAS

Scale
1:2,500 @ A3

Rev	Date	Amendment	Initials
-	-	-	-



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Legend

- Dredge Areas
- Sediment Samples**
- ◆ Grab

Do not scale this map

Client
Arch Henderson LLP

Project
Moray Council Dredging
Cullen Harbour

Title
Cullen Harbour Sediment Sample Locations

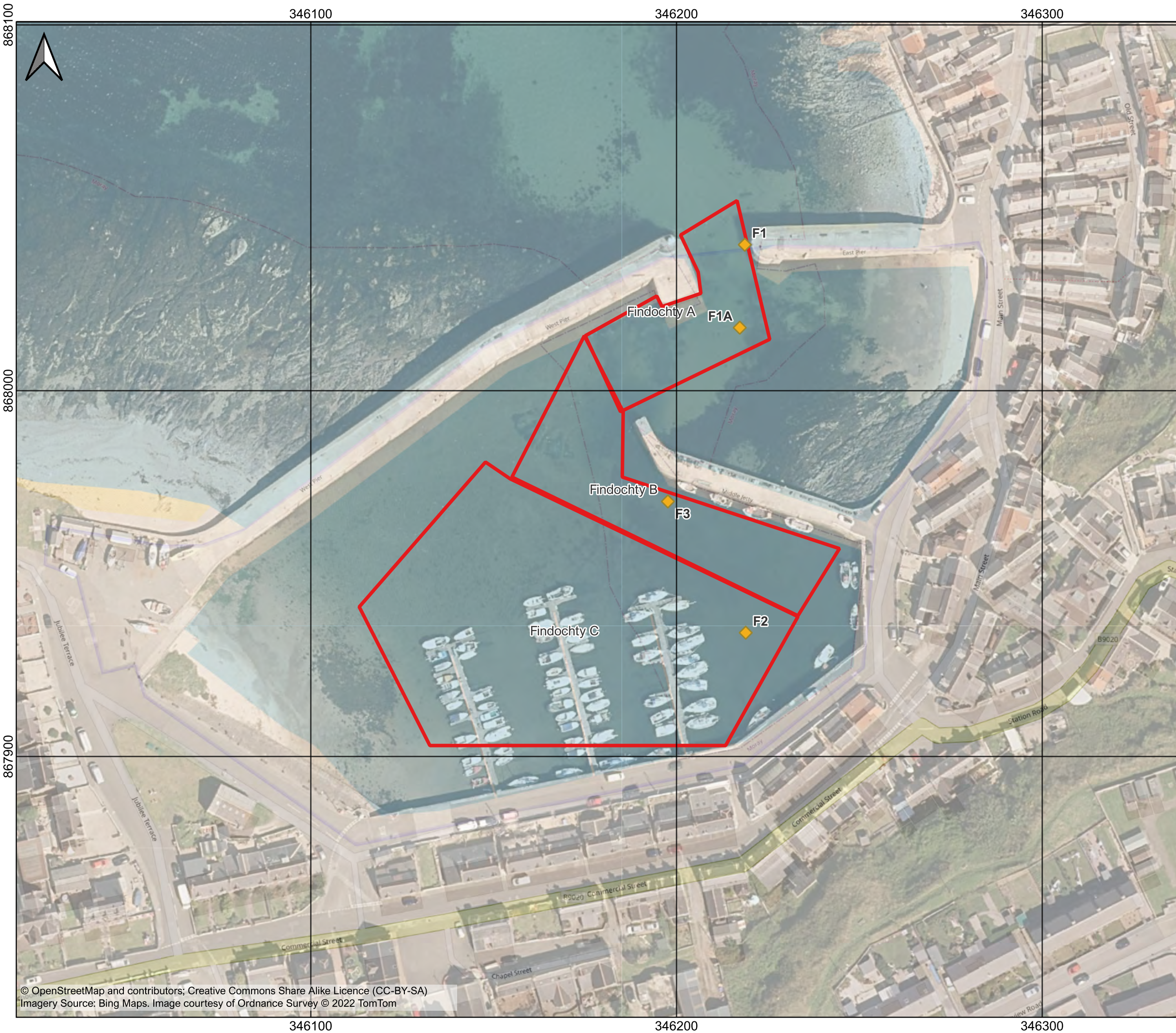
Status
Final

Drawing No. 377468-QGIS006	Revision -	Date 05 Apr 2023
Drawn FR	Checked GD	Approved CCAS

Scale
1:1,000 @ A3

Rev	Date	Amendment	Initials
-	-	-	-

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Legend

- Dredge Areas
- Sediment Samples
- ◆ Grab

Notes

1. No sample was submitted for analysis from location F1, as only coarse and gravel and cobbles were recovered. This location was re-sited to F1A obtain material suitable for analysis.

Do not scale this map

Client
Arch Henderson LLP

Project
Moray Council Dredging
Findochty Harbour

Title
Findochty Harbour Sediment Sample Locations

Status
Final

Drawing No. 377468-QGIS004	Revision -	Date 05 Apr 2023
Drawn FR	Checked GD	Approved CCAS

Scale
1:1,000 @ A3

Rev	Date	Amendment	Initials
-	-	-	-



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348600

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Legend

- Dredge Areas
- Sediment Samples
- ◆ Grab

Do not scale this map

Client
Arch Henderson LLP

Project
Moray Council Dredging
Portknockie Harbour

Title
Portknockie Harbour Sediment Sample Locations

Status
Final

Drawing No. 377468-QGIS005	Revision -	Date 05 Apr 2023
Drawn FR	Checked GD	Approved CCAS

Scale
1:750 @ A3

Rev	Date	Amendment	Initials
-	-	-	-



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B SAMPLE LOGS

Project Name	Moray Harbours - Pre-Dredge Licensing Support	Location ID BK1A
Project No.	377468 (Buckie)	
Client	Arch Henderson	

SEDIMENT CORE LOG

Date/Time:	14/02/2022	Latitude/Longitude:	57.680287 , -2.9600132
Dredge Area:	Buckie	Sampled/logged by:	FR/AK
Method:	Cores: Vibrocore Grabs: 0.045m ² Van Veen Grab Sampler	Core Length (m):	1.2m

Remarks:

0.0 – 0.2m
 Soft dark grey (grey-brown on surface) fine sandy silt with rare rootlets throughout. Strong H₂S odour.

0.2 – 0.5m
 Dark grey very silty fine sand.

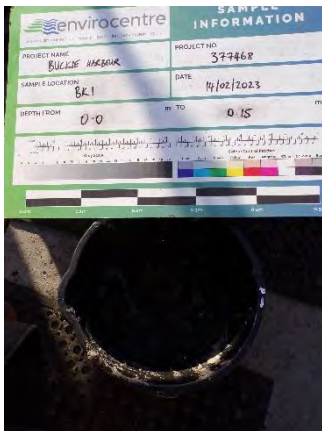
0.5 – 1.2m
 Dark grey silty fine sand with rare angular coarse gravel. Strong H₂S odour.


Biota: None noted.

Odours: Strong H₂S odour at depths 0.0 – 0.2m and 0.5 – 1.2m.

Anthropogenic Inputs: None noted.

Notes: Core depth of 1.2m achieved on 2nd attempt.



 8 Eagle Street, Craighall Business Park, Glasgow, G4 9XA	Project Name Moray Harbours - Pre-Dredge Licensing Support	Location ID BK2
	Project No. 377468 (Buckie)	
	Client Arch Henderson	

SEDIMENT CORE LOG

Date/Time:	14/02/2022	Latitude/Longitude:	57.680033 , -2.9565945
Dredge Area:	Buckie	Sampled/logged by:	FR/AK
Method:	Cores: Vibrocore Grabs: 0.045m ² Van Veen Grab Sampler	Core Length (m):	1.3m

Remarks:

0.0 – 0.15m
Soft dark grey/black (grey-brown on the surface) slightly silty sand. Rare vegetation and rootlets.

0.3 – 0.8m
Soft dark grey slightly sandy silt. Rare coarse gravel.

0.8 – 1.3m
Soft dark grey/black fine to course sandy slightly gravelly silt. Occasional twigs/rootlets. Rare blue paint chips and large piece of subrounded gravel at base.


Biota: None noted.

Odours: Strong H₂S odour at depths 0.0 – 0.15m and 0.3 – 0.8m.

Anthropogenic Inputs: Ink well (0.5m) and cloth material (0.8m), blue paint chips.

Notes: Core depth of 1.3m achieved on 3rd attempt.



 8 Eagle Street, Craighall Business Park, Glasgow, G4 9XA	Project Name Moray Harbours - Pre-Dredge Licensing Support	Location ID BK3
	Project No. 377468 (Buckie)	
	Client Arch Henderson	

SEDIMENT CORE LOG

Date/Time:	14/02/2022	Latitude/Longitude:	57.680823 , -2.9548485
Dredge Area:	Buckie	Sampled/logged by:	FR/AK
Method:	Cores: Vibrocore Grabs: 0.045m ² Van Veen Grab Sampler	Core Length (m):	1.5m

Remarks: **0.0 – 0.15m**
 Soft dark grey (grey-brown on the surface) silt. Frequent seaweed. Rare twigs.

0.15 – 1.5m
 Soft dark grey silt. Rare gravel and rootlets.


Biota: None noted.

Odours: Strong H₂S odour at depths of 0.15 – 1.5m

Anthropogenic Inputs: None noted.

Notes: Core depth of 1.5m achieved on 1st attempt



 8 Eagle Street, Craighall Business Park, Glasgow, G4 9XA	Project Name Moray Harbours - Pre-Dredge Licensing Support	Location ID BK4D
	Project No. 377468 (Buckie)	
	Client Arch Henderson	

SEDIMENT CORE LOG

Date/Time:	14/02/2022	Latitude/Longitude:	57.681105 , -2.9542810
Dredge Area:	Buckie	Sampled/logged by:	FR/AK
Method:	Cores: Vibrocore Grabs: 0.045m ² Van Veen Grab Sampler	Core Length (m):	0.9m

Remarks: **0.0 – 0.15m**
 Soft dark grey/ black silty with frequent seaweed.

0.15 – 0.9m
 Very soft dark grey/black silt. Rare gravel and rootlets.
 Grey/reddish brown fine to medium sand in core catcher at base.


Biota: None noted.

Odours: Strong H₂S odour at between 0.15 – 0.9m.

Anthropogenic Inputs: None noted.

Notes: Core depth of 0.9m achieved on 5th attempt



 8 Eagle Street, Craighall Business Park, Glasgow, G4 9XA	Project Name Moray Harbours - Pre-Dredge Licensing Support	Location ID BK5
	Project No. 377468 (Buckie)	
	Client Arch Henderson	

GRAB SAMPLE LOG

Date/Time	14/02/2022	Latitude	57.679985
Dredge Area	Buckie	Longitude	-2.9583288
Method	0.045m ² Van Veen Grab Sampler	Sampled/logged by	FR/AK

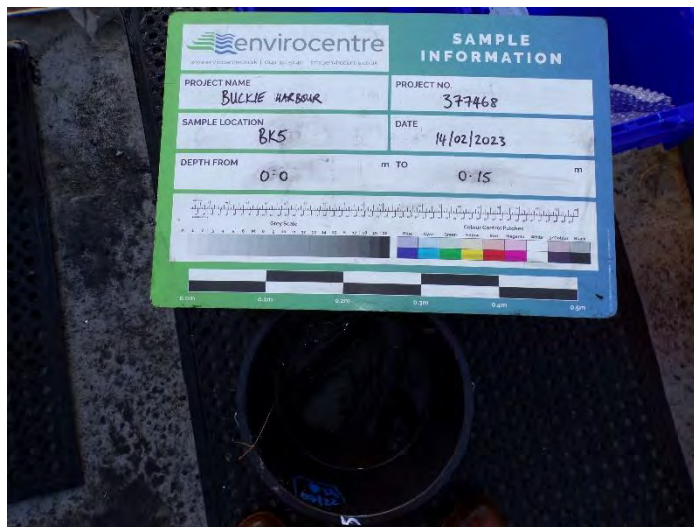
Remarks: **0.0 – 0.15m**
 Soft dark grey/black (grey-brown on surface) fine slightly sandy silt. Occasional seaweed, vegetation and rootlets.

Biota: None noted.

Odours: None noted.

Anthropogenic Inputs: None noted.

Notes: -



GRAB SAMPLE LOG

Date/Time	14/02/2022	Latitude	57.680337
Dredge Area	Buckie	Longitude	-2.9618005
Method	0.045m ² Van Veen Grab Sampler	Sampled/logged by	FR/AK

Remarks: **0.0 – 0.15m**
 Light brown/grey silty fine to medium sand.

Biota: None noted.

Odours: None noted.

Anthropogenic None noted.

Inputs:

Notes: -



GRAB SAMPLE LOG

Date/Time	14/02/2022	Latitude	57.680828
Dredge Area	Buckie	Longitude	-2.9567577
Method	0.045m ² Van Veen Grab Sampler	Sampled/logged by	FR/AK

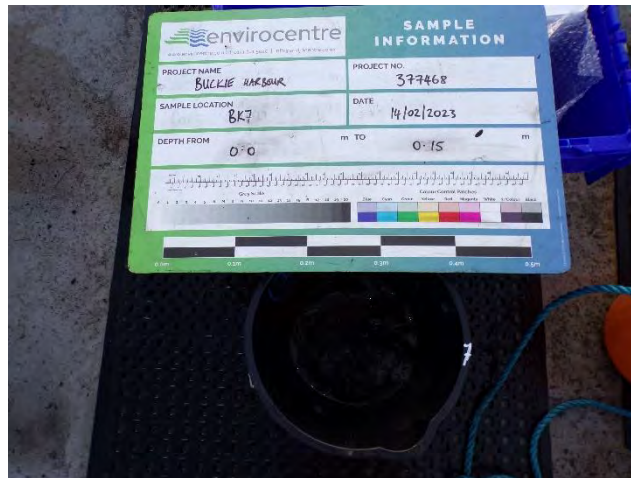
Remarks: **0.0 – 0.15m**
 Soft dark grey (grey-brown on surface) very gravelly silt. Gravel is fine to medium. Rare seaweed and vegetation.

Biota: Singular worm.

Odours: None noted.

Anthropogenic None noted.
Inputs:

Notes: -



GRAB SAMPLE LOG

Date/Time	15/02/2023	Latitude	57.694150
Dredge Area	Cullen A	Longitude	-2.8239387
Method	0.045m ² Van Veen Grab Sampler	Sampled/logged by	FR/AK

Remarks: Light brown silty fine to medium sand.

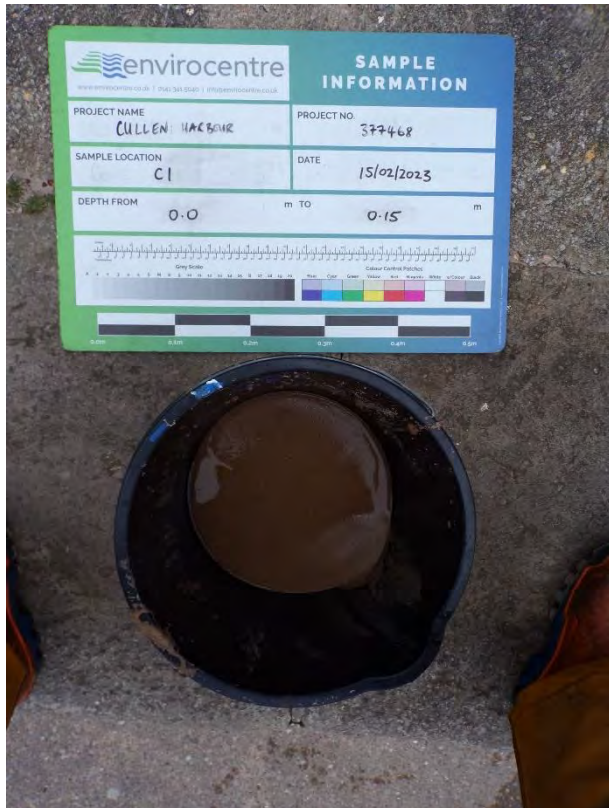
Biota: Singular dead sand eel.

Odours: None noted.

Anthropogenic None noted.

Inputs:

Notes: -



Project Name	Moray Harbours - Pre-Dredge Licensing Support	Location ID C2
Project No.	377468	
Client	Arch Henderson	

GRAB SAMPLE LOG

Date/Time	15/02/2023	Latitude	57.693704
Dredge Area	Cullen B	Longitude	-2.8235102
Method	0.045m ² Van Veen Grab Sampler	Sampled/logged by	FR/AK

Remarks: Light brown, rarely black silty fine to medium sand. Black material likely to be plankton / seaweed fragments.

Biota: None noted.

Odours: None noted.

Anthropogenic Inputs: None noted

Notes:

-



Project Name	Moray Harbours - Pre-Dredge Licensing Support	Location ID
Project No.	377468	C3
Client	Arch Henderson	

GRAB SAMPLE LOG

Date/Time	15/02/2023	Latitude	57.693420
Dredge Area	Cullen B	Longitude	-2.8228918
Method	0.045m ² Van Veen Grab Sampler	Sampled/logged by	FR/AK

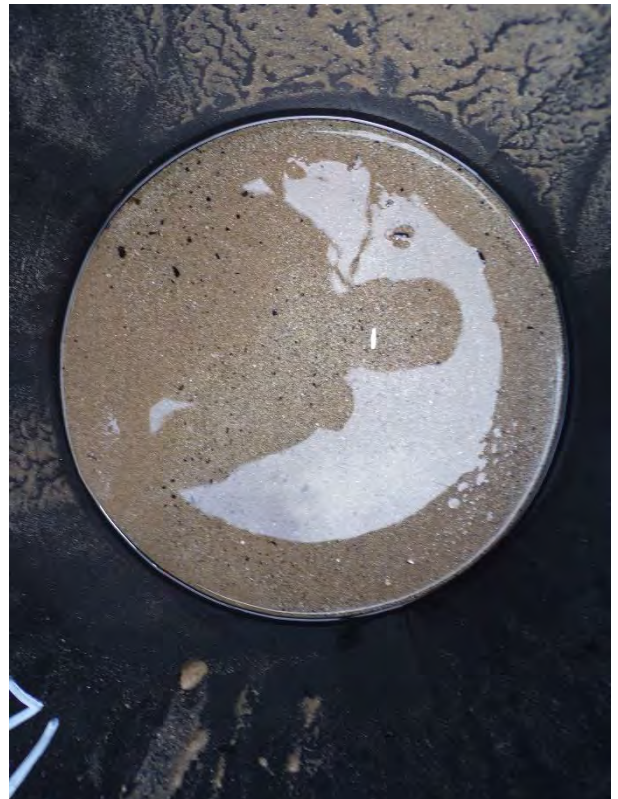
Remarks: Light brown silty fine to medium sand with rare black plankton / seaweed underlain by grey silty fine to medium sand.

Biota: None noted.

Odours: None noted.

Anthropogenic Inputs: None noted.

Notes: Sample taken from pontoon as water was too shallow for the boat.



GRAB SAMPLE LOG

Date/Time	15/02/2023	Latitude	57.69872
Dredge Area	Findochty A	Longitude	-2.90397
Method	0.045m ² Van Veen Grab Sampler	Sampled/logged by	FR/AK

Remarks: Light brown silty fine to medium sand with rare black seaweed/plankton fragments.

Biota: None noted.

Odours: None noted.

Anthropogenic Inputs: None noted.

Notes: Multiple attempts made at location F1 and only recovered coarse gravel and cobbles. Sampling location relocated further into harbour as F1A.



GRAB SAMPLE LOG

Date/Time	15/02/2023	Latitude	57.697990
Dredge Area	Findochty B	Longitude	-2.9039286
Method	0.045m ² Van Veen Grab Sampler	Sampled/logged by	FR/AK

Remarks: Soft dark grey silt.

Biota: None noted.

Odours: Strong H₂S odour.

Anthropogenic Inputs: None noted.

Notes: Sample obtained from pontoon as there was no access to location during low tide.



GRAB SAMPLE LOG

Date/Time	15/02/2023	Latitude	57.698413
Dredge Area	Findochty C	Longitude	-2.9043398
Method	0.045m ² Van Veen Grab Sampler	Sampled/logged by	FR/AK

Remarks: Soft sark grey slight sandy (fine) silt. Occasional vegetation/rootlets.

Biota: None noted.

Odours: Mild H₂S odour.

Anthropogenic Inputs: None noted.

Notes: Sample obtained from middle pier as there was no access to location during low tide.



GRAB SAMPLE LOG

Date/Time	15/02/2023	Latitude	57.704864
Dredge Area	Portknockie A	Longitude	-2.8633887
Method	0.045m ² Van Veen Grab Sampler	Sampled/logged by	FR/AK

Remarks: Grey silty fine to medium sand with occasional black seaweed fragments.


Biota: None noted.

Odours: None noted.

Anthropogenic Inputs: None noted.

Notes: -



 8 Eagle Street, Craighall Business Park, Glasgow, G4 9XA	Project Name	Moray Harbours - Pre-Dredge Licensing Support	Location ID
	Project No.	377468 (Portknockie)	P2
	Client	Arch Henderson	

GRAB SAMPLE LOG

Date/Time	15/02/2023	Latitude	57.704757
Dredge Area	Portknockie B	Longitude	-2.8618871
Method	0.045m ² Van Veen Grab Sampler	Sampled/logged by	FR/AK

Remarks: Soft dark grey silt (grey-brown on surface).


Biota: None noted.

Odours: Moderate H₂S odour.

Anthropogenic Inputs: None noted.

Notes: Sample obtained from pontoon as there was no access to location with the boat.



 8 Eagle Street, Craighall Business Park, Glasgow, G4 9XA	Project Name	Moray Harbours - Pre-Dredge Licensing Support	Location ID
	Project No.	377468 (Portknockie)	P3
	Client	Arch Henderson	

GRAB SAMPLE LOG

Date/Time	15/02/2023	Latitude	57.704501
Dredge Area	Portknockie C	Longitude	-2.8617392
Method	0.045m ² Van Veen Grab Sampler	Sampled/logged by	FR/AK

Remarks: Soft dark grey silt (grey-brown on surface).

Biota: None noted.

Odours: Moderate H₂S odour.

Anthropogenic Inputs: None noted.

Notes: Sample obtained by dry suit/foot as there was no access to location with the boat.



C DATA SUMMARY TABLES

Summary Table B

Buckie Harbour Average Concentrations

All units in mg/kg

Source	AL1	AL2	BAC CSEMP	<ERL CSEMP	PEL Canada	Dredge Average	Exceed AL1?	Exceed AL2?	Exceed BAC?	Exceed ERL ?	Exceed PEL?
Arsenic	20	70	25	-	41.6	11.4	No	No	No	N/A	No
Cadmium	0.4	4	0.31	1.2	4.2	0.5	Yes	No	Yes	No	No
Chromium	50	370	81	81	160	21.2	No	No	No	No	No
Copper	30	300	27	34	108	75.7	Yes	No	Yes	Yes	No
Mercury	0.25	1.5	0.07	0.15	0.7	0.1	No	No	Yes	No	No
Nickel	30	150	36	-	-	15.6	No	No	No	N/A	N/A
Lead	50	400	38	47	112	50.2	Yes	No	Yes	Yes	No
Zinc	130	600	122	150	271	148.7	Yes	No	Yes	No	No
Napthalene	0.1	-	0.08	0.16	0.319	0.0	No	N/A	No	No	No
Acenaphthylene	0.1	-	-	-	0.128	0.0	No	N/A	N/A	N/A	No
Acenaphthene	0.1	-	-	-	0.0889	0.0	No	N/A	N/A	N/A	No
Fluorene	0.1	-	-	-	0.144	0.0	No	N/A	N/A	N/A	No
Phenanthrene	0.1	-	0.032	0.24	0.544	0.1	No	N/A	Yes	No	No
Anthracene	0.1	-	0.05	0.085	0.245	0.0	No	N/A	No	No	No
Fluoranthene	0.1	-	0.039	0.6	1.494	0.2	Yes	N/A	Yes	No	No
Pyrene	0.1	-	0.024	0.665	1.398	0.3	Yes	N/A	Yes	No	No
Benzo(a)anthracene	0.1	-	0.016	0.261	0.693	0.1	Yes	N/A	Yes	No	No
Chrysene	0.1	-	0.02	0.384	0.846	0.1	Yes	N/A	Yes	No	No
Benzo(b)fluoranthene	0.1	-	-	-	-	0.1	Yes	N/A	N/A	N/A	N/A
Benzo(k)fluoranthene	0.1	-	-	-	-	0.1	Yes	N/A	N/A	N/A	N/A
Benzo(a)pyrene	0.1	-	0.03	0.384	0.763	0.1	Yes	N/A	Yes	No	No
Indeno(1,2,3cd)pyrene	0.1	-	0.103	0.24	-	0.1	Yes	N/A	Yes	No	N/A
Benzo(ghi)perylene	0.1	-	0.08	0.085	-	0.1	Yes	N/A	Yes	Yes	N/A
Dibenzo(a,h)anthracene	0.01	-	-	-	0.135	0.0	Yes	N/A	N/A	N/A	No
TPH	100	-	-	-	-	521.2	Yes	N/A	N/A	N/A	N/A
PCBs	0.02	0.18	-	-	0.189	0.004	No	No	N/A	N/A	No
TBT	0.1	0.5	-	-	-	0.031	No	No	N/A	N/A	N/A

Summary Table C

Cullen Harbour Average Concentrations

All units in mg/kg

Source	AL1	AL2	BAC	<ERL	PEL	Dredge Average	Exceed AL1?	Exceed AL2?	Exceed BAC?	Exceed ERL ?	Exceed PEL?
			CSEMP	CSEMP	Canada						
Arsenic	20	70	25	-	41.6	4.2	No	No	No	N/A	No
Cadmium	0.4	4	0.31	-	1.2	4.2	No	No	No	No	No
Chromium	50	370	81	-	81	160	No	No	No	No	No
Copper	30	300	27	-	34	108	No	No	No	No	No
Mercury	0.25	1.5	0.07	-	0.15	0.7	No	No	No	No	No
Nickel	30	150	36	-	-	6.7	No	No	No	N/A	N/A
Lead	50	400	38	-	47	112	No	No	No	No	No
Zinc	130	600	122	-	150	271	No	No	No	No	No
Napthalene	0.1	-	0.08	-	0.16	0.319	No	N/A	No	No	No
Acenaphthylene	0.1	-	-	-	-	0.128	No	N/A	N/A	N/A	No
Acenaphthene	0.1	-	-	-	-	0.0889	No	N/A	N/A	N/A	No
Fluorene	0.1	-	-	-	-	0.144	No	N/A	N/A	N/A	No
Phenanthrene	0.1	-	0.032	-	0.24	0.544	No	N/A	No	No	No
Anthracene	0.1	-	0.05	-	0.085	0.245	No	N/A	No	No	No
Fluoranthene	0.1	-	0.039	-	0.6	1.494	No	N/A	No	No	No
Pyrene	0.1	-	0.024	-	0.665	1.398	No	N/A	No	No	No
Benzo(a)anthracene	0.1	-	0.016	-	0.261	0.693	No	N/A	No	No	No
Chrysene	0.1	-	0.02	-	0.384	0.846	No	N/A	No	No	No
Benzo(b)fluoranthene	0.1	-	-	-	-	-	No	N/A	N/A	N/A	N/A
Benzo(k)fluoranthene	0.1	-	-	-	-	-	No	N/A	N/A	N/A	N/A
Benzo(a)pyrene	0.1	-	0.03	-	0.384	0.763	No	N/A	No	No	No
Indeno(1,2,3cd)pyrene	0.1	-	0.103	-	0.24	-	No	N/A	No	No	N/A
Benzo(ghi)perylene	0.1	-	0.08	-	0.085	-	No	N/A	No	No	N/A
Dibenzo(a,h)anthracene	0.01	-	-	-	-	0.135	No	N/A	N/A	N/A	No
TPH	100	-	-	-	-	-	No	N/A	N/A	N/A	N/A
PCBs	0.02	0.18	-	-	0.189	0.0006	No	No	N/A	N/A	No
TBT	0.1	0.5	-	-	-	0.0	No	No	N/A	N/A	N/A

Summary Table D

Findochty Harbour Average Concentrations

All units in mg/kg

Source	AL1	AL2	BAC	<ERL	PEL	Dredge Average	Exceed AL1?	Exceed AL2?	Exceed BAC?	Exceed ERL ?	Exceed PEL?
			CSEMP	CSEMP	Canada						
Arsenic	20	70	25	-	41.6	6.0	No	No	No	N/A	No
Cadmium	0.4	4	0.31	1.2	4.2	0.4	No	No	Yes	No	No
Chromium	50	370	81	81	160	18.5	No	No	No	No	No
Copper	30	300	27	34	108	30.8	Yes	No	Yes	No	No
Mercury	0.25	1.5	0.07	0.15	0.7	0.02	No	No	No	No	No
Nickel	30	150	36	-	-	11.3	No	No	No	N/A	N/A
Lead	50	400	38	47	112	17.9	No	No	No	No	No
Zinc	130	600	122	150	271	71.5	No	No	No	No	No
Napthalene	0.1	-	0.08	0.16	0.319	0.02	No	N/A	No	No	No
Acenaphthylene	0.1	-	-	-	0.128	0.02	No	N/A	N/A	N/A	No
Acenaphthene	0.1	-	-	-	0.0889	0.01	No	N/A	N/A	N/A	No
Fluorene	0.1	-	-	-	0.144	0.02	No	N/A	N/A	N/A	No
Phenanthrene	0.1	-	0.032	0.24	0.544	0.16	Yes	N/A	Yes	No	No
Anthracene	0.1	-	0.05	0.085	0.245	0.05	No	N/A	No	No	No
Fluoranthene	0.1	-	0.039	0.6	1.494	0.32	Yes	N/A	Yes	No	No
Pyrene	0.1	-	0.024	0.665	1.398	0.29	Yes	N/A	Yes	No	No
Benzo(a)anthracene	0.1	-	0.016	0.261	0.693	0.15	Yes	N/A	Yes	No	No
Chrysene	0.1	-	0.02	0.384	0.846	0.15	Yes	N/A	Yes	No	No
Benzo(b)fluoranthene	0.1	-	-	-	-	0.14	Yes	N/A	N/A	N/A	N/A
Benzo(k)fluoranthene	0.1	-	-	-	-	0.14	Yes	N/A	N/A	N/A	N/A
Benzo(a)pyrene	0.1	-	0.03	0.384	0.763	0.18	Yes	N/A	Yes	No	No
Indeno(1,2,3cd)pyrene	0.1	-	0.103	0.24	-	0.12	Yes	N/A	Yes	No	N/A
Benzo(ghi)perylene	0.1	-	0.08	0.085	-	0.11	Yes	N/A	Yes	Yes	N/A
Dibenzo(a,h)anthracene	0.01	-	-	-	0.135	0.02	Yes	N/A	N/A	N/A	No
TPH	100	-	-	-	-	91.6	No	N/A	N/A	N/A	N/A
PCBs	0.02	0.18	-	-	0.189	0.001	No	No	N/A	N/A	No
TBT	0.1	0.5	-	-	-	0.007	No	No	N/A	N/A	N/A

Summary Table E

Portknockie Harbour Average Concentrations

All units in mg/kg

Source	AL1	AL2	BAC	<ERL	PEL	Dredge Average	Exceed AL1?	Exceed AL2?	Exceed BAC?	Exceed ERL ?	Exceed PEL?
			CSEMP	CSEMP	Canada						
Arsenic	20	70	25	-	41.6	5.0	No	No	No	N/A	No
Cadmium	0.4	4	0.31	1.2	4.2	0.1	No	No	No	No	No
Chromium	50	370	81	81	160	16.0	No	No	No	No	No
Copper	30	300	27	34	108	26.1	No	No	No	No	No
Mercury	0.25	1.5	0.07	0.15	0.7	0.05	No	No	No	No	No
Nickel	30	150	36	-	-	10.5	No	No	No	N/A	N/A
Lead	50	400	38	47	112	16.2	No	No	No	No	No
Zinc	130	600	122	150	271	63.1	No	No	No	No	No
Napthalene	0.1	-	0.08	0.16	0.319	0.02	No	N/A	No	No	No
Acenaphthylene	0.1	-	-	-	0.128	0.02	No	N/A	N/A	N/A	No
Acenaphthene	0.1	-	-	-	0.0889	0.01	No	N/A	N/A	N/A	No
Fluorene	0.1	-	-	-	0.144	0.02	No	N/A	N/A	N/A	No
Phenanthrene	0.1	-	0.032	0.24	0.544	0.14	Yes	N/A	Yes	No	No
Anthracene	0.1	-	0.05	0.085	0.245	0.04	No	N/A	No	No	No
Fluoranthene	0.1	-	0.039	0.6	1.494	0.29	Yes	N/A	Yes	No	No
Pyrene	0.1	-	0.024	0.665	1.398	0.30	Yes	N/A	Yes	No	No
Benzo(a)anthracene	0.1	-	0.016	0.261	0.693	0.12	Yes	N/A	Yes	No	No
Chrysene	0.1	-	0.02	0.384	0.846	0.12	Yes	N/A	Yes	No	No
Benzo(b)fluoranthene	0.1	-	-	-	-	0.11	Yes	N/A	N/A	N/A	N/A
Benzo(k)fluoranthene	0.1	-	-	-	-	0.11	Yes	N/A	N/A	N/A	N/A
Benzo(a)pyrene	0.1	-	0.03	0.384	0.763	0.14	Yes	N/A	Yes	No	No
Indeno(1,2,3cd)pyrene	0.1	-	0.103	0.24	-	0.10	No	N/A	No	No	N/A
Benzo(ghi)perylene	0.1	-	0.08	0.085	-	0.09	No	N/A	Yes	Yes	N/A
Dibenzo(a,h)anthracene	0.01	-	-	-	0.135	0.02	Yes	N/A	N/A	N/A	No
TPH	100	-	-	-	-	89.5	No	N/A	N/A	N/A	N/A
PCBs	0.02	0.18	-	-	0.189	0.001	No	No	N/A	N/A	No
TBT	0.1	0.5	-	-	-	0.005	No	No	N/A	N/A	N/A

Summary Table F

	AL1	AL2	BAC	<ERL	ISQG/TEL	PEL	Buckie 2000 Sample
Source			CSEMP	CSEMP	Canada		
Arsenic	20	70	25	-	7.2	41.6	2.9
Cadmium	0.4	4	0.31	1.2	0.7	4.2	<0.2
Chromium	50	370	81	81	52.3	160	6.2
Copper	30	300	27	34	18.7	108	5.7
Mercury	0.25	1.5	0.07	0.15	0.13	0.7	0.01
Nickel	30	150	36	-	-	-	7.5
Lead	50	400	38	47	30.2	112	11.0
Zinc	130	600	122	150	124	271	27.6
Napthalene	0.1		0.08	0.16	-	0.319	0.20
Acenaphthylene	0.1		-	-	0.00587	0.128	ND
Acenaphthene	0.1		-	-	0.00671	0.0889	ND
Fluorene	0.1		-	-	0.0212	0.144	1.40
Phenanthrene	0.1		0.032	0.24	0.0867	0.544	0.90
Anthracene	0.1		0.05	0.085	0.0469	0.245	0.20
Fluoranthene	0.1		0.039	0.6	0.113	1.494	-
Pyrene	0.1		0.024	0.665	0.153	1.398	1.20
Benzo(a)anthracene	0.1		0.016	0.261	0.0748	0.693	0.50
Chrysene	0.1		0.02	0.384	0.108	0.846	0.90
Benzo(b)fluoranthene	0.1		-	-	-	-	-
Benzo(k)fluoranthene	0.1		-	-	-	-	-
Benzo(a)pyrene	0.1		0.03	0.384	0.0888	0.763	0.80
Indeno(1,2,3cd)pyrene	0.1		0.103	0.24	-	-	1.20
Benzo(ghi)perylene	0.1		0.08	0.085	-	-	-
Dibenzo(a,h)anthracene	0.01		-	-	0.00622	0.135	-
PCBs	0.02	0.18	-	-	0.0215	0.189	-
TBT	0.1	0.5	-	-	-	-	-