BAE Systems
Best Practicable Environmental Options (BPEO) Report -Scotstoun Deep Water Berth

November 2021

BAE Systems
Best Practicable Environmental Options (BPEO) Report -Scotstoun Deep Water Berth

Client:	Arch Henderson
Document number:	9278
Project number:	174067
Status:	Final
Author:	Graeme Duff
Reviewer:	Campbell Stewart
Date of issue:	10 November 2021
Filename:	BAE Systems Maintenance Dredge Final Working CCAS

Glasgow

Craighall Business Park
8 Eagle Street
Glasgow
G4 9XA
0141 341 5040
info@envirocentre.co.uk
www.envirocentre.co.uk

Aberdeen

Banchory Business Centre
Burn O'Bennie Road
Banchory
AB31 5ZU
01330 826 596

Inverness

Alder House
Cradlehall Business Park
Inverness
IV2 5GH
01463 794 212

Edinburgh

1st Floor, Sirius Building, The Clocktower Estate,
South Gyle Crescent,
Edinburgh, EH12 9LB

Contents

Appendices

Tables

1 INTRODUCTION

1.1 Scope of Report

EnviroCentre have been commissioned by Arch Henderson on behalf BAE Systems Surface Ships Limited (BAE) to produce a Best Practicable Environmental Option Assessment (BPEO) in support of maintenance dredging on the River Clyde, as part of their normal ship building programme under the Dredging and Deposit of Solid Waste in the Territorial Sea and UK Controlled Waters Adjacent to Scotland Marine (Scotland) Act 2010.

This application relates to proposed maintenance dredging of the Deep Water Berth Area at the BAE Scotstoun yard (the dredge area and depths are detailed on the Arch Henderson Drawings provided in Appendix A.

There is a current Maintenance Dredge Licence (licence number MS-00009087) which relates to dredging of the BAE Scotstoun and Govan yards including the area of the Deep Water Berth.

Capital dredging to increase the depth of the Deep Water Berth area was undertaken in 2021 under dredge licence MS-00009092, as such the maintenance dredge depths required for this area differ from those defined as part of the MS-00009087 licence.

An application for a maintenance dredge of the newly formed Deep Water Berths is therefore being submitted, which this BPEO relates to.

As the area has been recently dredged under the Capital Dredge licence there is no sediment currently accumulated to sample or assess. To inform this BPEO sediment quality information relating to the previous capital dredge BPEO has been adopted. It is noted that the both the noted previous maintenance dredge and capital dredge BPEO's identified disposal to sea as the preferred option for the sediment disposal.

The purpose of this report is to review each of the available potential disposal options for the maintenance 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 Programme of Work

The programme of work involves the removal of up to 14,000m3 (28,000 tonnes) of material in the Deep Water Berth Pit area, assumed to form a mixture of silts, sands and clay. It is likely that the silt will require to be removed by trailer suction or grab dredger.

1.3 Dredging Activities

The method of dredging at the dredge site has not been completely finalised and the specific plant will not be confirmed until a contractor has been appointed. However, the method is most likely to be a combination of using a suction cutter dredger or a grab dredger or marine based plant working in conjunction with a hopper barge.

These are all tried and tested techniques which have been ongoing on the River Clyde (and continue with other river users) for decades. There is understood to be no impact on wildlife and sedimentation patterns continue as per previous dredging exercises.

1.4 Sources of Information

In compiling this report, the following information sources have been consulted either in connection with this application or as part of the ongoing consultation process for the maintenance dredging regime:

- Peel Ports Clydeport Limited;
- Crown Estates Commissioner;
- Scottish Natural Heritage;
- Marine Scotland; and
- BAE SYSTEMS

1.5 Nature of the Marine Sediments

As part of the Capital Dredging campaign a pre-dredge sampling exercise incorporating 4 vibrocored sample locations (and subsequent analysis of 13 samples from these cores) was undertaken in November 2020. To inform this BPEO these results and associated discussion have been adopted.

The locations of the samples are detailed in EnviroCentre drawings 174067-GIS-04. The sediment sampling report is provided in Appendix B.

A summary of the laboratory testing is detailed below:

- None of the samples recorded exceedances of REV AL2.
- All 13 of the samples recorded exceedances of REV AL1 for heavy metals (exceedances noted for cadmium, chromium, copper, lead, mercury, nickel and zinc).
- All of the 13 samples recorded exceedances of REV AL1 for PAHs.
- All 13 samples recorded exceedances of REV AL1 for THC.
- 12 of the 13 samples recorded exceedances of REV AL1 for PCBs.

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?
Estuary/ Riverbank	Leave in situ	Not an option due to the project specific requirements to provide appropriate depth for the Deep Water Berth.	No
	Infilling of an existing dry dock/harbour facility/development site (re-use)	There are no identified projects that are currently progressing that will require material within the timeframe of the proposed Scotstoun dredging work.	No
	Beach Nourishment	Large areas of the Firth of Clyde and Inner Estuary are designated sites (SSSI, SPA, Ramsar) 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 dredge material comprises a mixture of gravel, sand and predominately silt. Fine sediments (i.e. silt) is not suitable for beach nourishment in the traditional sense.	No
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.	Yes
	Land Incineration	The dredged material consists of non-combustible material (silts, sands, gravels, shells, rock) 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 the Clyde estuary 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. The closest spoil ground Cloch Point (MA021) is located approximately 35km from the closest proposed dredge site with an assigned licensed annual capacity of 830,000 tonnes.	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:

- Landfill Disposal; 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 Landfill Disposal

Dredged material is considered to be controlled waste for the purpose of transport, storage and disposal as per Section 34 (7) of the Environmental Protection Act 1990. The Landfill (Scotland) Regulations 2003 require the classification and characterisation (i.e. inert, non-hazardous or hazardous) of the dredged material to be determined prior to landfill acceptance.

Disposal to landfill would require several stages in material handling operations:

- Dredging and transport to shore;
- Transfer to shore to a dewatering facility;
- Dewatering;
- Transfer of dewatered material to storage area for stockpiling;
- Loading of lorries and transport to landfill site; and
- Disposal at Landfill site.

Transport to the shore would require the identification of an available jetty facility suitable for receiving material directly to the dewatering facility. Two options are available for off-loading; namely grabbing the spoil from the barge or hopper or pumping directly ashore.

The dewatering facility would require being purpose built and capable of receiving large quantities of bulk material. Currently no facility exists on the Clyde. Settlement tanks, with the aid of sluices and rotational management, would allow solids to settle out and the water element drain off and return to the River Clyde. Temporary mobilisation of bespoke mechanical dewatering equipment could also be utilised but at greater cost. The dewatered dredged sediment would then be removed from the facility and stockpiled for transfer via lorry to a suitably licensed landfill.

We understand that the type of vehicle most suitable for transporting the dewatered dredged material is either a rigid bodied tipper or an articulated tanker both with a 16 tonne load capacity. It is estimated that the dredge volume equates to c. 56,000 tonnes of material and would require approximately 3,500 return trips would typically be required to transport the dewatered dredged material to landfill.

The number of landfills within a viable distance of the River Clyde is considered to be low. In addition, the available capacity of each site is limited by the amount of material it can receive per annum. Due to the proposed quantity of material to be dredged it is therefore unlikely that any landfill within viable distance of the River Clyde will have the capacity to receive the dredged material.

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 1.6 nautical miles North of Cloch Point. 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	• 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	• Safety Implications • Public Health Implications • Pollution/ Contamination Implications • General Ecological Implications • Interference with other legitimate activities e.g. fishing • Amenity/Aesthetic Implications
Costs	• 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	Landfill	Sea Disposal
Operational Aspects (inc. handling and transport)	Would involve double handling of material through dewatering and transportation to landfill. A facility would need to be built for dewatering purposes. Would also increase the number of HGV's on the road network. Four jetties which could be suitable for landing the spoil have been identified within 30 km of the dredge site; these are: • BAE SYSTEMS, Clyde Yards; • Faslane, Gare Loch. Owned and operated by MoD; • James Watt Dock, Greenock. Owned and operated by Peelports Clydeport Limited; and • Inchgreen Owned and operated by Peelports Clydeport Limited. Faslane and BAE Systems have been discounted by their owners as being unavailable for this type of activity. The James Watt Dock has previously been used for the unloading of aggregates and has been confirmed as being suitable but a temporary storage area is not readily available. Inchgreen may be suitable but further discussions on availability and storage area available are required.	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.
Availability of suitable sites/facilities	The geotechnical composition of the dewatered River Clyde dredged material is considered to be suitable for disposal via this route. However, there is typically a limit to the amount of waste that can be accepted both on a daily and annual basis at a landfill. The landfill capacity will therefore not be able to accommodate the quantity of material generated by the River Clyde dredging activities and another disposal option will be required for the surplus material.	The marine disposal site has been designed to accommodate the quantities typically generated by dredging operations and is anticipated to be active for the foreseeable future. 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.

Criteria	Landfill	Sea Disposal
General Public /Local acceptability	Increase traffic on haul routes therefore potential for increase in public complaints because of danger to pedestrians and other road users, impact on the environment and interruption to traffic flow.	Traditionally accepted disposal route for dredged material and limited public impact.
Legislative Implications	Contravenes the principles of minimising waste and long-term commitments by the government to reduce land filling.	This is an accepted disposal route as long as a Marine Licence is obtained.

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	Landfill	Sea Disposal
Safety Implications	Double handling of material increases the 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	Measures will be required to limit human contact during transfer of material from dredger to dewatering facility and transportation to landfill. The additional lorry movements are likely to give rise to increases in noise, dust and exhaust emission levels and interference for other road users. Security measures typically employed at licensed landfills which will minimise human contact once accepted and emplaced at site.	Low potential for human contact during dredging and disposal operations. Once deposited at disposal site pathways for human contact greatly reduced.
Pollution/contamination	Pumping ashore to dewatering facility and transportation to landfill will all require energy. Road transport increases the carbon footprint of this disposal option. Potential for spillages to occur. Saline sediment may not meet Waste Acceptance Criteria requirements for disposal in inert landfill facilities?	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	Licensed landfill would be away from protected species and habitats with measures in place to prevent or minimise pollution of the surrounding environment.	Disposal at Cloch Point site has historically been used and is the closest licensed disposal site.

Criteria	Landfill	Sea Disposal
Interference with other legitimate activities	Potential from limited short term local impact to commercial operations in the area of the dredged material handling and road hauling principally related to noise and dust potential.	Designated disposal site, as such there is considered no significant impact to commercial vessels or commercial fishing.
Amenity / Aesthetic Implications	Odour release from dewatering facility. Increase traffic noise during transportation from dewatering facility to landfill facility. Potential for spillages on haul route. No significant additional visual/ odour/noise effects as using existing landfill site.	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

An operating cost estimate is provided in the table below. It should be noted that the rates in Table 4a are based on the dredged spoil being able to be transferred ashore in its as dug state and do not allow for placing within a bunded area, draining the material or transporting in watertight wagons. If any of these are required, the costs would increase significantly.

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

Table 3-4: BPEO Cost Analysis

Disposal Option	Activity Description	Weight (Tons)	Unit Cost (Tonne)	Cost (£)
Landfill Disposal	Excavation	28,000	1.50	42,000
	Transport by barge	28,000	3.00	84,000
	Transfer to lorry	28,000	2.00	56,000
	Transport by lorry	28,000	8.00	224,000
	Disposal to land	28,000	2.50	70,000
	Total	28,000	**17**	**£476,000**
Sea Disposal	**Sea Disposal**	28,000	**4.50**	**£126,000**

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	Landfill Disposal	Sea Disposal
Environment	4	2
Strategic	4	2
Costs	4	1
TOTAL SCORE	**12**	**5**

Disposal to landfill is considered to be the least suitable option for the dredged material. It contravenes the principles of minimising waste and reducing landfilling. Several stages in material handling operations would be required to dispose of the material by this route. The cost associated with setting up a suitable treatment facility to dewater the dredged material is significant. Transportation of material by road is also undesirable as a result of increased traffic and the potential for accidental spillages. Landfill capacity is also typically limited and potentially unable to accommodate the quantities of material typically generated by the River Clyde dredging operations. Any surplus dredged material will therefore require to be disposed of via an alternative route.

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 maintenance dredge from the Deep Water Berths has therefore been assessed as sea disposal.

As identified in the sediment chemical quality section, further assessment is deemed necessary to confirm the suitability of the sediment for sea disposal. 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 C, 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 Background Data – Dredge and Disposal Site

Cloch Point Disposal site is located in the Firth of Clyde and is licensed annually to receive close to 830,000 tonnes of dredge material. Less than half of the annual licensed capacity has been used in the past 3 years.

Marine Scotland noted that in Scotland the preference for disposal site selection is those which are dispersive, and as such it is assumed that the Cloch Point disposal ground is dispersive.

Chemical analysis data for samples collected from the disposal ground in 1995, 1997, 2003, and 2005 were provided for review by Marine Scotland, to enable an assessment of the existing conditions at the site to be undertaken. A high-level review of these data highlights the following with the summary table presented as Table C in Appendix C with observations as follows:

- Average concentrations at Cloch Point exceed the ERL for chromium, copper, mercury, lead, zinc and benzo(a)pyrene (PAHs)

- Average concentrations at Cloch Point exceed the PEL for lead and benzo(a)pyrene (PAHs)
- The maximum concentrations of the following contaminants exceed the PEL at Cloch Point chromium, copper, mercury, lead and zinc as well as PCBs (ICEs 7) and various PAH species including benzo(a)pyrene.

4.2 Analytical Data Review

Existing analytical data for the proposed dredge site is 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.

A summary of the exceedances is detailed below:

Existing analytical data for the proposed dredge site is provided in Appendix C.

4.3 Scotstoun Dredge Site

The information can be summarised as follows:

- All 13 samples exceed RAL1 for one or more metal;
- All 13 samples record exceedances of RAL1 for various PAH species;
- All 13 samples record RAL1 exceedances for THC
- 12 of 13 samples record total PCBs above RAL1;
- The ERL is exceeded in all samples by various metals and PAHs where values are available for review;
- The PEL is exceeded for chromium (3 samples), copper (5 samples), mercury (2 samples), lead (12 samples) and zinc (12 samples). The PEL is exceeded for a number of PAHs with benzo(a)pyrene having the most exceedances in 12 samples.
- No samples recorded contaminants in exceedance of RAL 2 where one is available for review.

4.4 Averages

Review of the averaged data as presented in in Appendix C for both sites i.e. considering the material as a single volume for disposal. The concentrations of the various contaminants of concern are quite variable, the review of average data against the available adopted assessment criteria are as follows:

- Averaged concentrations for both sites exceeded RAL1 for all contaminants of concern with the exception of arsenic, acenaphthylene and TBT.

- Averaged concentrations of cadmium, chromium, copper, lead, mercury, zinc, and various PAH species exceed the ERL;

- Lead, zinc, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, benzo(a)anthracene, chrysene, benzo(a)pyrene and dibenz(a,h)anthracene recorded averages which were above the PEL;

- All samples recorded average concentrations below RAL2.

4.5 Chemical Assessment Conclusions

While several contaminants of concern were recorded in exceedance of REV AL1, no exceedances of RAL 2 were recorded in any of the samples collected. The disposal site at Cloch Point has similar levels and ranges, and sometimes higher levels, of contaminants of concern as the material which is proposed to be deposited and is not considered to have an adverse effect upon the disposal site and is considered to be consistent with the material already present at the disposal site

4.6 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	The dredge site is within the Inner Clyde Estuary which is classified as a Heavily Modified Water Body (HWMB) of Moderate Status/Potential[2]. The disposal site is located within the Firth of Clyde Inner - Dunoon and Wemyss Bay area which is Classified as Good and is not considered to be heavily Modified. The classification of this water body takes into account the presence of the disposal site, so no further assessment is considered to be required.
Biology - habitats	Included to assess potential impacts to sensitive/high value habitats.	No	The inner Clyde Estuary and Firth of Clyde Inner - Dunoon and Wemyss Bay are all classified as Good Potential/Status or pass for Coastal and Transitional Waters for fish. The outer Clyde Estuary has been classified as High Potential Status for macro invertebrates. There was no classification for the inner estuary. Clyde Inner - Dunoon and Wemyss Bay are all classified as Good Potential/Status or pass for Coastal waters for macro invertebrates. Proposed material to be deposited as part of dredging campaign(s) similar in nature with material previously deposited. No further assessment considered necessary.

[1] https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters
[2] https://map.environment.gov.scot/sewebmap/

Key Receptor[1]	Brief Summary of Potential Effects on Receptor	Further Consideration Required?	Comment
Biology – fish	Consideration of fish both within the estuary and also potential effects on migratory fish in transit through the estuary	No	The inner and outer Clyde Estuary and Firth of Clyde Inner - Dunoon and Wemyss Bay are all classified as Good Potential/Status or pass for Coastal and Transitional Waters for fish. Proposed material to be deposited as part of dredging campaign(s) similar in nature with material previously deposited. No further assessment considered necessary. It is noted that under periods of exceptionally hot and dry weather the potential for oxygen related issues to arise i.e. oxygen depletion and it is proposed that dredging works will be avoided as far as practicable during such times.
Water Quality	Consideration must be given to water quality when contaminants are present in exceedance of CEFAS RAL1.	No	The inner Clyde Estuary is classified as Bad potential/status or fail for “specific pollutants”. The outer estuary and Firth of Clyde Inner - Dunoon and Wemyss Bay are classified as Good potential/status or pass for “specific pollutants”. No classification is provided for the inner Clyde Estuary for status for “priority pollutants”. The Outer estuary and Firth of Clyde Inner - Dunoon and Wemyss Bay both are both classified as Good Potential/Status or pass for Coastal and Transitional Waters. Contaminants are noted to exceed CEFAS RAL1 within sediment samples. It is noted that sediments with comparable contaminant levels have been deposited at Cloch Point historically, chemical status has not been affected. Potential effects are considered to be both local and temporary. Further consideration of potential effects is discussed in section 4.7 for completeness.

Key Receptor[1]	Brief Summary of Potential Effects on Receptor	Further Consideration Required?	Comment
Protected Areas	If your activity is within 2km of any WFD protected area, include each identified area in your impact assessment. • special areas of conservation (SAC) • special protection areas (SPA) • shellfish waters • bathing waters • nutrient sensitive areas	Yes	The proposed disposal site is not located within 2km of an SAC or SPA, marine protected area or Ramsar sites. The disposal site is located approximately 4.5km from the closest designated bathing water at Lunderston Bay. The dredge and disposal sites are not designated as shellfish water. The closest Shellfish Waters Protected Areas are located at Kyles of Bute and Loch Striven over 20km to the south and west; and Loch Long located approximately 20km north of the disposal site. The locations of dredging activity area are within close proximity to (but not within) the Inner Clyde SPA and River Clyde Ramsar site. The minimum distance between any of the dredge areas and the designated SPA/Ramsar is approximately 40m. The Inner Clyde Estuary has been notified as a Special Protection Area (SPA) under the EC Wild Birds Directive and as a Ramsar site under international designation. The dredging activities are focussed adjacent to the maintained channel area of the River Clyde. The birds of the estuary feed on the eelgrass, mussel beds, and on the abundant invertebrate fauna of the intertidal mudflats, sandflats and saltmarsh which are not included with the proposed works.

4.7 Potential Risk to Water Quality and Marine Life

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 coastal water body Firth of Clyde Inner - Dunoon and Wemyss in the area of the disposal ground as “good” for both specific and priority pollutants in 2018[3]. The dredge area is in the Inner estuary, which has an estuarine classification of “moderate ecological potential” (SEPA, 2018). No further information was available relating to the reason for the moderate status.

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 in proximity to the disposal site. While any effects are considered to be both localised and temporary, the potential for dilution in the Firth of Clyde (Firth of Clyde Inner - Dunoon and Wemyss) is considerable when comparing the size of disposal site in relation to the wider Firth of Clyde.. On this basis the risks from the sediment are considered to be low, with the associated dilution potential providing further mitigation.

The key contaminants for impacting water quality are considered to be metals as these have the potential to dissolve/desorb from sorption sites, whereas the organic contaminants (e.g. PAHs and PCBs) have a greater affinity for the organic materials which they are bound to, and are more likely to remain strongly bound to the sediment, or if become dissolved, quickly adsorbed onto organic matter within the water column or sediments.

Additionally, the sediment quality within the disposal ground which is also noted to contain levels of contaminants of concern, with some recorded to exceed the PEL, does not appear to have impacted on the Water Quality classification of “good” in this area.

The key risk is considered to be an increase in turbidity/suspended solids during the disposal activity, although this is likely to cause localised degradation in water quality, it is considered that this will be a local and temporary event and has been factored in to the selection and location of the agreed disposal ground. The material is similar in chemical nature to material previously deposited.

The sediment material primarily ranges silt to gravel with the dominant fraction recorded as silt. As part of the dredge there is also anticipated to a fraction of bedrock, which would likely be broken up into smaller fragments during dredging.

Consultation previously undertaken with Marine Scotland in November 2017 indicated there was no recent information regarding modelling or dispersion studies for the area. On this basis, there is no current information available to inform the potential for dispersion of sediment out with the disposal grounds (i.e. water current velocity, stratification in water column, weather impacts etc). The disposal site is a sacrificial disposal ground and as such there is considered to be an allowance for some lateral dispersal of materials within the area of disposal.

The dominant sediment type at the site is silt. Considering the dredge volume as a whole using averaged particle size analysis data, the dominant sediment type is silt comprising up to 82.8% silt and the remainder made up of sand and a minor content of gravel.

[3] https://map.environment.gov.scot/sewebmap/

Once deposited larger grained materials (rock, gravel and sands) will fall quickly to the bottom, while finer grained material (silt and clay) can suspend for longer within the water column. If the finer grained material is cohesive and in clumps, the it will sink much quicker than if in a slurry.

It is noted that the Cloch Point disposal grounds have been utilised for the maintenance dredge disposal from the River Clyde 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”).

On the basis of the information from dredge disposal to the Cloch Point site, it is considered that the potential for impact to the Water Environment out with the disposal grounds from the clay/silt sediment fractions is considered to be low.

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.

4.8 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 grounds and are at similar levels previously deposited at Cloch Point.

Overall, based on the multiple lines of evidence approach adopted to further assess the exceedances identified in the sediment assessment, the recommendation for sea disposal is considered to be the preferred option.

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.

REFERENCES

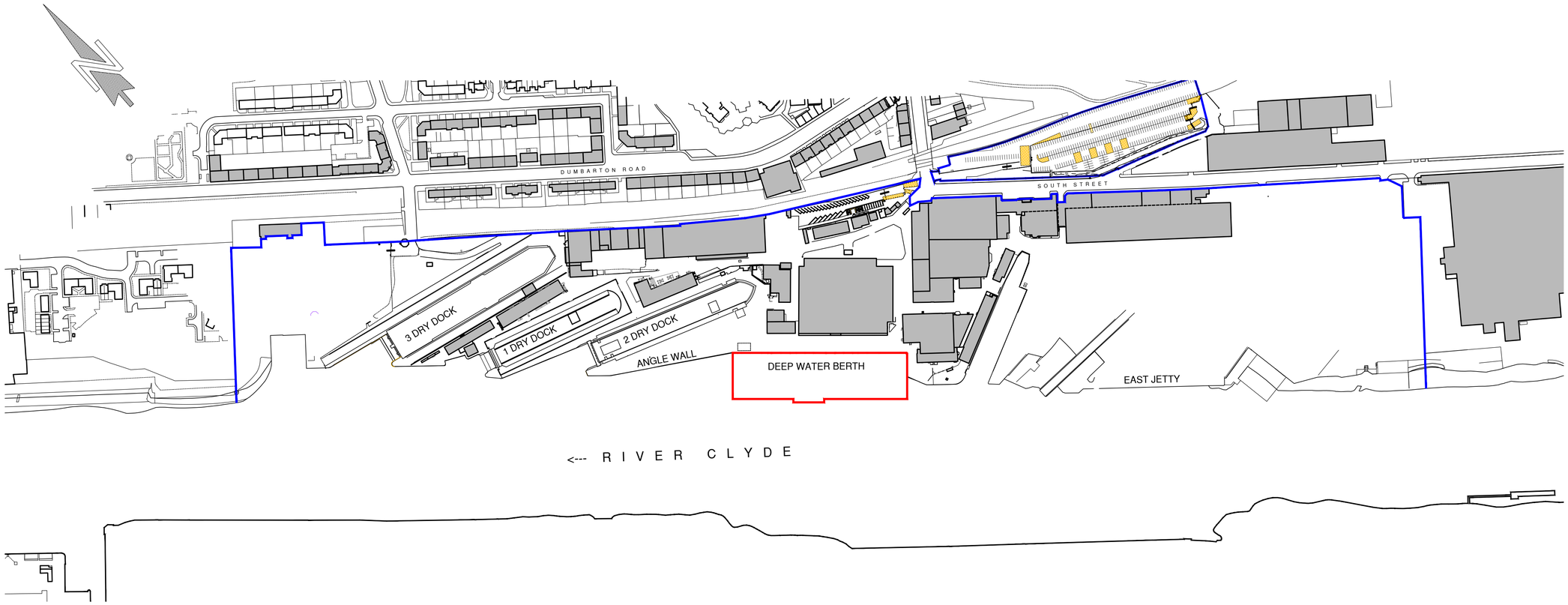
Marine Scotland (2017). *Pre-Dredge Sampling Guidance Version 2*: Scottish Government.

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

APPENDICES

APPENDICES

A FIGURES



EXISTING SITE OWNERSHIP BOUNDARY @ 1:2500

Denotes Site Ownership Boundary

Denotes boundary of dredging works.

NOTES

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL DRAWINGS IN THE 205026 SERIES.

REV	DATE	REVISION DESCRIPTION	DRN	VER

Arch Henderson 1919

Civil Engineers
Structural Engineers
Principal Designers
Architects
Geotechnical services
Environmental services

142 St. Vincent Street, Glasgow G2 5LA
Tel : 0141 227 3060 - Fax : 0141 248 9542
www.arch-henderson.co.uk - email : glasgow@arch-henderson.co.uk

Offices in : Aberdeen, Dundee, Falkland Islands, Glasgow, Inverness, Lerwick, Southampton, Stromness and Thurso

PROJECT :

BAE SURFACE SHIPS Ltd.
SCOTSTOUN DEEP WATER BERTH

TITLE :

NEW PITS AND DREDGING
SITE LOCATION PLAN

DRAWN :	DATE :	VERIFIED :	APPROVED :
G.B.	6.10.21	G.B.	G.B.

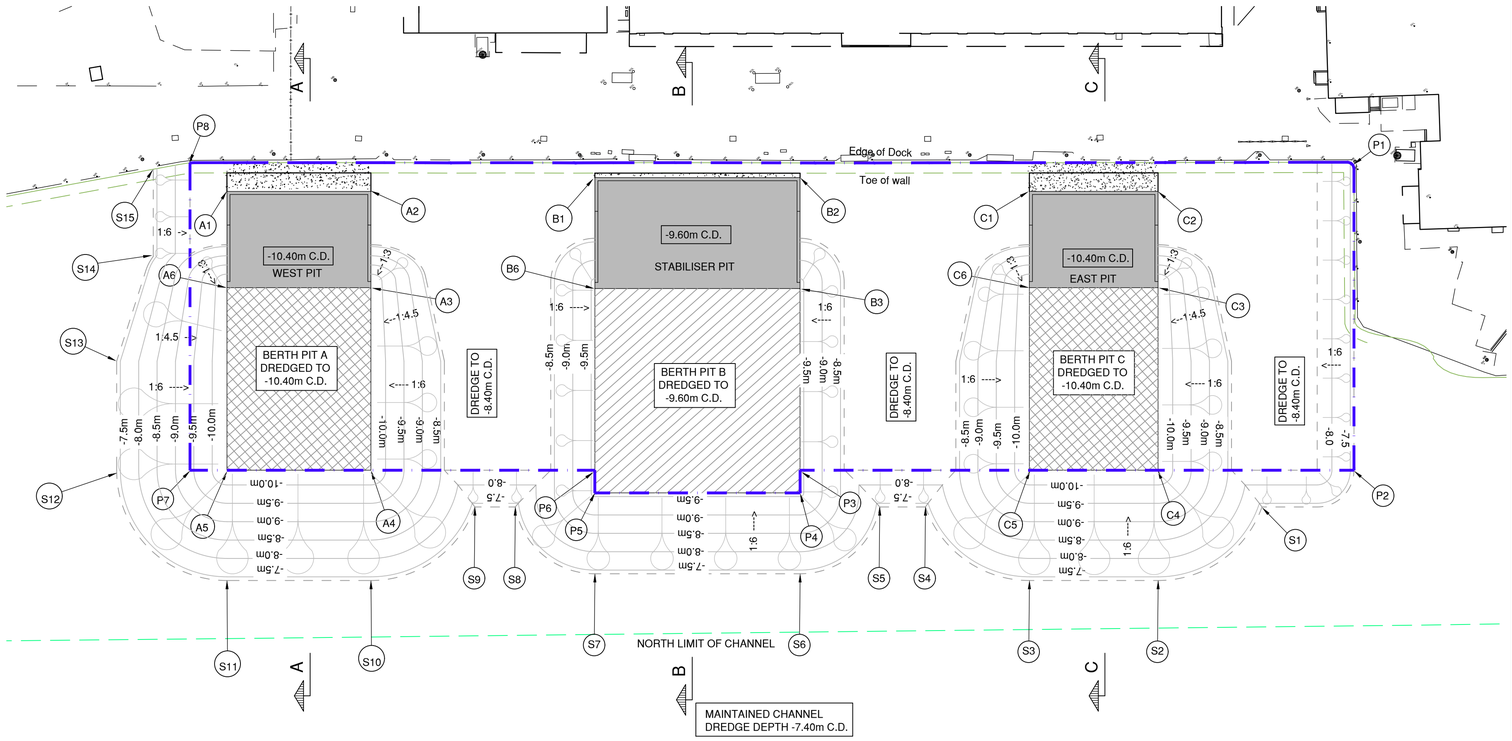
SCALE : (A1)

DRAWING STATUS : CONSENT

DRAWING No : 205026-201

REV : /

DO NOT SCALE



NEW DREDGING LAYOUT

DREDGING CO-ORDINATES NATIONAL GRID

BERTH DREDGING TOP OF SLOPE		
S1	251994.543E	667792.388N
S2	251973.897E	667794.704N
S3	251958.205E	667808.678N
S4	251953.512E	667828.926N
S5	251947.940E	667833.888N
S6	251930.984E	667834.392N
S7	251905.965E	667856.670N
S8	251903.507E	667873.455N
S9	251898.584E	667877.838N
S10	251877.930E	667880.162N
S11	251860.380E	667895.791N
S12	251858.908E	667921.204N
S13	251870.746E	667934.497N
S14	251887.093E	667942.972N
S15	251896.035E	667953.916N

BERTH DREDGING		
P1	252043.171E	667824.423N
P2	252009.744E	667786.886N
P3	251942.223E	667847.013N
P4	251939.762E	667844.250N
P5	251914.744E	667866.528N
P6	251917.204E	667869.291N
P7	251867.849E	667913.242N
P8	251901.193E	667950.686N

EAST PIT "C"		
C1	252000.435E	667856.101N
C2	252016.118E	667842.135N
C3	252005.677E	667830.410N
C4	251985.859E	667808.155N
C5	251970.176E	667822.121N
C6	251989.994E	667844.376N

WEST PIT "A"		
A1	251902.610E	667943.213N
A2	251920.160E	667927.585N
A3	251892.169E	667931.488N
A4	251889.901E	667893.605N
A5	251872.351E	667909.233N
A6	251909.719E	667915.860N

STABILISER PIT "B"		
B1	251948.960E	667904.952N
B2	251973.978E	667882.673N
B3	251961.941E	667869.156N
P4	251939.762E	667844.250N
P5	251914.744E	667866.528N
B6	251936.923E	667891.434N

DREDGING CO-ORDINATES LATITUDE & LONGITUDE

BERTH DREDGING TOP OF SLOPE		
S1	55° 52.82850	-4° 22.05376
S2	55° 52.82940	-4° 22.07362
S3	55° 52.83660	-4° 22.08911
S4	55° 52.84746	-4° 22.09427
S5	55° 52.84998	-4° 22.09978
S6	55° 52.84998	-4° 22.11604
S7	55° 52.86150	-4° 22.14074
S8	55° 52.87050	-4° 22.14365
S9	55° 52.87278	-4° 22.14851
S10	55° 52.87362	-4° 22.16838
S11	55° 52.88172	-4° 22.18571
S12	55° 52.89540	-4° 22.18795
S13	55° 52.90278	-4° 22.17705
S14	55° 52.90764	-4° 22.16166
S15	55° 52.91370	-4° 22.15345

BERTH DREDGING		
P1	55° 52.84668	-4° 22.00821
P2	55° 52.82580	-4° 22.03901
P3	55° 52.85700	-4° 22.10568
P4	55° 52.85544	-4° 22.10795
P5	55° 52.86696	-4° 22.13266
P6	55° 52.86846	-4° 22.13039
P7	55° 52.89126	-4° 22.17913
P8	55° 52.90116	-4° 22.14840

EAST PIT "C"		
C1	55° 52.86294	-4° 22.05020
C2	55° 52.85568	-4° 22.03471
C3	55° 52.84920	-4° 22.04434
C4	55° 52.83684	-4° 22.06260
C5	55° 52.84410	-4° 22.07808
C6	55° 52.85646	-4° 22.05982

WEST PIT "A"		
A1	55° 52.90806	-4° 22.14680
A2	55° 52.89990	-4° 22.12947
A3	55° 52.90158	-4° 22.15642
A4	55° 52.88130	-4° 22.14776
A5	55° 52.88922	-4° 22.17469
A6	55° 52.89348	-4° 22.13909

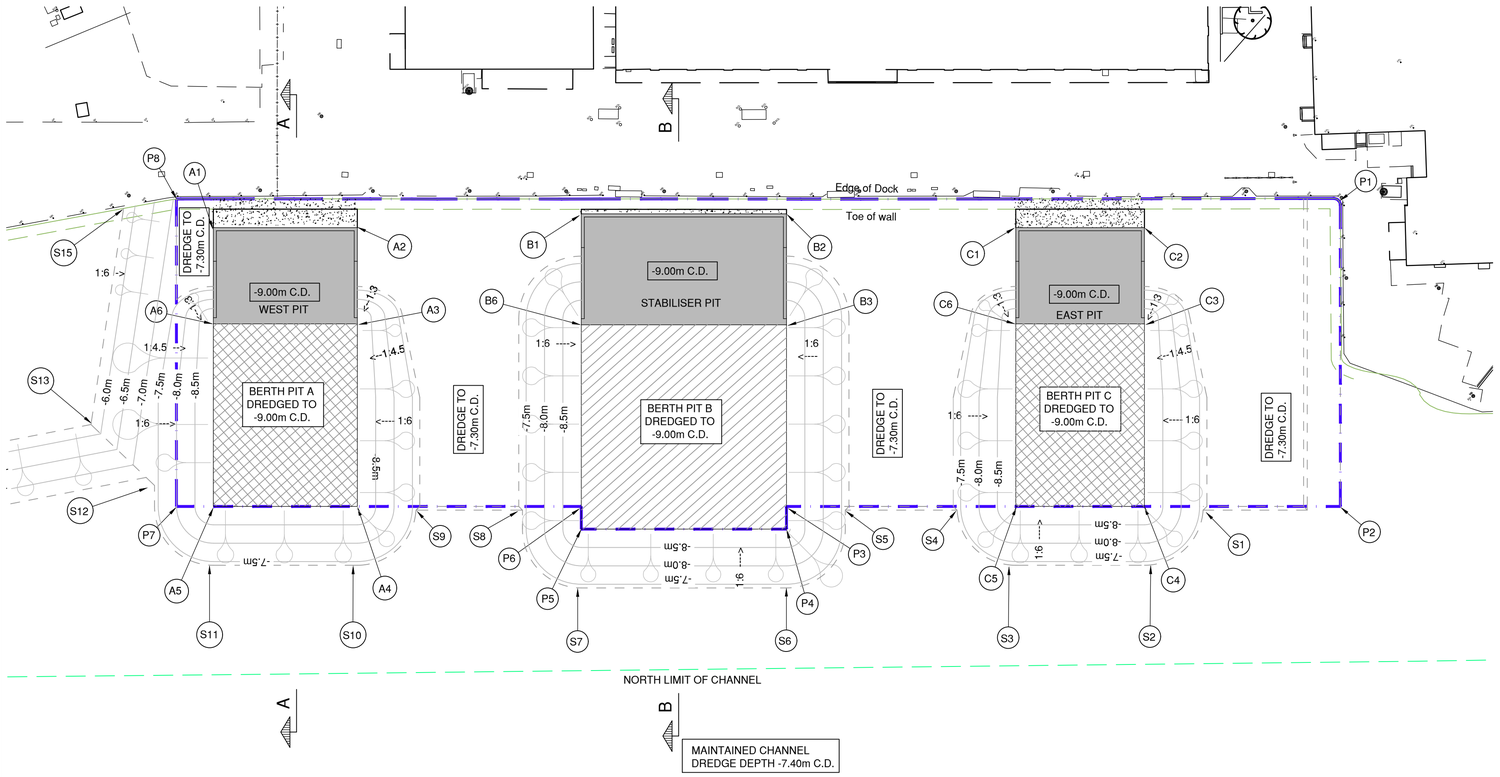
STABILISER PIT "B"		
B1	55° 52.88832	-4° 22.10113
B2	55° 52.87674	-4° 22.07642
B3	55° 52.86924	-4° 22.08751
P4	55° 52.85544	-4° 22.10795
P5	55° 52.86696	-4° 22.13666
B6	55° 52.88082	-4° 22.11222

NOTES

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL DRAWINGS IN THE 205034-100 SERIES.
2. FOR SECTIONS A-A & B-B, REFER TO DRAWING NUMBER 205034-104.

LEGEND

BOUNDARY OF PROPOSED CONSTRUCTION WORKS



EXISTING DREDGING LAYOUT

DREDGING CO-ORDINATES NATIONAL GRID

BERTH DREDGING TOP OF SLOPE		
S1	251992.615E	667801.335N
S2	251979.097 E	667801.322N
S3	251963.791 E	667814.951N
S4	251962.621E	667828.044N
S5	251948.993E	667840.180N
S6	251933.378E	667837.080N
S7	251908.359E	667859.359N
S8	251909.635E	667875.227N
S9	251896.657E	667886.785N
S10	251883.517E	667886.436N
S11	251865.966 E	667902.064N
S12	251867.458E	667918.175N
S13	251866.325 E	667932.507N
S14	-	-
S15	251893.760E	667955.298 N

BERTH DREDGING		
P1	252043.171E	667824.423N
P2	252009.744E	667786.886N
P3	251942.223E	667847.013N
P4	251939.762E	667844.250N
P5	251914.744E	667866.528N
P6	251917.204E	667869.291N
P7	251867.849E	667913.242N
P8	251901.193E	667950.686N

EAST PIT "C"		
C1	252000.435E	667856.101N
C2	252016.118E	667842.135N
C3	252005.677E	667830.410N
C4	251985.859E	667808.155N
C5	251970.176E	667822.121N
C6	251989.994E	667844.376N

WEST PIT "A"		
A1	251902.610E	667943.213N
A2	251920.160E	667927.585N
A3	251892.169E	667931.488N
A4	251889.901E	667893.605N
A5	251872.351E	667909.233N
A6	251909.719E	667915.860N

STABILISER PIT "B"		
B1	251948.960E	667904.952N
B2	251973.978E	667882.673N
B3	251961.941E	667869.156N
P4	251939.762E	667844.250N
P5	251914.744E	667866.528N
B6	251936.923E	667891.434N

DREDGING CO-ORDINATES LATITUDE & LONGITUDE

BERTH DREDGING TOP OF SLOPE		
S1	55° 52.82850	-4° 22.05376
S2	55° 52.82940	-4° 22.07362
S3	55° 52.83660	-4° 22.08911
S4	55° 52.84746	-4° 22.09427
S5	55° 52.84998	-4° 22.09978
S6	55° 52.84998	-4° 22.11604
S7	55° 52.86150	-4° 22.14074
S8	55° 52.87050	-4° 22.14365
S9	55° 52.87278	-4° 22.14851
S10	55° 52.87362	-4° 22.16838
S11	55° 52.88172	-4° 22.18571
S12	55° 52.89540	-4° 22.18795
S13	55° 52.90278	-4° 22.17705
S14	55° 52.90764	-4° 22.16166
S15	55° 52.91370	-4° 22.15345

BERTH DREDGING		
P1	55° 52.84668	-4° 22.00821
P2	55° 52.82580	-4° 22.03901
P3	55° 52.85700	-4° 22.10568
P4	55° 52.85544	-4° 22.10795
P5	55° 52.86696	-4° 22.13266
P6	55° 52.86846	-4° 22.13039
P7	55° 52.89126	-4° 22.17913
P8	55° 52.90116	-4° 22.14840

EAST PIT "C"		
C1	55° 52.86294	-4° 22.05020
C2	55° 52.85568	-4° 22.03471
C3	55° 52.84920	-4° 22.04434
C4	55° 52.83684	-4° 22.06260
C5	55° 52.84410	-4° 22.07808
C6	55° 52.85646	-4° 22.05982

WEST PIT "A"		
A1	55° 52.90806	-4° 22.14680
A2	55° 52.89990	-4° 22.12947
A3	55° 52.90158	-4° 22.15642
A4	55° 52.88130	-4° 22.14776
A5	55° 52.88922	-4° 22.17469
A6	55° 52.89348	-4° 22.13909

STABILISER PIT "B"		
B1	55° 52.88832	-4° 22.10113
B2	55° 52.87674	-4° 22.07642
B3	55° 52.86924	-4° 22.08751
P4	55° 52.85544	-4° 22.10795
P5	55° 52.86696	-4° 22.13666
B6	55° 52.88082	-4° 22.11222

REV	DATE	REVISION DESCRIPTION	DRN	VER

Arch Henderson
1919
Civil Engineers
Structural Engineers
Principal Designers
Architects
Geotechnical services
Environmental services
142 St. Vincent Street, Glasgow G2 5LA
Tel : 0141 227 3060 - Fax : 0141 248 9542
www.arch-henderson.co.uk - email : glasgow@arch-henderson.co.uk
Offices in : Aberdeen, Dundee, Falkland Islands, Glasgow, Inverness, Lerwick, Southampton, Stromness and Thurso

PROJECT :
BAE SYSTEMS SURFACE SHIPS LTD
SCOTSTOUN DEEP WATER BERTH

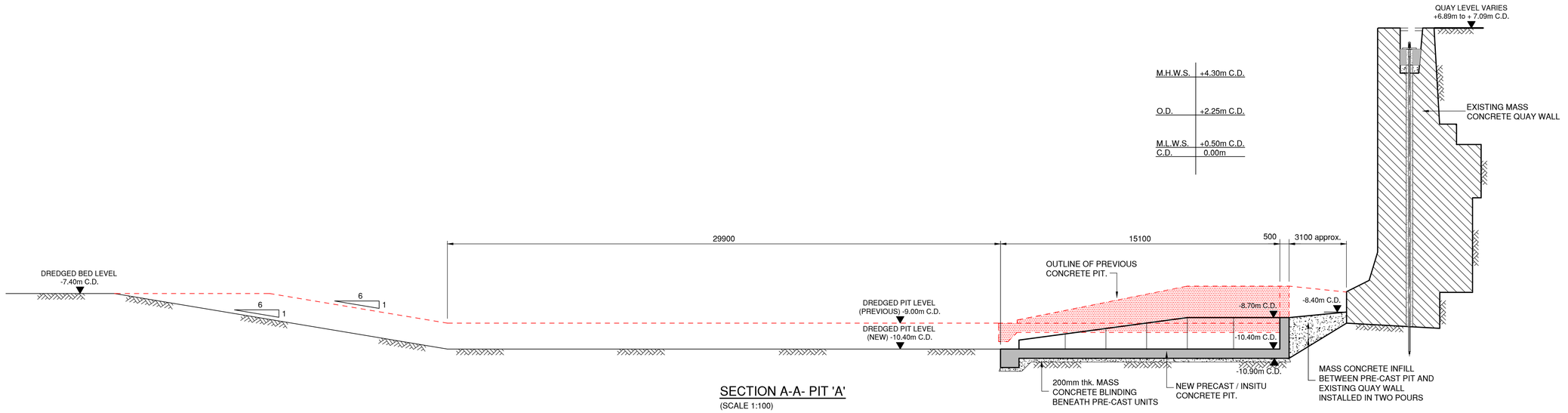
TITLE :
EXISTING AND PROPOSED WORKS

DRAWN :	DATE :	VERIFIED :	APPROVED :
G.B.	7.10.21	G.B.	G.B.

SCALE : (A1)	DRAWING STATUS :
1:500	CONSENT

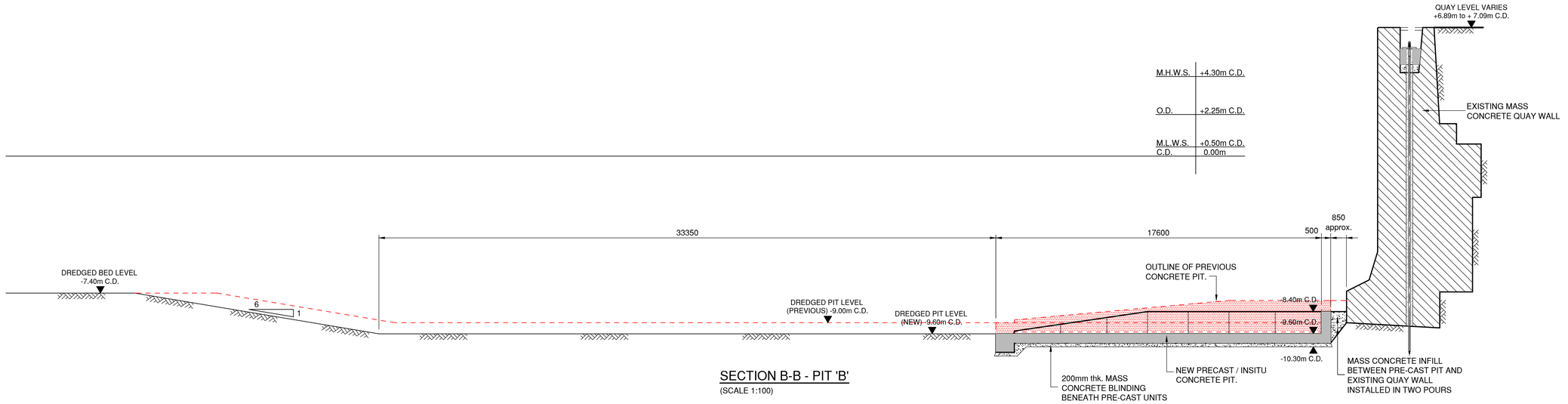
DRAWING No : 205026-202 REV : /

DO NOT SCALE



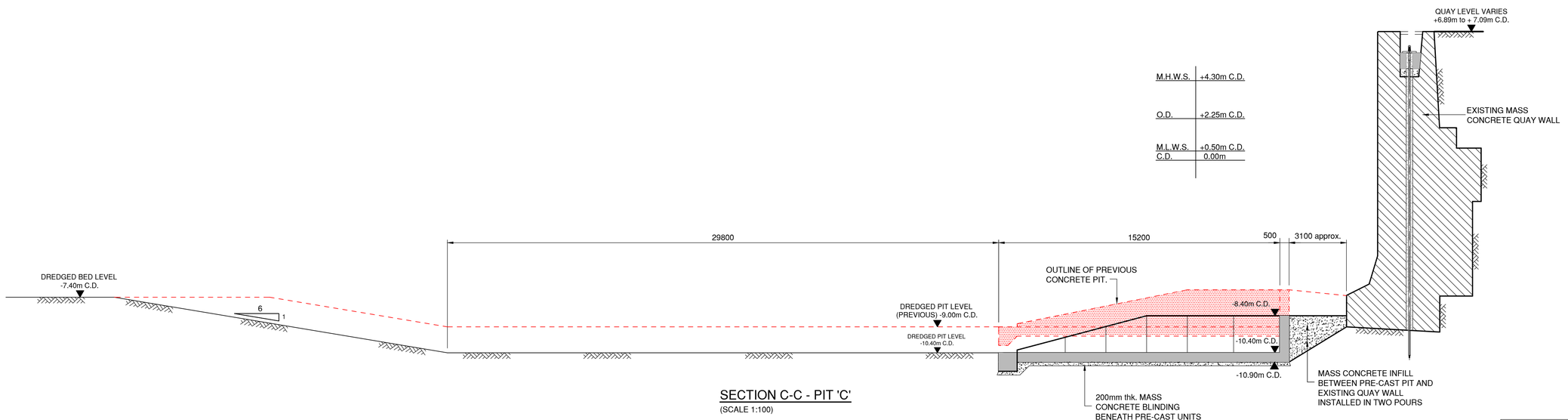
SECTION A-A- PIT 'A'

(SCALE 1:100)



SECTION B-B - PIT 'B'

(SCALE 1:100)



SECTION C-C - PIT 'C'

(SCALE 1:100)

DO NOT SCALE

NOTES

1 THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL DRAWINGS IN THE 205026 SERIES.

REV	DATE	REVISION DESCRIPTION	DRN	VER

Arch Henderson 1919

Civil Engineers
Structural Engineers
Principal Designers
Architects
Geotechnical services
Environmental services

142 St. Vincent Street, Glasgow G2 5LA
Tel : 0141 227 3060 - Fax : 0141 248 9542
www.arch-henderson.co.uk - email : glasgow@arch-henderson.co.uk

Offices in : Aberdeen, Dundee, Falkland Islands, Glasgow, Inverness, Lerwick, Southampton, Stromness and Thurso

PROJECT :

BAE SYSTEMS SRFACE SHIPS Ltd
SCOTSTOUN DEEP WATER BERTH

TITLE :

CROSS SECTIONS

DRAWN :	DATE :	VERIFIED :	APPROVED :
G.B.	7.10.21	G.B.	G.B.

SCALE : (A1)	DRAWING STATUS :
1:125	CONSENT

DRAWING No :	REV :
205026/203	/

B SEDIMENT SAMPLING REPORT

BAE Systems Scotstoun – DWB Dredge Sediment Sampling Report

December 2020

BAE Systems Scotstoun – DWB Dredge Sediment Sampling Report

Client:	Arch Henderson LLP
Document number:	9398
Project number:	174067
Status:	WORKING
Author:	Fraser Russell
Reviewer:	Graeme Duff
Date of issue:	2 December 2020
Filename:	BAE Scotstoun Sediment Sampling Report Nov 2020

Glasgow

Craighall Business Park
8 Eagle Street
Glasgow
G4 9XA
0141 341 5040
info@envirocentre.co.uk
www.envirocentre.co.uk

Aberdeen

Banchory Business Centre
Burn O'Bennie Road
Banchory
AB31 5ZU
01330 826 596

Inverness

Alder House
Cradlehall Business Park
Inverness
IV2 5GH
01463 794 212

Edinburgh

1st Floor
Sirius Building
The Clocktower Estate
South Gyle Crescent
Edinburgh
EH12 9LB
0131 370 4070

Contents

Appendices

Figures

Tables

1.1 Background

Arch Henderson LLP appointed EnviroCentre Ltd to undertake the collection of sediment samples from the Deep Water Berth (DWB) at BAE Systems Scotstoun. The samples were collected to support a dredging licence application to enable the deepening of the berth through capital dredge.

The purpose of these samples is to provide supporting information to Marine Scotland during the licensing process on sediment quality within the proposed dredge area. The dredging and disposal activities are regulated by Marine Scotland under the Marine (Scotland) Act 2010. The licensing conditions require representative samples to be collected and the nature (i.e. physical composition), quality and contamination status to be determined.

The samples were sub-sampled for analysis in accordance with best practice, as described in the Sampling Plan and Method Statement (EnviroCentre Report No. 9335, dated 26/10/2020).

Sample locations and the proposed dredge area are detailed in Drawing No. 174067-GIS004 in Appendix A. Proposed depths and volume of the dredging activity, as detailed within the agreed sampling plan, are given in Table 2-1.

Table 2-1: Summary of Proposed Dredging Works

Dredge Area	Approximate Dredge Volume (m^3)	Target Dredge Depth (m CD)	No. of Dredge Samples
BAE Deep Water Berth	15,000	-8.4 to -10.4 (depth of sediment for removal ranging from 600mm to 1400mm)	Core x4

1.2 Action Levels – AL1 Vs AL2

Two action levels are currently used to assess the suitability of sea based disposal of dredged sediment material, Revised Action Level 1 (RAL1) and Revised Action Level 2 (RAL2).

Sediment with contaminant concentrations below RAL1 is generally considered to be below background levels for contamination and is suitable for disposal at sea.

For samples between RAL1 and RAL2, additional risk assessment may be required including further sampling and testing to fully identify pockets of contamination or implementation of bioassays to assess the materials suitability for sea disposal.

Material above RAL2 is generally considered to be unsuitable for disposal to sea. If the sea disposal route is to be pursued, further testing along the lines of bioassay accompanied by a robust justification for selecting sea disposal as the BPEO may be required. This would need to be supported further with additional information regarding any mitigation measures which could be put in place as part of these works. This would require further discussion and agreement with Marine Scotland.

1.3 Scope of Report

The following report details the sampling methodology, field and laboratory analysis and provides a summary of the sediment quality present within the proposed dredge areas.

1.4 Report Usage

The information and recommendations contained within this report have been prepared in the specific context stated above and should not be utilised in any other context without prior written permission from EnviroCentre.

If this report is to be submitted for regulatory approval more than 12 months following the report date, it is recommended that it is referred to EnviroCentre for review to ensure that any relevant changes in data, best practice, guidance or legislation in the intervening period are integrated into an updated version of the report.

EnviroCentre accept no liability for use of the report for purposes other than those for which it was originally provided, or where EnviroCentre have confirmed it is appropriate for the new context.

2 SAMPLING LOCATIONS AND METHODOLOGY

Sampling works were undertaken on 11th November 2020, with sub-sampling undertaken the following day. The following sections detail the sampling methodology used to retrieve sediment samples.

2.1 Sample Locations

A total of 4 cores were collected. Sample station locations are outlined in Table 2-1.

Table 2-1: Final Sample Station Locations

Sample Station ID	Latitude	Longitude	Easting	Northing
VCEC01	55°52.86654'	-004°22.11224'	251936.623	667865.297
VCEC02	55°52.84500'	-004°22.05528'	251994.888	667823.551
VCEC03	55°52.86228’	-004°22.05407'	251996.358	667855.047
VCEC04	55°52.87830'	-004°22.08993'	251960.07	667886.903

2.2 Survey Vessel

Sampling works were undertaken from the workboat *Oscar of Glasgow*. The vessel was operated by Offshore Workboats Ltd., with EnviroCentre Ltd. personnel undertaking sampling works.

2.3 Navigation and Sample Location

Sample stations were navigated to using a Trimble Kenai Tablet GPS with pre-determined sample locations programmed in for navigation and sample location purposes. The anchor would then be deployed, and combined with engine thrust to keep the vessel in position. Sampling equipment was deployed and then recovered. The position was then recorded on the GPS device. The anchor would then be lifted and the vessel moved to the next sample station. Once the sampling media was deployed, the position was recorded using the GPS.

2.4 Sample Collection

Core samples were recovered using a vibrocorer with 75mm aluminium sample tube. The vibrocorer was lifted and lowered using the deck mounted crane.

Once the core tube was recovered, the core was detached from the head unit, and the recovery depth and sediment type at the base were both noted. Where necessary, additional attempts would be made at the same location to obtain a better recovery. Cores were labelled and capped, ready for preparation for sub-sampling the following day.

All core samples were supplemented by a grab sample, to ensure there was sufficient surface sediment for analysis. Grab samples were obtained using a 0.045m^2 stainless steel Van Veen grab sampler. Recovered material was emptied into a plastic bucket ready for sub-sampling. Where required, the grab was deployed multiple times to ensure enough material was recovered for testing.

Once enough material was recovered, the vessel moved to the next sampling station.

The maximum depth of vibrocore recovered was 2.1m of sediment. The vibrocores were noted to potentially terminate on compacted clay and/or bedrock (not proven).

2.5 Field Information

The following field data was recorded for each sample obtained:

- A unique sample ID;
- Sample location;
- Sample co-ordinates in latitude and longitude in degrees, minutes and decimals of minutes;
- Date, time and depth of collection;
- Sampler's ID;
- Sediment description;
- Sample photograph(s); and
- Details of any deviation from sampling protocol.

2.6 Sample Preparation

Cores were cut into sub-sections and extruded into a plastic core holder, split lengthways, photographed and logged prior to sub-sampling. Grab samples (surface sediment) were also photographed and logged prior to sub-sampling.

Where part of a core was not required to be sub-sampled, these sections were labelled, capped and retained in EnviroCentre's sample freezer.

Samples for metals and particle size analysis were sub-sampled using a plastic spoon and stored in plastic tubs. Samples for organic analysis were collected using stainless steel spoons and stored in amber glass jars.

Sampling equipment (spoons etc.) was cleaned with tap water between samples to minimise the risk of cross-contamination.

Once samples had been placed within appropriate containers, they were labelled and placed immediately into cool boxes with frozen ice packs. Samples were dispatched to the project laboratory on 12th November 2020.

2.7 Analysis Requirements

The laboratory analysis required by Marine Scotland (MS-LOT), and undertaken as part of this investigation, was as follows:

- Metals - Arsenic, Chromium, Cd, Copper, Mercury, Nickel, Lead, Zn;
- Organotins - Tributyl Tin & Dibutyl Tin (TBT);
- Polycyclic Aromatic Hydrocarbons (PAH USEPA 16);
- Polychlorinated Biphenyls (PCB ICES 7);
- Total Hydrocarbons (TPH);
- Moisture Content;
- Total Organic Carbon (TOC);
- Particle Size Analysis (PSA); and
- Asbestos (presence/absence).

Samples were sent to Socotec's Marine Laboratory for analysis.

3 RESULTS

Results are detailed in the following section. Core sample logs are provided in Appendix B. The laboratory certificate is provided in Appendix C and a summary sheet highlighting exceedances above the RALs in Excel format accompanies this report in the submission to Marine Scotland.

3.1 Sediment Summary

Sediment generally comprised of soft silt, overlying gravelly clay. Full descriptions and photographs for each sample station are given in Appendix B.

3.2 Physical Analysis

3.2.1 Particle Size Analysis (PSA)

The Particle Size Analysis data set for each sample is included within Appendix C.

3.3 Chemical Analysis

3.3.1 Chemical Analysis Assessment Criteria

All chemical analytical results were assessed against Revised Action Levels (RAL) criteria as adopted by Marine Scotland. The results are summarised in sections 3.3 and 3.4. Summary reports detailing exceedances in the Marine Scotland format have been submitted along with the supporting information for the application. The laboratory certificate is provided in Appendix C.

Where contaminants have RALs as adopted by Marine Scotland, exceedances above these criteria are summarised in Table 3-1, along with the maximum concentration recorded for each parameter.

Table 3-1: Exceedances of Revised Action Levels and Maximum Concentrations

Contaminant	No. of Exceedances (of 13 samples)*		Maximum Concentration (mg/kg) and Location
	RAL 1	RAL 2	
Arsenic	0	0	17.7 (VCEC04 – 0.0-0.15m)
Cadmium	13	0	3.79 (VCEC02 – 0.0-0.15m)
Copper	13	0	148 (VCEC01 – 0.15-0.8m)
Chromium	13	0	170 (VCEC03 – 1.0-1.5m)
Lead	13	0	153 (VCEC03 – 1.0-1.5m)
Mercury	12	0	0.48 (VCEC03 – 1.0-1.5m)
Nickel	13	0	45.8 (VCEC04 – 0.0-0.15m)
Zinc	13	0	430 (VCEC01 – 0.15-0.6m)
PAH (All Species)	13	-	1.82 (Fluoranthene at VCEC01 – 0.6-1.1m)
PCBs	12	0	0.049 (VCEC01 0.0-0.15m)
TBT	0	0	<0.005 in all samples
TPH	13	-	2,680 (VCEC02 – 1.6-2.1m)

All samples recorded exceedances above RAL 1 for more than one metal and PAH species. All samples exceeded RAL 1 for TPH, with all but one exceeding RAL 1 for PCBs. TBT was recorded below the limit of detection (LOD) for all samples.

All results were recorded below RAL 2 where they exist.

Parameters exceeding RAL 1 are given for each sample in Table 3-2.

Table 3-2: Exceedances above RAL 1 by Sample

Sample Station ID	Depth (m)	Parameters exceeding RAL 1
VCEC01	0.0 - 0.15	Cadmium, Chromium, Copper, Mercury, Nickel, Lead, Zinc, PAHs, PCBs and TPH.
	0.15 - 0.6	Cadmium, Chromium, Copper, Mercury, Nickel, Lead, Zinc, PAHs, PCBs and TPH.
	0.6 - 1.1	Cadmium, Chromium, Copper, Mercury, Nickel, Lead, Zinc, PAHs, PCBs and TPH.
VCEC02	0.0 - 0.15	Cadmium, Chromium, Copper, Mercury, Nickel, Lead, Zinc, PAHs, PCBs and TPH.
	0.6 - 1.1	Cadmium, Chromium, Copper, Mercury, Nickel, Lead, Zinc, PAHs, PCBs and TPH.
	1.1 - 1.6	Cadmium, Chromium, Copper, Mercury, Nickel, Lead, Zinc, PAHs, PCBs and TPH.
	1.6 - 2.1	Cadmium, Chromium, Copper, Mercury, Nickel, Lead, Zinc, PAHs, PCBs and TPH.
VCEC03	0.0 - 0.15	Cadmium, Chromium, Copper, Mercury, Nickel, Lead, Zinc, PAHs, PCBs and TPH.
	0.5 - 1.0	Cadmium, Chromium, Copper, Mercury, Nickel, Lead, Zinc, PAHs, PCBs and TPH.
	1.0 - 1.5	Cadmium, Chromium, Copper, Mercury, Nickel, Lead, Zinc, PAHs, PCBs and TPH.
VCEC04	0.0 - 0.15	Cadmium, Chromium, Copper, Mercury, Nickel, Lead, Zinc, PAHs, PCBs and TPH.
	0.3 - 0.8	Cadmium, Chromium, Copper, Mercury, Nickel, Lead, Zinc, PAHs, PCBs and TPH.
	0.8 - 1.3	Cadmium, Chromium, Copper, Nickel, Lead, Zinc, PAHs and TPH.

3.4 Asbestos

Asbestos was not detected in any of the samples submitted for analysis.

4 SUMMARY

A pre-dredge sediment sampling exercise was undertaken within the proposed Deep Water Berth dredge area at BAE Systems Scotstoun yard in November 2020. Four core samples were obtained using a vibrocorer, with additional surface sediment obtained using a Van-Veen grab. A total of 13 sediment samples were submitted for analysis for the standard Marine Scotland suite.

Sediment generally comprised soft silt overlying gravelly clay.

Exceedances above RAL 1 were recorded in all 13 samples tested for metals, PAHs and TPH. All but one sample exceeded RAL 1 for PCBs. No exceedances for RAL 1 were recorded for TBT. Asbestos was not detected in any of the samples analysed.

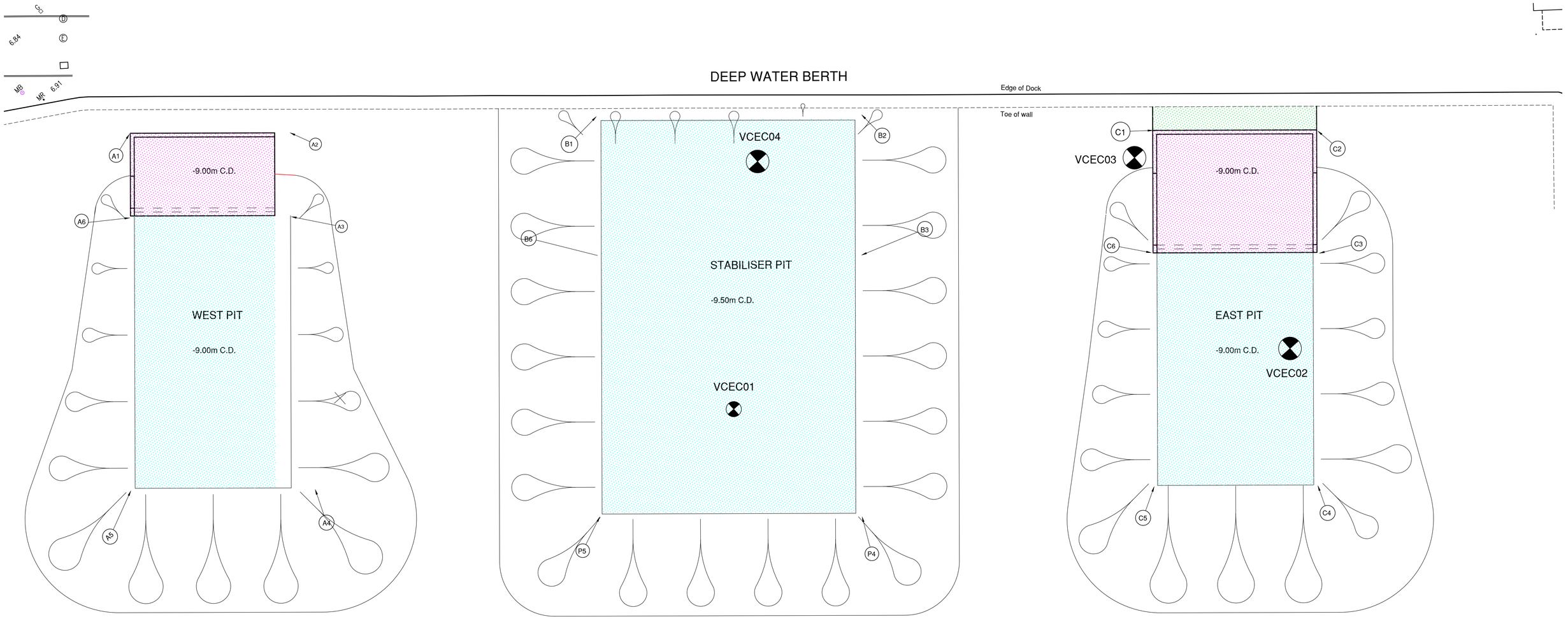
There were no exceedances of key contaminants of concern above RAL 2 recorded in the 13 samples analysed.

REFERENCES

EnviroCentre (2020). *River Clyde BAE Systems DWB Dredge – October 2020 – Sampling Plan*, Report Ref. 9335.
Marine Scotland (2017). *Pre-Dredge Sampling Guidance Version 2*: Scottish Government.

APPENDICES

A FIGURES



WEST PIT "A"

A1	251902.610E	667943.213N
A2	251917.929E	667929.573N
A3	251910.879E	667921.658N
A4	251887.665E	667895.598N
A5	251872.351E	667909.233N
A6	251895.565E	667935.295N

EAST PIT "C"

C1	252000.435E	667856.101N
C2	252016.118E	667842.135N
C3	252005.677E	667830.410N
C4	251985.859E	667808.155N
C5	251970.176E	667822.121N
C6	251989.994E	667844.376N

STABILISER PIT "B"

B1	251948.960E	667904.952N
B2	251973.978E	667882.673N
B3	251961.941E	667869.156N
P4	251939.762E	667844.250N
P5	251914.744E	667866.528N
B6	251936.923E	667891.434N

EXISTING DREDGE POCKET (NO CONCRETE).

EXISTING PIT REINFORCED CONCRETE.

EXISTING MASS CONCRETE.

REV	DATE	REVISION DESCRIPTION	DRN	VER

Arch Henderson 1919
Civil Engineers
Structural Engineers
Principal Designers
Architects
Geotechnical services
Environmental services
142 St. Vincent Street, Glasgow G2 5LA.
Tel : 0141 227 3060 - Fax : 0141 248 9542
www.arch-henderson.co.uk - email : glasgow@arch-henderson.co.uk
Offices in : Aberdeen, Dundee, Falkland Islands, Glasgow, Inverness, Lerwick, Southampton, Stromness and Thurso

PROJECT :
FARRANS CONSTRUCTION
BAE INITIAL ENABLING INFRASTRUCTURE

TITLE :
DEEP WATER BERTH ALTERATIONS
EXISTING PITS

DRAWN :	DATE :	VERIFIED :	APPROVED :
G.B.	16.3.21	J.McL.	G.B.

SCALE : (A1)	DRAWING STATUS :
1 : 250 @ A1	INFORMATION

DO NOT SCALE

DRAWING No : 205030-skB REV : /

B SEDIMENT LOGS

envirocentre 8 Eagle Street, Craighall Business Park, Glasgow, G4 9XA	**Project Name**	BAE Systems – Scotstoun	**Location ID**
	Project No.	174067	**VCEC01**
	Client	Arch Henderson	

SEDIMENT CORE LOG

Date:	11/11/2020	**Latitude/Longitude:**	55°52.86654' -004°22.11224'
Dredge Area:	Deep Water Berth (DWB)	**Sampled/logged by:**	AK/FR/NC
Method:	Vibrocore (Grab for surface sample)	**Core Length (m):**	1.1

Remarks:

0.0m – 0.15m (grab): Soft dark grey silt with soft brown silt. Occasional leaf litter.

0.15m – 1.05m (core): Soft dark grey/black silt with rare decomposing leaf litter and rootlets throughout. Very faint H_2S odour. Becoming drier from 0.6m down.

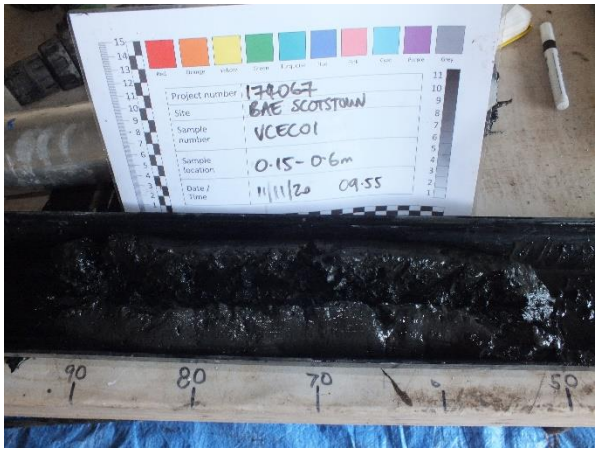
1.05m – 1.1m: Grey silty clay with one piece of subrounded coarse gravel.

Biota: None noted.

Odours: Very faint H_2S.

Anthropogenic Inputs: None noted.

Notes: -



envirocentre 8 Eagle Street, Craighall Business Park, Glasgow, G4 9XA	**Project Name**	BAE Systems – Scotstoun	**Location ID**
	Project No.	174067	**VCEC02**
	Client	Arch Henderson	

SEDIMENT CORE LOG

Date:	11/11/2020	**Latitude/Longitude:**	55°52.84500' -004°22.05528'
Dredge Area:	Deep Water Berth (DWB)	**Sampled/logged by:**	AK/FR/NC
Method:	Vibrocore (Grab for surface sample)	**Core Length (m):**	2.1

Remarks:

0.0m – 0.15m (grab): Soft black/dark grey silt with soft brown silt. Occasional leaf litter and twigs. Faint H_2S odour.

0.6m – 2.0m (core): Soft black/dark grey silt with rare decomposing leaf litter and rootlets. Faint H_2S odour. Gradually becoming firmer and drier with depth.

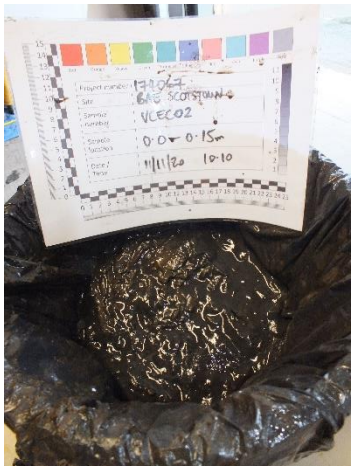
2.0m – 2.1m: Dark grey silty clay.

Biota: None noted.

Odours: Faint H_2S.

Anthropogenic Inputs: None noted.

Notes: -



envirocentre 8 Eagle Street, Craighall Business Park, Glasgow, G4 9XA	**Project Name**	BAE Systems – Scotstoun	**Location ID**
	Project No.	174067	**VCEC03**
	Client	Arch Henderson	

SEDIMENT CORE LOG

Date:	11/11/2020	**Latitude/Longitude:**	55°52.86228 -004°22.05407'
Dredge Area:	Deep Water Berth (DWB)	**Sampled/logged by:**	AK/FR/NC
Method:	Vibrocore (Grab for surface sample)	**Core Length (m):**	1.5

Remarks: **0.0m – 0.15m (grab):** Soft black/dark grey silt with soft brown silt. Rare leaf litter and twigs.

0.5m – 1.0m (core): Soft black/dark grey silt with very rare leaf litter and rootlets. Faint H_2S odour. Gradually becoming firmer and drier with depth.

1.4m – 1.5m: Dark grey clay with single piece of subrounded coarse gravel.

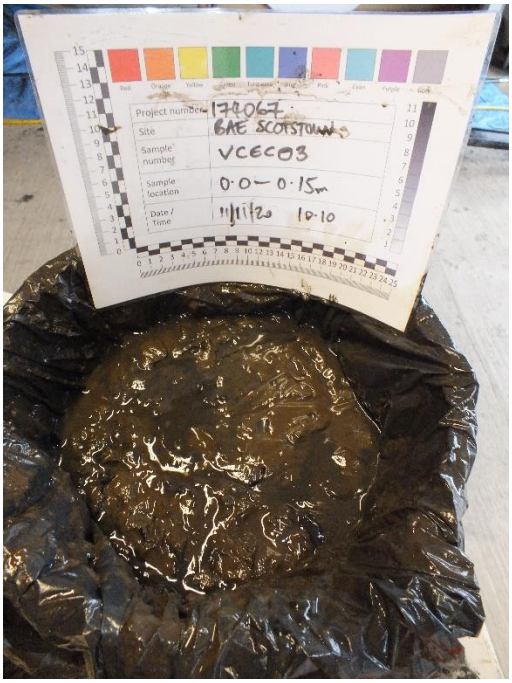
Biota: None noted.

Odours: Faint H_2S.

Anthropogenic Inputs: None noted.

Notes: -

55°52.86228 -004°22.05407'



envirocentre 8 Eagle Street, Craighall Business Park, Glasgow, G4 9XA	**Project Name**	BAE Systems – Scotstoun	**Location ID**
	Project No.	174067	**VCEC04**
	Client	Arch Henderson	

SEDIMENT CORE LOG

Date:	11/11/2020	**Latitude/Longitude:**	55°52.87830' -004°22.08993'
Dredge Area:	Deep Water Berth (DWB)	**Sampled/logged by:**	AK/FR/NC
Method:	Vibrocore (Grab for surface sample)	**Core Length (m):**	1.3

Remarks:

0.0m – 0.15m (grab): Soft black/dark grey silt with soft brown silt. Occasional leaf litter and two textile pieces (approx. 20 x 15cm).

0.15m – 0.8m (core): Soft dark grey-brown silt. Faint H_2S odour. Gradually becoming firmer and drier with depth.

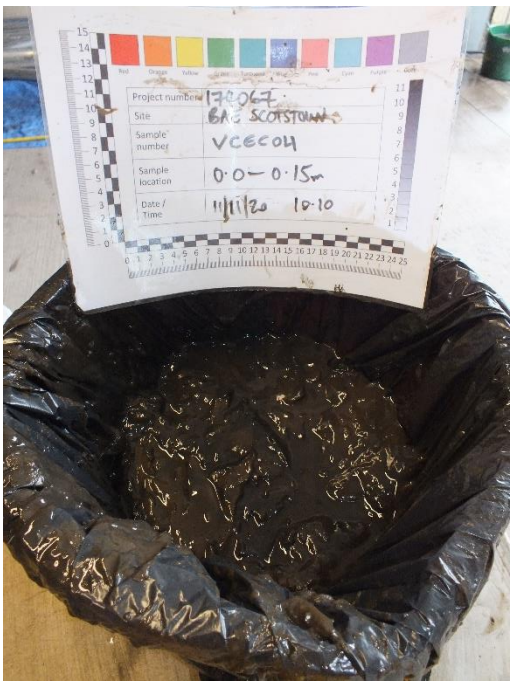
1.2m – 1.3m: Firm brown gravelly clay. Gravel is medium to coarse, subrounded.

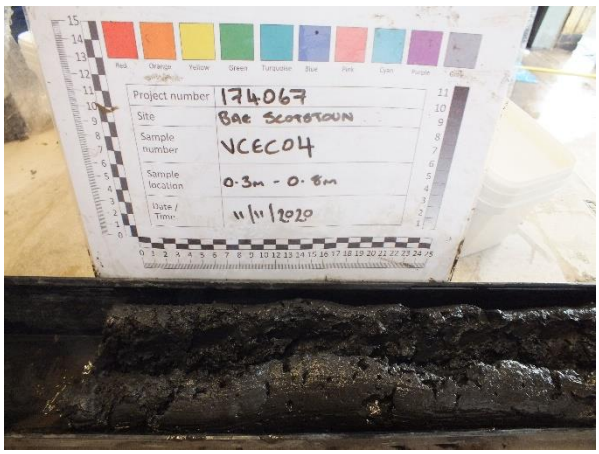
Biota: None noted.

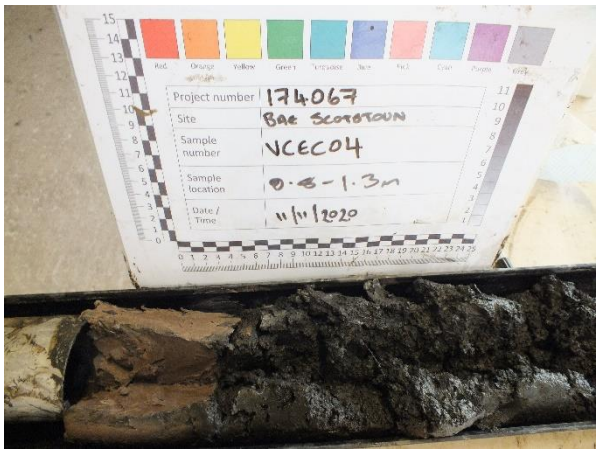
Odours: Faint H_2S.

Anthropogenic Inputs: None noted.

Notes: -







C LABORATORY CERTIFICATE

Certificate of Analysis

Issuing Laboratory SOCOTEC, Marine Department, Specialist Chemistry, Etwall House, Bretby Business Park, Ashby Road, Bretby, Burton-upon-Trent DE15 0YZ

Test Report ID	**MAR00832**	
Issue Version	1	
Customer	EnviroCentre Ltd, Craighall Business Park, 8 Eagle Street, Glasgow, G4 9XA	
Customer Reference	BAE Scotstoun	
Date Sampled	11-Nov-20	
Date Received	13-Nov-20	
Date Reported	02-Dec-20	
Condition of samples	Cold	Satisfactory

Authorised by:	Marya Hubbard
Position:	Laboratory Manager

Any additional opinions or interpretations found in this report, are outside the scope of UKAS accreditation.

Certificate of Analysis

Issuing Laboratory SOCOTEC, Marine Department, Specialist Chemistry, Etwall House, Bretby Business Park, Ashby Road, Bretby, Burton-upon-Trent DE15 0YZ

Test Report ID	MAR00832
Issue Version	1
Customer Reference	BAE Scotstoun

		Units	%	%	%	%	%
		Method No	ASC/SOP/303	ASC/SOP/303	SUB_01*	SUB_01*	SUB_01*
		Limit of Detection	0.2	0.2	N/A	N/A	N/A
		Accreditation	UKAS	UKAS	N	N	N
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**Total Moisture @ 120°C**	**Total Solids**	**Gravel (>2mm)**	**Sand (63-2000 µm)**	**Silt (<63 µm)**
VCE01 0.0-0.15m	MAR00832.001	Sediment	71.7	28.3	2.0	33.5	64.5
VCE01 0.15-0.6m	MAR00832.002	Sediment	68.0	32.0	0.0	18.3	81.7
VCE01 0.6-1.1m	MAR00832.003	Sediment	66.2	33.8	6.8	24.7	68.5
VCE02 0.0-0.15m	MAR00832.004	Sediment	73.3	26.7	0.0	24.8	75.2
VCE02 0.6-1.1m	MAR00832.005	Sediment	66.1	33.9	0.0	20.1	79.9
VCE02 1.1-1.6m	MAR00832.006	Sediment	65.1	34.9	0.0	22.5	77.5
VCE02 1.6-2.1m	MAR00832.007	Sediment	61.5	38.5	0.0	15.0	85.0
VCE03 0.0-0.15m	MAR00832.008	Sediment	73.5	26.5	0.0	16.0	84.0
VCE03 0.5-1.0m	MAR00832.009	Sediment	61.9	38.1	0.0	17.2	82.8
VCE03 1.0-1.5m	MAR00832.010	Sediment	58.4	41.6	40.0	10.1	49.9
VCE04 0.0-0.15m	MAR00832.011	Sediment	72.9	27.1	0.0	24.0	76.0
VCE04 0.3-0.8m	MAR00832.012	Sediment	65.6	34.4	0.0	19.0	81.0
VCE04 0.8-1.3m	MAR00832.013	Sediment	34.6	65.4	9.5	20.7	69.8
		Reference Material (% Recovery)	N/A	N/A	N/A	N/A	N/A
		QC Blank	N/A	N/A	N/A	N/A	N/A

* See Report Notes

NAIIS - No Asbestos Identified In Sample

Certificate of Analysis

Issuing Laboratory SOCOTEC, Marine Department, Specialist Chemistry, Etwall House, Bretby Business Park, Ashby Road, Bretby, Burton-upon-Trent DE15 0YZ

Test Report ID	MAR00832
Issue Version	1
Customer Reference	BAE Scotstoun

		Units	N/A	% M/M
		Method No	SUB_02*	SOCOTEC Env Chem*
		Limit of Detection	N/A	0.02
		Accreditation	UKAS	UKAS
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**Asbestos**	**TOC**
VCE01 0.0-0.15m	MAR00832.001	Sediment	NAIIS	6.34
VCE01 0.15-0.6m	MAR00832.002	Sediment	NAIIS	5.93
VCE01 0.6-1.1m	MAR00832.003	Sediment	NAIIS	5.62
VCE02 0.0-0.15m	MAR00832.004	Sediment	NAIIS	4.72
VCE02 0.6-1.1m	MAR00832.005	Sediment	NAIIS	5.50
VCE02 1.1-1.6m	MAR00832.006	Sediment	NAIIS	7.11
VCE02 1.6-2.1m	MAR00832.007	Sediment	NAIIS	6.47
VCE03 0.0-0.15m	MAR00832.008	Sediment	NAIIS	7.21
VCE03 0.5-1.0m	MAR00832.009	Sediment	NAIIS	5.56
VCE03 1.0-1.5m	MAR00832.010	Sediment	NAIIS	5.85
VCE04 0.0-0.15m	MAR00832.011	Sediment	NAIIS	6.74
VCE04 0.3-0.8m	MAR00832.012	Sediment	NAIIS	6.00
VCE04 0.8-1.3m	MAR00832.013	Sediment	NAIIS	3.38
		Reference Material (% Recovery)	N/A	102
		QC Blank	N/A	<0.02

* See Report Notes

NAIIS - No Asbestos Identified In Sample

Certificate of Analysis

Issuing Laboratory SOCOTEC, Marine Department, Specialist Chemistry, Etwall House, Bretby Business Park, Ashby Road, Bretby, Burton-upon-Trent DE15 0YZ

Test Report ID	MAR00832
Issue Version	1
Customer Reference	BAE Scotstoun

		Units	mg/Kg (Dry Weight)							
		Method No	SOCOTEC Env Chem*							
		Limit of Detection	0.5	0.04	0.5	0.5	0.01	0.5	0.5	2
		Accreditation	UKAS	UKAS	UKAS	UKAS	N	UKAS	UKAS	UKAS
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**Arsenic**	**Cadmium**	**Chromium**	**Copper**	**Mercury**	**Nickel**	**Lead**	**Zinc**
VCE01 0.0-0.15m	MAR00832.001	Sediment	13.9	1.07	126	127	0.38	37.0	123	301
VCE01 0.15-0.6m	MAR00832.002	Sediment	15.6	1.16	155	148	0.46	39.7	150	430
VCE01 0.6-1.1m	MAR00832.003	Sediment	13.0	0.88	128	72.6	0.37	43.5	114	280
VCE02 0.0-0.15m	MAR00832.004	Sediment	13.8	3.79	125	131	0.36	33.6	123	302
VCE02 0.6-1.1m	MAR00832.005	Sediment	15.2	1.17	156	95.6	0.47	42.2	146	323
VCE02 1.1-1.6m	MAR00832.006	Sediment	13.7	1.05	126	76.3	0.36	43.1	135	312
VCE02 1.6-2.1m	MAR00832.007	Sediment	16.5	1.10	167	98.3	0.46	43.8	150	338
VCE03 0.0-0.15m	MAR00832.008	Sediment	15.6	1.04	145	115	0.41	39.1	138	311
VCE03 0.5-1.0m	MAR00832.009	Sediment	15.8	1.10	154	97.5	0.45	41.3	145	328
VCE03 1.0-1.5m	MAR00832.010	Sediment	16.4	1.10	170	92.7	0.48	43.3	153	334
VCE04 0.0-0.15m	MAR00832.011	Sediment	17.7	1.11	160	148	0.44	45.8	149	352
VCE04 0.3-0.8m	MAR00832.012	Sediment	16.0	0.92	133	87.9	0.37	38.8	132	275
VCE04 0.8-1.3m	MAR00832.013	Sediment	9.6	0.55	78.0	52.9	0.20	39.0	76.9	198
Certified Reference Material SETOC 774 (% Recovery)			103	108	90	103	94	96	98	101
QC Blank			<0.5	<0.04	<0.5	<0.5	<0.01	<0.5	<0.5	<2

* See Report Notes

Certificate of Analysis

Issuing Laboratory SOCOTEC, Marine Department, Specialist Chemistry, Etwall House, Bretby Business Park, Ashby Road, Bretby, Burton-upon-Trent DE15 0YZ

Test Report ID	MAR00832
Issue Version	1
Customer Reference	BAE Scotstoun

		Units	µg/Kg (Dry Weight)	
		Method No	ASC/SOP/301	
		Limit of Detection	1	1
		Accreditation	UKAS	UKAS
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**Dibutyltin (DBT)**	**Tributyltin (TBT)**
VCE01 0.0-0.15m	MAR00832.001	Sediment	67.9	<5
VCE01 0.15-0.6m	MAR00832.002	Sediment	16.6	<5
VCE01 0.6-1.1m	MAR00832.003	Sediment	30.7	<5
VCE02 0.0-0.15m	MAR00832.004	Sediment	47.4	<5
VCE02 0.6-1.1m	MAR00832.005	Sediment	24.7	<5
VCE02 1.1-1.6m	MAR00832.006	Sediment	17.2	<5
VCE02 1.6-2.1m	MAR00832.007	Sediment	<5	<5
VCE03 0.0-0.15m	MAR00832.008	Sediment	20.1	<5
VCE03 0.5-1.0m	MAR00832.009	Sediment	21.2	<5
VCE03 1.0-1.5m	MAR00832.010	Sediment	27.4	<5
VCE04 0.0-0.15m	MAR00832.011	Sediment	39.0	<5
VCE04 0.3-0.8m	MAR00832.012	Sediment	20.6	<5
VCE04 0.8-1.3m	MAR00832.013	Sediment	11.5	<5
Certified Reference Material BCR-646 (% Recovery)			97	83
QC Blank			<1	<1

* See Report Notes

Certificate of Analysis

Issuing Laboratory SOCOTEC, Marine Department, Specialist Chemistry, Etwall House, Bretby Business Park, Ashby Road, Bretby, Burton-upon-Trent DE15 0YZ

Test Report ID MAR00832
Issue Version 1
Customer Reference BAE Scotstoun

		Units	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)
		Method No	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304
		Limit of Detection	1	1	1	1	1	1
		Accreditation	UKAS	UKAS	UKAS	UKAS	UKAS	UKAS
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**ACENAPTH**	**ACENAPHY**	**ANTHRACN**	**BAA**	**BAP**	**BBF**
VCE01 0.0-0.15m	MAR00832.001	Sediment	91.1	69.1	218	639	770	723
VCE01 0.15-0.6m	MAR00832.002	Sediment	112	86.7	265	761	957	974
VCE01 0.6-1.1m	MAR00832.003	Sediment	136	116	343	976	1250	1250
VCE02 0.0-0.15m	MAR00832.004	Sediment	141	101	313	871	1090	1090
VCE02 0.6-1.1m	MAR00832.005	Sediment	143	98.1	318	855	1030	1090
VCE02 1.1-1.6m	MAR00832.006	Sediment	132	95.0	306	913	1130	1140
VCE02 1.6-2.1m	MAR00832.007	Sediment	177	107	310	991	1220	1200
VCE03 0.0-0.15m	MAR00832.008	Sediment	113	95.7	275	866	1100	1050
VCE03 0.5-1.0m	MAR00832.009	Sediment	111	91.4	278	937	1210	1130
VCE03 1.0-1.5m	MAR00832.010	Sediment	106	84.9	260	821	980	1030
VCE04 0.0-0.15m	MAR00832.011	Sediment	116	122	278	900	1220	1160
VCE04 0.3-0.8m	MAR00832.012	Sediment	105	72.4	253	820	1030	1010
VCE04 0.8-1.3m	MAR00832.013	Sediment	38.9	25.6	81.6	253	324	300
Certified Reference Material QPH098MS (% Recovery)			94	96	92	67	72	72
QC Blank			<1	<1	<1	<1	<1	<1

For full analyte name see method summaries
~ Indicates result is for an In-house Reference Material as no Certified Reference Materials are avaliable.
As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

Certificate of Analysis

Issuing Laboratory SOCOTEC, Marine Department, Specialist Chemistry, Etwall House, Bretby Business Park, Ashby Road, Bretby, Burton-upon-Trent DE15 0YZ

Test Report ID MAR00832
Issue Version 1
Customer Reference BAE Scotstoun

		Units	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)
		Method No	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304
		Limit of Detection	1	1	1	1	1	1
		Accreditation	UKAS	UKAS	UKAS	UKAS	UKAS	UKAS
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**BENZGHIP**	**BKF**	**CHRYSENE**	**DBENZAH**	**FLUORANT**	**FLUORENE**
VCE01 0.0-0.15m	MAR00832.001	Sediment	571	299	673	111	1170	142
VCE01 0.15-0.6m	MAR00832.002	Sediment	769	481	781	150	1350	163
VCE01 0.6-1.1m	MAR00832.003	Sediment	1030	590	1080	152	1820	242
VCE02 0.0-0.15m	MAR00832.004	Sediment	915	570	918	180	1540	191
VCE02 0.6-1.1m	MAR00832.005	Sediment	876	398	921	168	1580	208
VCE02 1.1-1.6m	MAR00832.006	Sediment	961	567	1010	183	1690	199
VCE02 1.6-2.1m	MAR00832.007	Sediment	983	609	1050	196	1770	198
VCE03 0.0-0.15m	MAR00832.008	Sediment	906	369	905	129	1490	155
VCE03 0.5-1.0m	MAR00832.009	Sediment	970	495	986	189	1470	162
VCE03 1.0-1.5m	MAR00832.010	Sediment	798	513	889	166	1500	159
VCE04 0.0-0.15m	MAR00832.011	Sediment	961	614	935	148	1460	152
VCE04 0.3-0.8m	MAR00832.012	Sediment	852	477	863	166	1480	145
VCE04 0.8-1.3m	MAR00832.013	Sediment	271	157	270	50.5	456	58.1
Certified Reference Material QPH098MS (% Recovery)			75	91	81	78	73	89
QC Blank			<1	<1	<1	<1	<1	<1

For full analyte name see method summaries
~ Indicates result is for an In-house Reference Material as no Certified Reference Materials are avaliable.
As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

Certificate of Analysis

Issuing Laboratory SOCOTEC, Marine Department, Specialist Chemistry, Etwall House, Bretby Business Park, Ashby Road, Bretby, Burton-upon-Trent DE15 0YZ

Test Report ID MAR00832
Issue Version 1
Customer Reference BAE Scotstoun

		Units	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)
		Method No	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/306
		Limit of Detection	1	1	1	1	100
		Accreditation	UKAS	UKAS	UKAS	UKAS	N
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
VCE01 0.0-0.15m	MAR00832.001	Sediment	550	158	544	1160	1530000
VCE01 0.15-0.6m	MAR00832.002	Sediment	741	188	637	1370	1790000
VCE01 0.6-1.1m	MAR00832.003	Sediment	982	223	977	1810	2260000
VCE02 0.0-0.15m	MAR00832.004	Sediment	897	214	760	1580	2560000
VCE02 0.6-1.1m	MAR00832.005	Sediment	840	219	788	1580	2560000
VCE02 1.1-1.6m	MAR00832.006	Sediment	899	224	924	1630	2320000
VCE02 1.6-2.1m	MAR00832.007	Sediment	937	194	841	1720	2680000
VCE03 0.0-0.15m	MAR00832.008	Sediment	876	183	707	1490	2370000
VCE03 0.5-1.0m	MAR00832.009	Sediment	926	203	687	1460	2490000
VCE03 1.0-1.5m	MAR00832.010	Sediment	813	175	686	1510	2280000
VCE04 0.0-0.15m	MAR00832.011	Sediment	986	183	669	1450	2460000
VCE04 0.3-0.8m	MAR00832.012	Sediment	709	177	674	1470	2180000
VCE04 0.8-1.3m	MAR00832.013	Sediment	230	56.6	251	448	766000
Certified Reference Material QPH098MS (% Recovery)			68	84	84	78	104~
QC Blank			<1	<1	<1	<1	<100

For full analyte name see method summaries
~ Indicates result is for an In-house Reference Material as no Certified Reference Materials are avaliable.
As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

Certificate of Analysis

Issuing Laboratory SOCOTEC, Marine Department, Specialist Chemistry, Etwall House, Bretby Business Park, Ashby Road, Bretby, Burton-upon-Trent DE15 0YZ

Test Report ID MAR00832
Issue Version 1
Customer Reference BAE Scotstoun

		Units	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)
		Method No	ASC/SOP/302	ASC/SOP/302	ASC/SOP/302	ASC/SOP/302	ASC/SOP/302	ASC/SOP/302	ASC/SOP/302
		Limit of Detection	0.1	0.1	0.1	0.1	0.1	0.1	0.1
		Accreditation	UKAS	UKAS	UKAS	UKAS	UKAS	UKAS	UKAS
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**PCB28**	**PCB52**	**PCB101**	**PCB118**	**PCB138**	**PCB153**	**PCB180**
VCE01 0.0-0.15m	MAR00832.001	Sediment	3.28	16.9	7.21	7.60	4.44	6.74	3.23
VCE01 0.15-0.6m	MAR00832.002	Sediment	3.70	11.2	7.03	6.79	6.36	9.10	4.94
VCE01 0.6-1.1m	MAR00832.003	Sediment	2.05	6.59	3.44	2.96	3.20	4.45	2.29
VCE02 0.0-0.15m	MAR00832.004	Sediment	2.66	8.49	4.78	4.41	4.80	7.30	3.59
VCE02 0.6-1.1m	MAR00832.005	Sediment	3.18	9.68	4.92	4.35	4.39	6.92	3.68
VCE02 1.1-1.6m	MAR00832.006	Sediment	1.99	6.11	3.72	3.80	3.48	5.12	2.67
VCE02 1.6-2.1m	MAR00832.007	Sediment	3.77	11.0	5.78	5.73	5.59	7.65	4.31
VCE03 0.0-0.15m	MAR00832.008	Sediment	2.93	9.11	5.21	4.75	5.27	7.44	4.04
VCE03 0.5-1.0m	MAR00832.009	Sediment	3.11	9.30	4.77	4.62	4.92	6.74	3.79
VCE03 1.0-1.5m	MAR00832.010	Sediment	3.53	11.8	5.95	5.17	5.95	8.78	4.68
VCE04 0.0-0.15m	MAR00832.011	Sediment	2.97	10.5	4.96	4.47	4.72	6.25	3.28
VCE04 0.3-0.8m	MAR00832.012	Sediment	2.68	8.96	4.86	4.40	4.09	5.33	2.85
VCE04 0.8-1.3m	MAR00832.013	Sediment	0.71	2.24	1.19	1.18	1.24	1.64	1.00
Certified Reference Material QOR136MS (% Recovery)			71	149	104	122	117	140	65
QC Blank			<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08

For full analyte name see method summaries
~ Indicates result is for an In-house Reference Material as no Certified Reference Materials are avaliable.

Certificate of Analysis

Issuing Laboratory SOCOTEC, Marine Department, Specialist Chemistry, Etwall House, Bretby Business Park, Ashby Road, Bretby, Burton-upon-Trent DE15 0YZ

Test Report ID MAR00832
Issue Version 1
Customer Reference BAE Scotstoun

REPORT NOTES

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report
SOCOTEC Env Chem*	MAR00832.001-013	Analysis was conducted by an internal SOCOTEC laboratory. UKAS accredited analysis by this laboratory is under UKAS number 1252.
SUB_01*	MAR00832.001-013	Analysis was conducted by an approved subcontracted laboratory.
SUB_02*	MAR00832.001-013	Analysis was conducted by an approved subcontracted laboratory.
ASC/SOP/301	MAR00832.001-013	The matrix of this sample has been found to interfere with the result for this test. The sample has therefore been diluted, but in doing so, the detection limit for this test has been elevated.
ASC/SOP/303/304	MAR00832.001-013	Chrysene is known to coelute with Triphenylene and these peaks can not be resolved. It is believed Triphenylene is present in these samples therefore it is suggested that the Chrysene results should be taken as a Chrysene (inc. Triphenylene).This should be taken into consideration when utilising the data.

DEVIATING SAMPLE STATEMENT

Deviation Code	Deviation Definition	Sample ID	Deviation Details. The following information should be taken into consideration when using the data contained within this report
D1	Holding Time Exceeded	N/A	N/A
D2	Handling Time Exceeded	N/A	N/A
D3	Sample Contaminated through Damaged Packaging	N/A	N/A
D4	Sample Contaminated through Sampling	N/A	N/A
D5	Inappropriate Container/Packaging	N/A	N/A
D6	Damaged in Transit	N/A	N/A
D7	Insufficient Quantity of Sample	N/A	N/A
D8	Inappropriate Headspace	N/A	N/A
D9	Retained at Incorrect Temperature	N/A	N/A
D10	Lack of Date & Time of Sampling	N/A	N/A
D11	Insufficient Sample Details	N/A	N/A

Certificate of Analysis

Issuing Laboratory SOCOTEC, Marine Department, Specialist Chemistry, Etwall House, Bretby Business Park, Ashby Road, Bretby, Burton-upon-Trent DE15 0YZ

Test Report ID	MAR00832
Issue Version	1
Customer Reference	BAE Scotstoun

Method	Sample and Fraction Size	Method Summary
Total Solids	Wet Sediment	Calculation (100%-Moisture Content).Moisture content determined by drying a portion of the sample at 120°C to constant weight.
Particle Size Analysis	Wet Sediment	Wet and dry sieving followed by laser diffraction analysis.
Total Organic Carbon (TOC)	Air Dried and Ground	Carbonate removal and sulphurous acid/combustion at 1600°C/NDIR.
Metals	Air dried and seived to <63µm	Aqua-regia extraction followed by ICP analysis.
Organotins	Wet Sediment	Solvent extraction and derivatisation followed by GC-MS analysis.
Polyaromatic Hydrocarbons (PAH)	Wet Sediment	Solvent extraction and clean up followed by GC-MS analysis.
Total Hydrocarbon Content (THC)	Wet Sediment	Solvent extraction and clean up followed by GC-FID analysis.
Polychlorinated Biphenyls (PCBs)	Air dried and seived to <2mm	Solvent extraction and clean up followed by GC-MS-MS analysis.

Analyte Definitions

Analyte Abbreviation	Full Analyte name	Analyte Abbreviation	Full Analyte name	Analyte Abbreviation	Full Analyte name
ACENAPTH	Acenaphthene	C2N	C2-naphthalenes	THC	Total Hydrocarbon Content
ACENAPHY	Acenaphthylene	C3N	C3-naphthalenes	AHCH	alpha-Hexachlorcyclohexane
ANTHRACN	Anthracene	CHRYSENE	Chrysene	BHCH	beta-Hexachlorcyclohexane
BAA	Benzo[a]anthracene	DBENZAH	Dibenzo[ah]anthracene	GHCH	gamma-Hexachlorcyclohexane
BAP	Benzo[a]pyrene	FLUORANT	Fluoranthene	DIELDRIN	Dieldrin
BBF	Benzo[b]fluoranthene	FLUORENE	Fluorene	HCB	Hexachlorobenzene
BEP	Benzo[e]pyrene	INDPYR	Indeno[1,2,3-cd]pyrene	DDD	p,p'-Dichorodiphenyldichloroethane
BENZGHIP	Benzo[ghi]perylene	NAPTH	Naphthalene	DDE	p,p'-Dichorodiphenyldicloroethylene
BKF	Benzo[k]fluoranthene	PERYLENE	Perylene	DDT	p,p'-Dichorodiphenyltrichloroethane
C1N	C1-naphthalenes	PHENANT	Phenanthrene		
C1PHEN	C1-phenanthrene	PYRENE	Pyrene		

C DATA SUMMARY TABLES

Summary Table A1 - Scotstoun

Sampling Results Incorporated with BPEO Assessment (mg/kg)

						Scotstoun 2020																
	AL1	AL2	BAC	ERL	PEL	VCE01 0.0-0.15m	VCE01 0.15-0.6m	VCE01 0.6-1.1m	VCE02 0.0-0.15m	VCE02 0.6-1.1m	VCE02 1.1-1.6m	VCE02 1.6-2.1m	VCE03 0.0-0.15m	VCE03 0.5-1.0m	VCE03 1.0-1.5m	VCE04 0.0-0.15m	VCE04 0.3-0.8m	VCE04 0.8-1.3m	AVERAGE	No. Exceed RAL 1	No. Exceed RAL 2	No.Exceed BAC?	No. Exceed ERL	No. Exceed PEL?
Source			CSEMP	CSEMP	Canada																			
Arsenic	20	70	25		41.6	13.9	15.6	13.0	13.8	15.2	13.7	16.5	15.6	15.8	16.4	17.7	16.0	9.6	14.83	0	0	0	N/A	0
Cadmium	0.4	4	0.31	1.2	4.2	1.07	1.16	0.88	3.79	1.17	1.05	1.10	1.04	1.10	1.10	1.11	0.92	0.55	1.23	13	0	13	1	0
Chromium	50	370	81	81	160	126	155	128	125	156	126	167	145	154	170	160	133	78.0	140.23	13	0	12	12	3
Copper	30	300	27	34	108	127	148	72.6	131	95.6	76.3	98.3	115	97.5	92.7	148	87.9	52.9	103.29	13	0	13	13	5
Mercury	0.25	1.5	0.07	0.15	0.7	0.38	0.46	0.37	0.36	0.47	0.36	0.46	0.41	0.45	0.48	0.44	0.37	0.20	0.40	12	0	13	13	0
Nickel	30	150	36	-	-	37.0	39.7	43.5	33.6	42.2	43.1	43.8	39.1	41.3	43.3	45.8	38.8	39.0	40.78	13	0	12	N/A	N/A
Lead	50	400	38	47	112	123	150	114	123	146	135	150	138	145	153	149	132	76.9	133.45	13	0	13	13	12
Zinc	130	600	122	150	271	301	430	280	302	323	312	338	311	328	334	352	275	198	314.15	13	0	13	13	12
Napthalene	0.1		0.08	0.16	0.391	0.158	0.188	0.223	0.214	0.219	0.224	0.194	0.183	0.203	0.175	0.183	0.177	0.0566	0.18	12	N/A	12	11	0
Acenaphthylene	0.1		-	-	0.128	0.069	0.087	0.116	0.101	0.098	0.095	0.107	0.096	0.091	0.085	0.122	0.072	0.0256	0.09	4	N/A	N/A	N/A	0
Acenaphthene	0.1		-	-	0.0889	0.0911	0.112	0.136	0.141	0.143	0.132	0.177	0.113	0.111	0.106	0.116	0.105	0.0	0.12	11	N/A	N/A	N/A	12
Fluorene	0.1		-	-	0.144	0.142	0.163	0.242	0.191	0.208	0.199	0.198	0.155	0.162	0.159	0.152	0.145	0.0581	0.17	12	N/A	N/A	N/A	11
Phenanthrene	0.1		0.032	0.24	0.544	0.544	0.637	0.977	0.760	0.788	0.924	0.841	0.707	0.687	0.686	0.669	0.674	0.251	0.70	13	N/A	13	13	12
Anthracene	0.1		0.05	0.085	0.245	0.218	0.265	0.343	0.313	0.318	0.306	0.310	0.275	0.278	0.260	0.278	0.253	0.0816	0.27	12	N/A	13	12	11
Fluoranthene	0.1		0.039	0.6	1.494	1.170	1.350	1.820	1.540	1.580	1.690	1.770	1.490	1.470	1.500	1.460	1.480	0.456	1.44	13	N/A	13	12	6
Pyrene	0.1		0.024	0.665	1.398	1.160	1.370	1.810	1.580	1.580	1.630	1.720	1.490	1.460	1.510	1.450	1.470	0.448	1.44	13	N/A	13	12	10
Benzo(a)anthracene	0.1		0.016	0.261	0.693	0.639	0.761	0.976	0.871	0.855	0.913	0.991	0.866	0.937	0.821	0.900	0.820	0.253	0.82	13	N/A	13	12	11
Chrysene	0.1		0.02	0.384	0.846	0.673	0.781	1.080	0.918	0.921	1.010	1.050	0.905	0.986	0.889	0.935	0.863	0.27	0.87	13	N/A	13	12	10
Benzo(b)fluoranthene	0.1		-	-	-	0.723	0.974	1.250	1.090	1.090	1.140	1.200	1.050	1.130	1.030	1.160	1.010	0.3	1.01	13	N/A	N/A	N/A	N/A
Benzo(k)fluoranthene	0.1		-	-	-	0.299	0.481	0.590	0.570	0.398	0.567	0.609	0.369	0.495	0.513	0.614	0.477	0.157	0.47	13	N/A	N/A	N/A	N/A
Benzo(a)pyrene	0.1		0.03	0.384	0.763	0.770	0.957	1.250	1.090	1.030	1.130	1.220	1.100	1.210	0.980	1.220	1.030	0.324	1.02	13	N/A	13	12	12
Indeno(1,2,3cd)pyrene	0.1		0.103	0.24	-	0.550	0.741	0.982	0.897	0.840	0.899	0.937	0.876	0.926	0.813	0.986	0.709	0.23	0.80	13	N/A	13	12	N/A
Benzo(ghi)perylene	0.1		0.08	0.085	-	0.571	0.769	1.030	0.915	0.876	0.961	0.983	0.906	0.970	0.798	0.961	0.852	0.271	0.84	13	N/A	13	13	N/A
Dibenzo(a,h)anthracene	0.01		-	-	0.135	0.111	0.150	0.152	0.180	0.168	0.183	0.196	0.129	0.189	0.166	0.148	0.166	0.0505	0.15	13	N/A	N/A	N/A	10
TPH	100		-	-	-	1530.000	1790.000	2260.000	2560.000	2560.000	2320.000	2680.000	2370.000	2490.000	2280.000	2460.000	2180.000	766	2172.77	13	N/A	N/A	N/A	N/A
PCBs	0.02	0.18	-	-	0.189	0.0494	0.04912	0.02498	0.03603	0.03712	0.02689	0.04383	0.03875	0.03725	0.04586	0.03715	0.03317	0.0092	0.0361	12	0	N/A	N/A	0
TBT	0.1	0.5	-	-	-	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.0500	0	0	N/A	N/A	N/A

Note: Underlined Values are < LOD. Values highlighted red are equal to or greater than AL1.
PEL Data Source: http://ceqg-rcqe.ccme.ca/en/index.html#void

Summary Table C

Cloch Point Contaminant Summary - Source: Marine Scotland

	Site Name	As mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Zn mg/kg	ICES7 ug/kg	TBT+ mg/kg	(a)Pyrene (mg/kg)
ERL	Cloch Point	-	1.2	81	34	0.15	-	47	150	-	-	0.384
PEL		41.6	4.2	160	108	0.7	-	112	271	189	-	0.763
Min		0.00	0.08	43.08	3.83	0.01	15.89	45.74	43.97	8.61	9.82	0.17
Average		15.18	0.69	151.51	68.83	0.61	35.25	154.58	259.60	46.89	55.93	0.84
Max		28.36	1.52	243.03	163.31	2.84	54.56	302.99	1214.74	191.05	342.71	3.09