River Clyde Maintenance Dredge Licence
BPEO Report – August 2020

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1 INTRODUCTION

1.1 Scope of Report

Peel Ports Limited/Clydeport Operations Ltd (PPG) are required to undertake a Best Practicable Environmental Option (BPEO) assessment for the disposal of dredged material originating from various sites marked out for maintenance dredging purposes. This submission is in support for the renewal of maintenance the dredging licence for sites currently licensed on 06582/18/0 which is due to expire on 13th February 2021.

This application also considers the proposed beneficial re-use project which has been the focus of recent discussion between PPG and Marine Scotland and other key stakeholders. A summary of this initiative this is further discussed in section 3.1 and 3.2 and considered further through the document.

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

At the ports of Glasgow, Greenock and Hunterston routine Maintenance Dredging is required to maintain depths in the Common Navigable Channels, Docks and Riverside Berths to allow for the safety of navigation for shipping using these facilities, as required under the Port Marine Safety Code.

The current method of disposal for the dredged material is to sea at the existing Marine Scotland licensed disposal site 1.6 nautical Miles North of Cloch Point in the Firth of Clyde, ref Cloch Point Spoil Ground, MA021.

The Average Annual Maintenance Dredging Commitment is made up from approximately 32% sand and 67% silt and clay(mud), and results from natural erosion of the hinterland, which is, carried into the common Navigable Channel, Docks and Riverside Berths by the River Clyde and its tributaries. Wave and tidal action puts materials into suspension and thereafter is accumulated in certain parts of the above areas.

The dredging works are carried out by Dredging Contractors to a programme determined by Clydeport Operations Limited in association with Peel Ports group dredging operations.

This programme takes account of current and future dredging requirements against financial budgets. To allow full commercial flexibility in terms of responding to urgent dredging requirements, taking advantage of commercially available dredging plant (often at short notice), removal of dredging backlog, new projects etc., all areas are included in the licence application.

This report covers 17 dredge licence areas which are detailed in the Figures in Appendix A and Table 1-1 below. It should be noted that other sites relating to this application are detailed in EnviroCentre Report 8993, February 2020 with a view to getting all maintenance dredge sites on a single licence.

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

Site Name	Dredge Volume (m3)
Buoy 17 River Channel	1000
Buoy 25 River Channel	1000
Dumbuck River Channel	1000
Longhaugh River Channel	1000
Donald's Quay River Channel	1000
Newshot River Channel West	15000
Rothesay Dock Approaches	75000
Rothesay Dock Canting Basin	
Rothesay Dock Tanker Berth	
River Cart Catchment	
Braehead River Channel	6000
King George V Approaches	15000
King George V Dock North	
Shieldhall River Channel	65000
Shieldhall Riverside Quay Bolls 1-23	
Adams Scrap Berth	
Shieldhall Catchment	

Dredging is carried out by a combination of Trailer Suction Hopper Dredger, Cutter suction dredger, Grab Hopper Dredger and Back-hoe Dredger as appropriate. Plough dredging is carried out in support of Trailer Suction Hopper Dredger operations and for limited and / or urgent dredging projects in between larger scale maintenance projects.

Some of the dredging areas are within the Inner Clyde Site of Special Scientific Interest (SSSI) / Special Protection Area (SPA). Given the close proximity of the works to the Ramsar/SPA, Scottish Natural Heritage (SNH now NatureScot) were consulted. Their response indicated that dredging works undertaken between mid-March and mid-September would have ‘no likely significant effect’ as birds would be absent. If dredging is to occur in the winter months then SNH state that a Habitat Regulations Appraisal will be required. The SNH response is included in Appendix D.

1.3 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.

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2 NATURE OF MARINE SEDIMENTS

Samples from the proposed dredge area were collected in July 2020 and submitted for analysis in line with Marine Scotland's Guidance. The results from this exercise are provided in Appendix B.

Sediments sampled within the proposed dredge areas are reported as ranging from silt to sand.

2.1 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 Table 2-1 below. Full summary reports detailing exceedances in the Marine Scotland format have been submitted along with the supporting information for the application. The full sediment sampling report is provided in Appendix B.

Where contaminants have RALs as adopted by Marine Scotland, exceedances above these criteria are summarised in Table 2-1, along with the maximum concentration recorded for each parameter.

Table 2-1: Exceedances of Revised Action Levels and Maximum Concentrations

Contaminant	**No. of Exceedances (of 44 samples)***		**Maximum Concentration (mg/kg) and Location**
	RAL 1	**RAL 2**	
Arsenic	4	0	23.35 (Sample 37)
Cadmium	27	0	1.37 (Sample 11)
Copper	29	0	137.6 (Sample 11)
Chromium	44	0	251.1 (Sample 11)
Lead	29	0	169.2 (Sample 1)
Mercury	26	0	1.28 (Sample 33)
Nickel	18	0	59.6 (Sample 13)
Zinc	29	0	425.1 (Sample 1)
PAH (All Species)	39	-	2.93 (Fluoranthene – Sample 11)
PCBs	17	0	0.09 (Sample 11)
TBT	0	0	0.036 (Sample 12)
TPH	35	-	4020 (Sample 11)

Multiple exceedances above RAL 1 were noted for metals, TPH, PAHs and PCBs, with all samples exceeding RAL 1 for chromium. There were no exceedances of RAL 1 for TBT.

All results were recorded below RAL 2 where they exist.

2.2 Physical Characteristics

Surface sediment encountered generally comprised finer material (silt) in the eastern (upstream) reaches. Material generally became coarser from the Newshot River Channel westwards with sand, gravel and shell content noted to be increasing further downstream. The average content of the dredge as a whole, considering the varying volumes at all the sites , is approximately 1% gravel, 32% sand and 67% silt and clay (mud).

2.3 2017 Sampling Data

The 2017 sampling campaign chemical results are summarised in Table 2-2 below.

Table 2-2: Exceedances of Revised Action Levels and Maximum Concentrations

Contaminant	No. of Exceedances (of 39 samples)*		Maximum Concentration (mg/kg)
	RAL 1	RAL 2	
Arsenic	5	0	51.4
Cadmium	20	0	1.08
Copper	21	0	99.4
Chromium	24	0	237
Lead	22	0	223
Mercury	19	1	2.72
Nickel	20	0	50.1
Zinc	22	0	379
PAH (All Species)	32	-	3.85 (fluoranthene)
PCBs	20	0	0.067
TBT	0	0	0.049
TPH	4	-	4,620

Comparison of the number of exceedances of Action Level 1 and maximum concentration between the 2017 and 2020 data sets are broadly similar with no RAL2 exceedances recorded in 2020. These data are compared in Table 2-3. They key changes noted are an increase in the frequency of chromium and Total Hydrocarbon content. The majority of other changes are generally within +/- 15% variability which would be expected considering both the dynamic nature of the environment as well as heterogeneity of sediments. Maximum concentrations recorded in 2017 and 2020 are also broadly similar.

Table 2-3: Exceedances of Revised Action Levels and Maximum Concentrations

Contaminant	% of RAL Exceedances		% Change	Maximum Concentration	
	2017	2020		2017	2020
Arsenic	12.8	9.1	-3.7	51.4	23.35
Cadmium	51.3	61.4	10.1	1.08	1.37
Copper	53.8	65.9	12.1	99.4	138
Chromium	61.5	100.0	38.5	237	251
Lead	56.4	65.9	9.5	223	169
Mercury	48.7	59.1	10.4	2.72	1.28

Contaminant	**% of RAL Exceedances**		**% Change**	**Maximum Concentration**	
	2017	**2020**		**2017**	**2020**
Nickel	51.3	40.9	-10.4	50.1	59.6
Zinc	56.4	65.9	9.5	379	425.1
PAH (All Species)	82.1	88.6	6.6	3.85	2.93
PCBs	51.3	38.6	-12.6	0.067	0.09
TBT	0.0	0.0	0.0	0.049	0.036
TPH	10.3	79.5	69.3	4,620	4,020

3 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.

3.1 River Clyde Beneficial Reuse Working Group

Peel Ports Group and Clydeport Operations Ltd. are currently in the process of identifying potential sites which could make beneficial reuse of material as an alternative to sea disposal. This is currently being explored through the Clyde Beneficial Reuse Working Group.

The group comprises the Port Authority, Clydeport Operations, as well as a number of regulators including SEPA, Marine Scotland and several of the key local authorities as well as potential benefactors of dredged materials such as RSPB and NatureScot,, formerly Scottish Natural Heritage.

The initiative will enable Clydeport Operations Ltd. to demonstrate that it is fulfilling its obligations under various international policy drivers (e.g. the London Protocol and OSPAR), which in turn underpin the principles enshrined in the preparation of the Best Practicable Environmental Options Assessment report required to accompany a dredging/disposal application.

In addition, the initiative should ideally contribute to the delivery of:

- The protection and enhancement objectives of the EU Habitats, Birds and Water Framework Directives
- Relevant existing and evolving policies in the Clyde Region Marine Plan and in other relevant plans, notably on climate change adaptation
- Wider environmental objectives, including the UN's Sustainable Development Goals
- Flexible, responsive solutions that enshrine adaptive management principles and take into account the dynamic nature of the coastal environment.

Through collaboration and innovation, the initiative may also enable other organisations to meet their respective objectives and responsibilities. For example, there may be opportunities with respect to the Scottish Government's 16 national outcomes, or coastal flood and erosion risk management deliverables.

To be viable, it is acknowledged that beneficial or alternative use options for maintenance dredged material must:

- Be technically feasible and practicable, but ambitious where appropriate (for example promoting implementation through pilot studies or phased implementation);
- Be appropriate in terms of the nature (size) and quantity of sediment required;
- Be flexible in terms of programming, to align with dredging activity;
- Be able to accommodate the levels of contaminants present within the sediment;
- Be located within a reasonable distance of the dredging area;
- Not be disproportionally costly to Clydeport, or have an identified source of funding to cover any extra-over costs;
- Have no significant adverse impacts on other legitimate uses;
- Be in line with all relevant licensing and consenting requirements.

3.2 The Proposed Beneficial Use Project

Following ongoing discussions and meeting between the key stakeholders, a candidate site at Langdyke has been identified as the preferred option. Discussions are ongoing at present with regards to agreeing the finer details to enable this to proceed. The beneficial use is outlined below as presented by PPG to Marine Scotland and NatureScot in August 2020.

3.2.1 Project Aim

The overall project aim of this beneficial reuse is to retain sediment, which would otherwise be surplus to requirement, within the overall estuarine system so that the landforms and coastal margins are offered better protection during sea-level rise and storm events. This would also go some way to helping restore the sediment budget of the estuary, to help sustain the associated habitats including intertidal flats and fringing marshes, while helping assist in maintenance of ecosystem services and protection to both coastal infrastructure and assets.

3.2.2 Background

Routine dredging activities are undertaken to maintain navigation depths, and as such inhibit natural processes which result in the accumulation of sediment which leads to shallowing of channels, migration and or splitting of the river channel. The removal of sediment and deposition within deep waters away from the estuary, which is undertaken at many licensed disposal sites around Scotland, significantly reduces the volumes of available sediment which an estuary can utilise in its natural processes.

Sea-levels within the Clyde are now rising due to global climate change which in-turn further increases the risk of both coastal erosion and flooding. In other Firths, the Dynamic Coast project has identified a trend of increasing erosion at the seaward end over recent decades, while the ‘internal’ shorelines have accreted seaward or remained unchanged. According to NatureScot, from discussions regarding the beneficial re-use project, it’s not clear if this also applies on the Clyde, because so much of the estuary shoreline has been historically modified or engineered. Saltmarsh margins have expanded in some locations and retreated in others.

Predictions of the effects on coastal features associated with rising sea levels is uncertain, but it is known that retaining sediment in the estuary system will help tidal flats and shorelines which may otherwise be destabilised with both rising sea levels and reduced sediment volumes to work with. Re-using sediment in this way supports the estuary's natural dynamics.

In summary, retaining dredgings within the estuary will work with nature, helping it to keep pace with sea-level rise. Adopting this approach has the added benefit of maintaining the highly important protection the estuary gives the Glasgow region against marine surge and storm waves, which can both cause flooding and erosion. Healthy, wider tidal flats and marshes mean less spending on coastal defences. They also maintain the complex estuary ecosystem, including internationally and nationally important bird populations, and support storage of 'blue carbon', including in saltmarsh.

3.3 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 3-1 along with justification for screening out those options which have not been taken forward for further consideration.

Table 3-1: 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 maintain the depth of the shipping channel in the River Clyde.	No
	Infilling of an existing dry dock/harbour facility/development site (re-use)	We are aware of a potential development opportunity on the Clyde Riverbank that may be able to receive dredged material for use as infill within the confines of an old dock. The project is in its very early stages, so specific details are not currently available. at time of writing, but this option will be explored further. The use of the dredged material on a development site is dependent upon programme timing and the suitability of the location of the receiving site. Once material is brought on to land it falls under the jurisdiction of SEPA. Further chemical and geotechnical testing is likely to be required before it is permitted for use on a development site.	Yes
	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 silt. Fine sediments (i.e. silt) is not suitable for beach nourishment in the traditional sense.	No

	Beneficial Reuse on Intertidal Mudflats	Peel Ports Group (PPG) are committed to exploring and investing in beneficial reuse initiatives where they exist. These opportunities may lie with a third party who require dredged material for a site stabilisation from erosion, or protection of habitats at risk of erosion as examples, as well as the more commonly used site infill/upfill opportunities. Typically, these sites need to be in proximity to the dredge areas and accessible by dredger for a range of disposal options including bottom dumping, rainbowing, or floatation of a discharge pipeline. PPG have championed the River Clyde Beneficial Reuse Working Group to engage a diverse group of stakeholders and decision makers to help support and identify potential reuse options. Recent efforts have narrowed down a number of candidate sites to two potential sites in proximity to Dumbarton. The current preferred option at present is to establish a trial disposal site at Langdyke for the deposition of dredged material with a view to keeping the sediment in the system so that landforms are robust to help mitigate against potential sea level rise and storms. Discussions are ongoing with Marine Scotland at present to establish this. Once the area of site is confirmed, baseline studies will likely be required to measure the potential effects. PPG/Clydeport Operations are currently seeking to include the trial site on the dredge licence to enable the trial to commence as part of this current application. It is understood that this will require further and separate consideration, however, it is envisaged that this can be included subject to meeting specific requirements from Marine Scotland. Further information on this will be submitted separately in due course.	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.	Yes
	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 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 7 km from the closest proposed dredge site with an assigned licensed annual capacity of 830,000 tonnes.	Yes

3.4 Summary of Identified BPEO Options

Four options were taken forward for further detailed BPEO assessment as follows:-

- Infilling of Existing Harbour / Dock Facility;
- Beneficial reuse
- 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.

3.4.1 Infilling of Existing Harbour/ Dock Facility

Infilling projects require a three-stage material handling operation:

- Dredging and transportation of material to infill site;
- Discharge of material to infill site; and
- Spreading of material at infill site.

Transportation to the infill site would require the identification and positioning or creation of a jetty / pontoon facility suitable for delivering material directly to the site for subsequent spreading of the material.

A system of pipelines and pumping stations aided by the dredgers own pump ashore facility (if required) would transfer the material from the hopper to the site. In some circumstances it may be possible for the dredger to place the material transported in the hopper directly into the harbour or dock by means of controlled bottom dumping or the ‘rainbow’ method of pump ashore.

Thereafter, the material could be spread to the required depth in the designated area by means of suitable tracked plant. Dependant on the silt content the material may also require some degree of physical stabilisation also prior to final placement.

Timing and vessel availability / suitability issues could be problematic in terms of matching routine maintenance dredging operations with development led infilling projects.

3.4.2 Beneficial Reuse

The current preferred beneficial reuse option has been identified as placement of dredged sediment at Langdyke. The exact methodology and trial site location are yet to be identified and agreed. The current working plan would be to deposit the material in a focused area and allow the material to be transported by the tides and river flow and naturally redistributed throughout the wider estuary. The material to be deposited in this area will need to be similar both physically and chemically to the receiving environment to minimise disruption to the habitats in the area.

Clydeport have experience of beneficially using dredged material for harbour infill and Peel Ports Group have experience of novel disposal practices on the River Mersey whereby sediment is strategically deposited in the lower estuary for natural dispersal rather than transporting to the traditional disposal sites. This retains sediment in the system and saves on fuel consumption and associated carbon emissions.

Based on the current discussions on this option the following operations would be required:-

- Dredging of material from suitable site (based on sampling data);
- Transport to disposal site;
- Deposition of dredged material within trial site boundary – split bottom barge bottom dumping, rainbowing at low tide or discharge pipeline.

3.4.3 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 approximately 26,000 return trips per annum 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.

3.4.4 Sea Disposal

This option only handles material at one 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.

4 FURTHER CONSIDERATION OF REMAINING DISPOSAL OPTIONS

4.1 Detailed BPEO Assessment

Each of the identified options was assessed against the criteria detailed in Table 4-1 below.

Table 4-1: 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

4.1.1 BPEO Strategic Assessment

Table 4-2below provides details of the strategic assessment for each option taken forward for the detailed BPEO assessment: BPEO Environmental Assessment.

Table 4-3 details the environmental assessment for each option taken forward for detailed BPEO assessment.

Table 4-2: BPEO Strategic Assessment

Criteria	Development Site Infill	Beneficial Reuse	Landfill	Sea Disposal
Operational Aspects (inc. handling and transport)	Clydeport have experience of beneficially using dredged material for harbour infill. As projects become available out with Clydeport's operations, they would be considered on a project by project basis. Any projects identified would have to be assessed in terms of associated costs and potential for environmental impacts as a minimum. Material could be directly emplaced from dredger. Additional machinery and plant operatives would be necessary to spread material once deposited.	Clydeport have experience of beneficially using dredged material for harbour infill and Peel Ports Group have experience of novel disposal practices on the River Mersey whereby sediment is strategically deposited in the lower estuary for natural dispersal rather than transporting to the traditional disposal sites saving on fuel consumption and associated carbon emissions. The latter is considered a simple operation and in line with the traditional sea based disposal, although the site would be intertidal rather than deep-water. Material would most likely be deposited directly through bottom dumping, rainbowing or discharge pipeline onto the agreed trial site area.	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.	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	There is currently one potential site identified which may be able to accommodate some of the dredged material for the infilling of a disused dock. Additional geotechnical testing may be required to confirm the suitability of the dredged material for this option. Early discussions have indicated that material with high sand content may be suitable for infilling purposes. Unsuitable/surplus dredged material will still require to be disposed of via an alternative route. The capacity is finite for each site and once infilled there is no further requirement for dredged material.	A site has been identified by all stakeholders following a review (and elimination of other potential candidate sites) at Langdyke near Port Glasgow. Baseline studies are required to establish the current conditions so that the effects of the trial can be measured overtime.	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. 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.
General Public /Local acceptability	Varied as can have good public perception as material is effectively being used to fill what may be seen as unwanted space. Alternatively, may be seen as a negative due to a loss of historic facility. There is a possibility of perceived negative temporary impacts to local amenity (e.g. dust, noise) while material movements are being undertaken on site.	Utilisation of intertidal mudflats as an area for dredged sediment disposal may have a negative view in public perception. Effective public engagement and provision of information detailing the benefits should help mitigate against this.	Increase traffic on haul routes therefore potential for increase in public complaints.	Traditionally accepted disposal route for dredged material and limited public impact.

Legislative Implications	Material falls under jurisdiction of SEPA when it is brought to land. A Waste Management Exemption will likely be required.	This would need to be approved by Marine Scotland. Dialogue is already in progress between key stakeholders PPG and Marine Scotland with regards to this option.	Contravenes the principles of minimising waste and long term commitments by the government to reduce land filling.	Material falls under jurisdiction of SEPA when it is brought to land. A Waste Management Exemption will likely be required.

Table 4-3:: BPEO Environmental Assessment

Criteria	Harbour Infill	Beneficial Reuse Trial	Landfill	Sea Disposal
Safety Implications	Minimal handling of dredged material as it is directly placed within the infilling area. Work would be undertaken in accordance with H&S legislation. Members of the public would have limited access to infilling area.	Minimal handling of material required as it is directly placed at the disposal site.	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	Depending on the method of delivery, measures are required to limit the impact from aerial dispersion, odour and noise during the infilling process. Once infilling complete pathways for human contact are greatly reduced.	Work would be undertaken in accordance with H&S legislation.	Measures will be required to limit human contact during transfer of material from dredger to dewatering facility and transportation to landfill. 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	Infilling operations would require measures to limit water, noise, and air (including odour) pollution.	Pollutant concentrations limited to acceptable levels through regulatory licensing (i.e. as with a conventional sea disposal site)	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.	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	Any identified development site is likely to be a brownfield site. Measures required to properly manage any species found to be present in the area to be infilled. Environmental Impact Assessment would likely be required for an infilling project which will incorporate consideration of ecological impact.	Potential impacts upon habitat and local ecology will need to be considered prior to implementation. It is a known feeding area for a variety of birds at low water.	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.
Interference with other legitimate activities	Interference with other activities will be dependent upon the location of any infilling project. Other activities are not likely to be occurring on the receiving site at the time of infill, but there may be disruption to adjacent sites relating to noise and air pollution and restrictions on vessel movements.	The proposed trial area is adjacent to the main navigable channel so works would need to be phased to ensure that interference to other river users is managed appropriately. This is the same approach as that undertaken routinely on the river for a variety of projects and forms standard practice.	Potential for 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	Temporary visual impacts during infilling but no long term impacts. Depending on nature of deposition potential for odour emissions, noise and aerial dispersion impacting properties although these impacts will be short term.	All potential impacts to the amenity of the site and aesthetics are considered to be both localised and temporary in nature. The material will be visible at low water and will disperse over a number of tidal cycles.	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.

4.2 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).

For the purposes of comparing costs associated with each option a benchmark of 100,000 tonnes (approximately 50,000m^3) of dredged material has been set.

The assumptions to calculate the costs are as follows:-

- Dredging costs are estimated to be £3.21 per m^3;
- Ship transportation costs from the dredged area to disposal / transfer site have been calculated based on £1.85 per tonne;
- Costs associated with the operation of a suitable reception / transfer facility for infilling projects (mobilisation / demobilisation assembly of pipelines, connectors, pumps, pollution prevention measures etc) is estimated to be in the region of £70,000;
- Costs associated with construction of a suitable barrier system to close of the entrance of the harbour / dock to be in filled depends on the method employed. For the purposes of this assessment it is estimated to be in the region of £400,000;
- The costs associated with beach nourishment and harbour infilling projects are based on 40% of the dredged material being used in this manner. It has been assumed that the remaining dredged material balance i.e. 60% will be disposed of via an alternative route. A range of costs is therefore provided for alternative disposal of the remaining balance i.e. 60% of the total cost of each of the other two identified disposal options;
- Costs associated with construction and operation of a dewatering facility are estimated to be in the order of £1,000,000 or greater;
- Cost associated with transfer of dewatered material to lorry are based on a wheeled shovel (costing £47 per hour) operating 2 hours per day for 6 days per week for ten weeks;
- Transportation costs from a dewatering facility to landfill are estimated to be £4.85 per tonne; and
- Landfill gate fees are estimated to be £15per tonne for a non-hazardous landfill (Note Maintenance dredgings are currently exempt from landfill tax as defined in HM Customs and Excise Notice LFT1, A general guide to landfill tax, May 2012, Part 4).

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

Table 4-4: BPEO Cost Analysis (based on 100,000 tonnes only)

Activity	Harbour In fill (£)	Beneficial Reuse Trial	Landfill Disposal (£)	Sea Disposal (£)
Dredging	160,500	160,500	160,500	160,500
Transport by vessel to disposal site	185,000	60,000[1]	185,000	185,000
Rainbowing onto Disposal Site additional costs	-	102,000[2]	-	-
Discharge to shore via pipeline additional costs	-	325,000[3]	-	-
Reception facility	70,000	-	70,000	-
Harbour / Dock Closure	400,000	-	-	-
Dewatering Facility	-	-	1000,000	-
Transfer of material to lorry	-	-	5,640	-
Transportation Cost	-	-	485,000	-
Landfill Gate Fee	-	-	1,500,000	-
Cost of using 40% of dredged material for beach nourishment	815,500	-	-	-
Cost associated with disposal of remaining dredging balance (60%)	Ranges from 207,300 to 2,043,684 depending on disposal option -	-	-	-
Total Costs	**1,022,800 to 2,859,184**	**220,500 to 545,500**	**3,406,140**	**345,500**

General 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). Harbour infilling and beach nourishment projects typically use smaller dredgers which are generally more expensive than ones used for sea disposal. The cost associated with the set- up of a reception facility for infilling, beach nourishment and landfill disposal will also vary depending on the nature of the particular project and specific site conditions.

Note 1 – Bottom dumping costs - £220,500. Would require c. 7m of water to enable laden split bottom barges/dredgers access at high tide.
Note 2 – £322,500 Rainbowing, assumed that silt will be deposited with laden dredger volume of c. 1500m^3, assumed 34 loads. 2 hours per load for deposition and positioning.

Note 3 – Pumping ashore – £545,500 would require installation of anchored discharge pipeline, assumed 200m at £100,000 plus 24/7 supervision from Workboat to ensure pipeline remained fast and anchored in place prior to demobilisation. Assumed that 2 hours per load for discharge as per rainbowing with 1,500m^3 of silt per load. Assumed to be undertaken over 6 days.

4.3 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 – 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 4-5 below provides a summary of the BPEO assessment.

Table 4-5: BPEO Summary

Criteria	Infill	Beneficial Reuse Trial	Landfill Disposal	Sea Disposal
Environment	2	2	4	2
Strategic	2	1	4	2
Costs	3	1- 3	4	1
TOTAL SCORE	**7**	**4-6**	**12**	**5**

4.4 BPEO Assessment Discussion

The use of suitable dredged material (i.e. sands) in construction or reclamation work is strategically attractive as it reduces the use of existing disposal facilities, either at sea or on land, and provides a raw material which would otherwise need to be obtained from another land source.

The use of the River Clyde dredged material for these types of projects is further limited by sediment characteristics i.e. only 32% of the total volume of material is sand sized in nature. As such up to 60% of the remaining dredging balance will need to be disposed of via an alternative disposal route. The viability of using dredged material from the River Clyde as suitable material for infilling should only be considered as future projects are identified.

Clydeport have a track record of utilising the sand fraction of maintenance dredging in a beneficial way and will continue to consider options for using this type of dredged material for other developments on Clydeport’s estate as and when they become available.

Disposal to landfill is considered to be the least suitable option for the River Clyde 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.

The proposed trial at Langdyke, albeit at present would form a small portion of the overall anticipated annual dredge volumes, could help reduce both transportation and carbon costs for dredging as well as potentially enhancing habitat and keeping sediment within the system for redistribution rather than completely removing it to a deep water site.

Deposition of the dredged material at a licensed marine disposal site is traditionally 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 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 out of the main options available

The placement of material for beneficial re-use on the intertidal mudflats at Langdyke is considered to be a favourable option in terms of reducing both cost and carbon emissions associated with dredge disposal, but this still requires further exploration. Therefore, sea disposal has been identified as currently being the most suitable option for the final end use of dredged material.

4.5 Conclusions

The Best Practicable Environmental Option for disposal of the River Clyde dredgings has therefore been assessed as sea disposal. However, it is anticipated a trial of sediment placement at the Langdyke site will likely take place involving a limited quantity of material in order to determine the suitability of this site for beneficial placement of sediment in the long term.

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.

5 FURTHER ASSESSMENT

As detailed in Section 2 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 fingerprints 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.

5.1 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. The proposed variation to the dredge licence will add another 19 discrete dredge areas into the Clyde maintenance dredge programme with an associated annual combined disposal volume of 111,990 m^3. Drawing No. 173842-GIS010 in Appendix C details the location and footprint of the Cloch Point Disposal site.

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.

5.2 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:

Table 5-1: Exceedances of Revised Action Levels

Contaminant	No. of Exceedances (of 44 samples)*	
	RAL 1	RAL 2
Arsenic	4	0
Cadmium	27	0
Chromium	44	0
Copper	29	0
Lead	29	0
Mercury	26	0
Nickel	18	0
Zinc	29	0
PAH (All Species)	39	-
PCBs	17	0
TBT	0	0
TPH	35	-

5.2.1 ERL & PEL Review

Exceedances of the ERL and PEL (where one is available) is summarised in Table 5-2. Full summary tables are provided in Table B in Appendix C : Note any contaminant of concern with N/A indicates no corresponding ERL or PEL value currently available.

Table 5-2: Exceedances of ERL and PEL

Contaminant	No. of Exceedances (of 44 samples)*	
	ERL	PEL
Arsenic	N/A	0
Cadmium	1	0
Chromium	44	22
Copper	27	3
Mercury	31	4
Nickel	N/A	N/A
Lead	29	14
Zinc	28	11
PAH (All Species)	36	20
PCBs	N/A	0
TBT	N/A	N/A

Contaminant	No. of Exceedances (of 44 samples)*	
	ERL	PEL
TPH	N/A	N/A

5.3 Averages

Review of the averaged data for all the data has been undertaken 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 exceeded RAL1 for all metals except for arsenic and various PAH species;
- Averaged concentrations exceeded the BAC for cadmium, chromium, copper, mercury, lead, zinc and numerous PAH species;
- Averaged concentrations exceeded the ERL cadmium, chromium, copper, mercury, lead, zinc and numerous PAH species;
- Average concentrations exceeded the PEL for chromium and acenapthene;
- All samples recorded averaged concentrations below RAL2 where they exist.

5.4 Chemical Assessment Conclusions

All 44 samples recorded exceedances of RAL1 for chromium. Exceedances were also recorded in a varying number of samples for the remaining metals, PCBs, PAHs and THC. There were no exceedances of RAL2 in any of the samples analysed where one is available for review.

Up to 44 individual samples recorded exceedances of one or more ERL value including metals and PAHs. Up to 22 individual samples recorded exceedances of the PEL for chromium and other metals and 20 PAHs. When the averaged data is considered, the ERL is exceeded for multiple metals and PAHs. Average concentrations were recorded in exceedance of the PEL, where one exists, for chromium and acenapthene.

Review of the background contaminant levels at the disposal site has identified that there are contaminants of concern with individual sample exceedances of the adopted ERL and PELs for the key contaminants of concern identified within this recent sampling exercise. There is no PEL currently available for Nickel but the average concentration of the proposed dredge material is 30.1 mg/kg compared to 35.3 mg/kg at Cloch Point, based on available data. Additionally, the average concentrations of lead, zinc and various PAH species across the disposal site are noted to be above the PEL.

In summary, the material that is earmarked for dredging and represented by the samples collected during this recent sampling campaign are similar in chemical composition to the site where it is proposed to be deposited.

Further consideration of the potential risks associated with the proposed disposal is considered in the following sections.

5.5 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 5-3 below:

Table 5-3: 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 areas proposed to be dredged have previously been subjected to routine maintenance dredging. The dredge sites are within the Inner and Outer 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 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. 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 5.6 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 to the existing and 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. However, given the close proximity of the works to the Ramsar/SPA, Scottish Natural Heritage (SNH) were consulted. Dredging works undertaken between mid-March and mid-September would have 'no likely significant effect' as birds would be absent. If dredging is to occur in the winter months then SNH state that a Habitat Regulations Appraisal will be required. The SNH response is included in Appendix D.

5.6 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 areas are all on the Inner and Outer Clyde 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. Additionally, when the sediment results are reviewed as an average to assess the sediment mass as a single unit for disposal then only the PEL chromium and acenapthene are slightly exceeded. 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 either at Cloch Point or at the trial site at Langdyke, 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 sand. Table 5-4 summarises the physical sediment type on average by each dredge area versus the proposed dredge volume.

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

Table 5-4: Summary of PSA Data – Averages by Dredge Area

Dredge Area	Gravel (>2mm)	Sand (0.063mm<Sand<2 mm)	Silt & Clay (<0.063mm)	Quantity to be dredged m^3
Shieldhall River Channel	0	18.2	81.8	65,000
Shieldhall Catchment	1	27.00	72.0	
Adams Scrap Berth	0	20.3	79.7	
Shieldhall Riverside Quay	0	22.2	77.8	
KGV Dock North	0	18.7	81.3	
KGV Dock Approaches	0	33.1	67.0	15,000
Braehead River Channel	2.2	30.4	67.4	6,000
Rothesay Dock Tanker Berth	0	15	85	75,000
Rothesay Dock Canting Basin	0	25	75	
River Cart Catchment	4.7	51.6	43.7	
Rothesay Dock Approaches	0.3	34.1	65.5	
Newshot River Channel East	0.6	40.6	58.8	15,000
Newshot River Channel West	2.6	52.7	44.8	15,000
Donald's Quay River Channel	2.9	70.9	26.2	1000
Longhaugh River Channel	11.3	72	16.7	1000
Dumbuck River Channel	1.5	96.7	1.8	1000
Buoy 25 River Channel	6.2	93.8	0	1000
Buoy 17 River Channel	24.7	72.8	2.5	1000
Dredge Average (%)	**1**	**32**	**67**	**196,000**

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 grain sizes in the dredge areas are sand and silt. The proportions of these vary with distance downstream and it is noted that the silt and clay content decreases the further downstream the samples are taken. The upstream samples have a max silt and clay content of around 82% and 18% sand, and at the lowest reaches sand is up to 97% of the overall content. Gravel content is also noted to increase downstream along with the sand content but forms a minor portion of the overall content. Average percentages, based on the samples collected and taking into account the various proportions of the dredge volumes at each site, calculate out at 32% sand and 67% silt with the remaining 1% noted as gravel.

Sands and gravel will fall from suspension quickly, along with any clumps of cohesive material. Silts and clays, being finer grained will suspend and have the potential for dispersal due to longer times in suspension, however it is expected that the majority will quickly fall quickly to the seabed. 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”).

The previous sediment quality report and BPEO compiled by EnviroCentre in November 2017 elevated metals and PAHs exceeding AL1 for sediment within several of the maintenance dredge sites throughout the river, indicating similar chemical quality findings to the samples collected in the June and October 2018 sampling exercise. Water quality does not appear to have been impacted as a result of previous maintenance dredge exercise.

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.

In addition, 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.

5.7 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 for the majority of maintenance dredge arisings.

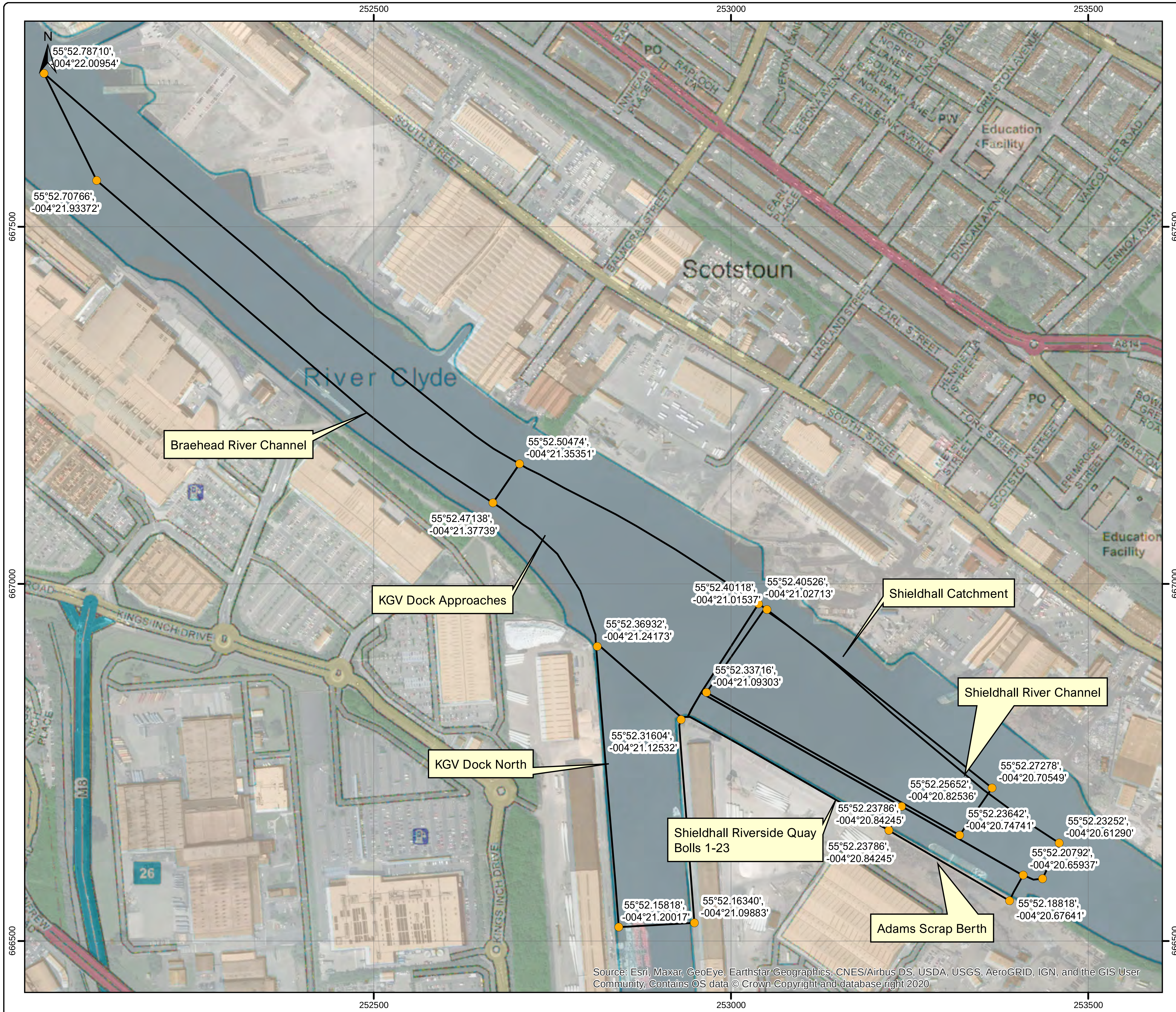
While the sea disposal option is considered to have no significant long-term impact on the marine environment; the disposal site is readily accessible from all the dredging areas and is the most cost-effective option, PPG/Clydeport Operations Ltd. are committed to exploring beneficial reuse options with the proposed trial site at Langdyke the current focus..

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 Area Boundary Points
- Dredge Areas

Do not scale this map

Client
Peel Ports Group

Project
Upper Clyde Sediment Sampling

Title
Dredge Area Boundary Points
Map 1 of 4

Status
Final

Drawing No.	Revision	Date
173842-GIS011	-	05 Oct 2020
Drawn	**Checked**	**Approved**
FR	JAS	CCAS

Scale
1:5,000 @A3
0 25 50 100 150 Metres

Rev	Date	Amendment	Initials
-	-	-	-

envirocentre
Craighall Business Park, Eagle Street, Glasgow, G4 9XA
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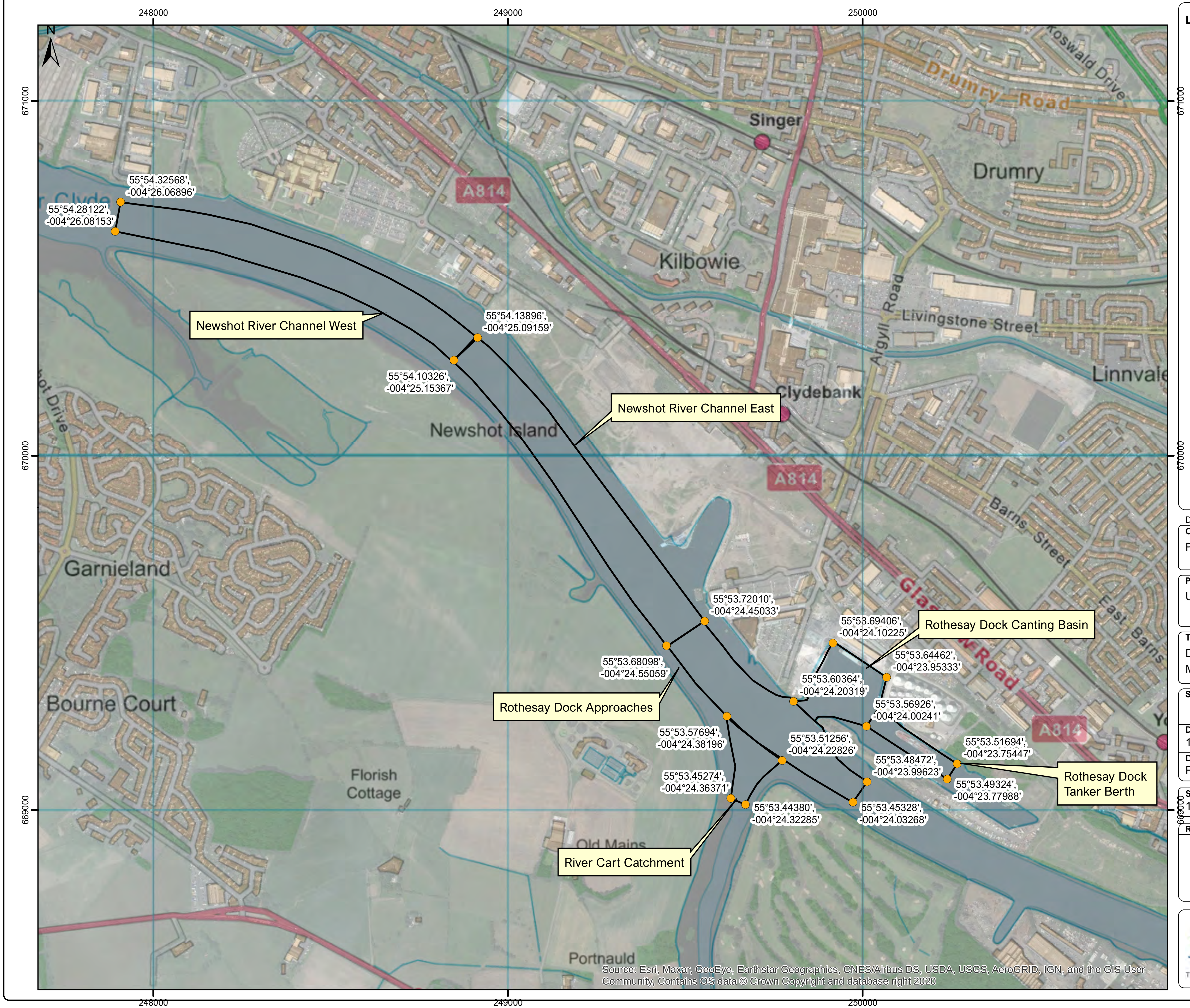

Legend

- Dredge Area Boundary Points
- Dredge Areas

Do not scale this map

Client
Peel Ports Group

Project
Upper Clyde Sediment Sampling

Title
Dredge Area Boundary Points
Map 2 of 4

Status
Final

Drawing No.	Revision	Date
173842-GIS012	-	05 Oct 2020
Drawn	**Checked**	**Approved**
FR	JAS	CCAS

Scale
1:10,000 @A3

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Rev	Date	Amendment	Initials

envirocentre

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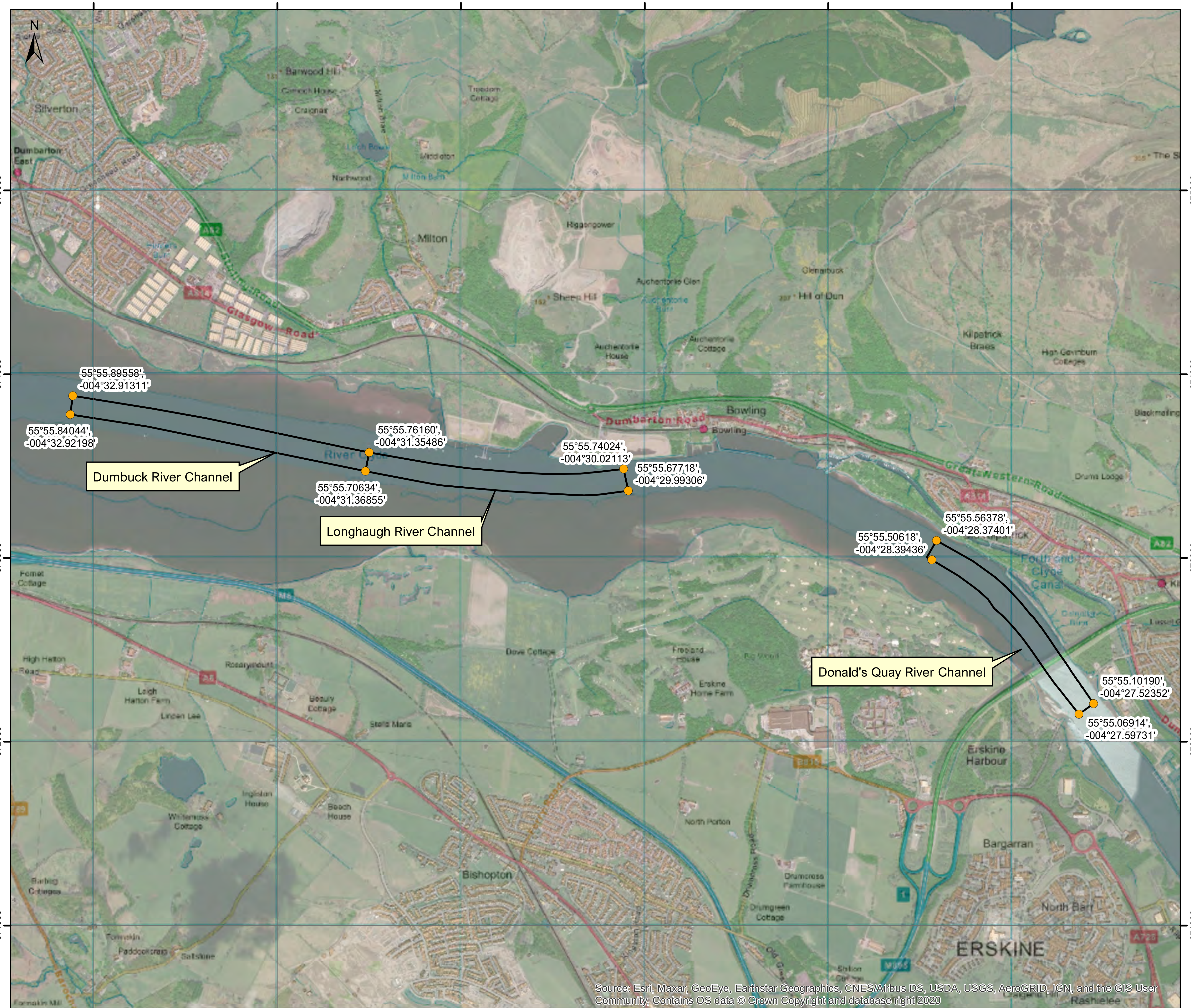

Legend

- Dredge Area Boundary Points
- Dredge Areas

Do not scale this map

Client
Peel Ports Group

Project
Upper Clyde Sediment Sampling

Title
Dredge Area Boundary Points
Map 3 of 4

Status
Final

Drawing No.	Revision	Date
173842-GIS013	-	05 Oct 2020
Drawn	**Checked**	**Approved**
FR	JAS	CCAS

Scale
1:20,000 @A3
0 100 200 400 600 Metres

Rev	Date	Amendment	Initials
-	-	-	-

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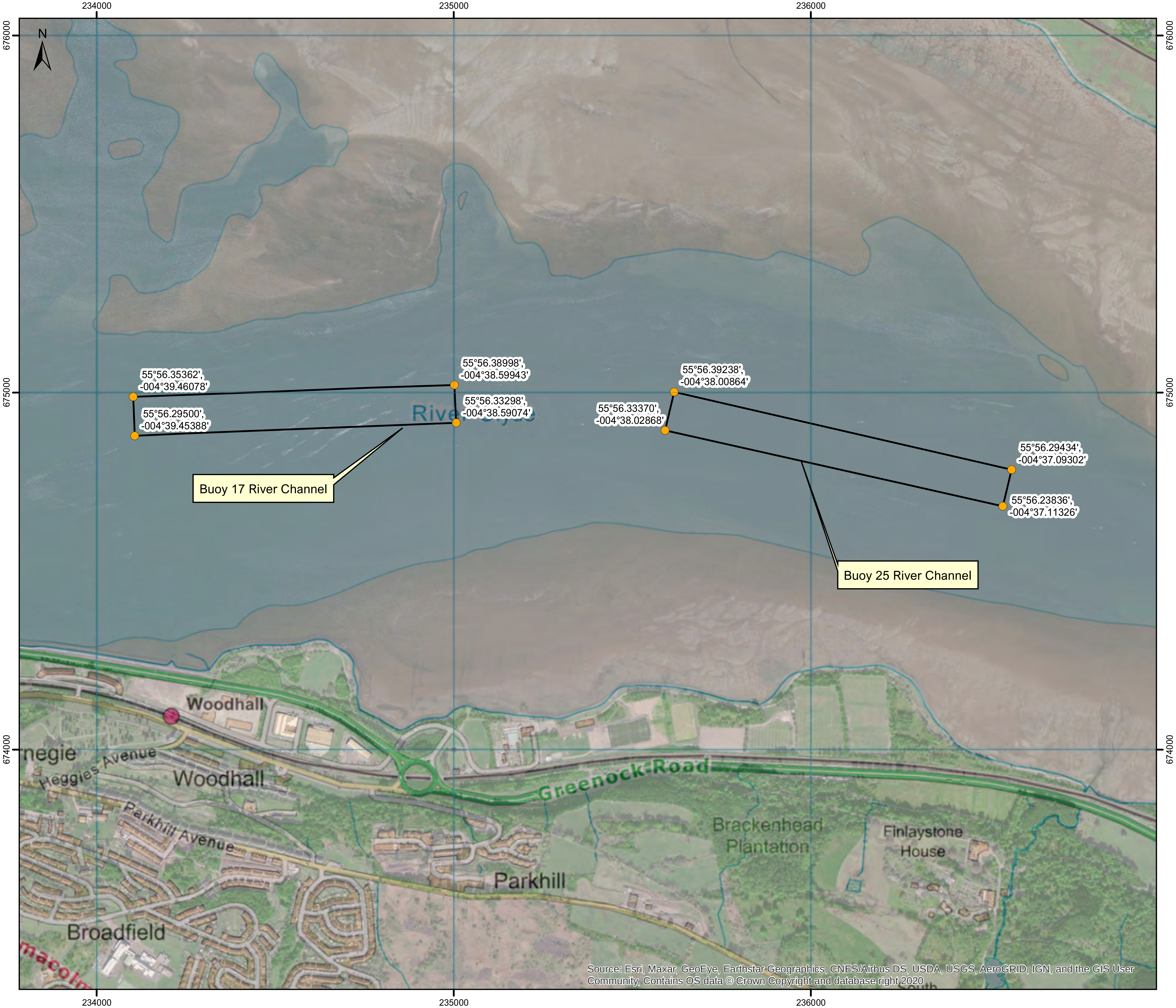

Legend

- Dredge Area Boundary Points
- Dredge Areas

Do not scale this map

Client
Peel Ports Group

Project
Upper Clyde Sediment Sampling

Title
Dredge Area Boundary Points
Map 4 of 4

Status
Final

Drawing No.	Revision	Date
173842-GIS014	-	05 Oct 2020
Drawn	**Checked**	**Approved**
FR	JAS	CCAS

Scale
1:10,000 @A3

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Rev	Date	Amendment	Initials
-	-	-	-

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Legend

- MA021 Cloch Point
- 370.4m Buffer Zone

Do not scale this map

Client Clydeport Operations Ltd.		
Project Upper Clyde Maintenance Dredge		
Title Cloch Point Disposal Site		
Status Final		
Drawing No. 173842-GIS010	**Revision** -	**Date** 03 Sep 2020
Drawn FR	**Checked** JAS	**Approved** CCAS
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Rev	Date	Amendment	Initials
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B SEDIMENT SAMPLING REPORT

C DATA SUMMARY TABLES

Summary Table A

Sampling Results Incorporated with BPEO Assessment (mg/kg)

	AL1	AL2	BAC	ERL	PEL	Shldhall Channel	Shieldhall Catchment			Adams	Sheildhall Quay	KGV North	KGV Approaches		Braehead River Channel		
						1	2	3	4	5	6	7	8	9	10	11	12
Source			CSEMP	CSEMP	Canada												
Arsenic	20	70	25		41.6	20.8	15.7	17	14.9	15.7	14.6	15.7	12.4	7.7	15.2	17.2	9.6
Cadmium	0.4	4	0.31	1.2	4.2	1.17	1.08	1.14	0.95	1.06	1.07	0.92	0.8	0.64	0.87	1.37	0.71
Chromium	50	370	81	81	160	240.6	208.2	211.4	181.2	194.9	194.8	181	136.5	144.6	224.5	251.1	166.9
Copper	30	300	27	34	108	118.4	87.7	102.9	116.2	94.7	87	102.3	90.1	55.3	76.5	137.6	80
Mercury	0.25	1.5	0.07	0.15	0.7	0.48	0.45	0.45	0.33	0.94	0.39	0.37	0.26	0.24	0.51	0.64	0.7
Nickel	30	150	36	-	-	54.7	47.2	46.4	39.5	44.7	48.3	38.5	40.5	36.7	39.1	42.7	29.7
Lead	50	400	38	47	112	169.2	137.2	137.1	118	123.4	133.5	110.5	100.2	83.9	114.8	152.7	98.8
Zinc	130	600	122	150	271	425.1	333.4	336.8	285.2	326	328.4	285.4	266.5	225.7	302.4	388.7	268.3
Napthalene	0.1		0.08	0.16	0.391	0.193	0.326	0.171	0.235	0.198	0.185	0.155	0.186	0.199	0.142	0.307	0.424
Acenaphthylene	0.1		-	-	0.128	0.0761	0.075	0.196	0.0927	0.0941	0.0626	0.0636	0.0545	0.0489	0.0632	0.113	0.0771
Acenaphthene	0.1		-	-	0.0889	0.131	0.23	0.14	0.154	0.171	0.135	0.13	0.104	0.122	0.125	0.254	0.208
Fluorene	0.1		-	-	0.144	0.165	0.211	0.164	0.172	0.194	0.163	0.137	0.12	0.134	0.148	0.33	0.194
Phenanthrene	0.1		0.032	0.24	0.544	0.639	0.981	0.884	0.71	0.875	0.775	0.57	0.593	0.677	0.509	1.14	0.623
Anthracene	0.1		0.05	0.085	0.245	0.239	0.349	0.377	0.256	0.298	0.246	0.21	0.181	0.205	0.226	0.51	0.272
Fluoranthene	0.1		0.039	0.6	1.494	1.38	1.71	2.66	1.43	1.8	1.44	1.22	1.14	1.15	1.2	2.93	1.15
Pyrene	0.1		0.024	0.665	1.398	1.3	1.57	2.24	1.36	1.73	1.33	1.17	1.06	1.13	1.18	2.89	1.05
Benzo(a)anthracene	0.1		0.016	0.261	0.693	0.769	0.905	1.34	0.778	0.976	0.766	0.717	0.605	0.623	0.635	1.56	0.614
Chrysene	0.1		0.02	0.384	0.846	0.823	0.925	1.27	0.794	1.02	0.827	0.743	0.652	0.662	0.594	1.67	0.664
Benzo(b)fluoranthene	0.1		-	-	-	0.862	0.998	1.25	0.911	1.19	0.874	0.882	0.731	0.695	0.785	1.82	0.993
Benzo(k)fluoranthene	0.1		-	-	-	0.373	0.448	0.634	0.503	0.43	0.419	0.381	0.285	0.352	0.306	0.921	0.491
Benzo(a)pyrene	0.1		0.03	0.384	0.763	0.905	1.06	1.39	0.936	1.22	0.905	0.895	0.732	0.738	0.816	1.83	1.13
Indeno(1,2,3cd)pyrene	0.1		0.103	0.24	-	0.695	0.802	1.01	0.689	0.998	0.726	0.665	0.597	0.579	0.662	1.46	0.977
Benzo(ghi)perylene	0.1		0.08	0.085	-	0.719	0.833	1	0.804	1.02	0.758	0.755	0.638	0.619	0.676	1.45	0.88
Dibenzo(a,h)anthracene	0.01		-	-	0.135	0.143	0.167	0.212	0.159	0.208	0.155	0.153	0.128	0.12	0.139	0.296	0.197
TPH	100		-	-	-	2190	2330	2180	2620	2970	2290	2400	2180	1830	1890	4020	1560
PCBs	0.02	0.18	-	-	0.189	0.04087	0.02753	0.02859	0.03206	0.02977	0.07002	0.0304	0.01729	0.01376	0.02228	0.09136	0.03398
TBT	0.1	0.5	-	-	-	<u>0.005</u>	<u>0.005</u>	<u>0.005</u>	<u>0.005</u>	<u>0.005</u>	<u>0.005</u>	<u>0.005</u>	<u>0.005</u>	<u>0.005</u>	0.0219	0.029	0.0364

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 A

Sampling Results Incorporated with BPEO Assessment (mg/kg)

	AL1	AL2	BAC	ERL	PEL	Rothesay Tanker B	Rothesay Canting	River Cart Catchment			Rothesay Dock Approaches			Newshot River Channel East			Newshot River Channel We			
Source			CSEMP	CSEMP	Canada	13	14	15	15A	15B	16	17	18	19	20	21	22	23	24	24A
Arsenic	20	70	25		41.6	12.7	15.9	9.8	8.2	12.7	11	16.4	11.7	8.6	9.6	8.3	8.4	6.3	10	9.1
Cadmium	0.4	4	0.31	1.2	4.2	0.79	0.92	0.42	0.32	0.82	0.69	0.87	0.92	0.48	0.53	0.46	0.63	0.21	0.62	0.6
Chromium	50	370	81	81	160	180.2	212.5	172.1	135.6	212.8	163.6	203.4	212.8	167.9	151.7	142.7	162.4	125.6	181	155.1
Copper	30	300	27	34	108	76.6	79.1	46.6	33.7	71.5	57.7	78.9	75.2	49.3	46.8	39.9	63.5	27.4	54.2	47.6
Mercury	0.25	1.5	0.07	0.15	0.7	0.58	0.49	0.21	0.08	0.36	0.28	0.43	0.42	0.31	0.33	0.44	0.44	0.7	0.26	0.24
Nickel	30	150	36	-	-	59.6	43.8	30.5	25.6	37	34.7	41.9	30.3	28.7	29.7	26.1	27.6	17.3	25.9	23.5
Lead	50	400	38	47	112	142.3	137.4	126.1	76.5	115.5	92.2	132.8	143.5	75.5	78.1	65.3	73	36.1	79.6	73.9
Zinc	130	600	122	150	271	256.2	308.1	179.2	156	270	224.8	304.4	261.9	176.4	180.6	155.4	187.1	84.3	173.4	170.4
Napthalene	0.1		0.08	0.16	0.391	0.18	0.148	0.0725	0.0418	0.136	0.119	0.135	0.208	0.124	0.0762	0.0978	0.324	0.0298	0.0721	0.131
Acenaphthylene	0.1		-	-	0.128	0.0854	0.0749	0.0321	0.0247	0.0681	0.0418	0.0959	0.0881	0.0659	0.0515	0.0403	0.0317	0.0095	0.0408	0.0816
Acenaphthene	0.1		-	-	0.0889	0.115	0.114	0.067	0.0312	0.116	0.0817	0.133	0.237	0.0878	0.0803	0.0781	0.695	0.031	0.0609	0.191
Fluorene	0.1		-	-	0.144	0.159	0.123	0.0693	0.0532	0.128	0.078	0.0981	0.228	0.0948	0.0775	0.0807	0.452	0.0308	0.0713	0.165
Phenanthrene	0.1		0.032	0.24	0.544	0.657	0.528	0.289	0.227	0.49	0.363	0.472	0.85	0.331	0.381	0.371	2.39	0.112	0.262	0.763
Anthracene	0.1		0.05	0.085	0.245	0.214	0.215	0.118	0.0736	0.201	0.138	0.179	0.347	0.147	0.207	0.134	0.761	0.053	0.116	0.284
Fluoranthene	0.1		0.039	0.6	1.494	1.19	1.09	0.483	0.344	1.12	0.74	1.04	1.79	0.732	1.04	0.744	2.77	0.278	0.603	1.45
Pyrene	0.1		0.024	0.665	1.398	1.15	1.05	0.503	0.329	1.07	0.718	1.01	1.68	0.73	0.935	0.716	2.37	0.282	0.606	1.4
Benzo(a)anthracene	0.1		0.016	0.261	0.693	0.63	0.595	0.255	0.181	0.603	0.386	0.559	0.855	0.376	0.514	0.397	1.5	0.117	0.326	0.744
Chrysene	0.1		0.02	0.384	0.846	0.682	0.629	0.273	0.192	0.62	0.399	0.603	0.886	0.365	0.518	0.424	1.36	0.117	0.344	0.755
Benzo(b)fluoranthene	0.1		-	-	-	0.851	0.747	0.334	0.243	0.735	0.456	0.741	0.935	0.521	0.562	0.512	1.21	0.132	0.419	0.827
Benzo(k)fluoranthene	0.1		-	-	-	0.388	0.35	0.135	0.127	0.323	0.181	0.321	0.394	0.259	0.25	0.215	0.573	0.0661	0.175	0.389
Benzo(a)pyrene	0.1		0.03	0.384	0.763	0.846	0.77	0.325	0.253	0.752	0.453	0.77	0.973	0.532	0.589	0.497	1.45	0.121	0.408	0.871
Indeno(1,2,3cd)pyrene	0.1		0.103	0.24	-	0.652	0.615	0.232	0.19	0.59	0.342	0.61	0.702	0.419	0.426	0.39	0.888	0.0873	0.309	0.63
Benzo(ghi)perylene	0.1		0.08	0.085	-	0.741	0.654	0.272	0.193	0.626	0.37	0.628	0.712	0.423	0.443	0.42	0.778	0.0986	0.333	0.657
Dibenzo(a,h)anthracene	0.01		-	-	0.135	0.142	0.131	0.0483	0.0395	0.124	0.0728	0.128	0.154	0.0847	0.0882	0.0849	0.225	0.0203	0.0685	0.137
TPH	100		-	-	-	1670	1520	1070	1120	2240	1070	3500	658	829	917	1110	528	319	929	1390
PCBs	0.02	0.18	-	-	0.189	0.02492	0.01973	0.01355	0.00959	0.03818	0.01558	0.02571	0.05433	0.01384	0.00883	0.0088	0.01014	0.0052	0.01944	0.02699
TBT	0.1	0.5	-	-	-	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.0179	0.0284

Note: Underlined Values are < LOD. Values highlighted red are equal to or greate

PEL Data Source: http://ceqg-rcqe.ccme.ca/en/index.html#void

Summary Table A

Sampling Results Incorporated with BPEO Assessment (mg/kg)

	AL1	AL2	BAC	ERL	PEL	st		Donald's Quay River Channel			Longhaugh River Channel		
Source			CSEMP	CSEMP	Canada	24B	24C	25	26	27	28	29	30
Arsenic	20	70	25		41.6	8.63	11.8	6.2	7	7.3	7.5	6.1	7.9
Cadmium	0.4	4	0.31	1.2	4.2	0.6	0.78	0.17	0.32	0.38	0.12	0.22	0.16
Chromium	50	370	81	81	160	159	207.8	119	145	176	106	154	135
Copper	30	300	27	34	108	49.2	60.6	28.2	27.2	32	14.5	16.6	15
Mercury	0.25	1.5	0.07	0.15	0.7	0.339	0.34	0.02	0.22	0.13	0.015	0.015	0.24
Nickel	30	150	36	-	-	23.4	26.1	19.1	22.2	26.2	17.5	16.9	16
Lead	50	400	38	47	112	71.8	102.9	24.4	42	53.2	17.7	25.8	23.6
Zinc	130	600	122	150	271	170	202.6	121	118	139	78.8	87.9	80.8
Napthalene	0.1		0.08	0.16	0.391	0.0807	0.0936	0.0169	0.0464	0.0252	0.00734	0.0242	0.048
Acenaphthylene	0.1		-	-	0.128	0.0366	0.0497	0.00542	0.0139	0.0159	0.00303	0.0136	0.0136
Acenaphthene	0.1		-	-	0.0889	0.0498	0.0809	0.0189	0.144	0.0273	0.00566	0.0265	0.0168
Fluorene	0.1		-	-	0.144	0.0761	0.0986	0.0171	0.101	0.0264	0.00597	0.0281	0.0274
Phenanthrene	0.1		0.032	0.24	0.544	0.23	0.307	0.0989	0.874	0.107	0.0318	0.0953	0.13
Anthracene	0.1		0.05	0.085	0.245	0.123	0.163	0.0273	0.147	0.0404	0.0111	0.0401	0.049
Fluoranthene	0.1		0.039	0.6	1.494	0.55	0.672	0.187	0.82	0.215	0.0634	0.198	0.2
Pyrene	0.1		0.024	0.665	1.398	0.556	0.653	0.185	0.753	0.217	0.0721	0.198	0.333
Benzo(a)anthracene	0.1		0.016	0.261	0.693	0.295	0.337	0.0683	0.301	0.113	0.0326	0.0979	0.0802
Chrysene	0.1		0.02	0.384	0.846	0.297	0.348	0.0812	0.359	0.117	0.0342	0.104	0.0892
Benzo(b)fluoranthene	0.1		-	-	-	0.38	0.432	0.0787	0.277	0.137	0.0444	0.121	0.114
Benzo(k)fluoranthene	0.1		-	-	-	0.184	0.177	0.0325	0.0992	0.0664	0.0172	0.0482	0.0493
Benzo(a)pyrene	0.1		0.03	0.384	0.763	0.372	0.425	0.0733	0.283	0.136	0.042	0.119	0.103
Indeno(1,2,3cd)pyrene	0.1		0.103	0.24	-	0.286	0.345	0.0509	0.202	0.108	0.0321	0.0887	0.0628
Benzo(ghi)perylene	0.1		0.08	0.085	-	0.303	0.36	0.0668	0.225	0.119	0.0366	0.099	0.116
Dibenzo(a,h)anthracene	0.01		-	-	0.135	0.0618	0.0733	0.012	0.0424	0.0219	0.00575	0.0201	0.0164
TPH	100		-	-	-	865	875	114	750	438	85.9	335	93
PCBs	0.02	0.18	-	-	0.189	0.0205	0.02682	0.00202	0.0055	0.0061	0.00166	0.00457	0.00312
TBT	0.1	0.5	-	-	-	0.005	0.00611	0.005	0.005	0.005	0.005	0.005	0.005

Note: Underlined Values are < LOD. Values highlighted red are equal to or greate

PEL Data Source: http://ceqg-rcqe.ccme.ca/en/index.html#void

Summary Table A

Sampling Results Incorporated with BPEO Assessment (mg/kg)

						Dumbuck River Channel			Buoy 25 River Channel			Buoy 17 River Channel		
	AL1	AL2	BAC	ERL	PEL	31	32	33	34	35	36	37	38	39
Source			CSEMP	CSEMP	Canada									
Arsenic	20	70	25		41.6	6.6	9.9	8	11.2	15.3	13.2	23.5	20.9	21.7
Cadmium	0.4	4	0.31	1.2	4.2	0.11	0.08	0.06	0.06	0.05	0.04	0.1	0.08	0.06
Chromium	50	370	81	81	160	134	132	124	128	120	133	91.7	105	82.7
Copper	30	300	27	34	108	11.5	14.1	20	10.3	9.9	9.4	13	10.8	11.6
Mercury	0.25	1.5	0.07	0.15	0.7	0.015	0.015	1.28	0.03	0.015	0.015	0.015	0.015	0.015
Nickel	30	150	36	-	-	15.3	19.4	16.6	21	21.4	21.2	17.6	17.7	17.1
Lead	50	400	38	47	112	23.6	26.2	21.1	17.5	20.3	19.3	17.2	15.8	15.5
Zinc	130	600	122	150	271	64.9	85.8	68	83.6	88.1	88.3	76.5	64.8	62.5
Napthalene	0.1		0.08	0.16	0.391	0.00311	0.00729	0.00197	0.00151	0.00205	0.0123	0.0166	0.0377	0.0116
Acenaphthylene	0.1		-	-	0.128	0.00209	0.0297	0.001	0.001	0.00103	0.00316	0.00478	0.00611	0.00353
Acenaphthene	0.1		-	-	0.0889	0.00261	0.0093	0.00204	0.00102	0.00294	0.00804	0.013	0.0183	0.00867
Fluorene	0.1		-	-	0.144	0.00384	0.00872	0.00272	0.0013	0.00328	0.0111	0.0124	0.0171	0.0104
Phenanthrene	0.1		0.032	0.24	0.544	0.0255	0.0235	0.0157	0.0182	0.019	0.169	0.289	0.471	0.164
Anthracene	0.1		0.05	0.085	0.245	0.00738	0.014	0.00549	0.0034	0.00943	0.0188	0.0257	0.0383	0.0168
Fluoranthene	0.1		0.039	0.6	1.494	0.0381	0.0817	0.0219	0.0303	0.0636	0.102	0.287	0.219	0.142
Pyrene	0.1		0.024	0.665	1.398	0.057	0.107	0.0394	0.0388	0.0746	0.13	0.337	0.266	0.193
Benzo(a)anthracene	0.1		0.016	0.261	0.693	0.0271	0.0365	0.00999	0.0124	0.0232	0.0514	0.125	0.101	0.0764
Chrysene	0.1		0.02	0.384	0.846	0.0305	0.046	0.0138	0.0196	0.035	0.064	0.197	0.2	0.11
Benzo(b)fluoranthene	0.1		-	-	-	0.0335	0.163	0.0152	0.0191	0.0336	0.0506	0.12	0.11	0.0972
Benzo(k)fluoranthene	0.1		-	-	-	0.0159	0.0624	0.00563	0.00605	0.0111	0.0169	0.045	0.0284	0.0251
Benzo(a)pyrene	0.1		0.03	0.384	0.763	0.032	0.169	0.0119	0.0133	0.023	0.0425	0.0899	0.07	0.067
Indeno(1,2,3cd)pyrene	0.1		0.103	0.24	-	0.0214	0.118	0.00808	0.00794	0.0122	0.0183	0.0396	0.0326	0.0363
Benzo(ghi)perylene	0.1		0.08	0.085	-	0.0249	0.121	0.0128	0.0154	0.0313	0.0358	0.112	0.0746	0.15
Dibenzo(a,h)anthracene	0.01		-	-	0.135	0.00502	0.0239	0.00219	0.00246	0.0041	0.00677	0.0144	0.0161	0.0145
TPH	100		-	-	-	42.9	67.5	17.9	26.3	31.1	60.2	168	134	93.6
PCBs	0.02	0.18	-	-	0.189	0.00102	0.00149	0.00129	0.00097	0.00077	0.00065	0.00082	0.00174	0.00096
TBT	0.1	0.5	-	-	-	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005

Note: Underlined Values are < LOD. Values highlighted red are equal to or greate

PEL Data Source: http://ceqg-rcqe.ccme.ca/en/index.html#void

Summary Table A

Sampling Results Incorporated with BPEO Assessment (mg/kg)

Source	AL1	AL2	BAC CSEMP	ERL CSEMP	PEL Canada	AVERAGE	No. Exceed RAL 1	No. Exceed RAL 2	No.Exceed BAC?	No. Exceed ERL	No. Exceed PEL?
Arsenic	20	70	25		41.6	12.00	4	0	0	N/A	0
Cadmium	0.4	4	0.31	1.2	4.2	0.56	27	0	30	1	0
Chromium	50	370	81	81	160	162.89	44	0	44	44	22
Copper	30	300	27	34	108	53.42	29	0	32	27	3
Mercury	0.25	1.5	0.07	0.15	0.7	0.32	26	0	33	31	4
Nickel	30	150	36	-	-	30.11	18	0	15	N/A	N/A
Lead	50	400	38	47	112	78.75	29	0	30	29	14
Zinc	130	600	122	150	271	194.11	29	0	29	28	11
Napthalene	0.1		0.08	0.16	0.391	0.11	21	N/A	24	13	1
Acenaphthylene	0.1		-	-	0.128	0.05	2	N/A	N/A	N/A	1
Acenaphthene	0.1		-	-	0.0889	0.10	20	N/A	N/A	N/A	20
Fluorene	0.1		-	-	0.144	0.10	19	N/A	N/A	N/A	13
Phenanthrene	0.1		0.032	0.24	0.544	0.47	36	N/A	38	29	16
Anthracene	0.1		0.05	0.085	0.245	0.17	28	N/A	30	28	10
Fluoranthene	0.1		0.039	0.6	1.494	0.88	38	N/A	41	26	6
Pyrene	0.1		0.024	0.665	1.398	0.84	39	N/A	44	24	7
Benzo(a)anthracene	0.1		0.016	0.261	0.693	0.46	33	N/A	42	27	11
Chrysene	0.1		0.02	0.384	0.846	0.48	35	N/A	42	22	6
Benzo(b)fluoranthene	0.1		-	-	-	0.53	36	N/A	N/A	N/A	N/A
Benzo(k)fluoranthene	0.1		-	-	-	0.24	28	N/A	N/A	N/A	N/A
Benzo(a)pyrene	0.1		0.03	0.384	0.763	0.55	34	N/A	41	25	16
Indeno(1,2,3cd)pyrene	0.1		0.103	0.24	-	0.42	31	N/A	31	26	N/A
Benzo(ghi)perylene	0.1		0.08	0.085	-	0.44	34	N/A	36	36	N/A
Dibenzo(a,h)anthracene	0.01		-	-	0.135	0.09	38	N/A	N/A	N/A	14
TPH	100		-	-	-	1171.08	35	N/A	N/A	N/A	N/A
PCBs	0.02	0.18	-	-	0.189	0.0185	17	0	N/A	N/A	0
TBT	0.1	0.5	-	-	-	0.0075	0	0	N/A	N/A	N/A

Note: Underlined Values are < LOD. Values highlighted red are equal to or greate

PEL Data Source: http://ceqg-rcqe.ccme.ca/en/index.html#void

Summary Table B

River Clyde Average Concentrations
All units in mg/kg

	AL1	**AL2**	**BAC**	**<ERL**	**PEL**	**Dredge Average**	**Exceed AL1?**	**Exceed AL2?**	**Exceed BAC?**	**Exceed ERL ?**	**Exceed PEL?**
Source			**CSEMP**	**CSEMP**	**Canada**						
Arsenic	20	70	25	-	41.6	12.0	No	No	No	N/A	No
Cadmium	0.4	4	0.31	1.2	4.2	0.6	**Yes**	No	**Yes**	No	No
Chromium	50	370	81	81	160	162.9	**Yes**	No	**Yes**	**Yes**	**Yes**
Copper	30	300	27	34	108	53.4	**Yes**	No	**Yes**	**Yes**	No
Mercury	0.25	1.5	0.07	0.15	0.7	0.3	**Yes**	No	**Yes**	**Yes**	No
Nickel	30	150	36	-	-	30.1	**Yes**	No	No	N/A	N/A
Lead	50	400	38	47	112	78.8	**Yes**	No	**Yes**	**Yes**	No
Zinc	130	600	122	150	271	194.1	**Yes**	No	**Yes**	**Yes**	No
					-						
Napthalene	0.1	-	0.08	0.16	0.319	0.11	**Yes**	N/A	**Yes**	No	No
Acenaphthylene	0.1	-	-	-	0.128	0.05	No	N/A	N/A	N/A	No
Acenaphthene	0.1	-	-	-	0.0889	0.10	**Yes**	N/A	N/A	N/A	**Yes**
Fluorene	0.1	-	-	-	0.144	0.10	**Yes**	N/A	N/A	N/A	No
Phenanthrene	0.1	-	0.032	0.24	0.544	0.47	**Yes**	N/A	**Yes**	**Yes**	No
Anthracene	0.1	-	0.05	0.085	0.245	0.17	**Yes**	N/A	**Yes**	**Yes**	No
Fluoranthene	0.1	-	0.039	0.6	1.494	0.88	**Yes**	N/A	**Yes**	**Yes**	No
Pyrene	0.1	-	0.024	0.665	1.398	0.84	**Yes**	N/A	**Yes**	**Yes**	No
Benzo(a)anthracene	0.1	-	0.016	0.261	0.693	0.46	**Yes**	N/A	**Yes**	**Yes**	No
Chrysene	0.1	-	0.02	0.384	0.846	0.48	**Yes**	N/A	**Yes**	**Yes**	No
Benzo(b)fluoranthene	0.1	-	-	-	-	0.53	**Yes**	N/A	N/A	N/A	N/A
Benzo(k)fluoranthene	0.1	-	-	-	-	0.24	**Yes**	N/A	N/A	N/A	N/A
Benzo(a)pyrene	0.1	-	0.03	0.384	0.763	0.55	**Yes**	N/A	**Yes**	**Yes**	No
Indeno(1,2,3cd)pyrene	0.1	-	0.103	0.24	-	0.42	**Yes**	N/A	**Yes**	**Yes**	N/A
Benzo(ghi)perylene	0.1	-	0.08	0.085	-	0.44	**Yes**	N/A	**Yes**	**Yes**	N/A
Dibenzo(a,h)anthracene	0.01	-	-	-	0.135	0.09	**Yes**	N/A	N/A	N/A	No
TPH	100	-	-	-	-	1171.08	**Yes**	N/A	N/A	N/A	N/A
PCBs	0.02	0.18	-	-	0.189	0.018	No	No	N/A	N/A	No
TBT	0.1	0.5	-	-	-	0.0075	No	No	N/A	N/A	N/A

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	Benzo (a)Pyrene
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

Summary Table D
Disposal Site Average Data (mg/kg)

	AL1	AL2	BAC	<ERL	ISQG/TEL	PEL	Clyde Dredge Average	Cloch Point Average
Source			CSEMP	CSEMP	Canada			
Arsenic	20	70	25	-	7.2	41.6	12.0	15.18
Cadmium	0.4	4	0.31	1.2	0.7	4.2	0.6	0.69
Chromium	50	370	81	81	52.3	160	162.9	151.51
Copper	30	300	27	34	18.7	108	53.4	68.83
Mercury	0.25	1.5	0.07	0.15	0.13	0.7	0.3	0.61
Nickel	30	150	36	-	-	-	30.1	35.25
Lead	50	400	38	47	30.2	112	78.8	154.58
Zinc	130	600	122	150	124	271	194.1	259.60
Napthalene	0.1		0.08	0.16	-	0.319	0.11	
Acenaphthylene	0.1		-	-	0.00587	0.128	0.05	
Acenaphthene	0.1		-	-	0.00671	0.0889	0.10	
Fluorene	0.1		-	-	0.0212	0.144	0.10	
Phenanthrene	0.1		0.032	0.24	0.0867	0.544	0.47	
Anthracene	0.1		0.05	0.085	0.0469	0.245	0.17	
Fluoranthene	0.1		0.039	0.6	0.113	1.494	0.88	
Pyrene	0.1		0.024	0.665	0.153	1.398	0.84	
Benzo(a)anthracene	0.1		0.016	0.261	0.0748	0.693	0.46	
Chrysene	0.1		0.02	0.384	0.108	0.846	0.48	
Benzo(b)fluoranthene	0.1		-	-	-	-	0.53	
Benzo(k)fluoranthene	0.1		-	-	-	-	0.24	
Benzo(a)pyrene	0.1		0.03	0.384	0.0888	0.763	0.55	0.837
Indeno(1,2,3cd)pyrene	0.1		0.103	0.24	-	-	0.42	
Benzo(ghi)perylene	0.1		0.08	0.085	-	-	0.44	
Dibenzo(a,h)anthracene	0.01		-	-	0.00622	0.135	0.09	
PCBs	0.02	0.18	-	-	0.0215	0.189	0.018	0.047
TBT	0.1	0.5	-	-	-	-	0.007	0.056

D SNH CONSULTATION RESPONSE

Campbell Stewart

From: Dave Lang <Dave.Lang@nature.scot>
Sent: 10 December 2019 14:05
To: Fraser Russell
Cc: Campbell Stewart
Subject: RE: Clyde Maintenance Dredge Revisions

Hi Fraser,

As you may very well be aware, prior to the advent of Marine Licensing in 2010 SNH were required to regulate maintenance and capital dredging of the Clyde in that part of the channel that passed through the SPA.

Originally, our view was that dredging should be undertaken in the 'summer' months of April to August when the protected birds were not present as this meant that there was no requirement to undertake the potentially tricky process of establishing what impact dredging has on them in order to demonstrate on the basis of "no reasonable scientific doubt" (as required by the legislation).

This, ultimately, was not deemed to be a workable restriction by the Port Authority, as they often could not guarantee in advance when dredging equipment would become available to them.

Consequently, we were ultimately unable to avoid the whole process of Habitats Regs Appraisal and appropriate assessment.

Happily, with the help of sedimentation modelling carried out by the FRS Marine Lab, SNH were able to conclude that dredging OF THE SORT THEN BEING DISCUSSED would not impact on the protected birds, regardless of where it was undertaken in the Clyde. The main reason we were able to reach this conclusion in a manner that met the legislative tests was because it had been clearly demonstrated to us that the dredging equipment proposed for use in all of the projects for which Clydeport (as they were then) were seeking consent did not give rise to levels of noise or vibration that were in excess of those from normal shipping in the Clyde – to which we had confirmed that the birds were generally habituated.

So given all that I would say –

If all of your dredging for this project can be scheduled for the 'summer' months of – at the most generous – mid-March to mid-September, then the birds we are concerned about will likely be absent and there will be no issues. There will be 'no likely significant effect' and Marine Scotland need give the issue no further thought. (I presume that Marine Scotland will be the regulators for this project – with ourselves as statutory consultees?)

If that is not possible, and you would rather have the freedom to also dredge in winter, then Marine Scotland will need to perform and HRA. But if it can be demonstrated in some way that all of the equipment you refer to is either similar or better (in terms of noise and vibration levels) to that used by Clydeport for their capital and maintenance dredging prior to 2010, then that HRA should conclude that there will be no adverse effects on the birds and everything should still be fine.

I hope that the above helps in developing these proposals.

Yours,

Dave Lang
SNH Operations Officer
Strathclyde & Ayrshire