



## **Ardersier Port Sediment Transport Monitoring Plan**



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# Ardersier Port

## Sediment Transport Monitoring Plan

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# 1 INTRODUCTION

This plan has been produced to ensure that the recommendations made for sediment transport monitoring as part of the assessment of sediment transport undertaken during the planning stages of this project are implemented during the construction and operational phase of the port.

This plan was produced initially in 2017 and has been updated in 2018 as part of the Environmental Impact Assessment report (EIAR) update being undertaken to support the renewal of the existing consents and previous licences. The development proposals remain unchanged, with the only material difference being that the proposed dredge volume has increased from 2,000,000 m<sup>3</sup> to 2,300,000 m<sup>3</sup> due to ongoing sediment transport into the former navigation channel and inner harbour.

This plan will remain an active document during the construction and future operation of the port to inform forward management decisions potentially impacting coastal processes.

The Draft Construction Environment Management Plan (CEMP) submitted as part of the Environmental Statement (ES) produced in 2013 stated within the Draft Scheme of Mitigation for coastal processes that:

*“Monitor the circulation of capital dredge material around Whiteness Sands through further bathymetric surveys to confirm modelling predictions for dredged material deposited at the spoil ground. Adopt a dynamic monitoring and mitigation approach which can adapt to consider deposition of maintenance dredged material at other locations (including along the line of the Spit) to protect designated features as required and with the approval of Marine Scotland in consultation with SNH.”*

The Coastal Processes Assessment included within the ES (Vol. 3 Appending 11.1) recommended:

*To confirm the findings of the coastal processes review, and to inform future modelling at the site, a sediment transport monitoring plan will be implemented. This will be agreed with Marine Scotland and SNH and it is recommended that this would include:*

- *Regular (2 to 3) bathymetric/topographic surveys of Whiteness Sands, access channel and Whiteness Spit during the first year post capital dredge. Ideally one of the surveys would be carried out after a storm event. These should include at least one detailed survey along with agreed transects.*
- *Monthly visual inspections of the disposal area at low tide, incorporating fixed point photography for visual comparison to document sediment dispersal.*
- *A monitoring buoy will be deployed for a three month period post capital dredge to gather wave and tidal data, this would provide site specific data to inform any future modelling.*
- *Installation of a mechanical bed-load trap samplers such as booner tubes to record sediment transport in the intertidal zone and also include foreshore sand traps for aeolian transport.*

The present 2018 dredge strategy does not include for placement of capital dredge material on the Whiteness Sands spoil disposal ground, or along the outer shore of Whiteness Spit. As a result, the aeolian transport sampling noted in the final bullet point above is not considered necessary.

Subsequent to the assessment undertaken as part of the ES, the Scottish Government has recently completed the National Coastal Change Assessment (NCCA). The NCCA establishes historic coastal change by comparing Ordnance Survey maps (1892-1905) to both the 1970's and current coastal position in order to estimate past erosion/accretion rates. These historic coastal change rates are then projected into the future using a Coastal Erosion Susceptibility Model (CESM) to limit erosion to areas where the hinterland is susceptible to erosion. The NCCA aims to inform existing strategic planning and also identify those areas which may remain susceptible in the coming decades and require supplementary support through the development of future management policies and adaptation plans robustly based on a strategic and objective evidence base. Whiteness Head is identified as an area susceptible to erosion and the sediment data collected as part of this plan will contribute to future management and adaptation plans.

## 2 AIMS AND OBJECTIVES

The plan is intended to provide relevant information on sediment transport, erosion and deposition within the area of Whiteness Spit, Whiteness Sands and Ardersier Port, to inform future maintenance dredge works.

The sediment transport monitoring information collected will be used to guide volumes of material to be dredged and what quantities of material could potential be disposed of to the coastal environment.

The aims of this plan are to:

- Monitor the movement of natural material around Whiteness Sands;
- Provide a dataset of sediment transport information to inform future maintenance dredging; and
- Provide supporting information to the Natural Heritage Management Plan (formerly the Habitat Management Plan) in relation to Whiteness Head and Whiteness Sands.

The objectives of this plan are to:

- Define the scope of the type and frequency of monitoring that will be undertaken;
- Define areas that will be monitored to assess sediment transport;
- Collect data to compare with modelling predictions for dredged material deposited at the spoil ground;
- Provide data for analysis or modelling to design future maintenance dredge operations; and
- Inform the Spit Habitat and Protection and Enhancement Plan within the Natural Heritage Management Plan.

This plan will commence from prior to the capital dredge works through the ongoing operation of Ardersier Port.

Reporting will include a post-dredge factual report and update reports prior to subsequent maintenance dredge operations. The update reports will include a review of the type, extent and frequency of monitoring. Any changes proposed will be considered in consultation with the Ardersier Port Ecological Management Group (EMG).

## 3 MONITORING

### 3.1 Overview

The sediment transport monitoring plan is designed to monitor the circulation of dredged material deposited in the licenced disposal area at Whiteness Sands during the post-capital dredge phase at Ardersier, in accordance with the commitments made in the 2013 ES. The extent of the monitoring will include the harbour access channel and Whiteness Spit.

The anticipated maintenance dredge interval is approximately 2-3 years following capital dredge, so the monitoring plan is designed for commencement prior to the pre-capital dredge phase and will continue through the operation of the port while dredging activities are planned.

The proposed dredge volume is 2,300,000 m<sup>3</sup> as per the Marine Licence application. This material will be disposed of in three areas as shown in Table 3.1, again consistent with the Marine Licence. The material will be dredged by a cutter suction dredger and deposited by means of a discharge pipeline, typically manoeuvred by pontoon and workboat unless on land.

**Table 3.1: Capital dredge volumes**

Disposal Area	Capital Dredge Volume (m <sup>3</sup> )	Comments
Reinstatement of Inner Channel	200,000	Reinstate historically excavated area of inner spit to general profile of surrounding spit.
On-site Storage (on land)	2,100,000	Material stockpiled on site.

The sediment transport monitoring plan comprises of routine monitoring, completed at regular frequencies as outlined in Table 3.2. Where practicable, the routine monitoring activities will be carried out during suitable tidal conditions to allow observation of potential changes between monitoring events.

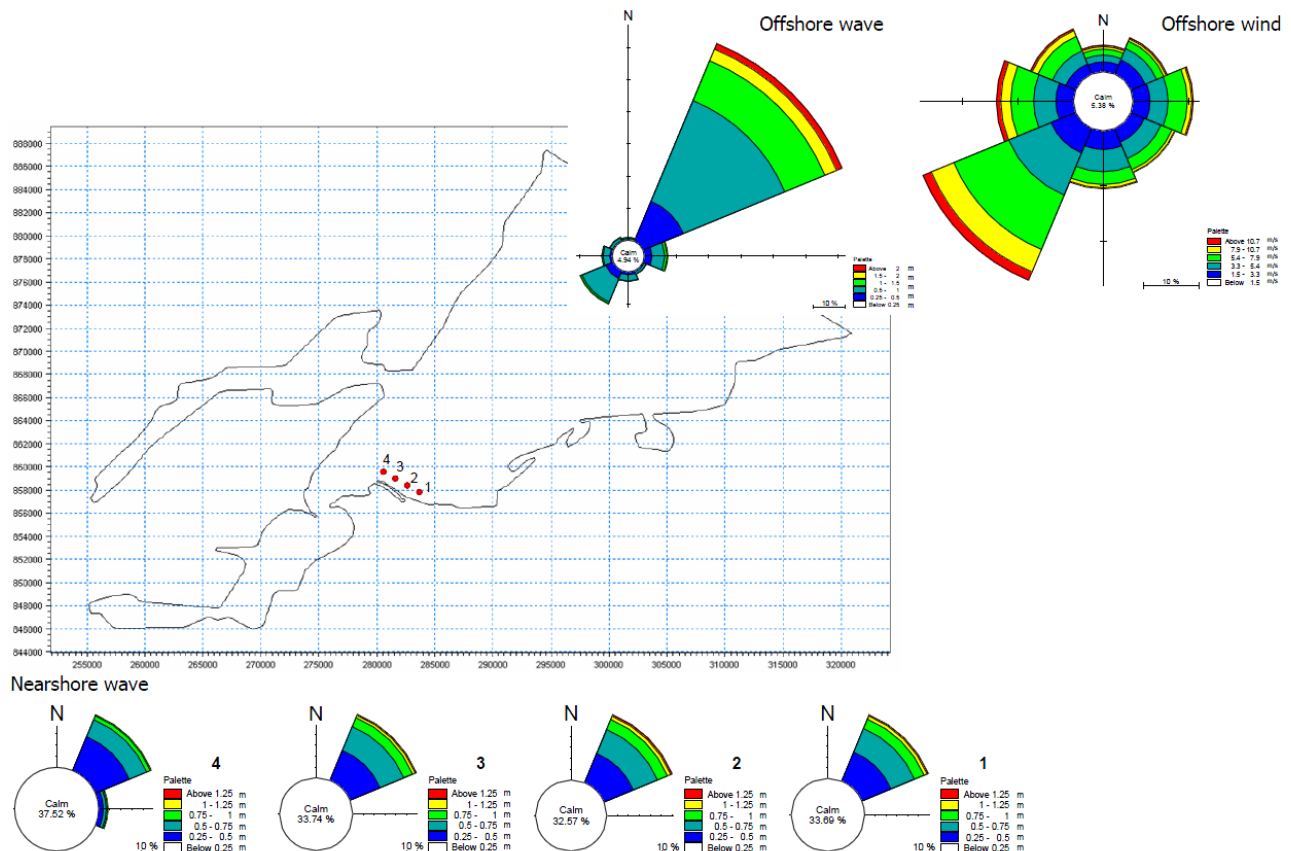
**Table 3.2: Monitoring schedule and frequency**

Item	Frequency	Timing (in relation to dredge)		
		Pre	During	Post
Site inspection including fixed point photography	Monthly*	✓	✓	✓
Bathymetric survey	Annual*	✓		✓
Topographic survey	Twice yearly*	✓		✓
Aerial photography	Twice yearly*	✓		✓
Weather station	Sub-hourly	✓	✓	✓
Tide level monitoring	Sub-hourly	✓	✓	✓
Wave buoy	Once (3 month period)			✓
Intertidal sediment sampling	Annual (1 month period)	✓	✓	✓
Suspended sediment sampling	Annual (1 event)	✓	✓	✓

\* Year 1, then frequency reviewed.

In addition to routine monitoring, provision is made for event monitoring, which is considered to be required following the occurrence of an event (such as a large storm) which may require management intervention prior to the next planned maintenance dredge. This monitoring would be expected to involve some, but not all of the routine monitoring activities. The events that are considered likely to trigger such a monitoring event are as follows:

- Offshore wave swell waves greater than 2.5 m, as available from websites including magicseaweed and swellmap, based on Met Office offshore wave data from previous analysis showing 1 in 2 year return period, or 50% annual exceedance probability (AEP), significant wave height as 2.56 m (Figure 3.1);
- Sustained wind speed recorded at Kinloss in excess of 18 m/s, which is approximately the 1 in 2 year return period (or 50% AEP) and 75% of the predicted 1 in 50 year return period average hourly wind speed of 24 m/s as predicted in BS 6399; and
- End of spit visibly encroaching into the navigation channel.



**Figure 3.1: Offshore Met Office wind and wave data transformed to inshore waves in 2008 Ardersier model**

### 3.2 Site Inspection

Site inspections will be undertaken monthly, where practicable, at key locations within the study area and will include ground-based fixed-point and direction photographs. These photographs will provide a continuous record of the coastline. Site inspections will be used to assist the identification of changes to the intertidal and shoreline areas. The key locations will include:

- Proximal end of the spit;
- Representative mid section of the spit;
- Distal end of the spit (at navigation channel);
- Island to west of navigation channel (former distal end of spit cut off by channel dredge);
- Restored area of spit on inner channel;
- Head of the inner channel; and
- 2-3 larger scale intertidal bedforms within Whiteness Sands (informed by topographic survey).

A geomorphic inspection of key coastal features will be completed twice yearly by an experienced practitioner to identify coastline condition at regular intervals along the shoreline. Observations will be recorded on a standard proforma and include information on erosion or accretion, sediment characteristics, the extent of sedimentary features and any transient features identified.

### **3.3 Topographic and Nearshore Hydrographic Survey**

The extent of the topographic and nearshore hydrographic surveys are shown in Drawing 169051-001. These extend west to east across Whiteness Sands and Whiteness Head and north to south from the centre of the South Channel to the head of the inner channel saltmarsh.

Topographic surveys will be obtained twice yearly to quantify changes in the coastal features from the inter-tidal area and upwards to the dunes and spit crest within the study area. Topographic surveys will be captured using a technique (or combination of techniques) capable of generating a comprehensive digital surface elevation model (DEM). It is anticipated that an Unmanned Aerial Vehicle (UAV) will be deployed to increase data capture across the inter-tidal sands. The minimum spatial resolution of the DEM will be 1.0 m, which is considered sufficient to capture the topographic variations across the intertidal and landward areas.

Nearshore hydrographic surveys will be undertaken annually to record the inter-tidal to sub-tidal conditions. The hydrographic surveys will include the inner channel and dredge area seawards to the centre of the South Channel including the disposal ground. The hydrographic survey will extend to meet the extent of the topographic survey coverage to provide an integrated ground model and the timing of the surveys will ensure that they are undertaken at or very close to the same time to ensure consistency of conditions.

The inter-tidal changes in the bed level will also be ground-truthed at three locations on Whiteness Sands where measuring stakes will be installed to gauge the relative change in bed level at fixed points. These locations will be surveyed in to ensure that should the pins be displaced, there is at least an annual change recorded from the topographic surveys. Depths at these locations will be recorded at least twice annually and can be manually verified during monthly inspections if tides permit.

The reporting of this survey data will comprise of:

- DEM data as surveyed;
- Change in level dataset when compared to previously surveyed DEM;
- At least two fixed transects at the Spit and across Whiteness Sands extracted from the DEM for comparison;
- Volumetric change provided for the sub-tidal, inter-tidal and landward zones; and
- Ground-truthing of DEM with fixed points.

### **3.4 Aerial Photograph Survey**

Using UAV techniques to collect the ground model data will allow aerial photographs to be captured at the same time.

### **3.5 Weather Monitoring**

Weather data recording for the site comprising a minimum of wind speed and direction, rainfall and temperature will be set up prior to the pre-dredge sediment sampling commencing. This will be provided either through installing a weather station on site or obtaining weather data from nearby weather stations at Inverness Airport or Kinloss.



### **3.6 Tide Monitoring**

Prior to the capital dredge operations commencing, a tide gauge will be installed within the harbour. This will be installed 4 weeks prior to the capital dredge to provide a period of pre-dredge conditions. The monitoring gauge will be a pressure transducer, secured in a protective housing with easy and safe access for inspection and maintenance. A data logger and readily accessible interface will be used to access the data in real time for port operations. The data will be calibrated on a regular basis (minimum weekly) against a gauge board in the immediate vicinity of the pressure transducer.

### **3.7 Wave Monitoring**

The coastal modelling previously undertaken in support of the ES for the development of Ardersier Port relied on offshore wave data. One of the recommendations was to collect an inshore wave dataset to provide a calibration dataset for future modelling that may be required to inform maintenance dredging activities.

A monitoring buoy will be deployed for a three month period during the winter period post capital dredge to gather wave data (wave height and direction) which will provide site specific data to inform any future modelling.

### **3.8 Sediment Transport Monitoring**

Sediment transport monitoring will be undertaken using a combination of field sampling, field survey measurements and comparison of wider scale topographic survey/aerial photographs.

#### **Inter-tidal - sampling**

Sediment transport in the intertidal zone will be monitored pre-, during and post capital dredge through the installation of mechanical bed-load trap samplers (such as Booner tubes) to record sediment processes in the intertidal zone

The Booner tubes will be located at three fixed point intertidal locations. The deployment will extend for between a minimum of one neap to spring or spring to neap cycle and a full tidal cycle range. Where the number of days differ between deployment durations, they will be standardised to a consistent time period

Sediment samples taken from the tubes will be measures and subject to particle size analysis (PSA). These will be compared to sediment samples taken at each location prior to installing the tubes and samples taken from the dredged material at source.

At each monitoring location, the pre-, during and post- dredge results will be compared in terms of total suspended solids collected and PSA.

#### **Suspended Sediment Sampling**

As a minimum, on a single day during a spring to high tide cycle, suspended sediment samples will be collected from up to four locations pre- and post- capital dredge to characterise the suspended sediment load and provide correlation with the bed sediment sampling.

During the capital dredge works, suspended sediment samples will be taken on a weekly basis. The samples will be analysed by mass and PSA.

## 4 REPORTING

The monitoring information will be reviewed as required with a monitoring data report produced, which will be reviewed by the Ardersier Port Ecological Management Group. This will inform the Spit Habitat Protection and Enhancement Plan within the Habitat Management Plan.

The annual report will be a factual report containing the following:

- Monthly inspection reports;
- Fixed point photographs;
- Aerial photographs;
- Topographic surveys;
- Bathymetric surveys;
- Relative change in survey plots;
- Inter-tidal sediment sampling and measurement data;
- Weather (and wave when deployed) information;
- Tide data;
- Any event monitoring undertaken in addition to routine monitoring; and
- Recommendations for any change to type/extent/duration of monitoring.

Updates will be provided when new survey data has been collected to ensure that the most recent data is available for the EMG to consider (typical 6 month basis).

In addition to the factual data report, a summary interpretative report will be produced in advance of any future maintenance dredging planned. This will compare the observed changes to what was expected, taking into account weather conditions and will make any recommendations with regard to the content and frequency of forward monitoring. This will provide a narrative to the monitoring data collected, analysing the changes observed and examining the dispersal and circulation of material from the capital dredge. This report may establish that sufficient information is available to inform the maintenance dredge, or identify recommendations for further data collection or modelling.

## **APPENDICES**

## **A      DRAWINGS**





- Legend**
- Mean Low Water Spring (MLWS)
  - Mean High Water Spring (MHWS)
  - Survey Transects
  - Spit Restoration
  - Dredge Storage Area
  - Aerial Photography of Whiteness Sands and Whiteness Head
- Monitoring Locations (Provisional Locations V0.1)**
- Inter-tidal Sediment Peg
  - Inter-tidal Sediment Sample
  - Suspended Sediment Sample
  - TG Tide Gauge
  - WB Wave Buoy
  - WS Weather Station
  - Harbour Revision Order Works
  - Quay Wall Construction Works Extents 2018 License Application
  - Capital Dredge Extent 2018 License Application
  - Bathymetric Survey Extents
  - Unmanned Aerial Vehicle (UAV) Survey Extents

**Note:**  
Tidal contours from May 2018 Aspect Topographic and Bathymetric survey

UAV survey to be supplemented with additional RTK survey data.

Do not scale this map

Client
Ardersier Port Ltd

Project
Ardersier Port Redevelopment

Title
Sediment Transport Monitoring Locations

Status
FINAL

Drawing No.	Revision
670191-016	

Scale	A3	Date
1:25,000		24 Sep 2018
Drawn	Checked	Approved
JS	KMD	KMD



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