ABERDEEN HARBOUR
EXPANSION PROJECT
*November 2015*

*Volume 3:*
*Technical*
*Appendices*

# APPENDIX 7-C WATER FRAMEWORK DIRECTIVE ASSESSMENT

FUGRO EMU LIMITED

# ABERDEEN HARBOUR EXPANSION PROJECT

## WATER FRAMEWORK DIRECTIVE ASSESSMENT

Report Reference. P1974_R3896_Rev2

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# SUMMARY

Aberdeen Harbour Board (AHB) is investigating the potential expansion of harbour facilities at Aberdeen. Fugro EMU Limited (Fugro) is carrying out an Environmental Impact Assessment (EIA) on behalf of AHB for the proposed expansion. This report has been prepared for Fugro by Intertek Energy and Water Consultancy Services (Intertek) in support of the EIA, assessing modelled water quality and morphological impacts of the potential expansion with respect to the Water Framework Directive (WFD) and other relevant legislation. These investigations include the impacts at identified sensitive sites near the development as given below:

- Nigg Bay Site of Special Scientific Interest (SSSI)
- Cove SSSI
- River Dee Special Area of Conservation (SAC)
- Ythan Estuary and Sands of Forvie draft Special Protection Area (SPA)
- Aberdeen Ballroom Bathing Water (BW)

The aim of this assessment is to understand the existing baseline WFD conditions and to predict impacts from the developed harbour over its lifetime in terms of WFD status and compliance.

## METHOD

The WFD assessment utilised the findings of other modelling investigations including:

- Hydrodynamic modelling
- Sediment transport
- Water quality tracer plume modelling

Outputs were used from each of these modelling investigations to predict the WFD status of the modelled waterbodies following the construction of the proposed Aberdeen Harbour Expansion Project.

Compliance was assessed against the stated WFD status objectives and a condition of “no deterioration”. The following approach was used in the assessment:

**1)** Identify the potentially impacted waterbodies and provide baseline data. These waterbodies include the Don Estuary to Souter Head and the Dee (Aberdeen) Estuary.

**2)** Assess the potential impacts of the development on the relevant WFD classification elements of the waterbodies and the WFD objectives.

**3)** Assess cumulative impacts on WFD classification status and objectives.

## RESULTS

Two waterbodies were identified as having the potential to be impacted by the proposed harbour expansion: Don Estuary to Souter Head and Dee (Aberdeen) Estuary.

The project is not predicted to cause deterioration of the WFD status of the Dee Estuary waterbody or the Don Estuary to Souter Head waterbody outwith Nigg Bay. However, the project is predicted to cause deterioration of the WFD status of the Don Estuary to Souter Head waterbody within Nigg Bay.

The project is not predicted to compromise the ability of the Dee Estuary waterbody or the Don Estuary to Souter Head waterbody outwith Nigg Bay to meet its targeted WFD objective. However, the project is predicted to compromise the ability of the Don Estuary to Souter Head waterbody within Nigg Bay to meet its WFD objective.

It is considered that the development will not compromise the WFD objectives in the three identified waterbodies neighbouring the two principal waterbodies modelled explicitly in this assessment. This is due to the fact that these lie at a greater distance from the harbour than the two considered in detail here and would therefore be subject to greater dilution, dispersal and decay of pollutants from the study area and negligible morphological change. Furthermore, there are no predicted cumulative impacts with either the European Offshore Development Centre or the Kincardine Offshore Windfarm.

# CONCLUSIONS

The modelling results have been used to test the impacts from the expansion of Aberdeen Harbour on the WFD classification of nearby waterbodies. Results generally showed that WFD compliance is unaffected by the development. The exception to this is the local effect caused by the development within Nigg Bay. This results in a deterioration of WFD status within the bay only.

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# ABBREVIATIONS

| | |
|---|---|
| AA | Annual Average |
| AHB | Aberdeen Harbour Board |
| BOD | Biochemical Oxygen Demand |
| BW | Bathing Water |
| CSO | Combined Sewer Overflow |
| D&B | Design and Build |
| DIA | Drainage Impact Assessment |
| DIN | Dissolved Inorganic Nitrogen |
| dl | decilitre |
| DO | Dissolved Oxygen |
| EA | Environment Agency |
| EC | Escherichia coli |
| EIA | Environmental Impact Assessment |
| EQS | Environmental Quality Standard |
| ES | Environmental Statement |
| EODC | European Offshore Development Centre |
| FRA | Flood Risk Assessment |
| HDM | Hydrodynamic Modelling |
| Intertek | Intertek Energy and Water Consultancy Services |
| MAC | Maximum Allowable Concentration |
| MPS | Minimum Performance Specifications |
| PAH | Polycyclic Aromatic Hydrocarbon |
| RBMP | River Basin Management Plan |
| SAC | Special Area of Conservation |
| SEPA | Scottish Environment Protection Agency |
| SPA | Special Protection Area |
| SSSI | Site of Special Scientific Interest |
| UFI | United Fish Industries |
| WFD | Water Framework Directive |

# 1 INTRODUCTION

Intertek Energy & Water Consultancy Services (Intertek) was commissioned by Fugro EMU Limited (Fugro) to undertake a range of technical studies to inform the relevant chapters of an Environmental Impact Assessment (EIA). Fugro is carrying out the EIA work on behalf of Aberdeen Harbour Board (AHB) for the proposed expansion of Aberdeen Harbour at Nigg Bay.

This report has been prepared by Intertek, and summarises investigations into the impact that the development would have on compliance with the Water Framework Directive (WFD).

## 1.1 PROJECT BACKGROUND

Aberdeen Harbour Board has proposed the design and construction of a new harbour facility at Nigg Bay, immediately south of the existing harbour. The purpose of the new facility is to complement and expand the capabilities of the existing harbour, accommodate larger vessels, retain existing custom, and attract increased numbers of vessels and vessel types to Aberdeen.

The new harbour development shall include but is not limited to:

- Dredging the existing bay to accommodate vessels up to 9 m draft with additional dredge depth of 10.5 m to the east quay and entrance channel;
- Construction of new North and South breakwaters to form the harbour;
- Provision of approximately 1,500 m of new quays and associated support infrastructure. The quay will be constructed with solid quay wall construction and suspended decks over open revetment;
- Construction of areas for development by others to facilitate the provision of fuel, bulk commodities and potable water;
- Land reclamation principally through using materials recovered from dredging operations and local sources, where possible;
- Provision of ancillary accommodation for the facility;
- Off-site highway works to the extent necessary to access the facility and to satisfy statutory obligations; and
- Diversions and enabling works necessary to permit the development.

The current proposed option for the Aberdeen Harbour expansion at Nigg Bay is shown in Figure 1-1. The construction of the Aberdeen Harbour Expansion Project will be let under a Design & Build (D&B) contract. AHB has defined Minimum Performance Specifications (MPS) that the completed harbour would need to meet, in respect of a number of aspects such as minimum draft, length of solid-faced quayside and protection from overtopping of the breakwaters (waves breaking over the top of the breakwaters). Under the terms of the contract, D&B contractors are free to employ the methods and technologies of their choosing to meet the MPS, provided they are legal, within the parameters of the assessed Rochdale Envelope and in accordance with any consent conditions. AHB will not appoint a contractor until consent for the development

has been granted. For this reason, it is not possible to state with complete certainty at the time of writing what methods the chosen contractor will use. Therefore the assessments in this study have been made employing the Rochdale Envelope approach. This approach makes realistic assumptions about the development, but will tend towards conservatism (in terms of potential impacts) where there is presently uncertainty regarding the precise details of the project.

## 1.2 SCOPE OF ASSESSMENT

The technical studies included in Intertek's commission as part of the wider EIA are:

- Hydrodynamic Modelling (HDM). This topic covers currents, waves and sediment dynamics / coastal processes.
- Flood Risk Assessment (FRA).
- Drainage Impact Assessment (DIA).
- Water Framework Directive Assessment (WFDA). This topic includes tracer plume dispersion modelling and water quality studies.

This document reports on the findings of the WFDA and draws on the results of the hydrodynamic, sediment, morphological [1] and water quality [2] assessments. It sets out the method and results of the water quality assessment, reporting the baseline and operational scenarios for the proposed harbour.

The following designated sites that are relevant to the WFDA have been identified in the vicinity of the proposed expansion:

- Nigg Bay Site of Special Scientific Interest (SSSI).
- Cove SSSI.
- River Dee Special Area of Conservation (SAC).
- Ythan Estuary and Sands of Forvie draft Special Protection Area (SPA).
- Aberdeen Ballroom Bathing Water (BW).

These sites are indicated on Figure 1-1.

## 1.3 OVERVIEW OF APPROACH

The technical studies covered by this report were carried out using a range of supporting data sources and a variety of analytical techniques. A key component of these studies is the use of complex environmental modelling to aid the following project aims with respect to the WFD:

- Define existing conditions (baseline scenario).
- Predict impacts due to the proposed development over its lifetime (operational scenario).

- Evaluate the magnitude of these impacts on the local and regional environment, in particular in terms of relative impacts on designated sites.

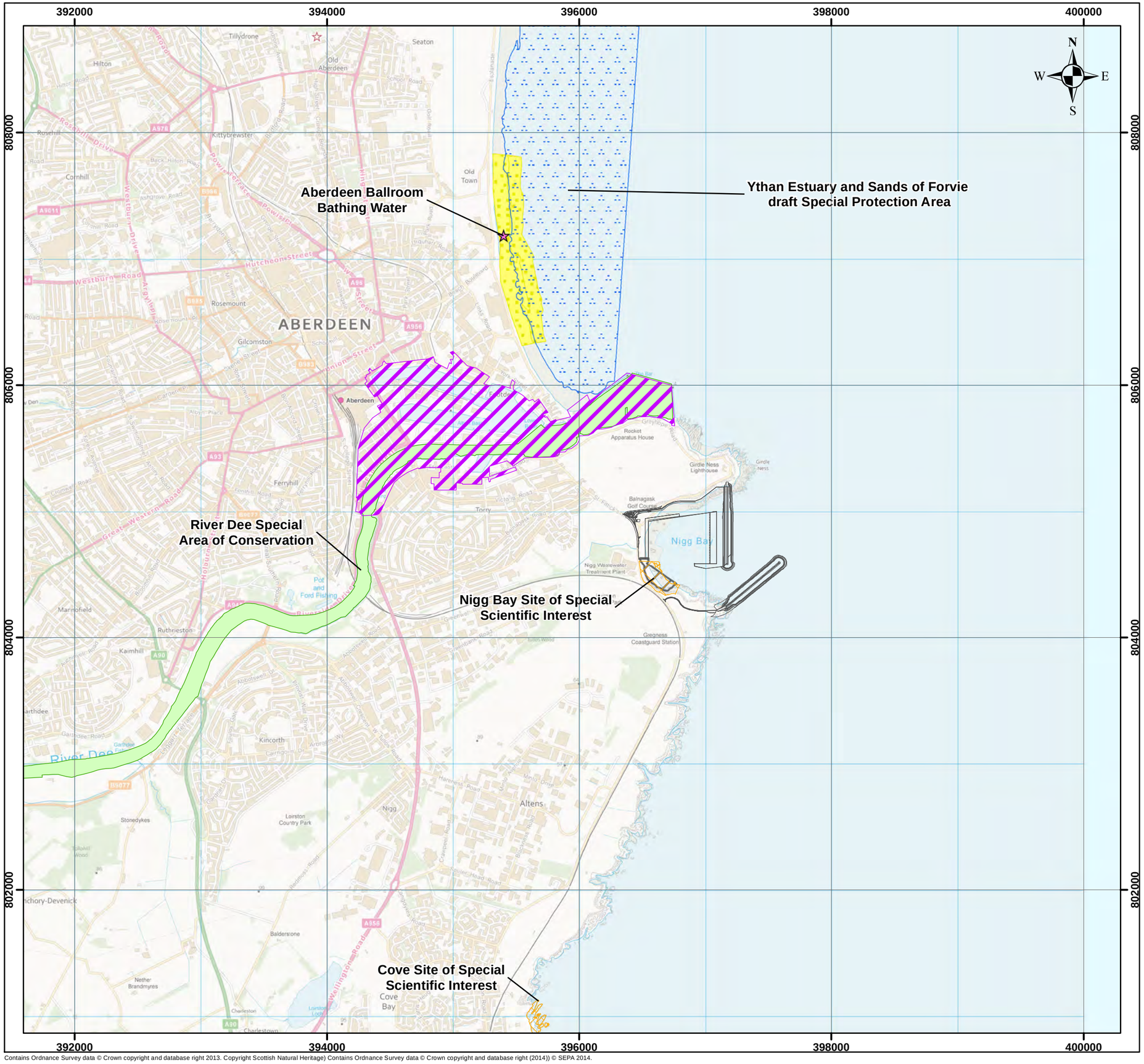
The key modelling tool used in this work is a coastal modelling system covering Nigg Bay and the surrounding area known as the Aberdeen Coastal Model.

The substances that were modelled within this study were determined through an examination of the River Basin Management Plans for contributing waterbodies, the assessment of available sampling data for the area and the application of a priority substance selection procedure. The procedure and findings of the priority substance selection are reported separately [3].

The technical studies followed guidance set out in the Water Framework Directive [4] and the UKTAG documents [5] [6]. SEPA, Marine Scotland, Aberdeen City Council and Scottish Natural Heritage were consulted during the assessment process.

# ABERDEEN HARBOUR EXPANSION PROJECT

**Figure 1-1: Geographic overview of the area of interest**




## Legend

- Aberdeen Harbour Expansion Project area
- Existing Aberdeen Harbour Area
- Special Area of Conservation
- Site of Special Scientific Interest
- Draft Special Protection Area
- Bathing Water Monitoring Location
- Aberdeen Ballroom Bathing Water

NOTE: Not to be used for Navigation

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| **Created By** | Emma Langley |
| **Reviewed By** | Ian Charlton |
| **Approved By** | Kevin McGovern |

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0 0.2 0.4 0.8 1.2 1.6 km

# 2 WFDA

## 2.1 INTRODUCTION

The Water Framework Directive (Directive 2000/60/EC) is a key European Union (EU) directive that aims to protect the water quality of all ground and surface waters (rivers, lakes, transitional waters, and coastal waters) in the EU. It does this by setting a target classification of “Good” for all waterbodies and prescribing a condition of “no deterioration”. The status criteria are wide ranging looking at hydrology, morphology, ecology and physio-chemical water quality, with the overall classification given by the lowest determinand classification of all of those considered.

This report is concerned principally with the elements of the WFD that can be assessed using the modelling tools developed for the Aberdeen Harbour Expansion Project assessment. This uses the outputs of the hydrodynamic, water quality and sediment transport modelling investigations to assess the impact of the proposed harbour expansion on WFD status.

The following objectives are addressed within this document:

**1)** Identify the potentially impacted waterbodies and provide baseline data. These waterbodies include:

- The Don Estuary to Souter Head.
- Dee (Aberdeen) Estuary.

**2)** Assess the potential impacts of the development on the relevant WFD classification elements of the waterbodies and the WFD objectives.

**3)** Assess cumulative impacts on WFD classification status and objectives. The European Offshore Wind Deployment Centre (EODC) and Kincardine Offshore Wind Farm were identified in the ES as having the potential to cause cumulative impacts.

Water quality modelling was carried out for substances identified within the relevant River Basin Management Plans (RBMP) and via the priority substance selection process [3].

Each of these elements is described in more detail in the following sections.

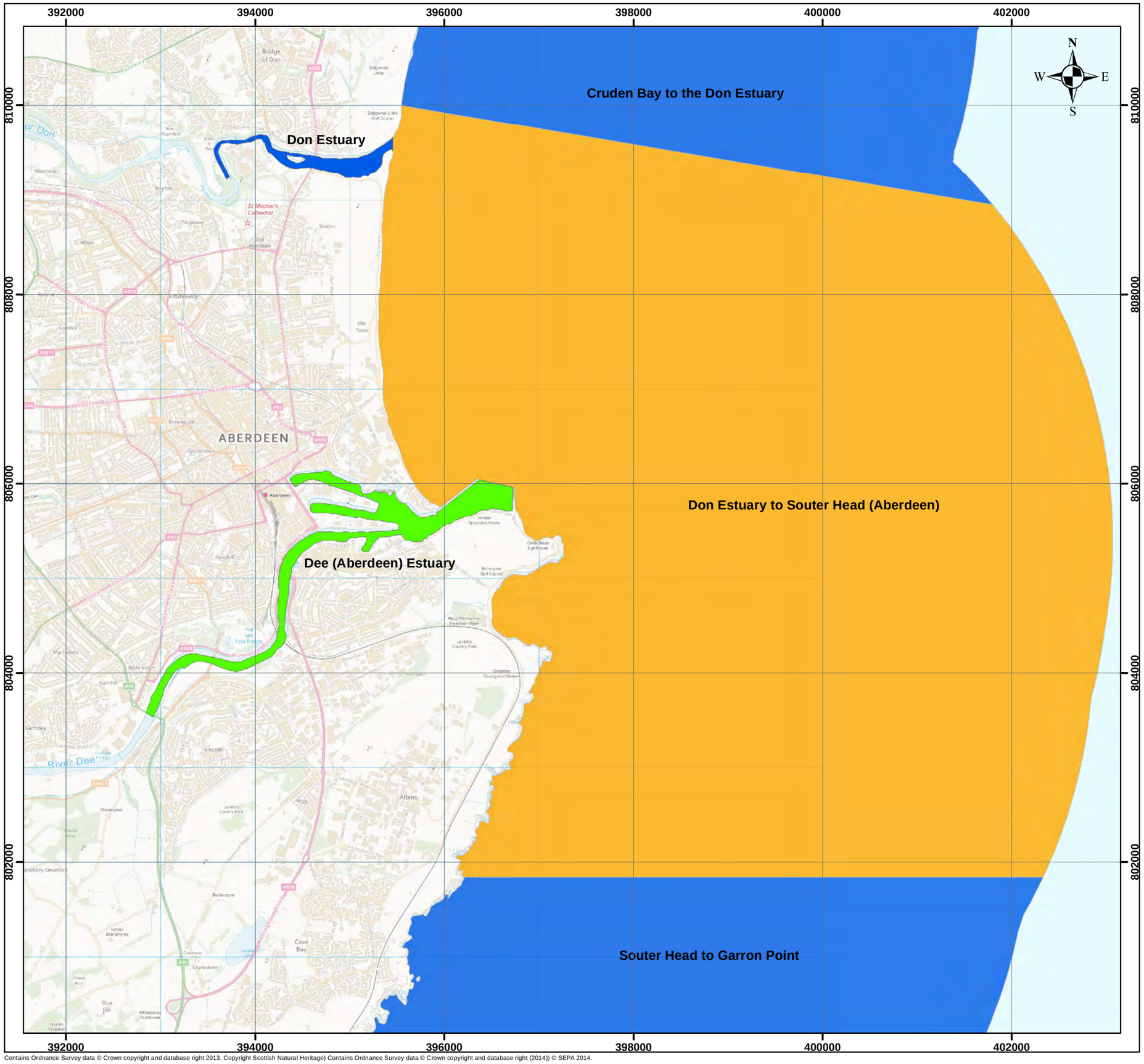
## 2.2 IDENTIFICATION OF WATERBODIES

Two waterbodies were identified as having the potential to be impacted by the development:

- The Don Estuary to Souter Head.
- Dee (Aberdeen) Estuary.

These waterbodies are shown in Figure 2-1.

Descriptions of and objectives for these two waterbodies are provided in Appendix A.




# ABERDEEN HARBOUR EXPANSION PROJECT

**Figure 2-1: WFD Waterbodies**

## Legend

**WFD Waterbodies - Status (Name)**

- Poor (Don Estuary to Souter Head (Aberdeen))
- Good (Dee (Aberdeen) Estuary)
- High (Other waterbodies)

NOTE: Not to be used for Navigation

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| **File Reference** | J:\P1974\Mxd\Method_Statement\ WFD_Waterbodies_v1.mxd |
| **Created By** | Emma Langley |
| **Reviewed By** | Ian Charlton |
| **Approved By** | Ann Saunders |

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### 2.2.1 Hydrological connectivity

Tracer plume modelling reported in RN3858 [2] has been used to understand the hydrological connectivity between the proposed development and the identified waterbodies. The results of this analysis are summarised in Table 2-1 below.

Table 2-1: Hydrological connectivity

| WFD waterbodies | Distance from proposed development / km | Hydrological connectivity to development | Comments |
|---|---|---|---|
| Don Estuary to Souter Head | 0 | High | The proposed development is within this waterbody. |
| Dee (Aberdeen) Estuary | 2 km | Low | There is a headland between the proposed development and this waterbody, which significantly reduces connectivity. |

#### 2.2.1.1 Don Estuary to Souter Head

The proposed expansion project is within this waterbody and thus hydrological connectivity is clearly assessed as high.

In addition, this waterbody has a number of protected areas (see Appendix A):

- River Dee – SAC
- Aberdeen, Footdee – Public access and water contact activity – recreational water
- Nigg Bay – SSSI
- Balmedie to River Don – Public access, salmon netting – recreational water
- Aberdeen Ballroom BW
- South of River Don – Public access, wind-surfing – recreational water

The connectivity of these protected areas to the proposed development are summarised in Table 2-2.

Table 2-2: Connectivity of Don Estuary to Souter Head protected areas and the development

| Protected Area | Connectivity | Comment |
|---|---|---|
| River Dee – SAC | Low | The pollutant plumes from discharges within and around the proposed development can be seen to remain seaward of the River Dee Estuary. |
| Aberdeen, Footdee Access | Low | The pollutant plumes from discharges within and around the proposed development can be seen to impact on Footdee at low concentrations. |
| Nigg Bay SSSI | High | Nigg Bay SSSI is within the development. |
| Balmedie to R.Don Public access | Low | The pollutant plumes from discharges within and around the proposed development can be seen to impact on this area at low concentrations. |
| Aberdeen - EC bathing water | Low | The pollutant plumes from discharges within and around the proposed development can be seen to impact on this area at low concentrations. |

The connectivity between the proposed development and the protected areas within this waterbody has been assessed by considering the impact of water quality parameters discharged from within the development area [2]. Four water quality parameters were selected for this analysis on the basis that they discharge directly into Nigg Bay but are not recorded as discharging elsewhere; therefore their sources are only related to Nigg Bay. The four water quality parameters are:

- Chloroalkanes – see Figure C-5 (baseline), Figure C-24 (development) and D-5 (percentage difference) in Water Quality report [2].
- Hexachlorobutadiene – see Figure C-11 (baseline), Figure C-30 (development) and D-11 (percentage difference) in Water Quality report [2].
- Mercury – See Figure C-13 (baseline), Figure C-32 (development) and D-13 (percentage difference) in Water Quality report [2].
- Phenol – see Figure C-16 (baseline), Figure C-35 (development) and D-16 (percentage difference) in Water Quality report [2].

#### 2.2.1.2 Dee (Aberdeen) Estuary

The connectivity between the proposed development and the Dee Estuary waterbody was again assessed by considering the impact of water quality determinands discharged at the proposed expansion site, that are not otherwise likely to be found in the Dee Estuary.

The pollutant plumes from discharges within and around the proposed development can be seen to remain seaward of the Dee Estuary waterbody. The percentage difference (Figure D-5, D-11 and D-16 [2]) plots show that the predicted change in concentration post development is less than 1%.

Overall hydrological connectivity is assessed as low.

This waterbody has a number of protected areas (see Appendix A):

- River Dee – SAC
- Moray / Aberdeenshire / Banff / Buchan – Nitrate Vulnerable Zones (NVZ)

The hydrological connectivity between the SAC and the NVZ and the proposed development is assessed as low.

### 2.2.2 Baseline Data

The baseline data for the two identified waterbodies are discussed in the following sections.

#### 2.2.2.1 Don Estuary to Souter Head

SEPA classified this waterbody in 2013 as having an overall status of Poor, with a Poor ecological status and a chemical status of Pass. The environmental objectives for the first, second and third River Basin Management Planning (RBMP) cycles are Good. SEPA has established an on-going programme of monitoring to identify pressures on this waterbody and has identified none. It is specified that no deterioration from Good status should be permitted, unless caused by a new activity providing significant specified benefits to society or the wider environment. The baseline data for this waterbody are provided in Table 2-3.

Table 2-3: Baseline data – Don Estuary to Souter Head

| Parameter | Status | Confidence of Class |
|---|---|---|
| Overall status | POOR | MEDIUM |
| Pre-HMWB status | Poor | Medium |
| Overall chemistry | Pass | Low |
| Priority Substances | Pass | Low |
| Overall ecology | Poor | Medium |
| Physico-Chemical | High | Low |
| Dissolved oxygen | High | Low |
| Dissolved inorganic nitrogen | High | Low |
| Biological elements | Good | Medium |
| Benthic invertebrates | Good | Medium |
| Imposex assessment | Good | Medium |
| Benthic invertebrates (IQI) | High | Medium |
| Alien species | High | Low |
| Macroalgae | High | Low |
| Macroalgae (FSL) | High | Low |
| Macroalgae (RSL) | High | Low |
| Combined phytoplankton | High | High |
| Specific pollutants | Pass | Low |
| Copper | Pass | Low |
| Zinc | Pass | Low |
| Unionised ammonia | Pass | Low |
| Hydromorphology | Poor | Medium |
| Morphology | Poor | Medium |
| Overall status | Poor | Medium |
| Water quality | Good | Medium |
| Oxygen levels | High | Low |
| Nutrient levels | High | High |
| Benthic invertebrates | Good | Medium |
| Toxic pollutants | Good | Medium |
| Physical conditions and barriers | Poor | Medium |
| Invasive non-native species | High | Low |

#### 2.2.2.2 Dee Estuary

SEPA has classified this waterbody in 2013 as having Good ecological potential, with an ecological status of Bad and a chemical status of Pass. The environmental objectives for the first, second and third River Basin Management Planning (RBMP) cycles are Pass. SEPA plan to carry out additional work over subsequent river basin cycles to identify pressures and to develop and implement measures to mitigate their impacts. The baseline data for this waterbody are provided in Table 2-4.

Table 2-4: Baseline data – Dee (Aberdeen) Estuary

| Parameter | Status | Confidence of Class |
|---|---|---|
| Overall status | Good ecological potential | Medium |
| Pre-HMWB status | Bad | Medium |
| Overall chemistry | Pass | Low |
| Priority Substances | Pass | Low |
| Overall ecology | Bad | Medium |
| Physico-Chemical | High | Low |
| Dissolved oxygen | High | Low |
| DO (lab. salinity) | High | Low |
| DO (field salinity) | High | Low |
| Dissolved inorganic nitrogen | High | Low |
| Biological elements | High | Low |
| Benthic invertebrates | High | Low |
| Alien species | High | Low |
| Fish | High | Low |
| Macroalgae | High | Low |
| Combined phytoplankton | High | Low |
| Specific pollutants | Pass | Low |
| Copper | Pass | Low |
| Zinc | Pass | Low |
| Hydromorphology | Bad | Medium |
| Morphology | Bad | Medium |
| Overall status | Good ecological potential | Medium |
| Water quality | High | |
| Oxygen levels | High | Low |
| Nutrient levels | High | Low |
| Benthic invertebrates | High | Low |
| Toxic pollutants | High | |
| Physical conditions and barriers | Bad | Medium |
| Invasive non-native species | High | Low |
| Fish | High | Low |

## 2.3 ASSESSMENT OF IMPACTS ON WFD STATUS & OBJECTIVES

This assessment investigates the potential impacts of the development on the relevant WFD classification and objectives of the waterbodies. These objectives are:

- The Project should not cause deterioration in the status of the elements of the waterbodies.

- The Project should not compromise the ability of the waterbodies to meet their WFD status objectives (objective of Good status or Good Ecological potential).
- The Project should not cause a permanent exclusion or compromise achieving the WFD objectives in other bodies of water within the same River Basin District (RBD).
- The Project should contribute to the delivery of the WFD objectives.

Each of these components is dealt with in turn in the following sections and refers to each specific waterbody where appropriate.

### 2.3.1 Assessment of Waterbody Status Deterioration

The elements which comprise this assessment can be divided into three components:

- Chemical elements
- Morphological elements
- Biological elements

Outputs from hydrodynamic, sediment transport and water quality modelling scenarios were used in the assessment of the WFD status under these three components.

#### 2.3.1.1 Assessment of chemical elements

**Don Estuary to Souter Head**

In this assessment, water quality parameters have been assessed including:

- Overall chemistry – priority substances
- Physico-chemical – dissolved oxygen and dissolved inorganic nitrogen
- Specific pollutants – copper, zinc and un-ionised ammonia
- Biological quality for bathing and recreational waters

The determinands have been assessed separately within and outwith Nigg Bay. The results of these assessments are summarised in Table 2-5 and Table 2-6 respectively. In addition, for the assessment outwith Nigg Bay (Table 2-6), the impact of the project on EC concentrations has been included to take account of the bathing water and the recreational waters.

Table 2-5: Impact of the project on WFD chemical status – Don Estuary to Souter Head within Nigg Bay

| Class | Parameter | Baseline EQS Assessment | Post-development EQS Assessment | Comment |
|---|---|---|---|---|
| Overall chemistry – priority substances | Cadmium | Breaches EQS | Breaches EQS | The distribution of impacts is changed with more of the bay above the EQS, post development. |
| | Chromium | Breaches AA EQS | Breaches AA EQS | The distribution of impacts is changed with more of the bay above the EQS. |
| | Mercury | Breaches AA & MAC EQS | Breaches AA & MAC EQS | A larger area of failure of the AA EQS within the harbour but a smaller area of MAC EQS failure post development. |
| | Lead | Achieves EQS | Achieves EQS | Does not fail its EQS under either scenario and reduces in concentration post development. |
| | Phenol | Breaches EQS | Breaches EQS | The area of failure changes in shape following harbour construction due to the deflection of tidal currents by the northern breakwater. |
| | Benzo(b/k) Fluoranthene | Breaches MAC EQS | Breaches MAC EQS | No change |
| | Anthracene | Breaches MAC EQS | Breaches MAC EQS | No change |
| | C10-13 Chloroalkanes | Breaches EQS | Breaches EQS | Area of EQS failure reduces due to increased depth around UFI outfall, post development. |
| | Hexachlorobutadiene | Breaches AA & MAC EQS | Breaches AA & MAC EQS | A larger area of failure of the AA EQS within the harbour but a smaller area of MAC EQS failure, post development. |
| | PAHs | No EQS | No EQS | No change |
| Physico-chemical | DO | Breaches EQS | Breaches EQS | Increased area of non-compliance, resulting from reduced exchange, post development. |
| | DIN | Breaches AA & MAC EQS | Breaches AA & MAC EQS | Increased area of non-compliance, resulting from reduced exchange, post development. |
| Specific pollutants | Copper | Breaches EQS | Breaches EQS | Area of EQS failure reduces due to increased depth around UFI outfall, post development. |
| | Zinc | Breaches EQS | Breaches EQS | Area of EQS failure reduces due to increased depth around UFI outfall, post development. |
| | Un-ionised ammonia | Breaches EQS | Breaches EQS | A larger area of failure of the EQS within the harbour, post development. |

This assessment indicates that:

- The project is predicted to cause deterioration of the chemical WFD status of the Don Estuary to Souter Head waterbody within Nigg Bay.
- The project is not predicted to cause deterioration of the chemical WFD status of the protected area within Nigg Bay SSSI. Nigg Bay has been designated a SSSI based on geology which will not be affected by the chemical changes in the area.

Table 2-6: Impact of the project on WFD chemical status– Don Estuary to Souter Head outwith Nigg Bay

| Class | Parameter | Baseline EQS Assessment | Post-development EQS Assessment | Comment |
|---|---|---|---|---|
| Overall chemistry – priority substances | Cadmium | Achieves EQS | Achieves EQS | No change |
| | Chromium | Achieves EQS | Achieves EQS | No change |
| | Mercury | Achieves EQS | Achieves EQS | No change |
| | Lead | Achieves EQS | Achieves EQS | No change |
| | Phenol | Achieves EQS | Achieves EQS | No change |
| | Benzo(b/k) Fluoranthene | Breaches MAC EQS | Breaches MAC EQS | No change |
| | Anthracene | Breaches MAC EQS | Breaches MAC EQS | No change |
| | C10-13 Chloroalkanes | Achieves EQS | Achieves EQS | No change |
| | Hexachlorobutadiene | Achieves EQS | Achieves EQS | No change |
| | PAHs | No EQS | No EQS | No change |
| Physico-chemical | DO | Achieves EQS | Achieves EQS | No change |
| | DIN | Breaches MAC EQS | Breaches MAC EQS | No change |
| Specific pollutants | Copper | Breaches EQS | Breaches EQS | No change. Very small area around St Fittick's Head exceeds the EQS as a result of CSO discharges. This CSO spills infrequently and so the EQS is unlikely to be breached in reality. |
| | Zinc | Breaches EQS | Breaches EQS | No change. Very small area around St Fittick's Head exceeds the EQS as a result of CSO discharges. This CSO spills infrequently and so the EQS is unlikely to be breached in reality. |

| Class | Parameter | Baseline EQS Assessment | Post-development EQS Assessment | Comment |
|---|---|---|---|---|
| | Un-ionised ammonia | Breaches EQS | Breaches EQS | The area of breach is reduced. Very small area around St Fittick's Head exceeds the EQS as a result of CSO discharges. This CSO spills infrequently and so the EQS is unlikely to be breached in reality. |
| Faecal Indicator organism | EC (at EC BW and Footdee | Achieves Excellent standard | Achieves Excellent standard | No change |
| | EC (Balmedie to River Don) | Achieves Good standard | Achieves Good standard | No change |

This assessment indicates that:

- The project is not predicted to cause deterioration of the chemical WFD status of the Don Estuary to Souter Head waterbody outwith Nigg Bay.
- The project is not predicted to cause deterioration of chemical WFD status of protected areas outwith Nigg Bay:
    - River Dee – SAC
    - Aberdeen, Footdee – Public access and water contact activity – recreational water
    - Balmedie to River Don – Public access, salmon netting – recreational water
    - Aberdeen Ballroom BW
    - South of River Don – Public access, wind-surfing – recreational water

**Dee Estuary**

In this assessment the following water quality parameters have been assessed:

- Overall chemistry – priority substances
- Physico-chemical – dissolved oxygen and dissolved inorganic nitrogen
- Specific pollutants – copper and zinc

The results of these assessments are presented in Table 2-7.

Table 2-7: Impact of the project WFD chemical status – Dee (Aberdeen) Estuary

| Class | Parameter | Baseline | Post-development | Comment |
|---|---|---|---|---|
| Overall chemistry – priority substances | Cadmium | Below EQS | Below EQS | No change |
| | Chromium | Below EQS | Below EQS | No change |
| | Mercury | Below EQS | Below EQS | No change |
| | Lead | Below EQS | Below EQS | No change |
| | Phenol | Below EQS | Below EQS | No change |
| | Benzo(b/k)Fluoranthene | Above MAC EQS | Above MAC EQS | No change |
| | Anthracene | Above MAC EQS | Above MAC EQS | No change |
| | C10-13 Chloroalkanes | Below EQS | Below EQS | No change |
| | Hexachlorobutadiene | Below EQS | Below EQS | No change |
| Physico-chemical | DO | Below EQS | Below EQS | No change |
| | DIN | Above AA EQS | Above AA EQS | No change |
| Specific pollutants | Copper | Below EQS | Below EQS | No change |
| | Zinc | Below EQS | Below EQS | No change |

This assessment indicates that the required EQSs are predicted to be met in the Dee Estuary waterbody for all but three parameters. High predicted concentrations of benzo(b/k)Fluoranthene, anthracene and Dissolved Inorganic Nitrogen (DIN) in the Dee estuary are the result of high concentrations measured in the River Dee.

These results indicate that:

- The project is not predicted to cause deterioration of WFD status of the Dee (Aberdeen) Estuary waterbody.
- The project is not predicted to cause deterioration of WFD status of protected areas within Dee Estuary waterbody.

#### 2.3.1.2 Assessment of morphological elements

This assessment is based on studies, including tables and figures relating to morphological conditions, reported in the Hydrodynamic Modelling and Coastal Processes Assessment [1] component of this study.

**Don Estuary to Souter Head**

In this assessment indicators of morphological change have been assessed including:

- Water levels (Table 5-1 to Table 5-4 [1]);
- Current velocity (Table 5-5 to Table 5-8, Figure B-1 and Figure B-2 [1]);
- Wave climate (Table 5-9 and Table 5-11 [1];
- Peak wave period (Table 5-10 [1]); and
- Sediment climate (Figure 4-1 [1]).

The parameters have been assessed separately within and outwith Nigg Bay. The results of these assessments are summarised in Table 2-8 and Table 2-9.

Table 2-8: Impact of the project on WFD morphological status – Don Estuary to Souter Head within Nigg Bay

| Parameter | Condition | Description | Comment |
|---|---|---|---|
| Water levels | Average | Maximum water levels change <4mm (0.1% mean spring tidal range) | No change |
| | Storm | Maximum water levels change <4mm (0.1% mean spring tidal range) | No change |
| | Extreme | Maximum water levels change <11mm (0.3% mean spring tidal range) | No change |
| | Future climate change | Maximum water levels change 10mm (0.1% mean spring tidal range) | No change |
| Current speed | Average | Current speed change varies between +0.05 m/s and -0.65 m/s | Major change |
| | Storm | Current speed change varies between +0.05 m/s and -0.65 m/s | Major change |
| Current direction | Average | Baseline eddy currents disappear. Reversal of direction of baseline currents along breakwater. | Major change |
| | Storm | Baseline eddy currents disappear. Reversal of direction of baseline currents along breakwater. | Major change |
| Wave climate | Average | Wave height reduce by up to 0.8 m. | Major change |
| | Annual | Significant wave heights reduce by up to 6.m. | Major change |
| | Extreme | Significant wave heights reduce by up to 6.6.m. | Major change |
| | Future climate change | Significant wave heights reduce by up to 6.5.m. | Major change |
| Peak wave period | Average | Small changes | Small change |
| | Annual | Small changes | Small change |
| | Extreme | Small changes | Small change |
| Sediment climate | Average | Minimal sediment compared to baseline | Major change |
| | Storm | Minimal sediment compared to baseline | Major change |
| | Extreme | Minimal sediment compared to baseline | Major change |

Table 2-9: Impact of the project on WFD morphological status– Don Estuary to Souter Head outwith Nigg Bay

| Parameter | Condition | Description | Comment |
|---|---|---|---|
| Water levels | Average | Maximum water levels change <10mm (0.27% mean spring tidal range). Small changes in area just outside the harbour. No change over far-field. | No change |
| | Storm | Maximum water levels change <10mm (0.27% mean spring tidal range). Small changes in area just outside the harbour. No change over far-field. | No change |
| | Extreme | Maximum water levels change <11mm (0.3% mean spring tidal range). Small changes in area just outside the harbour. No change over far-field. | No change |
| | Future climate change | Maximum water levels change 12mm (0.32% mean spring tidal range). Small changes in area just outside the harbour. No change over far-field. | No change |
| Current speed | Average | Current speed change by 0.2 m/s on average just outside the harbour. No change over far-field. | No change over far-field. Very small area just south of breakwater shows decrease in current velocity. |
| | Storm | Current speed change by 0.2 m/s on average just outside the harbour. No change over far-field. | No change over far-field. Very small area just south of breakwater shows decrease in current velocity. |
| Current direction | Average | Current direction reversal on outer wall of northern and southern breakwaters. An area 600 m north, 1000 m south and 500 m is affected by the proposed development. No change over far-field. | No change over far-field. Small area just around the development show change in current direction. |
| | Storm | Current direction reversal on outer wall of northern and southern breakwaters. An area 600 m north, 1000 m south and 500 m is affected by the proposed development. No change over far-field. | No change over far-field. Small area just around the development shows change in current direction. |
| Wave climate | Average | Reduction in wave height of up to 0.9 m along the breakwaters. No change over far-field. | No change over far-field. Small area just around the development shows reduction wave height. |
| | Annual | Increase of 0.3 m in significant wave height in small area at the end of the southern breakwater and along the northern breakwater. No change over far-field. | No change over far-field. Small area just around the development shows change in wave height. |

| Parameter | Condition | Description | Comment |
|---|---|---|---|
| | Extreme | Increase of up to 1.0 m in significant wave height in small area at the end of the southern breakwater and along the northern breakwater. No change over far-field. | No change over far-field. Small area just around the development shows change in wave height. |
| | Future climate change | Increase of up to 1.0 m in significant wave height in small area at the end of the southern breakwater and along the northern breakwater. No change over far-field. | No change over far-field. Small area just around the development shows change in wave height. |
| Peak wave period | Average | Small changes close to harbour. No change over far-field. | Small changes close to harbour. No change over far-field. |
| | Annual | Small changes close to harbour. No change over far-field. | Small changes close to harbour. No change over far-field. |
| | Extreme | Small changes close to harbour. No change over far-field. | Small changes close to harbour. No change over far-field. |
| Sediment climate | Average | Sediment transport and pathways outside the harbour largely unchanged. | Small changes close to harbour. No change over far-field. |
| | Storm | Sediment transport and pathways outside the harbour largely unchanged. | Small changes close to harbour. No change over far-field. |
| | Extreme | Sediment transport and pathways outside the harbour largely unchanged. | Small changes close to harbour. No change over far-field. |

This assessment indicates that:

- The project is not predicted to cause deterioration of the morphological WFD status of the Don Estuary to Souter Head waterbody outwith Nigg Bay.
- The project is not predicted to cause morphological deterioration of WFD status of protected areas outwith Nigg Bay:
    - River Dee – SAC
    - Aberdeen, Footdee – Public access and water contact activity – recreational water
    - Balmedie to River Don – Public access, salmon netting – recreational water
    - Aberdeen Ballroom BW
    - South of River Don – Public access, wind-surfing – recreational water

- The project is predicted to cause deterioration of the morphological WFD status of the Don Estuary to Souter Head waterbody within Nigg Bay.
- The project is not predicted to cause deterioration of the morphological WFD status of the protected area within Nigg Bay SSSI. Nigg Bay has been designated a SSSI based on geology (Quaternary glacial deposits [7]) which is only expected to see a small reduction in erosion after the construction of the harbour.

**Dee Estuary**

In this assessment indicators of morphological change have been assessed including:

- Water levels (Table 5-1 to Table 5-4 [1]);
- Current velocity (Table 5-5 to Table 5-8, Figure B-1 and Figure B-2 [1]);
- Wave climate (Table 5-9 and Table 5-11 [1];
- Peak wave period (Table 5-10 [1]); and
- Sediment climate (Figure 4-1 [1]).

The results of these assessments are presented in Table 2-10.

Table 2-10: Impact of the project on WFD morphological status– Dee Estuary

| Parameter | Condition | Description | Comment |
|---|---|---|---|
| Water levels | Average | No change in the far-field from the development. | No change |
| | Storm | No change in the far-field from the development. | No change |
| | Extreme | No change in the far-field from the development. | No change |
| | Future climate change | No change in the far-field from the development. | No change |
| Current speed | Average | No change in the far-field from the development. | No change |
| | Storm | No change in the far-field from the development. | No change |
| Current direction | Average | No change in the far-field from the development. | No change |
| | Storm | No change in the far-field from the development. | No change |
| Wave climate | Average | No change in the far-field from the development. | No change |
| | Annual | No change in the far-field from the development. | No change |
| | Extreme | No change in the far-field from the development. | No change |
| | Future climate change | No change in the far-field from the development. | No change |
| Peak wave period | Average | No change in the far-field from the development. | No change |
| | Annual | No change in the far-field from the development. | No change |

| Parameter | Condition | Description | Comment |
|---|---|---|---|
| | Extreme | No change in the far-field from the development. | No change |
| Sediment climate | Average | No change in the far-field from the development. | No change |
| | Storm | No change in the far-field from the development. | No change |
| | Extreme | No change in the far-field from the development. | No change |

These results indicate that:

- The project is not predicted to cause deterioration of the morphological WFD status of the Dee (Aberdeen) Estuary waterbody.
- The project is not predicted to cause deterioration of morphological WFD status of protected areas within Dee Estuary waterbody.

#### 2.3.1.3 Assessment of biological elements

This assessment is based on:

- Assessment of the chemical elements – described in this report.
- Assessment of the biological elements – described in the Hydrodynamic Modelling and Coastal Processes Assessment [1].

**Don Estuary to Souter Head**

In this assessment indicators of biological change have been assessed including:

- Phytoplankton — Free-floating microscopic plants
- Macroalgae — Seaweeds visible to the naked eye
- Angiosperms — Sea grasses and saltmarsh plants
- Benthic invertebrates — Worms, molluscs and crustacean
- Fish — Fish living all or partly in transitional waters

The parameters have been assessed separately within and outwith Nigg Bay. The results of these assessments are presented in Table 2-11 and Table 2-12.

Table 2-11: Impact of the project on WFD biological status – Don Estuary to Souter Head within Nigg Bay

| Parameter | Condition | Description | Comment |
|---|---|---|---|
| Phytoplankton | Chemical elements | Increased area of non-compliance with nutrient standards, resulting from reduced exchange, post development. | Major change |
| | Morphological elements | Reduced exchange, current speeds and significant wave height post development. | Major change |
| Macroalgae | Chemical elements | Increased area of non-compliance with nutrient standards, resulting from reduced exchange, post development. | Major change |
| | Morphological elements | Reduced exchange, current speeds and significant wave height post development. | Major change |
| Angiosperms | Chemical elements | Increased are of non-compliance with EQS nutrients, cadmium, chromium, mercury, hexachlorobutadiene, un-ionised ammonia. | Major change |
| | Morphological elements | Reduced exchange, current speeds, significant wave height, and sediment depth post development. | Major change |
| Benthic invertebrates | Chemical elements | Increased area of non-compliance with EQS cadmium, chromium, mercury, hexachlorobutadiene, un-ionised ammonia. | Major change |
| | Morphological elements | Reduced exchange, current speeds, significant wave height, and sediment depth post development. | Major change |
| Fish | Chemical elements | Increased area of non-compliance with DO EQS. Increased area of non-compliance with EQS cadmium, chromium, mercury, hexachlorobutadiene, un-ionised ammonia. | Major change |
| | Morphological elements | Reduced exchange, current speeds and significant wave height post development. | Major change |

Table 2-12: Impact of the project on WFD biological status– Don Estuary to Souter Head outwith Nigg Bay

| Parameter | Condition | Description | Comment |
|---|---|---|---|
| Phytoplankton | Chemical elements | No change to nutrient EQS compliance. | No change to WFD status |
| | Morphological elements | Small changes close to harbour. No change over far-field. | No change to WFD status |
| Macroalgae | Chemical elements | No change to nutrient EQS compliance. | No change to WFD status |
| | Morphological elements | Small changes close to harbour. No change over far-field. | No change to WFD status |
| Invertebrates | Chemical elements | No change to chemical or nutrient EQS compliance. | No change to WFD status |
| | Morphological elements | Small changes close to harbour. No change over far-field. | No change to WFD status |
| Angiosperms | Chemical elements | No change to chemical or nutrient EQS compliance. | No change to WFD status |
| | Morphological elements | Small changes close to harbour. No change over far-field. | No change to WFD status |
| Benthic invertebrates | Chemical elements | No change to chemical EQS compliance. | No change to WFD status |
| | Morphological elements | Small changes close to harbour. No change over far-field. | No change to WFD status |
| Fish | Chemical elements | No change to DO or chemical EQS compliance. | No change to WFD status |
| | Morphological elements | Small changes close to harbour. No change over far-field. | No change to WFD status |

This assessment indicates that:

- The project is not predicted to cause deterioration of the biological WFD status of the Don Estuary to Souter Head waterbody outwith Nigg Bay.
- The project is not predicted to cause biological deterioration of WFD status of protected areas outwith Nigg Bay:
    - River Dee – SAC
    - Aberdeen, Footdee – Public access and water contact activity – recreational water

- Balmedie to River Don – Public access, salmon netting – recreational water
- Aberdeen Ballroom BW
- South of River Don – Public access, wind-surfing – recreational water

- The project is predicted to cause deterioration of the biological WFD status of the Don Estuary to Souter Head waterbody within Nigg Bay.
- The project is not predicted to cause deterioration of the biological WFD status of the protected area within Nigg Bay SSSI. Nigg Bay has been designated a SSSI based on geology which will not be affected by the water quality, hydrodynamic, wave and sediment climate changes in the area.

**Dee Estuary**

In this assessment indicators of biological change have been assessed including:

- Phytoplankton — Free-floating microscopic plants
- Macroalgae — Seaweeds visible to the naked eye
- Angiosperms — Sea grasses and saltmarsh plants
- Benthic invertebrates — Worms, molluscs and crustacean
- Fish — Fish living all or partly in transitional waters

The results of these assessments are presented in Table 2-13.

These results indicate that:

- The project is not predicted to cause deterioration of the biological WFD status of the Dee (Aberdeen) Estuary waterbody.
- The project is not predicted to cause deterioration of biological WFD status of protected areas within Dee Estuary waterbody.

Table 2-13: Impact of the project on WFD biological status– Dee Estuary

| Parameter | Condition | Description | Comment |
|---|---|---|---|
| Phytoplankton | Chemical elements | No change to nutrient EQS compliance. | No change |
| | Morphological elements | No change over far-field. | No change |
| Macroalgae | Chemical elements | No change to nutrient EQS compliance. | No change |
| | Morphological elements | No change over far-field. | No change |
| Invertebrates | Chemical elements | No change to chemical or nutrient EQS compliance. | No change |
| | Morphological elements | No change over far-field. | No change |
| Angiosperms | Chemical elements | No change to chemical or nutrient EQS compliance. | No change |
| | Morphological elements | No change over far-field. | No change |
| Benthic invertebrates | Chemical elements | No change to chemical EQS compliance. | No change |
| | Morphological elements | No change over far-field. | No change |
| Fish | Chemical elements | No change to DO or chemical EQS compliance. | No change |
| | Morphological elements | No change over far-field. | No change |

### 2.3.2 Assessment of the Ability of the Waterbodies to Meet their WFD Status Objectives

As described previously, the elements which comprise the WFD assessment

- Chemical elements
- Morphological elements
- Biological elements

#### 2.3.2.1 Assessment of chemical elements

**Don Estuary to Souter Head**

In this assessment the water quality parameters have been assessed including:

- Overall chemistry – priority substances
- Physico-chemical – dissolved oxygen and dissolved inorganic nitrogen
- Specific pollutants – copper, zinc and un-ionised ammonia

The parameters have been assessed separately within and outwith Nigg Bay.

The results of these assessments are based on the information supplied in Table 2-5 and Table 2-6. These results indicate that:

- The project is not predicted to compromise the ability of the waterbody outwith Nigg Bay to meet its WFD objective.
- The project is predicted to compromise the ability of the waterbody within Nigg Bay to meet its WFD objective.

**Dee Estuary**

In this assessment the water quality parameters have been assessed including:

- Overall chemistry – priority substances
- Physico-chemical – dissolved oxygen and dissolved inorganic nitrogen
- Specific pollutants – copper and zinc

The results of this assessment are based on the information supplied in Table 2-7. These results indicate that:

- The project is not predicted to compromise the ability of the waterbody to meet its WFD objective.

#### 2.3.2.2 Assessment of morphological elements

**Don Estuary to Souter Head**

In this assessment the morphological elements have been assessed including:

- Water levels;
- Current velocity;
- Wave climate;
- Peak wave period; and
- Sediment climate.

The parameters have been assessed separately within and outwith Nigg Bay.

The results of these assessments are based on the information supplied in Table 2-8 and Table 2-9. These results indicate that:

- The project is not predicted to compromise the ability of the waterbody outwith Nigg Bay to meet its WFD objective.
- The project is predicted to compromise the ability of the waterbody within Nigg Bay to meet its WFD objective.

**Dee Estuary**

In this assessment the morphological have been assessed including:

- Water levels;
- Current velocity;
- Wave climate;
- Peak wave period; and
- Sediment climate.

The results of this assessment are based on the information supplied in Table 2-10. These results indicate that:

- The project is not predicted to compromise the ability of the waterbody to meet its WFD objective.

#### 2.3.2.3 Assessment of biological elements

**Don Estuary to Souter Head**

In this assessment the biological elements have been assessed including:

- Phytoplankton — Free-floating microscopic plants
- Macroalgae — Seaweeds visible to the naked eye
- Angiosperms — Sea grasses and saltmarsh plants
- Benthic invertebrates — Worms, molluscs and crustacean
- Fish — Fish living all or partly in transitional waters

The parameters have been assessed separately within and outwith Nigg Bay.

The results of these assessments are based on the information supplied in Table 2-11 and Table 2-12. These results indicate that:

- The project is not predicted to compromise the ability of the waterbody outwith Nigg Bay to meet its WFD objective.
- The project is predicted to compromise the ability of the waterbody within Nigg Bay to meet its WFD objective.

**Dee Estuary**

In this assessment the biological elements have been assessed including:

- Phytoplankton — Free-floating microscopic plants
- Macroalgae — Seaweeds visible to the naked eye
- Angiosperms — Sea grasses and saltmarsh plants
- Benthic invertebrates — Worms, molluscs and crustacean
- Fish — Fish living all or partly in transitional waters

The results of this assessment are based on the information supplied in Table 2-13. These results indicate that:

- The project is not predicted to compromise the ability of the waterbody to meet its WFD objective.

### 2.3.3 Assessment of Impact on Other Waterbodies within the Same RBD

The purpose of this section is to demonstrate whether the project causes a permanent exclusion or compromise to achieving the WFD objectives in other bodies of water within the same RBD. The project lies within the Scotland River Basin District and in the North East Scotland Sub Basin District.

The coastal and transitional waters to the south and north of the proposed development have been considered:

**1)** Souter Head to Garron Point coastal waterbody

**2)** Cruden Bay to Don Estuary coastal waterbody

**3)** Don Estuary transitional waterbody

The assessment of the impact of the development on the Don Estuary to Souter Head waterbody showed that the development is predicted to cause no change to the WFD status of this waterbody outwith of Nigg Bay. As the three neighbouring waterbodies are all more distant from the development than the Don Estuary to Souter Head waterbody, then it is considered that the development will not compromise the WFD objectives in these waterbodies.

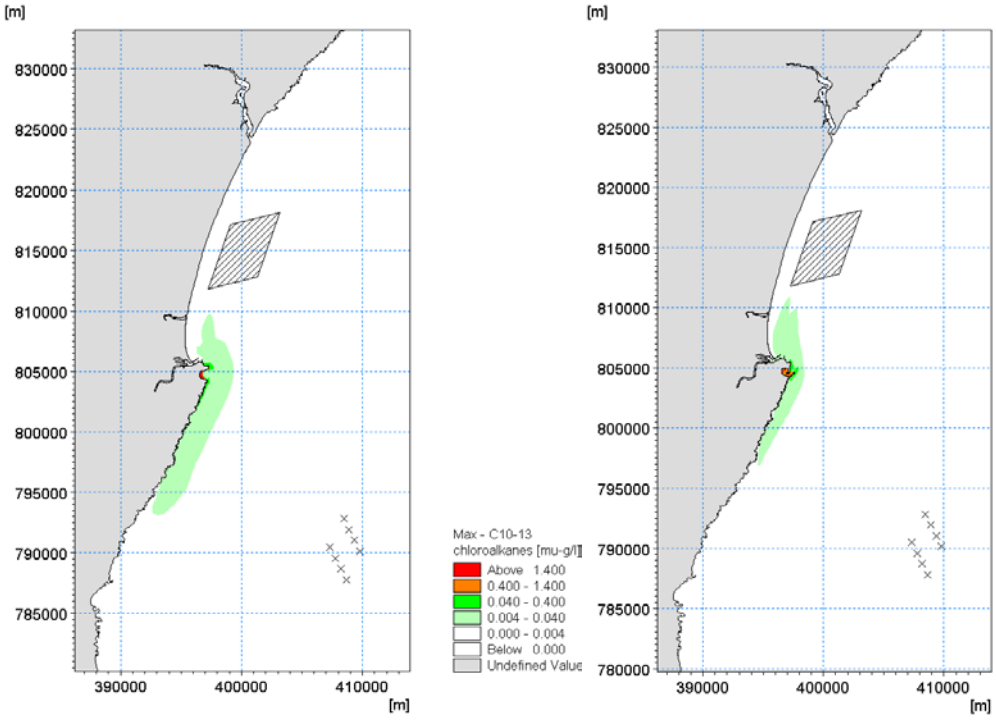
### 2.3.4 Assessment of Cumulative Impacts from nearby developments

The purpose of this section is to demonstrate whether the project has the potential to cause cumulative impacts upon the WFD waterbodies when considered in combination with other nearby developments. The EODC and the Kincardine Offshore Windfarm were previously identified in the ES.

As shown on Figure B-1 and Figure B-2 [1], the ebb and flood tides run parallel to the coast in the Aberdeen area. Therefore, it is unlikely that the Kincardine Offshore Windfarm (turbines represented by crosses on Figure 2-2 will have an impact on areas affected by the development at Aberdeen Harbour.

It is possible that as the EODC windfarm is upstream on the flood tide from the harbour expansion site, that it may impact. However, as Figure 2-2 shows, the EODC (shaded area just offshore) has no contact with significant volumes of water from the site so there are very low chances of a cumulative impact.

Figure 2-2 : Plots showing the potential for cumulative impacts



# 3 RESULTS SUMMARY

Two waterbodies were identified as having the potential to be impacted by the proposed harbour expansion: Don Estuary to Souter Head and Dee (Aberdeen) Estuary. SEPA classified the Don Estuary to Souter Head waterbody as having an overall status of Poor with Medium confidence in 2013, with overall ecological status of Poor and overall chemical status of Pass. The environmental objectives for the first, second and third River Basin Management Planning (RBMP) cycles are Good. SEPA has classified the Dee Estuary as having an overall status of Good ecological potential with Medium confidence in 2013, with overall ecological status of Bad and overall chemical status of Pass. The environmental objectives for the first, second and third River Basin Management Planning (RBMP) cycles are Pass.

The proposed project is not predicted to cause any deterioration of the WFD status of the Don Estuary to Souter Head waterbody outwith Nigg Bay. Neither is the project predicted to cause deterioration of the WFD status of protected areas outwith Nigg Bay. The project is predicted to cause deterioration to the WFD status of the Don Estuary to Souter Head waterbody within Nigg Bay. However, as Nigg Bay comprises approximately 1% of the total area of the WFD waterbody it will not have a significant impact as defined by SEPA's 'Significant water management issues in the Scotland river basin district' report [8]. Furthermore, the project is not predicted to cause deterioration of the WFD status of the protected area within Nigg Bay SSSI. Nigg Bay has been designated a SSSI based on geology which is only expected to see a small reduction in erosion after the construction of the harbour.

It is considered that the development will not compromise the WFD objectives in the neighbouring three waterbodies to those considered in detail within this study. This is due to the neighbouring waterbodies being more remote than the adjacent two and therefore being more influenced by dispersion, decay and dilution to reduce impacts yet further. Furthermore, there are no predicted cumulative impacts with either the EODC or the Kincardine Offshore Windfarm.

# 4 CONCLUSIONS

The modelling results have been used to test the predicted water quality resulting from the expansion of Aberdeen Harbour against the WFD. Results generally showed that WFD compliance is unaffected by the development. The exception to this is the local effect caused by the development within Nigg Bay. This results in a deterioration of WFD status within the bay only.

# 5 REFERENCES

[1] Intertek for Fugro EMU, “Aberdeen Harbour Expansion Project Hydrodynamic and Coastal Processes Assessment,” Intertek, Dundee, 2015.

[2] Intertek, “RN3858. Aberdeen Harbour Expansion Project, Water Quality Assessment,” 2015.

[3] Intertek, “BN3857 Rev 1. Aberdeen Harbour Expansion Project. Water Framework Directive Assessment. Priority Substance Selection.,” 2015.

[4] EU, “Directive 2006/7/EC of the European Parliament and of the Council of 15 February 2006 concerning the managment of bathing water quality and repealing Directive 76/160/EEC.,” *Official Journal of the European Union,* vol. L 64, pp. 37-51, 04/03/2006.

[5] WFD UKTAG, “UK Environmental standards and conditions (SR1-2006, phase 1),” April 2008.

[6] WFD UKTAG, “UK Environmental standards and conditions (SR2-2007, phase 2),” March 2008.

[7] Scottish Natural Heritage, “Nigg Bay: Site of Special Scientific Interest,” 09 2015. [Online]. Available: http://gateway.snh.gov.uk/sitelink/documentview.jsp?p_pa_code=1224&p_Doc_Type_ID=1. [Accessed 11 09 2015].

[8] SEPA, “Significant water management issues in the Scotland river basin district,” SEPA, 2007.

[9] Bowie, G.L., Mills, W.B., Porcella D.B., Campbell C.L., Pagenkopf, J.R., Rupp, G.L., Johnson K.M., Chan, P.W.H. & Gherini, S.A., Rates, Constants, and Kinetics Formulations in Surface Water Quality Modeling (Second Edition), Athens Georgia: United States Environmental Protection Agency, 1985.

# Appendix A Waterbody Descriptions

# TABLES

# A.1 Dee (Aberdeen) Estuary

## A.1.1 General details

Waterbody name: Dee (Aberdeen) Estuary

Waterbody Identifier code: 200103

Area: 91 $km^2$

Waterbody category: Transitional

River basin district: Scotland

Area advisory group: North East Scotland

Catchment – Associated protected areas:

- River Dee – SAC
- Moray / Aberdeenshire / Banff / Buchan – NVZ

Heavily modified: Yes

Artificial: No

Typology: TW2

National Grid Reference: NJ 95388 05647

Latitude: 57.14168

Longitude: -2.07785

## A.1.2 Current status of the waterbody

SEPA has classified this waterbody in 2012 as having:

- Overall status of Good ecological potential with Medium confidence;
- Overall ecological status of Poor; and
- Overall chemical status of Pass.

## A.1.3 Targets for the future status of the waterbody

Target for the future status are provided in Table A-1.

Table A-1: Targets for the future status of Dee Estuary waterbody

| Year | 2012 | 2015 | 2021 | 2027 |
|---|---|---|---|---|
| Status | Good ecological potential | Pass | Pass | Pass |

### A.1.4 Pressures and measures on this waterbody

Table A-2 shows information about pressures on this waterbody, their causes and measures which could be introduced to mitigate their effects, the date the measured will be effective and information on the justification for extending the deadlines or for setting an alternative objective, where appropriate.

Table A-2: Pressure on Dee Estuary Waterbody

| Pressure | Cause | Measure | Assessment Parameter | Objective | Owner | Effective date |
|---|---|---|---|---|---|---|
| Morphological Alterations | Construction / Structures - embankments | Improve modified habitat | Multiple pressure - intertidal | Good by 2015 | Aberdeen City Council | 08/05/2009 |
| Diffuse Source Pollution | Water transport (sea, coastal or inland water transport) | Reduce at source | Priority Substances (Annex 10) | Good by 2015 | International Maritime Organisation | 31/12/2008 |
| Morphological Alterations | Construction / Structures - embankments | Improve modified habitat | Multiple pressure - intertidal | Good by 2015 | Aberdeen Harbour Board | 31/12/2007 |
| Morphological Alterations | Water transport (dredging resulting in removal of sediment) | Improve modified habitat | Single pressure subtidal | Good by 2015 | Aberdeen Harbour Board | 31/12/2007 |

### A.1.5 Complete classification of this waterbody

The complete classification is given in

Table A-3: Complete classification Dee Estuary Waterbody

| Parameter | Status | Confidence of Class |
|---|---|---|
| Overall status | Good ecological potential | Medium |
| Pre-HMWB status | Bad | Medium |
| Overall chemistry | Pass | Low |
| Priority Substances | Pass | Low |
| Overall ecology | Bad | Medium |
| Physico-Chemical | High | Low |
| Dissolved oxygen | High | Low |
| DO (lab. salinity) | High | Low |
| DO (field salinity) | High | Low |
| Dissolved inorganic nitrogen | High | Low |
| Biological elements | High | Low |
| Benthic invertebrates | High | Low |
| Alien species | High | Low |
| Fish | High | Low |

| Parameter | Status | Confidence of Class |
|---|---|---|
| Macroalgae | High | Low |
| Combined phytoplankton | High | Low |
| Specific pollutants | Pass | Low |
| Copper | Pass | Low |
| Zinc | Pass | Low |
| Hydromorphology | Bad | Medium |
| Morphology | Bad | Medium |
| Overall status | Good ecological potential | Medium |
| Water quality | High | |
| Oxygen levels | High | Low |
| Nutrient levels | High | Low |
| Benthic invertebrates | High | Low |
| Toxic pollutants | High | |
| Physical conditions and barriers | Bad | Medium |
| Invasive non-native species | High | Low |
| Fish | High | Low |

## A.2 Don Estuary to Souter Head

### A.2.1 General details

Waterbody name: Don Estuary to Souter Head

Waterbody Identifier code: 200105

Area: 50.24 $km^2$

Waterbody category: Coastal

River basin district: Scotland

Area advisory group: North East Scotland

Catchment: Associated protected areas

- River Dee – SPECIA  AREA OF CONSERVATION
- Aberdeen, Footdee Access and water contact activity – RECREATIONAL WATER
- Nigg Bay – SSSI
- Balmedie to R.Don Public access, salmon netting – RECREATIONAL WATER
- Aberdeen – EC BATHING WATER
- South of R.Don Public access, wind-surfing – RECREATIONAL WATER

| | |
|---|---|
| Heavily modified: | No |
| Artificial: | No |
| Typology: | CW5 |
| National Grid Reference: | NJ 99203 05773 |
| Latitude: | 57.14284 |
| Longitude: | -2.01481 |

### A.2.2 Current status of the waterbody

SEPA has classified this waterbody in 2013 as having:

- Overall status of Poor with Medium confidence;
- Overall ecological status of Poor; and
- Overall chemical status of Pass.

### A.2.3 Targets for the future status of the waterbody

Target for the future status are provided in Table A-14.

Table A-4: Targets for the future status of Don Estuary to Souter Head waterbody

| Year | 2013 | 2015 | 2021 | 2027 |
|---|---|---|---|---|
| Status | Poor | Pass | Pass | Pass |

### A.2.4 Pressures and measures on this waterbody

SEPA has currently identified no pressures on this waterbody and has also specified that no deterioration from good status be permitted, unless caused by a new activity providing significant specified benefits to society or the wider environment.

### A.2.5 Complete classification of this waterbody

The complete classification is given in Table A-5.

Table A-5: Complete classification Don Estuary to Souter Head Waterbody

| Parameter | Status | Confidence of Class |
|---|---|---|
| Overall status | Poor | Medium |
| Pre-HMWB status | Poor | Medium |
| Overall chemistry | Pass | Low |
| Priority Substances | Pass | Low |
| Overall ecology | Poor | Medium |
| Physico-Chemical | High | Low |
| Dissolved oxygen | High | Low |

| | | |
|---|---|---|
| Dissolved inorganic nitrogen | High | Low |
| Biological elements | Good | Medium |
| Benthic invertebrates | Good | Medium |
| Parameter | Status | Confidence of Class |
| Imposex assessment | Good | Medium |
| Benthic invertebrates (IQI) | High | Medium |
| Alien species | High | Low |
| Macroalgae | High | Low |
| Macroalgae (FSL) | High | Low |
| Macroalgae (RSL) | High | Low |
| Combined phytoplankton | High | High |
| Specific pollutants | Pass | Low |
| Copper | Pass | Low |
| Zinc | Pass | Low |
| Unionised ammonia | Pass | Low |
| Hydromorphology | Poor | Medium |
| Morphology | Poor | Medium |
| Overall status | Poor | Medium |
| Water quality | Good | Medium |
| Oxygen levels | High | Low |
| Nutrient levels | High | High |
| Benthic invertebrates | Good | Medium |
| Toxic pollutants | Good | Medium |
| Physical conditions and barriers | Poor | Medium |
| Invasive non-native species | High | Low |

# Appendix B Priority Substance Selection

FUGRO EMU LIMITED

# ABERDEEN HARBOUR EXPANSION PROJECT

## WATER FRAMEWORK DIRECTIVE ASSESSMENT - PRIORITY SUBSTANCE SELECTION

Briefing Note Ref. P1974_BN3857_Rev1

Issued 10 September 2015

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# ABBREVIATIONS

| | |
|---|---|
| AA | Annual Average |
| AEVF | Allowable Effective Volume Flux |
| CSO | Combined Sewer Overflow |
| EQS | Environmental Quality Standard |
| ETB | East Tullos Burn |
| EVF | Effective Volume Flux |
| Intertek | Intertek Energy and Water Consultancy Services |
| LOD | Limit of Detection |
| LSO | Long Sea Outfall |
| MAC | Maximum Allowable Concentration |
| NTB | Ness Tip Burn |
| PAH | Polycyclic aromatic Hydrocarbons |
| SEPA | Scottish Environment Protection Agency |
| UFP | United Fish Products |
| WFDA | Water Framework Directive Assessment |

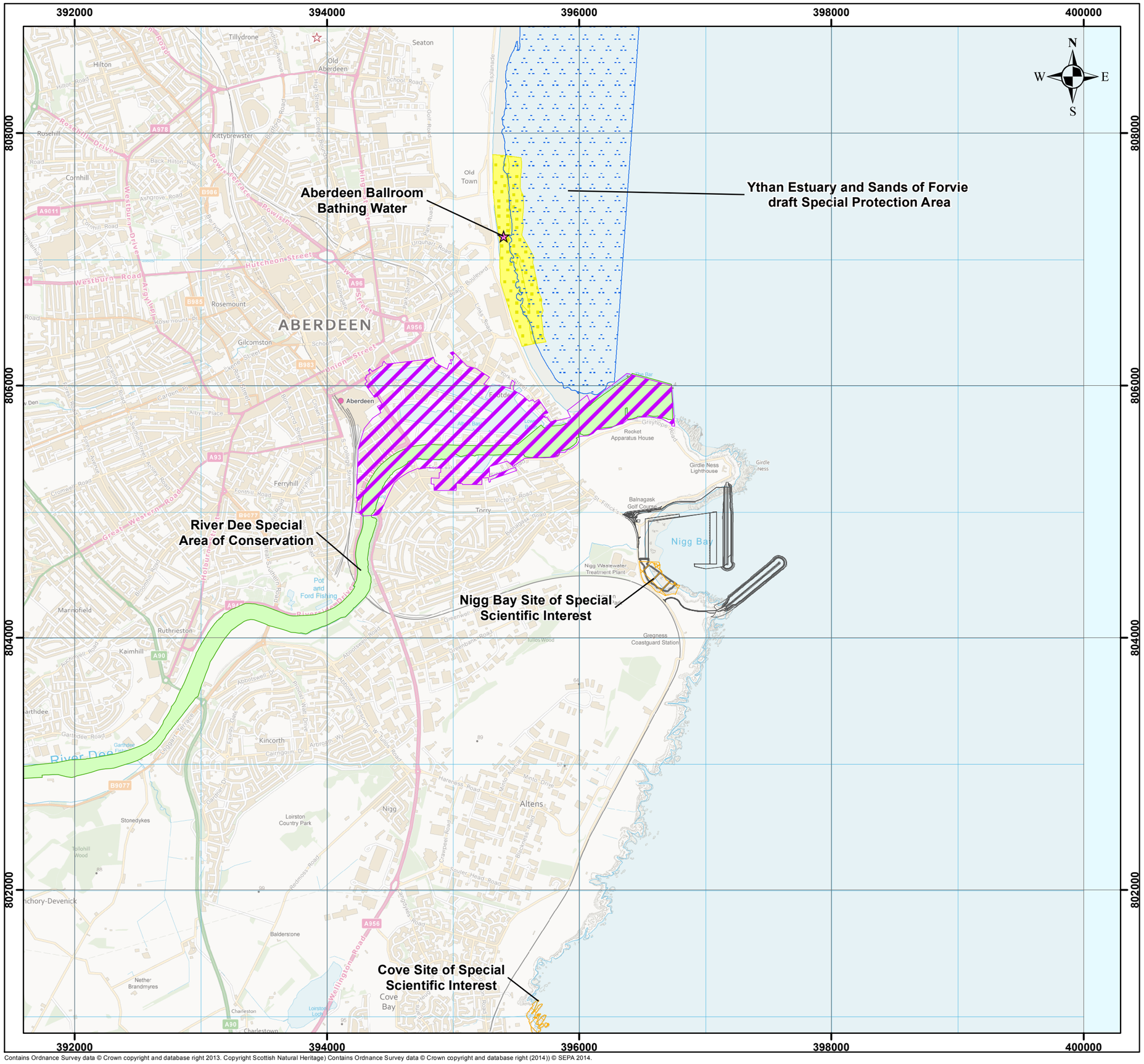
# 1 INTRODUCTION

This document has been prepared for Fugro EMU Limited (Fugro) by Intertek Energy & Water Consultancy Services (Intertek) as part of an environmental impact study for the potential expansion of Aberdeen Harbour. The briefing note documents the priority substance selection process as part of the Water Framework Directive Assessment (WFDA) for the proposed development of a new harbour at Nigg Bay.

The WFD priority substances list is a group of substances shown to be of major concern for European Waters due to their toxicity, bio-accumulating properties and/or persistence in the environment. Priority hazardous substances are a subset of these substances which have been found to be extremely harmful to the environment. The Scottish Environment Protection Agency (SEPA) is required to take account of priority substances when assessing risks to the water environment, classifying the status of water bodies and controlling discharges.

The assessment of priority substances must be made against their respective environmental quality standards (EQSs) as set out by SEPA[1]. A screening process has been undertaken to determine a shortlist of substances that require to be considered for Nigg Bay. This process consists of a number of stages at which a particular substance may be screened out as not liable to cause pollution at the site under investigation. Priority substances taken forward through this process should be subject to a full assessment against their EQSs using a two-dimensional modelling approach. The screening tests were carried out using an established method for transitional and coastal waters that was initially developed by the Environment Agency[2].

Figure 1-1 provides a geographic overview of the area of interest.

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# ABERDEEN HARBOUR EXPANSION PROJECT

**Figure 1-1: Geographic overview of the area of interest**

## Legend

- Aberdeen Harbour Expansion Project area
- Existing Aberdeen Harbour Area
- Special Area of Conservation
- Site of Special Scientific Interest
- Draft Special Protection Area
- Bathing Water Monitoring Location
- Aberdeen Ballroom Bathing Water

NOTE: Not to be used for Navigation

| | |
|---|---|
| **Date** | Monday, September 7, 2015 09:48:11 |
| **Projection** | British_National_Grid |
| **Spheroid** | Airy_1830 |
| **Datum** | D_OSGB_1936 |
| **Data Source** | OSOD, SNH, JNCC, SEPA |
| **File Reference** | J:\P1974\Mxd\Method_Statement\ Geographical_Overview.mxd |
| **Created By** | Emma Langley |
| **Reviewed By** | Ian Charlton |
| **Approved By** | Kevin McGovern |

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0 0.2 0.4 0.8 1.2 1.6 km

# 2 DISCHARGES

Only sources that discharge directly into the harbour area (Table 2-1) were selected for the priority substance screening process, as these substances have the potential to be retained within the bay for longer periods. Discharges outside the harbour are likely to be inhibited from entering the bay when compared to the current scenario as a result of the proposed breakwaters.

Table 2-1: Discharges in the study area

| Tracer release location | Discharge location (OSGB36) | |
|---|---|---|
| | Easting | Northing |
| East Tullos Burn | 396548 | 804713 |
| Ness Tip Burn | 396686 | 804357 |
| United Fish Products Limited (UFP) outfall | 396677 | 804700 |

For each discharge, all available sampling and flow data were collated and assessed.

## 2.1 FLOW

The mean flow for each discharge was determined based on the available data sources. The mean flow and method of calculation for the three discharges are provided in Table 2-2 below.

Table 2-2: Estimated mean flows

| Discharge | Flow ($m^3/s$) | Method of calculation |
|---|---|---|
| UFP outfall | 0.72 | From consent document SEPA variation to consent to discharge[3]. |
| East Tullos Burn | 0.02 | Hydrology calculations from donor catchment |
| Ness Tip Burn | 0.002 | Hydrology calculations from donor catchment with assumed catchment area |

## 2.2 WATER QUALITY

The concentrations of water quality parameters were assessed for each of the three discharges that discharge directly into the proposed harbour area. Samples were collected at the inlet and outfall from the United Fish Products (UPF) facility and in the East Tullos Burn and the Ness Tip Burn.

The results of the analyses of these are presented in Appendix A.

# 3 ENVIRONMENTAL QUALITY STANDARDS

The EQSs applied in this assessment were obtained from SEPA Guidance document WAT-SG-53[1]. Within this document, EQSs may be defined as annual average (AA) concentrations, and/or maximum allowable concentrations (MAC) or 95%'ile concentrations. The transitional and coastal waters EQSs for the substances within the guidance document are presented in Table 3-1. Both MAC and 95%'ile EQSs are presented in the columns headed "MAC/95%'ile" depending on the limit that is applicable to any particular substance.

Table 3-1: WFD Environmental Quality Standards for Priority Substances

| Determinand | EQS (µg/l) | | Determinand | EQS (µg/l) | |
|---|---|---|---|---|---|
| | AA | MAC/95%'ile | | AA | MAC/95%'ile |
| 1,1,1-Trichloroethane | 100 | N/A | Ethylbenzene | 20 | 200 |
| 1,1,2-Trichloroethane | 300 | N/A | Fenitrothion | 0.01 | N/A |
| 1,2-Dichloroethane | 10 | N/A | Fluoranthene | 0.1 | 1 |
| 2,4-Dichlorophenol[a] | 0.042 | 6 | Fluoride | 5,000 | 15,000 |
| 2,4-Dichlorophenoxy acetic acid (2,4-D)[a] | 0.3 | 1.3 | Hexachlorobenzene | 0.01 | 0.05 |
| 2-Chlorophenol | 50 | N/A | Hexachlorobutadiene | 0.1 | 0.6 |
| 2-methyl-4-Chlorophenoxy acetic acid (MCPA) | 80 | 800 | Hexachlorocyclohexane | 0.002 | 0.02 |
| 4-Chloro-3-methylphenol | 40 | N/A | Ioxynil | 10 | 100 |
| Anthracene | 0.1 | 0.4 | Lead | 7.2 | N/A |
| Arsenic[a] | 25 | N/A | Malathion | 0.02 | N/A |
| Atrazine | 0.6 | 2 | Mecoprop (MCPP)[a] | 18 | 187 |
| Azinphos-methyl | 0.01 | N/A | Mercury | 0.05 | 0.07 |
| Bentazone | 500 | N/A | Methylphenols | 100 | 300 |
| Benzene | 8 | 50 | Naphthalene | 1.2 | N/A |
| Benzo(a)pyrene | 0.05 | 0.1 | n-Dibutyl phthalate | 8 | 40 |
| Benzo(b/k)Fluoranthene | 0.03 | N/A | Nickel | 20 | N/A |
| Benzo(g,h,i)perylene & Indeno(123-cd)pyrene | 0.002 | N/A | p,p-DDT | 0.01 | N/A |
| bis(2-Ethylhexyl) phthalate | 1.3 | N/A | Pendimethalin[a] | 1.5 | 6 |
| Boron | 7,000 | N/A | Pentachlorophenol | 0.4 | 1 |
| Bromoxynil | 100 | 1,000 | Permethrin[a] | 0.0002 | 0.001 |
| C10-13 Chloroalkanes | 0.4 | 1.4 | Phenol[a] | 7.7 | 46 |
| Cadmium | 0.2 | N/A | Pirimiphos methyl | 0 | 0 |
| Chlorfenvinphos | 0.1 | 0.3 | Propetamphos | 0.03 | 0.1 |
| Chloroform | 2.5 | N/A | Silver | 0.5 | 1 |
| Chromium VI[a] | 0.6 | 32 | Simazine | 1 | 4 |
| Cobalt | 3 | 100 | Styrene | 50 | 500 |
| Copper[a] | 5.09 | N/A | Tecnazene | 1 | 10 |
| Cyanide, Free | 1 | 5 | Tin | 10 | N/A |
| Cyanide, Total[a] | 1 | 5 | Toluene[a] | 74 | N/A |

| Determinand | EQS (µg/l) | | Determinand | EQS (µg/l) | |
|---|---|---|---|---|---|
| | AA | MAC/95%'ile | | AA | MAC/95%'ile |
| Cyclodiene pesticides | 0.005 | N/A | Triallate | 0.25 | 5 |
| DDT | 0.025 | N/A | Triazophos | 0.005 | N/A |
| Diazinon[a] | 0.01 | 0.26 | Tributyl tin | 0.0002 | 0.0015 |
| Dichlorobenzene | 20 | 200 | Trichlorobenzene | 0.4 | N/A |
| Dichloromethane | 20 | N/A | Trifluralin | 0.03 | N/A |
| Dichlorvos | 0.04 | N/A | Triphenyl tin | 0.008 | N/A |
| Diethyl phthalate | 200 | 1,000 | Vanadium | 100 | N/A |
| Dimethoate[a] | 0.48 | 4 | Xylene | 30 | N/A |
| Dimethyl phthalate | 800 | 4,000 | Zinc[a] | 7.9 | N/A |
| Endosulfan | 0.0005 | 0.004 | | | |

Note: a – 95 %'ile EQS.

# 4 METHOD

## 4.1 BACKGROUND

This is initially a coarse screening investigation used to screen out substances which are not liable to cause pollution at the site under investigation. Substances that are not "screened out" in this phase will be subject to a more detailed assessment using water quality modelling that will be reported separately.

## 4.2 THE PROCESS

The screening process has a number of tests which increase in complexity as the method progresses. If a substance fails a test at any stage, it must be assessed using more extensive modelling methods. If all of the screening steps are passed, the substance is classed as insignificant and is screened out.

The screening stage uses raw data, where available, as these represent the worst-case scenario and minimise the time spent assessing substances which are not liable to cause pollution. Raw data are data which have undergone basic laboratory quality assurance checks but which have not been "cleaned up", that is there has been no adjustment of "less than" values or removal of outliers. These data therefore typically represent a wider range of values than cleaned data.

For transitional and coastal waters, it is recommended that substances are taken forward for further analysis if:

- The concentration of the substance in the discharge exceeds 100% of the EQS.
- The discharge is either to a location less than 50 m offshore from where the sea-bed is at Chart Datum, or to a location where the sea-bed is less than 1 m below Chart Datum.
- The discharge is to a location with restricted dilution/dispersion characteristics.
- The Effective Volume Flux (EVF) of the discharge is greater than the appropriate site-specific limit (known as the Allowable Effective Volume Flux (AEVF).
- The significant load (as defined in Table 4-1) is exceeded.

This process of substance selection is carried out in two parts: Part A (for all priority substances) and Part B (for priority hazardous substances only) which are described below.

## 4.3 PART A

This assessment consists of a number of tests of increasing complexity. Substances under consideration failing any of these tests are taken forward for detailed modelling.

Each screening step compares the discharge concentration against annual average (AA) and/or maximum allowable concentration (MAC) or 95 percentile EQSs, as appropriate. Where a substance has both AA and MAC (or 95

percentile) EQSs, the initial screening process will focus on the AA standard. However, for discharges to shallower locations (Test 4), comparisons of a sampled concentration with the MAC (or 95 percentile) EQS will also be made. Where the substance has a MAC (or 95 percentile) only, then the screening tests will be undertaken against this standard.

### 4.3.1 Test 1

This test examines whether the concentration of the substance in the discharge exceeds 100% of the EQS. This test was devised to quickly screen out substances and does not need any data for the receiving water. For AA EQS, the average concentration in the effluent is compared with the EQS. For MAC (or 95 percentile) EQSs, the maximum concentration in the effluent is compared with the EQS. Substances which are shown to have concentrations above the appropriate EQS are then subject to Test 2.

### 4.3.2 Test 2

This test examines whether the proposed discharge is to either a riverine estuary or a low water channel within an estuary. If the discharge is direct to either of these then the screening tests for freshwater will be applied. If this is found to not be the case, then substances selected under Test 1 will be subject to Test 3.

### 4.3.3 Test 3

This test examines whether the discharge is to a location with restricted dilution/dispersion characteristics. It has been assumed that discharges to Nigg Bay will have restricted dilution/dispersion characteristics. If the discharge is not to such a location then the substances selected are subject to Test 4.

### 4.3.4 Test 4

This test examines whether the discharge is either to a location less than 50 m offshore from where the sea-bed is at Chart Datum or to a location where the sea-bed is less than 1 m below Chart Datum. If the discharge is not to such a location then the substances selected are subject to Test 5.

### 4.3.5 Test 5

This test examines whether the Effective Volume Flux (EVF) of the discharge is greater than the Allowable Effective Volume Flux (AEVF). This test does not need any information about the receiving water other than the mean background concentration of the substance in the vicinity of the discharge. The basis of this test is that buoyant discharges which are likely to have an instantaneous mixing zone which is smaller than a site-specific allowable mixing zone can be considered to be insignificant.

The test is based on the value of the EVF of the discharge, which is expressed as a flow rate ($m^3/s$), where:

$$EVF = (EFR \times RC)/(EQS - BC)$$

Where:

EFR - effluent discharge rate ($m^3/s$)

RC - release concentration of the priority substance of concern (µg/l)

EQS - EQS of the substance of concern (µg/l)

BC - Mean background concentration (µg/l)

The basis of the test is to compare the discharge specific EVF with the location specific AEVF.

Location specific AEVFs are defined as follows:

- For water depths between 1.0 and 3.5 metres relative to Chart Datum, the AEVF in $m^3/s$ is equal to the water depth in metres. For example, if the water depth below Chart Datum is 2.0 m, the AEVF is 2.0 $m^3/s$.
- For water depths of more than 3.5 m below Chart Datum, the AEVF is fixed at 3.5 $m^3/s$.

If the EVF is less than the AEVF for a location, then the discharge is insignificant and can be screened out. This test is based on an assessment of the instantaneous size of the mixing zone, with an upper limit (when the EVF=3.5 $m^3/s$) of about 2,000 $m^3$. For AA EQS, the mean load (flow x concentration) will be considered, whilst for MAC EQS the 95 percentile or maximum load will be applied.

## 4.4 PART B

This screening process will be completed for all priority hazardous substances, even if the substance has been screened out in Part A. This Part B process comprises a significant loads test.

Significant loads are annual loads which should not be exceeded in any individual discharge and have been set for priority hazardous substances.

The significant loads for priority hazardous substances sampled during the monitoring programme are presented in Table 4-1.

Table 4-1: Significant load for priority hazardous substances

| Determinand | Load | Unit |
|---|---|---|
| Anthracene | 1 | kg/yr |
| Cadmium | 5 | kg/yr |
| C10-13 Chloroalkanes | 1 | kg/yr |
| Endosulfan | 1 | kg/yr |
| Hexachlorobenzene | 1 | kg/yr |
| HCH gamma total (Hexachloro-cyclohexane) | 1 | kg/yr |
| Mercury and compounds | 1 | kg/yr |
| Polycyclic aromatic Hydrocarbons (PAHs) | 5 | kg/yr |
| Tributyltin | 1 | kg/yr |

If any of the identified substances are found to exceed their significant load, then further analysis is carried out using “cleaned up” data.

The process of cleaning up data involves a number of steps including:

**1)** Liable to contain test – does the effluent really contain the substances or are the samples below the detection limit.

**2)** Fit for purpose test. Are there:

a) Step changes in effluent quality?

b) Unevenly distributed sampling?

c) Data not representative of current effluent quality?

d) Outliers?

e) Less than (or very low values) which need adjustment?

# 5 RESULTS

The heavy metal concentrations measured in the East Tullos Burn and Ness Tip Burn were total concentrations. EQSs for these substances are set in terms of dissolved concentrations. As total heavy metal concentrations will be higher than the equivalent dissolved concentration, their use and comparison against dissolved concentrations represents a worst case scenario.

## 5.1 PART A

### 5.1.1 Test 1

The results of the Test 1 analyses are presented in Tables 5-1 and Table 5-2. These results indicate that seven water quality parameters should be taken forward to Test 2.

Table 5-1: Substances at UFP outfall

| Determinand | Sample compliant? | |
|---|---|---|
| | AA | MAC |
| 1,1,1-Trichloroethane | ✓ | N/A |
| 1,1,2-Trichloroethane | ✓ | N/A |
| 1,2-Dichloroethane | ✓ | N/A |
| 2,4-Dichlorophenoxy acetic acid (2,4-D) | ✓ | ✓ |
| 2-Chlorophenol | ✓ | N/A |
| 2-methyl-4-Chlorophenoxy acetic acid (MCPA) | ✓ | ✓ |
| 4-Chloro-3-methylphenol | ✓ | N/A |
| Arsenic | ✓ | N/A |
| Bentazone | ✓ | N/A |
| Benzene | ✓ | ✓ |
| Boron | ✓ | N/A |
| Bromoxynil | ✓ | ✓ |
| Cadmium | X | N/A |
| Chlorfenvinphos | ✓ | ✓ |
| Chloroform | ✓ | N/A |
| Chromium | X | ✓ |
| Cobalt | ✓ | ✓ |
| Copper | X | N/A |
| DDT | ✓ | N/A |
| Dichlorobenzene | ✓ | ✓ |
| Dichloromethane | ✓ | N/A |
| Dichlorvos | ✓ | N/A |
| Diethyl phthalate | ✓ | ✓ |
| Dimethoate | ✓ | ✓ |
| Dimethyl phthalate | ✓ | ✓ |

| Determinand | Sample compliant? | |
|---|---|---|
| | AA | MAC |
| Ethylbenzene | ✓ | ✓ |
| Fluoride | ✓ | ✓ |
| Ioxynil | ✓ | ✓ |
| Lead | ✓ | N/A |
| Malathion | ✓ | N/A |
| Mecoprop (MCPP) | ✓ | ✓ |
| Mercury | X | X |
| Methylphenols | ✓ | ✓ |
| Naphthalene | ✓ | N/A |
| n-Dibutyl phthalate | ✓ | ✓ |
| n-Dioctyl phthalate | ✓ | ✓ |
| Nickel | ✓ | N/A |
| Pendimethalin | ✓ | ✓ |
| Pentachlorophenol | ✓ | ✓ |
| Phenol | X | ✓ |
| Pirimiphos-methyl | ✓ | ✓ |
| Propetamphos | ✓ | ✓ |
| Styrene | ✓ | ✓ |
| Tecnazene | ✓ | ✓ |
| Tin | ✓ | N/A |
| Toluene | ✓ | N/A |
| Triallate | ✓ | ✓ |
| Trifluralin | ✓ | N/A |
| Triphenyl tin | ✓ | N/A |
| Vanadium | ✓ | N/A |
| Xylene | ✓ | N/A |
| Zinc | ✓ | N/A |
| Note: ✓ - EQS met. X – EQS exceeded | | |

As Table 5-1 shows, Cadmium, Chromium, Copper and Phenol all exceed their annual average EQS whilst Mercury exceeds both the AA and MAC EQSs. Therefore, these five substances were taken forward for further testing. All other sampled substances met both their AA and MAC EQSs.

Table 5-2 : Substances at East Tullos Burn and Ness Tip Burn

| Determinand | Sample compliant? | | | |
|---|---|---|---|---|
| | Sample <AA? | | Sample <MAC? | |
| | East Tullos Burn | Ness Tip Burn | East Tullos Burn | Ness Tip Burn |
| 1,1,1-Trichloroethane | ✓ | ✓ | N/A | N/A |
| 1,1,2-Trichloroethane | ✓ | ✓ | N/A | N/A |
| 1,2-Dichloroethane | ✓ | ✓ | N/A | N/A |
| Anthracene | ✓ | ✓ | ✓ | ✓ |
| Arsenic | ✓ | ✓ | N/A | N/A |
| Benzene | ✓ | ✓ | ✓ | ✓ |
| Benzo(a)Pyrene | ✓ | ✓ | ✓ | ✓ |
| Benzo(b/k)Fluoranthene | ✓ | X | N/A | N/A |
| Cadmium | ✓ | ✓ | N/A | N/A |
| Chloroform | ✓ | ✓ | N/A | N/A |
| Copper | X | X | N/A | N/A |
| DDT | ✓ | ✓ | N/A | N/A |
| Dichlorobenzene | ✓ | ✓ | ✓ | ✓ |
| Dichlorvos | ✓ | ✓ | N/A | N/A |
| Dimethoate | ✓ | ✓ | ✓ | ✓ |
| EthylBenzene | ✓ | ✓ | ✓ | ✓ |
| Fluoranthene | ✓ | ✓ | ✓ | ✓ |
| Lead | ✓ | ✓ | N/A | N/A |
| Malathion | ✓ | ✓ | N/A | N/A |
| Mecoprop | ✓ | ✓ | ✓ | ✓ |
| Naphthalene | ✓ | ✓ | N/A | N/A |
| Nickel | ✓ | ✓ | N/A | N/A |
| Xylene | ✓ | ✓ | N/A | N/A |
| Phenol | ✓ | ✓ | ✓ | ✓ |
| Pirimiphos methyl | ✓ | ✓ | ✓ | ✓ |
| Styrene | ✓ | ✓ | ✓ | ✓ |
| Toluene | ✓ | ✓ | N/A | N/A |
| Zinc | X | X | N/A | N/A |
| Note: ✓ - EQS met. X – EQS exceeded | | | | |

As Table 5-2 shows, Copper and Zinc from both East Tullos Burn and Ness Tip Burn exceed the AA EQS. Also, Benzo(b/k)Fluoranthene from Ness Tip Burn exceeds the AA EQS. Therefore, these three substances were taken forward from these sites for further testing. All other sampled substances met both their AA and MAC EQSs.

### 5.1.2 Further Tests

Examination of the discharge locations indicates that none of the discharges are to a riverine estuary or direct to a low water channel within an estuary (Test 2). However, East Tullos Burn, Ness Tip Burn and the UFP outfall all discharge to locations less than 50 m offshore from where the sea-bed is at Chart Datum and to a location where the sea-bed is less than 1 m below Chart Datum (Test 4). The UFP outfall currently discharges at 1 m above Chart Datum.

Therefore, all of the substances selected under Test 1 were taken forward for further assessment using hydrodynamic and water quality modelling techniques (Table 5-3).

Table 5-3: Water quality parameters taken forward for modelling assessment

| Determinand | Sample compliant? | | | | | |
|---|---|---|---|---|---|---|
| | Sample <AA? | | | Sample <MAC? | | |
| | UFP outfall | East Tullos Burn | Ness Tip Burn | UFP outfall | East Tullos Burn | Ness Tip Burn |
| Benzo(b/k)Fluoranthene | N/A | ✓ | X | N/A | N/A | N/A |
| Cadmium | X | ✓ | ✓ | N/A | N/A | N/A |
| Chromium | X | N/A | N/A | ✓ | N/A | N/A |
| Copper | X | X | X | N/A | N/A | N/A |
| Mercury | X | N/A | N/A | X | N/A | N/A |
| Phenol | X | ✓ | ✓ | ✓ | ✓ | ✓ |
| Zinc | ✓ | X | X | N/A | N/A | N/A |

Key: ✓ - EQS met
X – EQS not met
N/A – Criterion is not applicable to substance

## 5.2 PART B

Priority hazardous substances are subjected to additional screening over and above priority substances to see if the annual discharged load for a particular priority hazardous substance is greater than the significant annual load. The loads for the substances have been calculated using average daily flows presented in Table 2-2 and the average concentrations presented in Table A-1. The results of these calculations are presented in Table 5-4 for all 10 priority hazardous substances that were found to be present in the water quality samples collected from the three key discharges.

None of the priority hazardous substances exceeded their significant annual load from Ness Tip Burn and only C10-13 Chloroalkanes from East Tullos Burn. However, six substances were greater than their significant annual load from the UFP outfall and therefore failed the test – Anthracene, C10-13 Chloroalkanes, Cadmium, Hexachlorobutadiene, Mercury and Polycyclic Aromatic Hydrocarbons (PAHs).

However, of the substances that exceeded their significant annual load, only Cadmium and Mercury from the UFP outfall were sampled at concentrations

greater than their limit of detection (LOD). All six substances are however proposed to be taken forward for further analyses as a precautionary measure.

Table 5-4: Significant load analysis results

| East Tullos Burn | | | | | | |
|---|---|---|---|---|---|---|
| Determinand | LOD (µg/l) | Average conc. (µg/l) | Annual load (kg/yr) | Significant annual load (kg/yr) | Sample compliant? | Samples at LOD? |
| Anthracene | 0.01 | 0.0175 | 1.1E-02 | 1 | Pass | No |
| C10-13 Chloroalkanes | 5 | 5 | 3.2E+00 | 1 | Fail | Yes |
| Cadmium | 0.02 | 0.045 | 2.8E-02 | 5 | Pass | No |
| Endosulfan | 0.01 | 0.01 | 6.3E-03 | 1 | Pass | Yes |
| Hexachlorobenzene | 0.01 | 0.01 | 6.3E-03 | 1 | Pass | Yes |
| Hexachlorocyclohexane | 0.01 | 0.01 | 6.3E-03 | 1 | Pass | Yes |
| Mercury and compounds | 0.05 | 0.05 | 3.2E-02 | 1 | Pass | Yes |
| Polycyclic Aromatic Hydrocarbons (PAHs) | 0.03 | 0.08 | 5.0E-02 | 5 | Pass | No |
| Ness Tip Burn | | | | | | |
| Determinand | LOD (µg/l) | Average conc. (µg/l) | Annual load (kg/yr) | Significant annual load (kg/yr) | Sample compliant? | Samples at LOD? |
| Anthracene | 0.01 | 0.0375 | 2.4E-03 | 1 | Pass | No |
| C10-13 Chloroalkanes | 5 | 5 | 3.2E-01 | 1 | Pass | Yes |
| Cadmium | 0.02 | 0.04 | 2.5E-03 | 5 | Pass | No |
| Endosulfan | 0.01 | 0.01 | 6.3E-04 | 1 | Pass | Yes |
| Hexachlorobenzene | 0.01 | 0.01 | 6.3E-04 | 1 | Pass | Yes |
| Hexachlorocyclohexane | 0.01 | 0.01 | 6.3E-04 | 1 | Pass | Yes |
| Mercury and compounds | 0.05 | 0.055 | 3.5E-03 | 1 | Pass | No |
| Polycyclic Aromatic Hydrocarbons (PAHs) | 0.03 | 0.0775 | 4.9E-03 | 5 | Pass | No |
| United Fish Products Outfall | | | | | | |
| Determinand | LOD (µg/l) | Average conc. (µg/l) | Annual load (kg/yr) | Significant annual load (kg/yr) | Sample compliant? | Samples at LOD? |
| Anthracene | 1 | 1 | 22.71 | 1 | Fail | Yes |
| C10-13 Chloroalkanes | 5 | 5 | 113.53 | 1 | Fail | Yes |
| Cadmium | 0.1 | 1 | 22.71 | 5 | Fail | No |
| Endosulfan | 0.03 | 0.03 | 0.68 | 1 | Pass | Yes |
| Hexachlorobenzene | 0.01 | 0.01 | 0.23 | 1 | Pass | Yes |
| Hexachlorobutadiene | 1 | 1 | 22.71 | 1 | Fail | Yes |
| Hexachlorocyclohexane | 0.03 | 0.03 | 0.68 | 1 | Pass | Yes |
| Mercury and compounds | 0.01 | 0.242 | 5.49 | 1 | Fail | No |
| Polycyclic Aromatic Hydrocarbons (PAHs) | 5 | 5 | 113.53 | 5 | Fail | Yes |
| Tributyltin compounds | 0.001 | 0.001 | 0.02 | 1 | Pass | Yes |

# 6 CONCLUSIONS

## 6.1 PART A

It is concluded that the seven priority substances identified from the Part A tests should be taken forward for a further modelling assessment as shown in Table 6-1.

Table 6-1: Water quality parameters taken forward for further testing

| Determinand | AA | MAC |
|---|---|---|
| Cadmium | X | N/A |
| Chromium | X | ✓ |
| Copper | X | N/A |
| Mercury | X | X |
| Phenol | X | ✓ |
| Zinc | X | X |
| Benzo(b/k)Fluoranthene | X | N/A |

## 6.2 PART B

The significant load testing showed that six priority hazardous substance determinands exceeded their significant load. Of those, two had samples which exceeded their limits of detection. All six substances should be taken forward for further analyses as a precautionary measure as shown in Table 6-2.

Table 6-2: Exceedance of significant load

| | Determinand | Significant annual load (kg/yr) | Annual load (kg/yr) | |
|---|---|---|---|---|
| | | | East Tullos Burn | UFP Outfall |
| | Cadmium | 5 | - | 22.7 |
| | Mercury and compounds | 1 | - | 5.5 |
| All samples at LOD | Anthracene | 1 | - | 22.7 |
| | C10-13 Chloroalkanes | 1 | 3.2 | 113.5 |
| | Hexachlorobutadiene | 1 | - | 22.7 |
| | Polycyclic Aromatic Hydrocarbons (PAHs) | 5 | - | 113.5 |

# 7 REFERENCES

[1] SEPA. Supporting Guidance (WAT-SG-53). Environmental Quality Standards and Standards for Discharges to Surface Waters. July 2014

[2] Environment Agency. H1 Annex D1. Assessment of hazardous pollutants within surface water discharges. October 2014.

[3] SEPA. Pollution prevention and control act 1999. Permit number PPC/N 20022/VN02. United Fish Industries Ltd (UK). 2012

# Appendix A UFP and Burns Sampling Data

# TABLES

## Table A-1: United Fish Processor sampling results

| Component | Limit of Detection (Unit) | Concentration |
|---|---|---|
| 1,1,1-Trichloroethane | <1 µg/l | <1 |
| 1,1,2-Trichloroethane | <1 µg/l | <1 |
| 1,2,3-Trichlorobenzene | <1 µg/l | <1 |
| 1,2,4-Trichlorobenzene | <1 µg/l | <1 |
| 1,2,4-Trichlorobenzene (aq) | <1 µg/l | <1 |
| 1,2-Dichlorobenzene | <1 µg/l | <1 |
| 1,2-Dichlorobenzene (aq) | <1 µg/l | <1 |
| 1,2-Dichloroethane | <1 µg/l | <1 |
| 1,3,5-Trichlorobenzene | <1 µg/l | <1 |
| 1,3-Dichlorobenzene | <1 µg/l | <1 |
| 1,3-Dichlorobenzene (aq) | <1 µg/l | <1 |
| 1,4-Dichlorobenzene | <1 µg/l | <1 |
| 1,4-Dichlorobenzene (aq) | <1 µg/l | <1 |
| 2,4-Dichlorophenol (aq) | <1 µg/l | <1 |
| 2,4-Dichlorophenoxy acetic acid (2,4-D) | <0.026 | <0.026 |
| 2-Chlorophenol (aq) | <1 µg/l | <1 |
| 2-methyl-4-Chlorophenoxy acetic acid (MCPA) | <0.03 µg/l | <0.03 |
| 2-Methylphenol (aq) | <1 µg/l | <1 |
| 4-Chloro-3-methylphenol (aq) | <1 µg/l | <1 |
| 4-Methylphenol (aq) | <1 µg/l | <1 |
| Aldrin | <0.01 µg/l | <0.01 |
| alpha-Hexachlorocyclohexane (HCH / Lindane) | <0.01 µg/l | <0.01 |
| Ammoniacal Nitrogen as N | <0.2 mg/l | 20.5 |
| Anthracene (aq) | <1 µg/l | <1 |
| Arsenic (diss.filt) | <0.12 µg/l | 22.9 |
| Atrazine | <1 µg/l | <1 |
| Azinphos-methyl | <0.01 µg/l | <0.01 |
| Bentazone | <0.018 | <0.018 |
| Benzene | <1 µg/l | <1 |
| Benzo(a)pyrene (aq) | <1 µg/l | <1 |
| Benzo(b)fluoranthene (aq) | <1 µg/l | <1 |
| Benzo(g,h,i)perylene (aq) | <1 µg/l | <1 |
| Benzo(k)fluoranthene (aq) | <1 µg/l | <1 |
| beta-Hexachlorocyclohexane (HCH / Lindane) | <0.01 µg/l | <0.01 |
| bis(2-Ethylhexyl) phthalate (aq) | <2 µg/l | <2 |
| BOD, unfiltered | <1 mg/l | 91.1 |
| Boron (diss.filt) | <9.4 µg/l | 3460 |
| Bromoxynil | <0.022 | <0.022 |
| Cadmium (diss.filt) | <0.1 µg/l | <1 |
| Chlorfenvinphos | <0.01 µg/l | <0.01 |
| Chloroform | <1 µg/l | <1 |

| Component | Limit of Detection (Unit) | Concentration |
|---|---|---|
| Chromium (diss.filt) | <0.22 µg/l | 6.57 |
| Cobalt (diss.filt) | <0.06 µg/l | <0.6 |
| Copper (diss.filt) | <0.85 µg/l | <8.5 |
| Cyanide, Free | <0.05 | <0.05 |
| Cyanide, Total | <0.05 | <0.05 |
| Diazinon | <0.01 µg/l | <0.01 |
| Dichloromethane | <3 µg/l | <3 |
| Dichlorvos | <0.01 µg/l | <0.01 |
| Dieldrin | <0.01 µg/l | <0.01 |
| Diethyl phthalate (aq) | <1 µg/l | <1 |
| Dimethoate | <0.01 µg/l | <0.01 |
| Dimethyl phthalate (aq) | <1 µg/l | <1 |
| Endosulphan I | <0.01 µg/l | <0.01 |
| Endosulphan II | <0.01 µg/l | <0.01 |
| Endosulphan sulphate | <0.01 µg/l | <0.01 |
| Endrin | <0.01 µg/l | <0.01 |
| Ethylbenzene | <1 µg/l | <1 |
| Fenitrothion | <0.01 µg/l | <0.01 |
| Fluoranthene (aq) | <1 µg/l | <1 |
| Fluoride | <0.5 mg/l | 0.793 |
| gamma-Hexachlorocycloh exane (HCH / Lindane) | <0.01 µg/l | <0.01 |
| Hexachlorobenzene | <0.01 µg/l | <0.01 |
| Hexachlorobutadiene | <1 µg/l | <1 |
| Indeno(1,2,3-cd)pyrene (aq) | <1 µg/l | <1 |
| Ioxynil | <0.017 | <0.017 |
| Isodrin | <0.01 µg/l | <0.01 |
| Lead (diss.filt) | <0.02 µg/l | <0.2 |
| m,p-Xylene | <1 µg/l | <1 |
| Malathion | <0.01 µg/l | <0.01 |
| Mecoprop (MCPP) | <0.025 | <0.025 |
| Mercury (diss.filt) | <0.01 µg/l | 0.242 |
| Naphthalene | <1 µg/l | <1 |
| n-Dibutyl phthalate (aq) | <1 µg/l | <1 |
| n-Dioctyl phthalate (aq) | <5 µg/l | <5 |
| Nickel (diss.filt) | <0.15 µg/l | 5.35 |
| Nitrite as N | <0.0152 | <0.0152 |
| o,p-DDT | <0.01 µg/l | <0.01 |
| o-Xylene | <1 µg/l | <1 |
| p,p-DDT | <0.01 µg/l | <0.01 |
| Pendimethalin | <0.01 µg/l | <0.01 |
| Pentachlorophenol | <0.032 | <0.032 |
| Permethrin I | <0.01 µg/l | <0.01 |
| Permethrin II | <0.01 µg/l | <0.01 |

| Component | Limit of Detection (Unit) | Concentration |
|---|---|---|
| Phenol (aq) | <1 µg/l | 29.7 |
| Pirimiphos-methyl | <0.01 µg/l | <0.01 |
| Propetamphos | <0.01 µg/l | <0.01 |
| Silver (diss.filt) | <1.5 µg/l | <15 |
| Simazine | <1 µg/l | <1 |
| Styrene | <1 µg/l | <1 |
| Tecnazene | <0.01 µg/l | <0.01 |
| Tin (diss.filt) | <0.36 µg/l | <3.6 |
| Toluene | <1 µg/l | <1 |
| Triallate | <0.01 µg/l | <0.01 |
| Triazophos | <0.01 µg/l | <0.01 |
| Tributyl tin | <1 ng/l | <1 |
| Trifluralin | <0.01 µg/l | <0.01 |
| Triphenyl tin | <1 ng/l | <1 |
| Vanadium (diss.filt) | <0.24 µg/l | <2.4 |
| Zinc (diss.filt) | <0.41 µg/l | <4.1 |

## Table A-2: East Tullos Burn and Ness Tip Burn sampling results

| | | | 01/12/2014 | | 07/01/2015 | | 26/02/2015 | | 01/04/2015 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Determinand | LOD | Units | NTB | ETB | NTB | ETB | NTB | ETB | NTB | ETB |
| 1,1,1-Trichloroethane | 1 | µg/l | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| 1,1,2-Trichloroethane | 1 | µg/l | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| 1,2-Dichlorobenzene | 1 | µg/l | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| 1,2-Dichloroethane | 1 | µg/l | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| 1,3-Dichlorobenzene | 1 | µg/l | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| 1,4-Dichlorobenzene | 1 | µg/l | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Aldrin | 0.01 | µg/l | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Anthracene | 0.01 | µg/l | <0.01 | <0.01 | 0.12 | 0.02 | <0.01 | 0.03 | <0.01 | <0.01 |
| As (Total) | 0.2 | µg/l | 3.1 | 1.8 | 5.1 | 3.5 | 2.5 | 2.9 | 5.4 | 2.7 |
| Azinphos methyl | 0.01 | µg/l | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Benzene | 1 | µg/l | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Benzo(a)Pyrene | 0.01 | µg/l | <0.01 | <0.01 | 0.05 | 0.03 | <0.01 | 0.02 | <0.01 | <0.01 |
| Benzo(b/k)Fluoranthene | 0.01 | µg/l | <0.01 | <0.01 | 0.08 | 0.06 | <0.01 | 0.05 | <0.01 | <0.01 |
| Benzo(ghi)Perylene | 0.01 | µg/l | <0.01 | <0.01 | 0.03 | 0.02 | <0.01 | 0.02 | <0.01 | <0.01 |
| Bromochloromethane | 1 | µg/l | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Bromodichloromethane | 1 | µg/l | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Cd (Total) | 0.02 | µg/l | 0.03 | 0.03 | 0.07 | 0.06 | <0.02 | 0.02 | 0.04 | 0.07 |
| Chloroethane | 1 | µg/l | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Chloroform | 1 | µg/l | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Chloromethane | 1 | µg/l | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Chromium VI | 0 | mg/l | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 |
| Cr (Total) | 1 | µg/l | 6 | <1 | 23 | 4 | 5 | <1 | 6 | <1 |

| | | | 01/12/2014 | | 07/01/2015 | | 26/02/2015 | | 01/04/2015 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Determinand | LOD | Units | NTB | ETB | NTB | ETB | NTB | ETB | NTB | ETB |
| Cu (Total) | 0.5 | µg/l | 21 | 20 | 7.9 | 15 | 13 | 18 | 11 | 21 |
| DDT | 0.01 | µg/l | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Diazinon | 0.01 | µg/l | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Dichloromethane | 50 | µg/l | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 |
| Dichlorvos | 0.01 | µg/l | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Dieldrin | 0.01 | µg/l | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Dimethoate | 0.01 | µg/l | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Endosulphan | 0.01 | µg/l | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Endrin | 0.01 | µg/l | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| EthylBenzene | 1 | µg/l | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Fenitrothion | 0.01 | µg/l | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Fluoranthene | 0.01 | µg/l | <0.01 | <0.01 | 0.02 | 0.03 | <0.01 | <0.01 | <0.01 | <0.01 |
| Hexachlorobenzene | 0.01 | µg/l | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Hexachlorocyclohexane | 0.01 | µg/l | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Hg (Total) | 0.05 | µg/l | <0.05 | <0.05 | 0.07 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Indeno(123-cd)Pyrene | 0.01 | µg/l | <0.01 | <0.01 | 0.03 | 0.02 | <0.01 | 0.02 | <0.01 | <0.01 |
| M/P Xylene | 1 | µg/l | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Malathion | 0.01 | µg/l | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Mecoprop | 0.1 | µg/l | 0.3 | <0.1 | 4.5 | <0.1 | 1.9 | <0.1 | 5.8 | <0.1 |
| Naphthalene | 0.01 | µg/l | <0.01 | <0.01 | <0.01 | 0.03 | <0.01 | 0.02 | <0.01 | <0.01 |
| Ni (Total) | 1 | µg/l | 11 | 10 | 12 | 9 | 9 | 9 | 10 | 8 |
| O Xylene | 1 | µg/l | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Pb (Total) | 0.3 | µg/l | 1.8 | 2 | 0.6 | 4.9 | 0.4 | 2.3 | 1 | 2.4 |

| | | | 01/12/2014 | | 07/01/2015 | | 26/02/2015 | | 01/04/2015 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Determinand | LOD | Units | NTB | ETB | NTB | ETB | NTB | ETB | NTB | ETB |
| Phenol | 0.5 | µg/l | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| Pirimiphos methyl | 0.01 | µg/l | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Styrene | 1 | µg/l | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Toluene | 1 | µg/l | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Trichlorofluoromethane | 1 | µg/l | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Zn (Total) | 2 | µg/l | 25 | 41 | 9 | 53 | 8 | 33 | 12 | 43 |